1 Eastern University, Sri Lanka

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1.1 History

The Batticaloa University College was established on 1st August 1981 to fill a long felt need for the development of a Higher Educational Institution in the Eastern Province, Sri Lanka. This College began with two faculties: Faculty of Science and Faculty of Agriculture. Both these faculties were affiliated to the University of Peradeniya. In 1986 this University College was elevated to the status of a University under the name of Eastern University, Sri Lanka (EUSL).

The Eastern University, Sri Lanka was established on 1st October 1986 by a University order dated 26th September 1986 issued under section 2 of the Universities Act No. 16 of 1978. In 1988 two new faculties, Faculty of Commerce and Management and Faculty of Cultural Studies were established.

The Faculty of Cultural studies was then expanded and renamed as Faculty of Arts and Culture in 1991. The Faculty of Health-Care Sciences was established in 2006. Faculty of Technology was established in 2017. A campus of Eastern University functions at Trincomalee with the Faculty of Applied Science, Faculty of Communication & Business Studies, and a unit of Siddha Medicine. Swami Vipulananda College of Music and Dance at Kallady, Batticaloa is attached to the Eastern University and renamed as Swami Vipulananda Institute of Aesthetic Studies (SVIAS) where Degree Programmes in Music, Dance and Performing Arts are conducted.

1.2 Location

The Eastern University, Sri Lanka is located in the village of Vantharumoolai, 17 km to north from Batticaloa and about the same distance to south from Valaichchenai.

The University lies on both sides of the Batticaloa-Colombo main road. The Senate block, Faculty of Agriculture, Faculty of Technology, some buildings belonging to Faculty of Science, Faculty of Arts & Culture, Staff Development

Centre, Centre for External Degrees and Extension Courses, and farm lie on the land-side of the road. The new Science Block, some buildings belonging to Faculty of Arts & Culture and Faculty of Commerce & Management, library, students' hostels, staff quarters, sports center, medical center, English Language Teaching Unit, Centre for Information and Communication Technology, and the play ground lie on the sea-side of the road. You can get a glimpse of the Eastern University, Sri Lanka by maps attached.

1.3 Vision

Centre of excellence for higher learning in Sri Lanka

1.4 Mission

To facilitate learning, research, and dissemination of knowledge to produce competent graduate through conducive environment with industry-community collaboration to serve socio-economic and cultural needs of the community

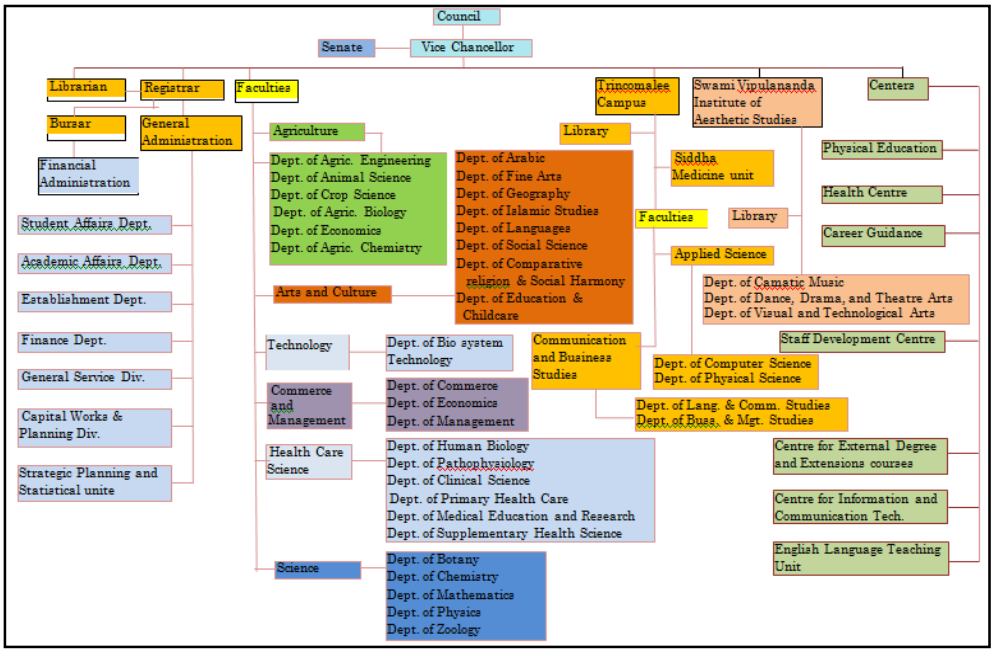
1.5 The Crest

The crest of the Eastern University, Sri Lanka is shown below.

The crest of the University, shown above, has the symbols of a half of sun and an open book at its centre. Around the center, name of the University appears in three languages English, Tamil, and Sinhala. The half sun symbolizes arise of light of wisdom. The crest is therefore symbolizes the growth of wisdom along with culture. The motto is "PER ARDUA AD SCIENTIAM": Knowledge Through Hard Work.

1.6 Organizational Structure

Organizational structure of Eastern University is as follows.



1.7 Authorities of the University

The Authorities of a University shall be the following:

(i) the Council;
(ii) the Senate;
(iii) the Campus Board(s);
(iv) the Faculty Boards.

The Council of a University shall be the executive body and governing authority of the University and shall consist of the Vice-Chancellor, Deputy Vice-Chancellor, Rectors of campuses, Deans of the faculties, two nominees from the Senate, and external members nominated by the University Grants Commission. The Chairperson of the Council shall be the Vice-Chancellor.

The Senate is the academic authority of the University and shall consist of the Vice-Chancellor, Deputy Vice-Chancellor, Rectors, Directors of Institutes, Deans of the faculties, Heads of academic departments, all Senior

Professors/Professors of the University, Librarian and two nominees from each Faculty Board. The Chairperson of the Senate shall be the Vice-Chancellor.

The Campus Boards is responsible for the internal administration of the Campus. The Chairperson of the Campus Board is the Rector.

The Faculty Board is the academic authority of the faculty and shall consist of the Dean, all permanent Senior Professors, Professors, Associate Professors, Senior Lecturers and Lecturers, two members elected by the permanent Lecturers(Probationary), two members of the permanent staff imparting instructions in the Faculty, two student representatives, and three persons not being members of the staff of the University elected by the Faculty Board from among persons of eminence in the areas of study relevant to the Faculty. Dean shall preside at all meetings of the Faculty Board.

1.8 Chancellor and Officers of the University

Chancellor

The President shall nominate the Chancellor of each University. The Chancellor shall be the Head of the University, hold office for a period of five years reckoned from the date of his nomination, and shall, preside at any Convocation of the University. **Dr. Velmurugu Vivekanandarajah** is the present Chancellor.

Vice Chancellor

The Vice Chancellor shall be a full-time officer, appointed for a term of three years, who is the chief executive, academic and accounting Officer. He shall be an ex officio member and Chairman of both the Council and the Senate. The present Vice Chancellor is **Prof. V. Kanagasingham.**

Rector, Trincomalee Campus

The Rector of a Campus shall be appointed by the Vice-Chancellor of the University to which such Campus is attached. He shall, unless he vacates office earlier, hold office for a period of three years reckoned from the date of his appointment and shall, unless removed from office, be eligible for re-appointment for a further period of three years immediately succeeding the

aforesaid period. The Rector shall be a full-time officer of the Campus, academic and administrative Head of the Campus, Chairman of the Campus Board. The Rector shall be responsible for the maintenance of discipline within the Campus. The present Rector is Prof (Mrs). C. G. Devadasan.

Deans of Faculties

Dean of a Faculty shall be a full-time officer and the academic and administrative Head of that Faculty. The Dean shall be elected by the Faculty Board from among the Heads of the Departments of Study comprising such Faculty. The Dean shall hold office for a period of three years. Where owing to leave of absence, illness or other cause, the Dean of a Faculty is temporarily unable to perform the duties of his office for a period not exceeding three months, the Vice-Chancellor shall appoint another Head of a Department of that Faculty to act in the post of Dean, for such period.

The academics at present holding the office are as follows:

Dr. M. Pagthinathan, Dean/Faculty of Agriculture

Dr. A. A. Anthony, Dean/Faculty of Health Care Sciences

Snr. Prof. P. Vinobaba, Dean/Faculty of Science

Dr. J. Kennedy, Dean/Faculty of Art & Culture

Dr. S. Jeyarajah Dean/Faculty of Commerce and Management

Dr. T. Mathiventhan, Dean/ Faculty of Technology

Mr. S. Thadchanamoorthy, Dean/Faculty of Applied Science, Trincomalee Campus

Mrs. K. Santhrakumar, Dean /Faculty of Communication & Business Studies, Trincomalee Campus

Dr. (Mrs.) F. B. Kennedy, Director, Swami Vipulananda Institute of Aesthetic Studies (SVIAS)

Registrar

The Registrar of a University shall be appointed by the Council. He shall be a full-time officer of that University and shall exercise, perform and discharge such powers, duties and functions as may be conferred or imposed on or assigned to him by this Act or by any appropriate Instrument. The Registrar shall be responsible for the custody of the records and the property of the University, the ex officio secretary of the Council and the Senate and the Assistant Accounting Officer of the University. The Registrar shall, subject to the direction and control of the Vice-Chancellor, be responsible for the general administration of the University and the disciplinary control of its non-academic staff. **Mr. A. Pahirathan** is the present Registrar of EUSL.

Bursar

The Bursar of a University shall be appointed by the Council upon the recommendation of a Selection Committee. He shall be a full-time officer of that University and shall exercise, perform and discharge such powers, duties and functions as may be conferred or imposed on or assigned to him by this Act or by any appropriate Instrument. The Bursar shall, subject to the direction and control of the Registrar, be responsible for the administration of the finances of the University, and maintain its accounts in such form and manner as may be prescribed by Rules. He shall have the custody of the funds of the University. **Mr. M. M. M. Fareez** is the present Bursar of EUSL.

Librarian

The Librarian of a University shall be appointed by the Council upon the recommendation of a Selection Committee. He shall be a full-time officer of the library and shall exercise, perform and discharge such powers, duties and functions as may be conferred or imposed on or assigned to him by this Act or by any appropriate Instrument.

The Librarian shall, subject to the direction and control of the Vice-Chancellor, be responsible for the administration of the library or libraries of the University. At present **Dr. W. J. Jeyaraj** is serving as Librarian.

1.9 Students Affairs Department (SAD)

The SAD facilitates all students' matters except academic activities. It functions under the guidance of the Director, Students' Support Services and Welfare, supported through an effective students' counseling system headed by the Senior Students' Counselor and a proctoral system headed by Proctor.

1.9.1 Students' Counseling

The Senior Student Counselor and the student counselors provide assistance and guidance to students on matters relating to outside their academic activity. The students can seek the assistance and guidance from the student counselors on following matters:

(i) adapting to the new campus life and environment;
(ii) advice in relation to accommodation, financial assistance (Mahapola, Bursaries, etc.); and
(iii) any personal problems students face.

1.9.2 Financial Assistance

The Mahapola scholarship programme and the Bursary scheme are the two major sources that provide financial assistance to the University students. Further information regarding this may be obtained from the SAD.

1.9.3 Student Identity

All registered students will be given an Identity Card and a Student Record Book. The students are advised to produce his/ her Identity Card when requested by any officials of the University and while attending to officials matters in the University. Therefore students should have their Identity Cards with them at all times. The records are maintained by the Assistant Registrar/Faculty of Science, in the Student Record Books.

1.10 Academic Affairs Department

This Department comes with the overall supervision of the Registrar and conducting all Examinations of the Faculties and Convening meetings and the key responsibilities of the Department is attending and follow up work of Research & Publication Committee, University Higher Degree Committee, Convocation Committee, Curriculum Evaluation Committee, and activities of

the General Convocation and coordinating the Senate as per existing rules and regulations.

1.11 Senior Assistant Registrars (SAR)/ Assistant Registrars (AR)

(i) SAR / Academic Affairs : Mrs. N. Nirumithan

(ii) SAR / Establishment (Academic) : Mr. A. Sujendran

(iii) DR / Establishment (Non-Academic) : Mr. V. Navirathan

(iv) SAR / General Services : Mr. T. Baskaran

(v) AR / CEDEC : Mrs. A. Vasitharan

(vi) SAR/ Student Affairs : Mr. M. F. M. Marsook

1.12 Learning Environment

Library

The Library Network of the Eastern University, Sri Lanka comprises the Main Library which caters the faculties of Agriculture, Arts & Culture, Commerce & Management and Science, one branch library for the Faculty of Health Care Sciences, Trincomalee Campus Library for the Faculties of Communication & Business Studies and Applied Sciences and the Institute Library of Swami Vipulanandha Institute of Aesthetics Studies for the Faculty of Music.

There is a diverse collection of information resources in the EUSL libraries, especially in terms of the breadth and depth of coverage. The collection is multi disciplinary, encompassing a variety of subjects related to the established faculties and a full range of services is provided in each of four libraries including loans, inter library loan, reference and advisory services.

The main library is opens at 8.00 am and closes at 8.00 p.m. on week days and at 4.30 p.m. in weekends. Students can access the e-resources through http://lib.esn.ac.lk/ .

Center for Information and Communication Technology (CICT)

CICT provides adequate opportunities for students to acquire ICT skills and also provides ICT related technical assistance to the University. It conducts various

foundation / supplementary courses in ICT for internal and external students of all the faculties. CICT provides computer laboratory facilities for courses conducted by all faculties in the main campus, and also provides students' access for computer usage (internet browsing, LMS, library resources through http://lib.esn.ac.lk/ , etc.) by opening the centre from 8.00 AM to 6.00 PM. The CICT also conducts certificate and diploma courses during weekends and vacation periods. The present Director of CICT is **Mr. M. Sakuntharaj.**

Department of English Language Teaching (DELT)

The DELT serves all the faculties at the University and provide students with guidance in learning and use of English as a Second Language (ESL) in their academic work. The DELT is sensitive to the needs of undergraduates who enter the University with varying levels of proficiency in English, and provide them adequate training to improve their English proficiency to enable them to follow the courses and read the literature in English in their chosen disciplines.

It is set up for the specific purpose of teaching English to the with a view to improving their knowledge of English to enable them to follow the courses and read the literature in English in their chosen disciplines. The present Head of DELT is **Dr. S. Umashankar**.

Career Guidance Unit (CGU)

Career Guidance Unit (CGU) was established in 2004 under the guidelines of University Grants Commission (UGC) in order to have a unique role to play as a mediator between the University and the world of work, while integrating the career guidance activities with the curricular. CGU organizes and facilitates adequate training for students on 'soft skills'/ 'life skills'; it is addressed through the core curriculum as well as through tailor-made programmes. The present Director of CGU is **Prof. S. Arasaratnam.**

Physical Education Unit (PEU)

All sports activities are managed by the PEU, which is guided by the Sports Advisory Boards. The students are advised to make the best use of the facilities and participate in sport activities.

PEU has been set up with the vision to socialize a law- abiding and socially productive graduate, with the ability of effective leadership qualities and fair decision making, who is physically and mentally well balance and mission of producing an active and healthy generation with theoretically knowledge and practical activities of physical education. **Mrs. R. A. Puvanasingam** is the present Director of PEU.

Religious Entities

A Hindu Kovil, a mosque, a church, and a Buddhist shrine room are located in the University premises (religious Court) for religious activities.

Gender Equity and Equality Cell (GEE Cell)

EUSL is committed to the promotion of Gender Equity/Equality (GEE) and women's empowerment where all students, academic, administrative and support staff, female and male, enjoy equal opportunities, human rights, and free from all forms of discrimination and harassment. As such members of the University community have the responsibility of ensuring that it is free from gender inequity and Sexual and Gender Based Violence (SGBV).

Thus EUSL policy on GEE is designed to promote equality between women and men; to eliminate unlawful discrimination and harassment; and to provide an inclusive working, learning and social environment in which the rights and dignity of all its staff and students are respected to assist them in reaching their full potential.

1.13 Guidance

Each student will be assigned with a senior member of the Faculty who will be the Course Advisor. He/she will be available to the student to discuss academic and personal matters and provides appropriate assistance and guidance. Students are requested to make use of this facility and discuss any problems they may face with the Course Advisors during their entire University career.

1.14 Facilities

Hostels

Several hostels are available in Vantharumoolai and other places in Batticaloa, eleven (including 4 rented houses) for male students and thirteen (including 2 rented houses) for female students. A warden is in-charge of each hostel and in addition there are residential and part time sub-wardens to attend to hostel matters of students. The students are advised to meet the wardens and the sub-wardens in all matters related to activities of students in the hostels.

Canteens

There are canteens which cater mainly to the needs of students, where students may obtain food and tea at reasonable prices. Canteens are open from 7.30 a.m. to 7.00 p.m. during the working days.

Health Service

A University health service is available to staff and students of the University to receive immediate medical assistance. **Dr. S. Sivachelvan** is the present Medical Officer.

Student Centre

The Student Centre provides a common meeting place for students and staff. Besides canteen facilities, the centre has a spacious common room for entertainment.

Post Office

The post office for the use of staff and students of the University is situated within the University premises. It is open from 8.00 a.m. to 4.00 p.m.

Banks

Branches of the People's Bank and Bank of Ceylon operate with Auto Teller Machines (ATM) service within the University premises. University accounts are maintained at these branches which also handle all transactions. The students can receive their Mahapola and Bursary Scholarships installments through these banks.

2 Faculty of Science

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2.1 Introduction

The Faculty of Science was set up when the Batticaloa University College was established on 1st August 1981. The Faculty consists of five Departments, namely, Department of Botany, Department of Chemistry, Department of Mathematics, Department of Physics and Department of Zoology. The Department of Botany and Department of Zoology have a good collection of locally available and imported Species the herbarium (Botany) and Museum (Zoology) to make the teaching more meaning full and fruitful. The faculty comprises with a strong academic community with good research output. The Faculty offers Botany, Chemistry, Computer Science, Mathematics, Physics and Zoology as Principal subjects for the degree programmes.

Infrastructures

The Faculty of Science building complex is situated in the East side of the University which is partly completed. Zoology, Chemistry and Mathematics departments function in this new building, while the Botany and Physics departments are still situated in the old faculty buildings located in West side of the University. The proposed Science complex with five blocks for each department will be built in near future with all modern facilities.

2.2 Administrative Officers

Dean of the Faculty

Senior Professor P. Vinobaba

BScHons (Jaffna), PhD.(Stirling-UK), CBiol(UK), MIBiol (U.K)

Heads of Departments

The Head of a Department of Study shall be a Professor, Associate Professor, Senior Lecturer or Lecturer appointed by the Council upon the recommendation of the Vice-Chancellor. The Head of a Department shall hold office for a period of three years. Provided that, where the Head of a Department of Study has not been appointed by the Council, the Vice-Chancellor may appoint a Head of Department for a period not exceeding one month.

Head / Department of Botany

Dr. (Mrs.) M. R. C. J. Mahendranathan

BScHons(EUSL), MPhil(UPDN), PhD (EUSL)

Head / Department of Chemistry

Dr. M. Koneswaran

BScHons(EUSL), MSc(UPDN), PhD(UK)

Head / Department of Mathematics

Mrs. T. Pio Jude Navinthan

BScHons (EUSL), MPhil (PGIS, UPDN)

Head / Department of Physics

Dr. (Mrs.) Queenie Y. Soundararaja

BScHons(EUSL), M.Phil (UPDN), PhD (UOB, UK)

Head / Department of Zoology

Dr. (Mrs.) M. Vinobaba

BScHons(Jaffna) DPhil. (Sussex-UK)

Assistant Registrar/ Faculty of Science

Mr. V. Pragash

BA (UPDN), MA in Public Administration (MKU)

Assistant Bursar/ Faculty of Science

Ms. Thilini Madhusha Masachchi

HNDA, CBA, MAAT

2.3 Faculty Board of Science

Faculty board of Science, Eastern University, Sri Lanka is the academic authority of the Faculty of Science. The major functions of the Faculty Board are concerned with the overall regulations of teaching, course structure, examinations and research within the Faculty subject to the control of the Senate of the University. The Faculty Board is basically a support agency of the Senate and its academic

role is very important as most of the recommendations of the Senate are based on reports originating from the Faculty Board.

A Faculty Board headed by a Dean shall consist of the following persons: the professors, associate professors, senior lecturers, lecturers, two representatives among probationary lectures, two students' representatives and three external members appointed by the Faculty.

The Faculty Board

Ex-officio members

Prof. P. Vinobaba	Dean /Science
Dr. (Mrs.) M. Vinobaba	Head /Zoology
Dr. (Mrs.) M.R.C.J Mahendranathan	Head /Botany
Dr. (Mrs.) Q. Y. Soundrararajah	Head /Physics
Mrs. T. Pio Jude Navinthan	Head/Mathematics
Dr. M. Koneswaran	Head /Chemistry

Professors

Prof. F. C. Ragel
Prof. S. Thirukkanesh
Prof. A. G. Johnpillai
Prof. P. Peratheepan
Prof. M. Sithambaresan

Associate Professors

Prof. (Mrs.) C. G. Devadason
Prof. S. Arasaretnam

Senior Lecturers

Dr. S. Sathananthan
Mr. G. Parthiban
Dr. T. Mathiventhan
Dr. P. Elango
Mr. P. Paramathevan
Dr. P. R. Fernando
Mrs. S. Sathaananthan
Mrs. U. Mathiventhan
Mrs. J. Sriranganesan

Mr. S. Sotheeswaran
Mr. K. A. N. K. Karunarathna
Dr. T. Ealasukanthan
Dr. A. J. M. Harris
Mrs. S. Thavareesan
Dr. B. S. W. Karunarathna
Dr. R. M. T. B. Ranathunge

Lecturers (Probationary)

Mrs. S. Aynharan
Mrs. K. Thushanthan

Student Representatives

Mr. S. N. S. B. D. K. Semasinghe
Ms. P. D. C. D. Wijesinghe

Appointed Members

Mr. V. Panchalingam
Mr. S. Suthaharan
Mr. U. Udayashrither

Secretary to the Board

Mr. V. Pragash

2.4 Coordinators of Faculty of Science

Mrs. U. Mathiventhan: Faculty Quality Assurance Cell
Prof. S. Arasaretnam: MSc. in Science Education
Prof. S. Arasaretnam: Postgraduate Degree (by Research)
Mr. G. Parthiban: MSc. in Environmental Science
Mr. P. Paramathevan: Core and Optional Courses
Prof. M. Sithambaresan: Community Outreach Science Unit
Mrs. S. Sriranganesan: Diploma in Laboratory Technology
Dr. T. Ealasukanthan: External Degree Programme
Mr. S. Sotheeswaran: Faculty Coordinator for Website
Mr. K.A.N.K. Karunarathna: Non-principle Courses

2.5 Programmes of Study

2.5.1 Internal Degree Programme

The Faculty of Science conducts courses leading to BSc(General) Degree and BSc Honours Degree in Physical and Biological Science streams. The semester system has been implemented in the Faculty since year 2000 and the evaluation has been based on the Grade Point Average (GPA). The present outcome based curriculum focuses on molding wholesome graduates, which is portrayed by the Graduate Profile of the Faculty. English continues to be the medium of instruction in the Faculty since the inception in 1981.

The Faculty of Science, Eastern University, Sri Lanka, is making a unified attempt to improve the quality and relevance of study programmes with continuous engagement with stakeholders.

2.5.2 Postgraduate Degree Programme

The Faculty offers taught masters degrees with research component: MSc in Science Education and MSc in Environmental Science, for which application are invited by open advertisements.

The Faculty of Science also offers research degree programmes: Degree of Master of Philosophy (MPhil) and Doctor of Philosophy (PhD). The fields of study in which students will be registered for these programmes depend on the availability of supervision and facilities in the particular field; details are available in the faculty web site as well as in the Prospectors for Research Degrees.

2.5.3 Extension Programmes

Diploma in Laboratory Technology

Faculty conducts a diploma programme in Laboratory Technology through Center for External Degree and Extension Courses (CEDEC) which of 18 months duration. Applications are invited by open advertisements.

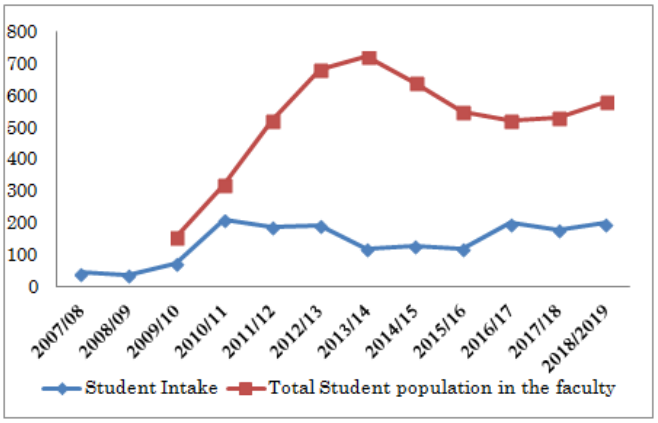
2.6 Academic Staff Strength

The following chart exhibits the strength of academic staff of the Faculty.

Academic Strength-Highest Qualification (2022)						
Status	**Department**					**Total**
Qualification	**Botany**	**Chemistry**	**Mathematics**	**Physics**	**Zoology**	
PhD	3	4	4	4	4	**19**
MPhil	1	1	6	-	1	**9**
MSc	1	-	2	-	-	**3**
BSc	2	2	2	2	2	**10**
Grade						
Senior Professor	-	-	-	-	1	**1**
Professor	-	1	2	2	-	**5**
Associate Professor	-	1	-	-	1	**2**
Senior Gr(I)	4	1	4	2	1	**12**
Senior Gr(II)	-	1	4	-		**5**
Lecturer (Prob)	3	2	4	2	3	**14**

2.7 Student Population

The following chart exhibits the growth of student population during last few years.



There has been a steady rise in student population after the war situation ended and has reached a saturation due to limited infrastructure, resources and staff cadre.

2.8 Faculty Journal

The Faculty of Science publishes Journal of Science (JSc) twice a year with open access policy (https://jsc.sljol.info/) and uniquely addresses the regional and national interest in a broad spectrum of pure and applied sciences. JSc is indexed by CrossRef and Google Scholar and JSc is available for harvesting via OAI-PMH and LOCKSS to create a distributed archiving system among participating libraries and permits to create permanent archives of the journal for purpose of preservation and restoration.

2.9 COSU

University's Community Outreach Science Unit (COSU) has been established in the Faculty of Science to extend the service of the faculty to community.

2.10 Newsletter

The Faculty of Science News (FOSnews) is published every six month and will continue to be a vehicle to reconnoiter the activities of the Faculty of Science.

2.11 Students' Magazine

The Faculty student union publishes annually a student magazine named as Blossom. The articles by the students decorate this magazine.

3 Undergraduate Programmes

3.1 Introduction

The Faculty of Science conducts courses under a semester based course unit system in English medium. An academic year is divided into two semesters, identified as the first semester and the second semester of a particular academic year such that each semester is of 15 weeks of academic activities.

The present curriculum under the semester system retains the strong commitment to interdisciplinary study and offers students more flexibility.

The Faculty offers the following degree programmes:

- Bachelor of Science (General) - BSc(Genral)
- Bachelor of Science Honours in Botany - BScHons(Botany)
- Bachelor of Science Honours in Chemistry - BScHons(Chemistry)
- Bachelor of Science Honours in Computer Science- BScHons(ComputerSc)
- Bachelor of Science Honours in Mathematics -BScHons(Mathematics)
- Bachelor of Science Honours in Physics - BScHons(Physics)
- Bachelor of Science Honours in Zoology - BScHons(Zoology)

The Degree of Bachelor of Science (General) programme is of three academic years duration and a student should have obtained a minimum of 90 credits for the award, and the Degree of Bachelor of Science Honours programmes are of four academic years duration and a student should have obtained a minimum of 120 credits for the award. The study progression is by offering *Course Units* sequenced in 100, 200, 300 and 400 *Levels*.

The Faculty adopts an Outcome Based Education where programme outcomes are clearly aligned with the course Intended Learning Outcomes (ILOs); and the teaching-learning activities and assessment strategies are aligned with the learning outcomes of each course (constructive alignment).

3.2 Programme Outcomes aligned to Graduate Profile

The Curriculum of the undergraduate study programmes are constructively aligned with the graduate profile.

Bachelor of Science (General) Degree Programme

The purpose of this qualification is to prepare a graduate with a broad knowledge on theory, practice and methodology of at least two principal subjects of science that enable them to bear responsibility in an academic or professional environment.

Alignment of BSc(General) degree programme with the graduate profile:

Desired Graduate attributes			Intended Programme Outcomes
1	**Competent in discipline knowledge & practice**	**Knowledge**	[1] Acquire a background in the basics of an array of relevant disciplines, and demonstrate in-depth knowledge and understanding of well-established theories, principles and concepts in at least two selected disciplines of physical or biological sciences. [2] Develop arguments and make sound judgments in accordance with basic theories and concepts in the discipline. [3] Collect, Analyse and interpret quantitative and qualitative data. [4] Use practical skills and enquiry, and use established techniques to undertake experimentation, analyz data, interpret results and propose solutions/ conclusions.
2	**Analytical, Solution seeking & creative**	**Skills**	[5] Apply knowledge and understanding of concepts and principles of the subject area. [6] Develop arguments and make appropriate judgments in accordance with theories and concepts of the areas of study.

3	**Effectively communicate & engage, ICT literate**	**Attitude, Values**	[7] Present information, ideas, and concepts efficiently and effectively. [8] Establish a rapport and build collaborative relationships with individuals and groups. [9] Demonstrate specialized transferable skills related to ICT.
4	**Adoptable, Independent, Sincere**		[10] Develop appropriate strategies for adapting to changing environments. [11] Exercise initiative, adoptability and accountability. [12] Exercise personal/team responsibility, and leadership in the professional environment/work place. [13] Demonstrate independence in learning and decision making, be principled and confident in activities.
5	**Visionary, Responsible (socially & environm- - entally)**	**Mind-set, Paradigm**	[14] Clearly identify where one wants to be and develop long term goals accordingly. [15] Acquire new competencies that will enable assume major responsibilities towards the goals. [16] Show an apprehension for societal and environmental concerns and work towards betterment. [17] Respect for diversity of communities with different cultural, social and religious backgrounds. [18] Empathy towards others and Philanthropy.

Bachelor of Science Honours Degree Programmes

Purpose of this qualification is to provide an in-depth knowledge in a particular Principal subject in order to equip graduates with knowledge, practice and methodology that prepare them for research based postgraduate studies or professional development in that discipline. This qualification demands a high level of theoretical/practical engagement and intellectual independence.

Alignment of BScHons degree programmes with the graduate profile:

Desired Graduate attributes			Intended Programme Outcomes
1	**Competent in discipline knowledge & practice**	**Knowledge**	[1] Acquire a background in the basics of an array of relevant disciplines, and demonstrate in-depth advanced knowledge and understanding of core aspects of a selected discipline of physical or biological sciences with another discipline as subsidiary. [2] Construct and sustain arguments and use these arguments, ideas and techniques in problem solving. [3] Critically Analyze data, make judgments and propose solutions to problems. [4] Use practical skills and enquiry efficiently and effectively, and use a range of established techniques to initiate and undertake experimentation, analysis of data, interpret results and propose solutions/conclusions.
2	**Analytical, Solution seeking & creative**		[5] Apply knowledge and understanding of concepts and principles of the subject area. [6] Construct and sustain arguments and use these arguments, ideas and techniques in problem solving for a given situation. [7] Engage in independent learning using scholarly reviews and secondary sources of information to research on a selected problem.
3	**Effectively communicate & engage**		[8] Receive and interpret information, Communicate/present information, ideas, issues and solutions effectively in a range of media and formats. [9] Demonstrate awareness of the current developments in the field of specialization. [10] Thorough in transferable skills related to ICT and information literacy.
		Skills	[11] Establish a rapport and build collaborative relationships with individuals and groups.

4	**Adoptable, Independent, sincere & visionary**	**Attitude**	[12] Analyse and devise appropriate strategies for adapting to changing environments. [13] Exercise initiative, adoptability and accountability. [14] Exercise personal/team responsibility, and leadership in the professional environment/ work place. [15] Demonstrate independence in learning and decision making, be principled and confident in activities. [16] Clearly identify where one wants to be and develop long term goals accordingly. [17] Exercise and further develop the new competencies and assume major responsibilities with confidence towards the goals.
5	**Responsible socially & environmentally**	**Mind-Set**	[18] Demonstrate positive attitudes and social responsibility. [19] Show an apprehension for societal and environmental concerns and work towards betterment. [20] Respect for diversity of communities with different cultural, social and religious backgrounds. [21] Empathy towards others and Philanthropy.

3.3 Credit Value

The volume of learning is described in terms of *credits*. The student workload of a study programme is about 1500 notional learning hours per academic year. The notional learning hours include direct contact hours with teachers and trainers, time spent in self-learning, preparation for assignments, carrying out assignments and assessments.

A. One credit of taught course, laboratory studies or field studies is equivalent to 50 notional learning hours.
   - ✓ 15 hours of lectures and 35 hours of independent learning and assessments; **or**
   - ✓ 30-45 hours of laboratory work or 45 hours of field work with additional time for independent learning and assessments; **or**
   - ✓ A blend of 50 notional learning hours of lecture, practical (and / or field work), independent learning and assessments.

B. One credit of industrial training (including time allocated for assessments) or research (including time allocated for literature survey) is considered equivalent to a minimum of 100 notional hours.

Credits have to be earned by students after successful completion of the work required and appropriate assessment of learning outcomes.

3.4 Course Units

A Course Unit is a selectively organized section of academic activity that may comprise either theory or practical, or a blend of both (50 notional hours per credit). There are few course units that comprise research or industrial training / internship / group project activity (100 notional hrs per credit) in the programmes. Content, teaching learning strategies and assessment of a course unit are carefully structured to facilitate the achievement of intended learning outcomes (ILOs) of a course unit, and course units are assessed on the basis of the students' attainment of ILOs.

Codes for Course Units: An alphanumeric code is used to identify a course unit. The first two alphabets identify the course from a Principal Subject Area (Table 1) or as *Enhancement / Supplementary* course. The first three numeric numbers designate the sequence of courses offered at 100, 200, 300 and 400 levels of progression. The 4th digit denotes the number of credit weight of that course unit.

Examples:

- CH2031 is a 1 credit course unit in Chemistry Principal Subject with number series 203 (i.e. offered at 200 series level).
- MT3072 is a 2 credit course unit in Mathematics Principal Subject with number series 307 (i.e. offered at 300 series level).
- EN1042 is a 2 credit *Enhancement* course unit with number series 104 (i.e. offered at 100 series level).
- SP2031 is a 1 credit *Supplementary* course unit with number series 203 (i.e. offered at 200 series level).

The *Auxiliary* courses are not assigned credit values and are basic level courses at 100, 200 and 300 levels, and hence assigned unique codes (see Table 3) for courses of three categories: English (ENG) language, Career and Personality Development (CPD) and Sri Lankan Values (SLV).

The study BSc and BScHons degree programmes are carefully designed by sequencing course units and the core of the curricula of these study programmes are through courses from Principal Subject Area, and the remaining course units are covered from *Auxiliary*, *Enhancement* (EN) and *Supplementary* (SP) courses. The *Auxiliary* and *Enhancement* courses are compulsory for all students and *Supplementary* courses are elective.

3.5 Principal Subject Area

The core of the curriculum emanates from the Principal Subject Area. The choice of Principal Subjects depends on the Stream of Study, namely Biological Science or Physical Science. The Faculty, at present, offers courses in six Principal Subjects. The Principal Subjects offered and the Letter Codes assigned to them together with the responsible academic department are given in Table 1.

At the beginning of the first year students are expected to choose **one** of the following Principal Subject combinations for the study, and the scope for specialization for a particular combination is also highlighted in Table 2.

Table 1: Principal Subjects designated by codes and identifying the department offering the subject

Principal Subject	**Prefix**	**Offered by**
Botany	BT	Department of Botany
Chemistry	CH	Department of Chemistry
Computer Science	CS	Department of Mathematics
Mathematics-I	MT	
Mathematics-II		
Physics	PH	Department of Physics
Zoology	ZL	Department of Zoology

Table 2: Principal Subject combinations a student may select at the first year of study and the scope for BScHons Degree(s) for that particular combination

Combination Code	Combination of Principal Subjects	Scope for BScHons Degrees
Physical Science Stream		
PS1	Chemistry, Mathematics-I, Physics	Chemistry, Physics
PS2	Mathematics-I, Mathematics-II, Chemistry	Mathematics, Chemistry
PS3	Mathematics-I, Mathematics-II, Computer Sc.	Mathematics, Computer Sc.
PS4	Mathematics-I, Mathematics-II, Physics	Mathematics, Physics
PS5	Mathematics -I, Physics, Computer Sc.	Physics, Computer Sc.
PS6	Mathematics-I, Computer Sc., Chemistry	Computer Sc., Chemistry
Biological Science Stream		
BS1	Botany, Zoology, Chemistry	Botany, Zoology, Chemistry

Note1: To claim a Principal Subject for BSc degree, a student should have offered minimum of 8 credits from each Level.

Note 2: A Student is required to select his/her Principal Subject combinations during the orientation. Any change of subject combination should be made within 2 weeks from the commencement of the academic programme.

Note 3: If the number of students that can be accommodated for a particular course/subject has to be limited due to lack of resources, then students for that course/subject will be selected by an appropriate selection procedure decided by the department/faculty.

Students can seek the assistance of the academic counselors and advisors who will help them to select appropriate subject combination.

For each Principal Subject, there is a comprehensive document named *Programme Specification* published for each academic department which specifies:

- *Subject Benchmark Statements* associated with BSc(General) and BScHons degree programmes that are aligned with graduate profile and Sri Lanka Qualification Framework (SLQF);
- Course Specification (Lesson Plan) of each course unit consist of intended learning outcomes (ILOs) for the course, course contents, teaching-learning methods, assessment methods and recommended readings.

Copies of the above documents are available in the library for reference.

In addition to the course units from Principal Subject area, a student is required to offer compulsory *Auxiliary* and *Enhancement* (EN) courses as explained in sections 3.5.1 and 3.5.2 Moreover, from 2nd year onwards a student may offer *Supplementary* courses that are elective as outlined in section 3.5.3.

3.5.1 *Auxiliary* Courses

Auxiliary courses are designed to provide (i) a basic *English* (ENG) language proficiency aligned with University Tests of English Language (UTEL); (ii) induce a sensitiveness to *Sri Lankan Values* (SLV), and (iii) mould a socially responsible graduate through a series of courses on *Career and Personality Development* (CPD).

The *Auxiliary* course units are compulsory, but not taken for the computation of Grade Point Average (GPA); however shall be evaluated and appear in academic transcript, and be partial requisite for the award of degrees (see Table 7 and sections 4.5.2(ii) and 4.5.3(ii)). Generally CPD & SLV courses will be conducted throughout the academic year, mostly outside the usual time-table hours, and continuous assessments would mainly contribute to the final grades. The *Auxiliary* course units offered and the Letter Codes assigned to them are given in Table 3.

Table 3: *Auxiliary* course units that are offered at 100, 200 and 300 levels.

Course Code	Course Titles	Course outlook
100 Level		
ENG100	English Level-I	UTEL Bands 3-4, exemption for Band 4

Course Code	Course Titles	Course outlook
CPD100€	Motivation for self development and adaptability	Orient fresh undergraduates to adapt to university life through a series of interactive lectures and counselling sessions, guided visits and engagement; facilitate self-reflection and setting vision for life and career goals towards lifelong learning; motivate qualities such as resilience, flexibility and co-operation; encourage and facilitate engagement in yoga/meditation/ aerobatics/ sports/ aesthetics.
SLV100€	Ethnic Cohesion and Social Harmony	Provide basic language skills in Sinhala♦ or Tamil♠ to each undergraduate through teacher centred teaching-learning activities as well as facilitating peer learning through multi-ethnic group activity motivating cohesion, harmony, respect for diversity of communities with different cultural, social and religious backgrounds. Documentation of experiences and reflections via e-portfolio†
200 Level		
ENG200	English Level-II	UTEL Bands 5-6, exemption for Band 6
CPD200	Career Prospects and personality development	Future trends of employability, threats and opportunities due to 4th generation technologies; Organisational culture, Roles and functions of managers, management styles, leadership theories, personality attributes for leadership, Influencing and persuasive skills, effective teamwork; personality development through scientific spirituality; encourage and facilitate engagement in yoga/meditation/ aerobatics/ sports/ aesthetics.

Course Code	Course Titles	Course outlook
		Documentation of experiences and reflections via e-portfolio†
SLV200	Community Outreach: Scientific Engagement[ξ]	Group project / activity / Internship: Student groups scientifically engage in a community activity that promote volunteerism, empathy, philanthropy, an apprehension for societal and environmental concerns and work towards betterment; documentation of experiences and reflections via e-portfolio†
300 Level		
ENG300	English Level-III	UTEL Bands 7-8, exemption for Band 8
CPD300	Career Skills and Professionalism‡	Motivate and guide to develop leadership qualities (honest, principled, self motivated, proactive, responsible, autonomous, independent, confident, accountable, impartial, work towards common objective, etc.); provide guidance for making effective presentations, preparation of CV, facing job interviews, etc.; facilitate professional experiences/industrial visit; encourage and facilitate engagement in yoga/meditation/ aerobatics/sports/aesthetics. documentation of experiences and reflections via e-portfolio†
SLV300	Science of Indigenous Knowledge and Practices	Scientific understanding/realization of the value of indigenous practices/wisdom via lecture/seminar sessions, independent learning; presentation / e-portfolio† based on a guided independent study (reporting realizations on scientific ground).

♦ For students who had their school education in Tamil medium

♠ For students who had their school education in Sinhala medium

† Same e-portfolio student ID be used for many such courses to upload experiences and reflections; e-portfolio is required to attain M grade; sincere and quality portfolios will be screened and validated for the purpose of employers' reference.

ξ Each academic department will handle a number of such projects/activities involving groups of students related to the discipline(s) of the department.

‡ Industrial visit included.

€ These courses cannot be repeated. (Students those who fail to get at least S grade in any of the SLV and/or CPD courses in all three levels will be allowed to re-do the project/re-submit the project of the SLV/CPD courses in 200 or 300 level)

Basic Sinhala/Tamil Course

In order to acquire the degree Tamil Speaking Students and Sinhala Speaking Students should pass the Basic Sinhala (NBS1110) and Basic Tamil (NBT1120) courses respectively.

3.5.2 *Enhancement* Courses

Enhancement course units are compulsory that are required for progression and career, are given in Table 4 together with the Letter Codes, which contributes for GPA computation.

Table 4: *Enhancement* course units that are offered at 100, 200 and 300 levels

Course Code	Course Titles	Hours♣ (L/P/ IL)	Credits
100 Level			
EN1011	Basic Mathematics♥	15/0/35	1
EN1021	Basic Statistics♥	15/0/35	1
EN1032	Basic Biology♀	15/30/55	2
EN1042	Introduction to Computing-I	15/30/55	2
EN1052	Introduction to Computing-II	15/30/55	2
200 Level			
EN2013	Visual Application Development	30/30/90	3
300 Level			

EN3012	Resource Efficiency and Cleaner Production	30/0/70	2

♥For those who have not offered Mathematics as a subject at GCE(A/L) Examination

ϛFor those who have not offered Biology as a subject at GCE(A/L) Examination

♣Hours are distinguished as (Lecture/Practical/Independent learning) that also cover time taken for assessments

3.5.3 *Supplementary* Courses

Supplementary course units are offered as electives in disciplines within and outside the faculty. However, students are allowed **not more than 12** credits from these *Supplementary* course units.

Table 5: *Supplementary* course units that are offered at 200 and 300 Levels

Course Code	Course Titles	Hours♣ (L/P/IL)	Credits
200 Level			
SP2012	Principles of Management	30/00/70	2
SP2022	Fundamentals of Economics	30/00/70	2
SP2032	Financial Accounting	30/00/70	2
300 Level			
SP3011	Entrepreneurship skills Development	15/00/35	1
SP3023	Object-Oriented Analysis and Design	30/30/90	3
SP3032	Science Education	25/10/65	2
SP3042	Science of Consciousness and Spirituality	15/30/55	2
SP3052	Data Analysis and Report Writing	00/60/40	2

♣Hours are distinguished as (Lecture/Practical/Independent learning) that cover time taken for assessments

For course units offered outside Principal Subject area, a document named "*Course Specification for Auxiliary, Enhancement and Supplementary* Course Units" is published for the Faculty and available in the library for reference.

3.5.4 Prerequisites

The subject matter in a course unit at a lower level is sometimes essential to follow a course unit at a higher level. The course unit at the lower level so needed is called a prerequisite of the course unit at higher level.

3.5.5 Flexibility

Levels shall not be tied rigidly to the corresponding **year of study.** If the exigencies of a particular student's circumstances requires, his/her time table permits, and provided that his/her programme can be completed within the allotted time limit, there shall be no objection to, for instance, a third year student taking 200 Level courses (courses of only levels below the current level are allowed to be taken, except for some 400 level courses that are offered for BScHons students at 3rd year).

A student who has accumulated more credits than necessary for GPA calculation (i.e. more than 90 for BSc(General) degree or 120 credits for BScHons degree), he/she may claim which **non-compulsory courses** to be considered for GPA calculation. However, all courses registered will appear in the transcript with grades.

3.5.6 Registration for Course Units

Registration for course units for the **entire academic year** commences **one** week prior to the start of the first semester, and continues during the first two week of this semester. Students only have registered are allowed to sit for examinations of that course unit, and should registers using the appropriate form on or before a date specified by Office of the Dean, and he/she can offer only these course units to earn credit. In **each academic year**, a student **must** register for course units (excluding auxiliary) not less than 27 and not more than 33 credits, excluding course units which are being repeated. However, for the award, a student should have obtained minimum of 30 credits (excluding auxiliary) from each **Level** (i.e. 100, 200, 300, etc.).

Selection of course units must be done very carefully as students will not be permitted to change their selections once the registration period is over. Students can obtain guidance from Academic Advisors to select course units judiciously.

Elective (optional) course units having less than five students may not be conducted (applicable only for BSc(General) degree programme and students who have registered for such course units are permitted to register for other available course units during the registration period.

If the number of students for a particular course unit exceeds the available capacity, students will be chosen on a selection procedure specified by the respective department. All information regarding above is made available at the Office of the Dean and the students are requested to contact the Assistant Registrar of the Faculty for further information.

3.6 Academic Progression

The study progression is through a series of Levels. The General Degree Programme consists of three academic years, progression through courses from 100, 200 and 300 Levels; and the Special Degree Programme consists of four academic years, progression through courses from 100, 200, 300 and 400 levels. The Faculty will notify the commencement of the academic year with the approval of the Faculty Board. An academic year consists of two semesters with approximate schedule given below:

Orientation	-	2 Weeks
First Semester	-	15 Weeks
Study leave	-	2 Weeks
Examination	-	4 Weeks
Vacation	-	2 Weeks
Second Semester	-	15 Weeks
Study leave	-	2 Weeks
Examination	-	4 Weeks
Vacation	-	6 Weeks

The Orientation Programme for new students consists of intensive courses in "English" and "IT" in addition to various activities to orient students to the degree programme and University life. The aim of the two intensive courses is to bring all students to a common level in English and IT knowledge so that the students are prepared to follow courses when the academic programme starts.

3.6.1 BSc (General) Degree

1st Year – A student shall select one combination from the Table 2 in section 3.5, offering 8 credits from each Principal Subject at 100 Level courses. In addition,

students shall offer compulsory *Auxiliary* (non-credit) and *Enhancement* courses (see Table 3 in section 3.5.1 and Table 4 in section 3.5.2).

2nd Year – Students shall continue with the at least TWO *Principal* Subjects of the combination offered at 1st year, offering minimum of 8 credits from each *Principle* Subject at 200 Level courses; the remaining credits requirement shall be covered through compulsory *Enhancement* courses and selecting courses from ANY *Principle* Subjects at 200 Level (provided prerequisites are met and time-table permits) and/or from *Supplementary* courses at 200 Level.

3rd Year – The general degree students shall continue with at least TWO *Principal* Subjects offered at the 2nd year offering minimum of 8 credits from each *Principle* Subject at 300 Level courses; the remaining credit requirements shall be covered through compulsory *Enhancement* courses and selecting courses from ANY *Principal* Subjects (provided prerequisites are met and time-table permits) or from *Supplementary* courses.

Note: Not more than 12 credits are allowed from the *Supplementary* courses for the award of BSc(General) degree.

3.6.2 BScHons Degree

Upon application at the end of 2nd year, students will be selected to follow an Honours Degree in a Principal Subject as stated in section 3.5.

Students who opt for specialization at the 3rd year of study must continue with two principal subjects offered in the 2nd year (one of which is the subject of specialization) and additionally should offer minimum of 10 credits from 400 level courses of the subject of specialization. At the 4th year of study, minimum of 30 credits (including research project) must be offered from 400 level courses of the subject of specialization.

To obtain a Honours Degree, students should have offered a minimum of 120 credits for GPA computation, out of which at least **72 credits must be from the subject of specialization** (88 credits in case of Mathematics); and out of which 40 must be from 400 level courses of specialization.

Each department will offer courses as per to the available resources and would specify the courses the department would offer for the program. Moreover, each Department of study will decide on the number of students to be enrolled in the

Special Degree Programme depending on its requirements and available facilities.

Note: Students who intend to follow Special degree are advised to obtain at least 12 credits at 200 level from the subject intended to specialise, so that their credits will add up to at least 12 per year at 200 and 300 levels from the subject of specialization.

3.6.2.1 Selection for BScHons Degree

Upon application at the end of 2nd year, students will be selected to follow a BScHons degree in a Principal Subject as outlined in Table 2 in section 3.5. To apply for an Honours Degree programme, the following requirements must be fulfilled:

I. Obtained at least an overall GPA (see section 4.2) of 2.00 at the 100 and 200 levels.
II. Obtained at least a GPA of 2.50 in the subject of specialization at 100 and 200 levels; 8 credits from each year are chosen for calculation of GPA that includes the compulsory courses (denoted by symbols "✓" in Principal Subject table), and the rest of the credits are selected to be best grades among the electives offered in subject of specialization.
III. Obtained at least B grades aggregating to 8 credits in the subject of specialization (12 credits in case of Mathematics) at 100 and 200 levels;
IV. Obtained no "E" grade in the subject of specialization.

3.6.2.2 Withdrawal from the Special Degree Programme

In the event a student wants to opt out from a special degree programme and revert to a general degree programme, he/she may inform to the relevant Head of Department with reasons before sitting any of the 4th year special degree examination. Based on the recommendation of the head of the relevant department, the Faculty Board shall take the decision.

In such case, the special course units (i.e., 10 Credits from subject of specialization at 400 level) followed in third year of study will be equalized to 3rd year general degree course. The GPA calculation follows as per the regulation of the general degree programme in the 300 level for the 10 Credits course units of specialization.

Further, if a student has sat the 4th year examination, but still wants to revert to general degree as fallback options, he/she shall be conferred with general only

with the special degree cohort; the best 10 grades will be considered when equalizing the credits to General Degree.

3.7 Curriculum Map

The curriculum map is given below.

Courses in the Curriculum	Graduate Profile				
	GA1	GA2	GA3	GA4	GA5
	Competent in discipline knowledge & practice	Analytical, Solution seeking, creative	Effectively communicate & engage, ICT literate	Adoptable, Independent, sincere	Visionary, Responsible (socially, environmentally)
	Knowledge	Skills		Attitude	Mind-Set
Principal Subject Area (BT, CH, CS, MT, PH, ZL)	H	H / M	M / L	L	L
ENG100, ENG200, ENG300			H		
CPD100, CPD200, CPD300				H	M
SLV100			H	L	H
SLV200	M	H		M	H
SLV300	M	H			M
EN1011, EN1021, EN1032	H	M			
EN1042, EN1052, EN2013, SP3023	M		H		
EN 3012	M	L			H
SP2012, SP2022, SP2032,	H				
SP3011, SP3032 SP3052	M	M			M
SP3042	L			M	H

Table above provides an overview of mapping of the curricula of the degree programmes to the Graduate Profile of the Faculty; notations H, M and L provides a rough measure of contributions of the Course Units to the graduate attributes as High, Medium and Low respectively.

Curriculum Matrix – BSc(General) & BScHons

Degree & Year	Level of offered Courses		No. of Credits in Principal Subjects X	Y	Z	Compulsory Auxiliary Courses*	Compulsory Enhancement(EN) courses & Credits		Supplementary (SP) courses & Credits		Total Credits for the Award
BSc(Gen) 1st Year	100		8	8	8	ENG 100 CPD 100 SLV 100	(EN 1011, EN1021)/ EN 1032 EN 1042 EN 1052	2 2 2	-		(24P+6EN)
BSc(Gen) 2nd Year	200	Op-I	≥ 8	≥ 8	≥ 8	ENG 200 CPD 200 SLV 200	EN 2013	3	SP 2012 SP 2022 SP 2032	2 2 2	(≥24P + 3EN) + ≤3(P†+SP)
		Op-II	≥ 8	≥ 8	< 8						(≥16P +3EN) + ≤11(P†+SP)
BSc(Gen) 3rd Year	300	Op-IA OP-1B	≥8 ≥8	≥ 8 ≥8	≥ 8 < 8	ENG 300 CPD 300 SLV 300	EN 3012	2	SP 3011 SP 3023 SP 3042 SP 3052 SP 3062	1 3 2 2 2	(≥24P+2EN) + ≤4(P†+SP) (≥16P +2EN) + ≤12(P†+SP)
		Op-II	≥8	≥8	< 8						
BScHons (X) 3rd Year	300		≥ 8	≥8	< 8						Accumulated credits from 100, 200 & 300 levels: [≥42P(X) + ≥16P(Y) + ≥8P(Z) + 11EN] + ≤13(P†+SP)
	400		10	-	-						
BScHons (Math) 3rd Year			M-I	M-II							
	300		≥ 8	≥ 8	< 8						
	400		10								
BScHons 4th Year	400		30	-	-	-	-				30P(X)
BSc(General) with THREE Subjects	Op-IA		**≥ 24**	**≥ 24**	**≥ 24**	Pass (S) in ENG 100 & ENG 200; Pass (S) at least one course each in CPD & SLV	11		≤ 12		(≥72P+11EN)+ ≤7((P†+SP)
	THREE Principal Subjects X, Y & Z										Min 90 credits, OGPA 2.00 with no E grade.
BSc(General) with TWO Subjects	OP-IB OP-II		**≥ 24**	**≥ 24**	< 24						(≥48P+11EN)+ ≤31((P†+SP)
	TWO Principal Subjects X & Y										Min 90 credits, OGPA 2.00 with no E grade.
BScHons(X)			**≥ 72**	≥ 16							Min 120 credits (min 96P†) OGPA 2.00; grades C or better in 96 credits with 24 in each year; no E grades.
BScHons(Math)			**≥ 88**								

P – Course Units from Principal Subjects X, Y, Z **P† - Course Units from any Principal Subject, provided prerequisites are met and time-table permits**

4 Evaluation Systems

Evaluation consists of continuous assessments and end semester assessments.

I. Continuous assessment usually account for 20 - 40% of the total grade. Continuous assessments may consist of mid-semester examinations, quizzes given in class, take-home assignments such as papers or problem sets, in-class presentations by students, projects, etc.

   All continuous assessments conducted shall be taken into computation, but the weight for different types of assessment (i.e. not equal weight for assignment, quizzes, open book exam, spot test, etc.) shall be decided by the Lecturer in-charge and expected to be announced to the students at the beginning of the course.

II. Except in the case of research projects, seminars, field work, practicals, *Auxiliary* courses, etc., the end semester assessment shall take the conventional form of a final examination at the end of semester, which may be closed book and shall account for 60 - 80% of the total grade. The duration of the final theory examination may vary according to the credit value of the course, as follows:

   1 Credit: 1 to 1 ½ hours

   2 Credits: 2 to 2 ½ hours

   3-4 Credits: 3 hours.

Allocated percentage marks for sub-questions of each question of a end semester examination shall be specified (denoted) in the question paper.

Assessments are carefully structured to ascertain students' attainment of intended learning outcomes (ILOs) of a course unit, and the teaching-learning strategies are to facilitate students attainment of ILOs of the course unit. The percentage weight given for continuous and end semester assessments may vary, and depends on the nature of ILOs of the Course Unit, and the definite percentage weight is stated in the Course Specification (Lesson Plan).

For a course unit for which both theory and practical are blended, but if both continuous and end semester assessments are done separately for each

component, then a student must obtain at least a D grade for each component (continuous plus end semester).

4.1 Grade and Grade Point

Based on the scheme of evaluation mentioned above, the total marks scored (continuous plus end semester) by the student for a course unit (or theory/practical component of a course unit) will be graded based on the distribution of marks in the class ('grading on a curve') for which the scheme is approved by the Faculty Board of Science. Accordingly, Letter grades of **A**, **B**, **C**, **D** (qualified as **+** or **-**) and **E**, are awarded for each course unit, and for purposes of computing Grade Point Average (GPA), each grade shall correspond to a particular Grade Point Value as in the following table, in accordance to the University Grant Commission (UGC) Circular No. 901:

Table 6: Grades and Grade Point Values together with attainment descriptors

Grade	Grade Point Value	Attainment descriptor
A+	4.00	Excellent
A	4.00	
A-	3.70	
B+	3.30	Meritorious
B	3.00	
B-	2.70	
C+	2.30	Satisfactory
C	2.00	
C-	1.70	
D+	1.30	Unsatisfactory
D	1.00	
E	0.00	Failure

To earn a *credit* or a *Grade Point* for a course unit (excluding *Auxiliary* courses), the student should obtain at least D grade for that course unit, and E is a failed grade. In case of a blended course unit, if theory and practical components are assessed separately, then a student should obtain at least D grade for each component of that course unit; if a component is failed, a transitional Grade "I" will be assigned (also see section 4.3_II) for the course unit until the failed component is improved to earn a Grade Point.

4.2 Assignment of Grades, Grade Point and Grade Point Average (GPA)

The grades submitted for a course unit by the examiner(s) (i.e. graded as per to the scheme stated in section 4.1) will be reviewed by a committee constituted by the faculty for that course unit, and shall finalize the results of that course unit. The Head of the Department will submit the grades obtained by the students for the course unit under his purview to the Office of the Dean.

The Grade Point Average (GPA) of each student for the j^{th} Level of study, G_j, is the credit-weighted arithmetic mean of the Grade Point values which is computed as,

$$G_j = \frac{\sum_i c_i g_i}{\sum_i c_i} \; ; j = 100, 200, 300, 400;$$

where c_i is number of credits for the i^{th} course and g_i is the grade point value for the i^{th} course. The GPA will be computed to the second decimal places.

The overall weighted GPA, $\overline{G}$ for BSc(General) degree will be computed as

$$\overline{G} = \frac{G_{100} + G_{200} + 2G_{300}}{4}$$

where $G_{100}, G_{200}, G_{300}$ are the *GPA* for 100, 200 and 300 levels respectively.

The overall weighted *GPA*, $\overline{G}$ for the BScHons degree, will be computed as

$$\overline{G} = \frac{G_{100} + G_{200} + 2G_{300} + 3G_{400}}{7}$$

where G_{400} is the GPA of all 400 level course units offered in third and fourth years of study. The final GPA for the awards shall be computed to the second decimal place.

The *Auxiliary* courses will not be considered for GPA calculation, and be assigned with three grades: Meritorious (M), Satisfactory (S) or Fail (F).

Table 7: Benchmarks of ENG courses, requisites and motivating reward upgrades for *Auxiliary* courses

<table>
<tr><th>Course Code</th><th>Grade</th><th colspan="2">Benchmarks / requisites / upgrades</th></tr>
<tr><td rowspan="2">ENG100</td><td>S</td><td>Benchmark UTEL Band 3</td><td rowspan="2">At least S grade for BSc degree award</td></tr>
<tr><td>M</td><td>Benchmark UTEL Band 4</td></tr>
<tr><td rowspan="2">ENG200</td><td>S</td><td>Benchmark UTEL Band 5</td><td rowspan="2">At least S grade for BSc degree award</td></tr>
<tr><td>M</td><td>Benchmark UTEL Band 6</td></tr>
<tr><td rowspan="2">ENG300</td><td>S</td><td>Benchmark UTEL Band 7</td><td rowspan="2"></td></tr>
<tr><td>M</td><td>Benchmark UTEL Band 8</td></tr>
<tr><td rowspan="4">CPD100,
SLV100,

CPD200,
SLV200,

CPD300,
SLV300,
ENG300</td><td rowspan="4">M, S</td><td colspan="2">Should have at least S grade in one course each in CPD and SLV for the Award of degree.</td></tr>
<tr><td colspan="2">(1) If a student is not eligible for the award of degree as due to $1.95 \leq \bar{G} < 2.00$, then each additional S and M grades than the minimum required in auxiliary courses for the award shall contribute to $\bar{G}$ with Grade Points 2.00 and 3.00 respectively with one credit weight for each course; maximum $\bar{G}$ attainable will be 2.00.</td></tr>
<tr><td colspan="2">(2) If a student is not eligible for BSc degree award due to number of E grades, “each M grade” / “two S grades” of auxiliary courses additional than minimum required for the award shall waive an E for one credit course (and proportionately so for more credit courses), but there shall be no addition in GPA. In all such upgraded award of degrees, the student will not be eligible for Class.</td></tr>
<tr><td colspan="2">Combination of (1) and (2) may also be considered for an award if required so (Grades used for upgrade in (1) cannot be used for (2)). Such revisions shall be done only if the student becomes eligible for an award by such revision.</td></tr>
</table>

4.3 Transitional Symbols

I. **Symbol W:** Withdrawal from a course unit within the first two weeks of **registration** is allowed provided that the minimum credit requirement is not violated. Withdrawals after this period cannot be made, except on medical grounds or other valid reasons; these courses will be assigned a grade **W**. Failure to complete a course unit, which has not been recorded as a withdrawal, the grade for that course unit shall be computed with the available continuous assessment marks.

II. **Symbol I:** Incomplete "I" shall be given for a student who has sufficiently covered the course, but not completed:

a) If "I" was given because the student was unable to get at least a D grade in either practical or theory component of a blended course unit, he/she may be allowed to upgrade it by re-sitting the end semester exam of the failed component when it is held next; maximum grade for that repeated course shall be C.

b) If "I" was given due to being absent for an end semester examination and the reason for the absence being acceptable by the Faculty Board and Senate, then he/she shall sit the next available examination as a proper candidate (in case of a repeat candidate, he/she shall retain the lost attempt), and a new grade will be assigned upon evaluation, replacing "I".

If a reason acceptable to the Faculty Board and Senate is not given for the absence, then the grade for that course unit shall be computed with the available continuous assessment marks.

c) If grade "I" was given due to student not applying for the end semester examination of a registered course unit due to reasons acceptable to the Faculty Board and Senate (or due to any restrictions imposed by the Senate), then in such case records should be kept in the respective department regarding the reasons for this grade and a scheme for its removal. A student should remove the grade "I" by re-sitting the end semester exam when it is held next (or until the end of any imposed restrictions).

If a student does not apply nor sit a end semester examination of a registered course unit without the approval of Faculty Board and Senate, the grade will be computed with the available continuous assessment marks.

Student should inform his/her absence to an end semester examination of a course unit to the Dean or Assistant Registrar within 7 days due to illness. Once informed within 7 days, the medical certificates (certified by the

University Medical Officer) should be submitted within 14 days of the recovery of illness.

Upon the request of a student after the release of final semester examination results (of the final year), a grade shall be computed for those course units with "I" symbol with the available formative/summative assessment marks.

4.4 Attendance and Repetition of Course Unit

I. University regulations require 80% attendance for all components of a course unit. Absence on medical grounds or any other valid reason must be approved by the Faculty Board and Senate. If a student do not meet the required attendance for a course unit, then he/she will not be allowed to sit the end semester examination of that course unit and will be considered as repeat candidate at the next attempts.

II. A student who obtains grades of C-, D^{+}, D or E for a course unit (or theory/practical component of a course unit) may be allowed to repeat the end semester examination component of that course to improve the grades. For this purpose **only three more attempts** will be given and the maximum grade shall be C. Students are expected to repeat such examinations when it is held next. In the event a candidate obtains a lower grade while attempting to improve a grade, he/she will be entitled to his/her previous grade.

III. Continuous assessment marks will be incorporated for the computation of final grade for students who sit an end semester examination (i) as proper candidate; (ii) as repeat candidate at the first time (i.e. 2^{nd} attempt). For 3^{rd} and 4^{th} attempts, only end semester examination marks shall contribute to the final grade of that course unit.

IV. Repeat students may be allowed to follow the lectures with the consent of the lecturer; however, they will not be allowed to attend practical classes.

4.5 Awards

The Board of Examiners chaired by the Vice Chancellor shall meet to consider the performance of the candidates and recommend the following awards to the Senate.

4.5.1 Award of Bachelor of Science (General) Degree

A candidate will be awarded the BSc (General) degree, if he/she has:

(i) Obtained a minimum overall weighted GPA (*G*) of 2.00 in minimum of 90 credits (excluding Auxiliary courses, but with the provision in table 7 in page 43), out of which,

a. should have completed minimum of 24 credits each in at least two Principal Subjects, and
b. should not have accumulated more than 12 credits from Supplementary courses, and
c. should not have any E grades after compensating E grades as per table 7 in page 43;

and

(ii) obtained at least a Satisfactory (S) grades for ENG100 and ENG200 courses and for at least one course each in CPD and SLV Auxiliary courses; and a pass in Basic Sinhala/Tamil

(iii) completed requirements (i) and (ii) above within six academic years.

Award of Class

A student who has fulfilled all the conditions for the award of BSc(General) shall be awarded a Class, if he/she fulfils the following additional requirements:

4.5.2.1 First Class:

(i) Obtain a minimum overall weighted GPA ($\overline{G}$) of 3.70;

(ii) Obtain A or better grades in at least 36 credits;

(iii) Obtain C or better in at least 80 credits;

(iv) Complete the degree programme within three academic years.

4.5.2.2 Second Class (Upper Division):

(i) Obtain a minimum overall weighted GPA ($\overline{G}$) of 3.30;

(ii) Obtain B or better grades in at least 36 credits;

(iii) Obtain C or better in at least 75 credits;

(iv) Complete the degree programme within three academic years.

4.5.2.3 Second Class (Lower Division):

(i) Obtain a minimum overall weighted GPA ($\overline{G}$) of 3.00;

(ii) Obtain B- or better grades in at least 36 credits;

(iii) Obtain C or better in at least 75 credits;

(iv) Complete the degree programme within three academic years.

4.5.2 Award of Bachelor of Science Honours Degree

A candidate will be awarded the Degree of Bachelor of Science Honours (BScHons), if he/she has

(i) obtained a minimum overall weighted GPA ($\overline{G}$) of 2.00 in minimum of 120 credits (excluding *Auxiliary* courses), out of which,

a. should have minimum of 72 credits from the Principal Subject of specialization (88 credits in case of Mathematics), out of which at least 40 credits from 400 level,

b. should have minimum of 96 credits from Principal Subject Area, and not have more than 12 credits from *Supplementary* courses;

c. should have C or better grades in at least 96 credits (including the research project), with minimum of 24 credits from each level;

d. should not have any E grades;
and,

(ii) obtained at least a Satisfactory (S) grade for ENG100 and ENG200 courses and for at least one course each in CPD and SLV *Auxiliary* courses; a pass in Basic Sinhala/Tamil

(iii) completed requirements (i) and (ii) above within seven academic years.

<u>Award of Class</u>

A student who has fulfilled all the conditions for the award of BScHons degree shall be awarded a Class, if he/she fulfils the following additional requirements:

4.5.2.1 First Class:

(i) Obtain a minimum overall weighted GPA ($\overline{G}$) of 3.70;

(ii) Obtain A or better grades in at least 48 credits of which at least 20 credits from 400 level;

(iii) Complete of the degree programme within four academic years.

4.5.2.2 Second Class (Upper Division):

(i) Obtain a minimum overall weighted GPA ($\overline{G}$) of 3.30;

(ii) Obtain B or better grades in at least 48 credits, of which at least 20 credits from 400 level;

(iii) Complete of the degree programme within four academic years.

4.5.2.3 Second Class (Lower Division):

(i) Obtain a minimum overall weighted GPA ($\overline{G}$) of 3.00;

(ii) Obtain B or better grades in at least 48 credits, of which at least 20 credits from 400 level;

(iii) Complete of the degree programme within four academic years.

4.5.3 Fall-back Qualifications

A student who fails to fulfil the above requirements in section 4.5.1 for BSc (General) degree, after completing maximum period of six academic years allowed for the degree become eligible to apply for fall-back qualification of a Higher Diploma in Science (SLQF Level 4) or Diploma in Science (SLQF Level 3). Moreover, a student who fails to fulfil the requirements in section 4.5.2 for BSc Honours degree, after completing maximum period of seven academic years allowed for the degree become eligible to apply for fall-back qualification of a Bachelor of Science General Degree (SLQF Level 5). However, a student expelled from the university on disciplinary grounds, might not be eligible for fall-back qualification.

A recommendation for award of a fall-back qualification to a student who applied for Bachelor of Science or Higher Diploma in Science or Diploma in Science under above condition should be made by the Faculty Board of Science, to the Senate, after an exit interview to judge the suitability of the student to the applied qualifications.

The effective date of award of a fall-back qualification of Bachelor of Science or Higher Diploma in Science or Diploma in Science will be the first day the month after which the Senate has approved the award of the qualification.

4.5.3.1 Award of Diploma in Science (SLQF Level 3)

A candidate will be awarded the Diploma in Science, if he/she has:

(i) Obtained a minimum overall GPA of 2.00 in minimum of **30 credits** (excluding *Auxiliary* courses), out of which,
   a. should have minimum of 8 credits each in at least two Principal Subjects, and
   b. should not have more than 6 credits from *Supplementary* courses, and

(ii) obtained at least a Satisfactory (S) grade in minimum one ENG/CPD/SLV courses

(iii) Become not eligible for the award of B.Sc. General Degree due to exhaustion/ completion of attempts on courses required for BSc general degree after completing the three academic years.

4.5.3.2 Award of Higher Diploma in Science (SLQF Level 4)

A candidate will be awarded the Higher Diploma in Science, if he/she has:

(i) Obtained a minimum overall GPA of 2.00 in minimum of **60 credits** (excluding *Auxiliary* courses), out of which,
   a. should have minimum of 16 credits each in at least two Principal Subjects, and
   b. should not have more than 8 credits from *Supplementary* courses, and

(ii) obtained at least a Satisfactory (S) grade in minimum two ENG/CPD/SLV courses

(iii) Become not eligible for the award of B.Sc General Degree due to exhaustion/ completion of attempts on courses required for BSc general degree after completing the six academic years.

4.5.3.3 Award of Bachelor of Science (SLQF Level 5)

A candidate will be awarded the BSc (General) degree, if he/she has:

(i) Obtained a minimum overall weighted GPA (*G*) of 2.00 in minimum of 90 credits (excluding Auxiliary courses, but with the provision in Table 7 in page 43, out of which,
   a. should have completed minimum of 24 credits each in at least two Principal Subjects, and
   b. should not have accumulated more than 12 credits from Supplementary courses, and
   c. should not have any E grades after compensating E grades as per Table 7 in page 43;

and

(ii) obtained at least a Satisfactory (S) grades for ENG100 and ENG200 courses and for at least one course each in CPD and SLV Auxiliary courses

(iii) Become not eligible for the award of B.Sc Hon. Degree due to exhaustion/ completion of attempts on courses required for BSc general degree after completing the seven academic years.

5 Office of the Dean

5.1 Administrative Officers

Dean / Faculty of Science

Senior Professor P. Vinobaba

BScHons (Jaffna), PhD. (Stirling-UK), CBiol(UK), MIBiol (U.K)

Senior Professor in Zoology

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Assistant Registrar/ Faculty of Science

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Management Assistants : Mr. M. Ariharan
Mr. T. Thanushan
Mr. S. Supananth
Mrs. S. Sivakaran

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6 Department of Botany

Botany is a dynamic department which is well positioned to provide its students with a local and world class education to become demandable-employable individual. A hallmark of the department is the broad spectrum of research specialties in plant sciences, reflecting the interest and expertise of individual staff members. We are fortunate in having senior academics trained both locally as well as internationally to understand botany as a whole in plant sciences to cater the local demand with interest. A three-year course leading to the degree of Bachelor of Science is available to the student who wishes to tailor a degree to his or her specific interests and requirements, as well as providing for certain specializations (a four-year preliminary research combined course) with postgraduate degree programmes. Students could be working in laboratories, doing fieldwork in the sites of lagoons, mangroves, national botanical gardens, sectors of local research stations, including field visits to tropical rainforest etc. Specializations cover areas as diverse as ecology, seed physiology, mangroves, plant biochemistry, eco-physiology, plant pathology, post-harvest technology and limnology. Research activities cover a spectrum, from fundamental curiosity-driven studies. Research also plays a role in the life of the Department, and many of the academics have considerable national and international recognition at various levels.

Head of the Department

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6.2 100 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L / P / IL)	Credits	Prerequisite	BSc (General)	BScHons (Botany)
First Semester						
BT1011	Plant Cell	15/0/35	01	-	✓	✓
BT1021	Plant Cell Practical	0/30/20	01	-	✓	✓
BT1032	Basic Microbiology	15/30/55	02	-	✓	✓
Second Semester						
BT1041	Basic Plant Physiology	15/0/35	01	-	✓	✓
BT1051	Basic Plant Physiology Practical	0/30/20	01	-	✓	✓
BT1061	Non-vascular Plant Diversity	15/0/35	01	-	✓	✓
BT1071	Non-vascular Plant Diversity Practical-	0/30/20	01	-	✓	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

BT1011-Plant Cell

Course Content: Prokaryotic and Eukaryotic cell, structure and function of the cell wall and cell organelles (Plasma membrane, nucleus and nucleolus, mitochondria, ribosomes, endoplasmic reticulum, golgi apparatus, peroxisomes, cytoskeleton and chloroplasts), structure and function of genetic material, cell growth and division.

Recommended Texts:

1. Raven, P.H. & Johnson, J.B. (2008). Biology, 8th Edition. McGrow Hill Higher Education.
2. Bolsover, S.R, Hyams, J. S., Shephard, E.A., White, H.A. & Wiedenann, C.G. (2004). Cell biology: a short course, 2nd edition. A John Wiley & Sons Inc., Publication.

BT1021-Plant Cell Practical

Course Content: Basic components of the light microscope and exercise/s involving light microscope, examination of plant cell, structural components, chromosomes and stages of cell division, Electron Micrographs of organelles.

Recommended Texts:

1. Gunning, B.E.S. and Steer, M.W. (1996). Plant Cell Biology. Jones and Bartlett Publishers Inc.
2. Raven, P.H. and Johnson, J.B. (2008). Biology, 8th Edition. McGrow Hill Higher Education.
3. Bolsover, S.R, Hyams, J. S., Shephard, E.A., White, H.A. and Wiedenann, C.G. (2004). Cell biology: a short course. 2nd edition. A John Wiley & Sons Inc. Publication.

BT1032-Basic Microbiology

Course Content: Brief history of Microbiology, Prokaryotic structure and function, differential staining, microbial nutrition and growth, microbiological media, sterile conditions, microbiological techniques, actinomycetes, phytoplasma, viruses (bacteriophages) and viroids, control of microbes. ***Practical:*** Laboratory safety, microbiological instruments/apparatus, sterile conditions, microbiological media and their preparation, microscopic examination of bacteria, bacterial smears and simple stains, Gram stain and the acid-fast stain, preparation of a serial dilution, pour plate and streak plate method.

Recommended Texts:

1. Panagoda, G.J. (2014). Text book of Basic Microbiology. S. Godage & Bros, Sri Lanka.
2. Arora, D. R. (2007). Text book of Microbiology. 2nd Edition, CBS Publ. New Delhi.
3. Leboffe, M.J., Pierce, B. E. and Ferguson, D. (2006). Microbiology Laboratory, Theory & Application, 2nd Edition. Morton Publishing Co. Englewood.

BT1041-Basic Plant Physiology

Course Content: Concepts of plant-water relations, components of water potential, soil-plant-atmosphere continuum concept, cavitation in xylem and embolism. Stomatal physiology, stomatal movement and the role of CO_2, K^+,

abscisic acid and blue light, antitranspirants. Solute translocation, phloem sap, *p*-protein, phloem loading and unloading, Mass-flow (pressure flow) hypothesis.

Recommended Texts:

1. Salisbury, F.B. and Ross, C.W. (1999). Plant Physiology (1999). CBS Publishers and Printers, New Delhi.
2. Gill, P.S.S. (2000). Plant Physiology. Chand & Co., New Delhi.
3. Taiz, L. and Zeiger, E. (2006). Plant Physiology. 3rd Edition. Sinauer Associates Inc., Sunderland, MA.

BT1051-Basic Plant Physiology Practical

Course Content: Models demonstrating diffusion. osmosis, membranes, measurement of diffusion pressure deficit (DPD), determination of water potential and osmotic potential; stomata structure & modification, stomatal movements, demonstration of stomatal & cuticular transpiration, root pressure and guttation, measurement of transpiration, conduct and translocation, stem-girdle experiment and determination of water movement.

Recommended Texts:

1. Salisbury, F.B. and Ross, C.W. (1999). Plant Physiology. CBS Publishers and Printers, New Delhi
2. Gill, P.S. S. (2000). Plant Physiology. Chand & Co., New Delhi.
3. Taiz, L. and Zeiger, E. (2006). Plant Physiology. 3rd Edition. Sinauer Associates Inc., Sunderland, MA.

BT1061-Non-vascular Plant Diversity

Course Content: Diversity, distribution, morphology, anatomy and life cycles of algae, Bacillariophyta (diatoms), Charophyta (stoneworts), Chlorophyta (green algae), Chrysophyta (golden algae), Cyanobacteria (blue-green algae), Dinophyta (dinoflagellates), Phaeophyta (brown algae), and Rhodophyta (red algae). Bryophyta (liverworts, mosses and hornworts). Economic importance of algae.

Recommended Texts:

1. Kumaresan, V. (1997). Algae and Bryophytes, Saras Publications, Nagercoil, India.

2. Gupta, R.K. and Kumar, M. (2013). Diversity of Lower Plants. First Edition. I.K. International Publishing House.
3. Graham, L.E., Graham, J.M. and Wilcox, L.W. (2009). Algae, Benjamin Cummings.

BT1071-Non-vascular Plant Diversity Practical

Course Content: Laboratory examination and study of specimens representing different groups of diatoms, stoneworts, green algae, golden algae, blue-green algae, dinoflagellates, brown algae, red algae, and liverworts, mosses and hornworts.

Recommended Texts:

1. Chopra, R.N. and Kumara, P.K. (1988). Biology of Bryophytes, Wiley Eastern Ltd., New Delhi.
2. Gupta, R.K. and Kumar, M. (2013). Diversity of Lower Plants. First Edition. I.K. International Publishing House.
3. Graham, L.E., Graham, J.M. and Wilcox, L.W. (2009). Algae. Benjamin Cummings.

6.3 200 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L/P/IL)	Credits	Prerequisite	BSc General	BScHons (Botany)
First Semester						
BT2011	Vascular Plant Diversity	15/0/35	01	BT1061	✓	✓
BT2021	Vascular Plant Diversity Practical	0/30/20	01	BT1071	✓	✓
BT2031	Principles of Ecology	15/0/35	01	Biology (A/L)	⊗	✓
BT2042	Mycology	15/30/55	02	BT1032	⊗	⊗
BT2051	Plant Morphology and Anatomy	15/0/35	01	BT1011	✓	✓
BT2061	Plant Morphology and Anatomy Practical	00/30/20	01	BT2051	✓	✓
BT2072	Molecular Biology	15/30/55	02	BT1011	⊗	✓
Second Semester						
BT2082	Bio-statistics	15/30/55	02	-	✓	✓
BT2092	Plant Biochemistry	15/30/55	02	BT1011	✓	✓
BT2102	Plant Propagation	15/30/55	02	-	⊗	⊗
BT2111	Plant Physiology	15/0/35	01	BT1041	⊗	⊗
BT2121	Plant Physiology Practical	0/30/20	01	BT1051	⊗	⊗
BT2132	Plant Genetics	15/30/55	02	BT1011	⊗	✓

♣ Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol "⊗" denotes that course is elective for the Degree Programme.

BT2011-Vascular Plant Diversity

Course Content: Pteridophytes, Gymnosperms and Angiosperms - characteristic features, classification, comparative study of vegetative and reproductive structures, life histories of major groups. Evolutionary trends.

Recommended Texts:

1. Kramer, K.U., Green, P.S.and Götz, E. (2010). Pteridophytes and Gymnosperms: The Families and Genera of Vascular Plants. Springer.
2. Verma, H.K. (2011). A Textbook of Pteridophyta Random Publications.
3. Johri, R.M., Lata, S. and Tyagi, K. (2012). A Textbook of Gymnosperms. Vedams publication.

BT2021-Vascular Plant Diversity Practical

Course Content: Laboratory/field examination of Pteridophyta and Gymnosperms – morphology, anatomy and their lifecycles.
Practical: Vegetative and reproductive morphology of species representing Pteridophytes and Gymnosperms in comparison with Angiosperms.

Recommended Texts:

1. Kramer, K.U., Green, P.S.and Götz, E. (2010). Pteridophytes and Gymnosperms (The Families and Genera of Vascular Plants. Springer.
2. Verma, H.K. (2011). A Textbook of Pteridophyta. Random Publications.

BT2031-Principles of Ecology

Course Content: The scope of ecology, level of organization, concept and management of ecosystems, trophic structure and components (abiotic substances, producers, consumers, decomposers), classification of ecosystems (natural and man-made) and Biomes, ecological conservation, energy and energy flow of ecosystems, global climate change, disaster cycle and management, limnology.

Recommended Texts:

1. Odum, E.P. and Barrett, G.W. (2005). Fundamentals of Ecology. Thomson Learning Academic Resource Centre.
2. Chapman, J.L. and Reiss, M.J. (2000). Ecology, 2nd Edition. Cambridge.

BT2042-Mycology

Course Content: Introduction, morphology, nutrition and reproduction of fungi. Classification of fungi and fungal-like organisms: Kingdoms (i) Protozoa (Phyla Myxomycota, Plasmodiomycota), (ii) Chromista (Oomycota), (iii) Fungi

(Chitridiomycota, Zygomycota, Ascomycota, Basidiomycota and Deuteromycota). Examples and lifecycles representing different Phyla. Importance of fungi and harmful effects and products. ***Practical:*** Examination of fungi and fungal-like organisms representing major taxonomic groups. Isolation and identification of fungi from soil, water, plants/fruits and air.

Recommended Texts:

1. Alexopoulos, C.J., Mims, C. W. Blackwell, M. M. (1996). Introductory Mycology. John Wiley & Sons.
2. Mishra, S. R. (2010). Textbook of Mycology. Discovery Publishing House.
3. Deacon, J.W. (2011). Fungal Biology, 4th Edition, Wiley.

BT2051-Plant Morphology and Anatomy

Course Content: Tissues and tissue systems; external features, internal structure, secondary growth of stem and root; leaf anatomy, morphology and modifications. Modifications of stems, roots, flowers and inflorescences, fruits and seeds to their environment/functions.

Recommended Texts:

1. Gifford, E. M. and Foster, A.S. (1989). Morphology and Evolution of Vascular Plants. W. H. Freeman & Co.
2. Esau, K. (1977). Anatomy of Seed Plants. John Wiley & Sons.
3. Dickinson, W. C. (2000). Integrative Plant Anatomy, Academic Press.

BT2061-Plant Morphology and Anatomy Practical

Course Content: Morphology and anatomy of root and shoot system (stem, leaf, stomata, trichomes) and modifications, identification of different flowers and inflorescence types, fruits and seeds, seed germination and seedlings morphology.

Recommended Texts:

1. Gifford, E. M. and Foster, A.S. (1989). Morphology and Evolution of Vascular Plants. W. H. Freeman.
2. Esau, K. (1977). Anatomy of Seed Plants. John Wiley & Sons.
3. Dickinson, W. C. (2000). Integrative Plant Anatomy. Academic Press.

BT2072-Molecular Biology

Course Content: Molecular basis of biological processes, emphasizing gene action in the context of entire genome. Chromosomes and DNA, chromatin, DNA replication, repair, mutations, recombination, transposition, transcription, protein synthesis, regulation of gene activity, genetic engineering.
Practical: Extraction of plant DNA, visualization by gel electrophoresis.

Recommended Texts:

1. Lodish, H. *et al*. (1995). Molecular cell biology, 3rd Edition. Scientific American Books Inc., New York, USA
2. Walker, J.M. and Gingold, E.B. (1993). Molecular biology and biotechnology, 3rd Edition. The Royal Society of Chemistry, U.K.

BT2082- Bio Statistics

Course Content: Data types, collection, organization, analysing and presentation of data. Probability and probability distribution. Skewness, measures of central tendency (mean, median and mode). Dispersion/variation (range, mean deviation, standard deviation, standard error, co-efficient of variation), sampling and test of significance, Design of experiments [Completely Randomized Block Design (CRBD) and Completely Randomized Design (CRD)], their advantages and disadvantages. Analysis of variance (ANOVA), correlation and regression.
Practical: Presentation of data - diagrammatic presentation, frequency distribution, probability distribution. Measures of central tendency and dispersion, Test of significance. Analysis of Variance, correlation and regression. Exercises using statistical software.

Recommended Texts:

1. Banerjee, P. K. (2013). Introduction to Biostatistics (English). 4th Edition. S Chand & Co. Ltd., New Delhi.
2. Rosner, B.F. (2010). Fundamentals of Biostatistics, 7th Edition. Duxbury Press.
3. Khan, I.A. and Khanum, A. (1994). Fundamentals of Biostatistics. Vikas Publications, Hyderabad.

BT2092-Plant Biochemistry

Course Content: Classification, structure, functions and importance of biomolecules, carbohydrates, proteins, lipids and nucleic acids. Enzymes, aerobic and anaerobic respiration, glycolysis, Kreb's cycle, electron transport mechanism, redox potential, oxidative phosphorylation, and pentose phosphate pathway (PPP).
Practical: Laboratory safety, instruments used for biochemical analysis, preparation of aqueous solutions and buffers. Qualitative and quantitative estimation of biomolecules. Assay for amylase and dehydrogenase activity.

Recommended Texts:

1. Jain, J.L. (1997). Fundamentals of Biochemistry. S Chand & Co. Ltd.
2. Nelson, D.L., Lehninger A. L. and Cox, M. M. (2000). Principles of Biochemistry, 3rd Edition. Worth Publishing.

BT2102-Plant Propagation

Course Content: Evolution of plant propagation, principles and practice of seed propagation, vegetative propagation (cuttings, layering, division, grafting, budding), plant hormones and interrelated factors, plant tissue culture techniques, micro-propagation and somatic embryogenesis, and commercial propagation.
Practical: Vegetative propagation techniques, division, stem/leaf/root cuttings; budding and grafting, layering; plant propagators, *in vitro* propagation techniques, micro-propagation. Visit to tissue culture laboratory and greenhouse.

Recommended Texts:

1. Hartmann, H.T, Kester, D.E., Davies, F.T. and Geneve, R.L. (2011). Plant Propagation (Principals and Practices), 8th edition. Prentice Hall, Upper Saddle River, NJ.

BT2111-Plant Physiology

Course Content: Photosynthesis – historical aspects, photosynthetic pigments, electron transport and carbon fixation (Calvin cycle). Photorespiration, C_3 and C_4 plants. CAM plants. Factor affecting respiration. Mineral deficiencies in plants and symptoms.

Recommended Texts:

1. Salisbury, F.B & Ross, C.W. (1999). Plant Physiology. CBS Publishers and Printers, New Delhi
2. Gill, P.S. (2000). Plant Physiology. S. Chand & Co., New Delhi.
3. Taiz, L. and Zeiger, E. (2006). Plant Physiology. 3rd Edition. Sinauer.

BT2121-Plant Physiology Practical

Course Content: Photosynthesis, chemical and paper chromatography separation of leaf pigments, spectrum analysis, observation of the effect of intensity & quality of light on photosynthesis, leaf anatomy of C_3, C_4 and CAM plants, demonstration of night accumulation of acids. Study of symptoms, collection and preservation of plants with mineral deficiencies.

Recommended Texts:

1. Salisbury, F.B. & Ross, C.W. (1999). Plant Physiology. CBS Publishers and Printers, New Delhi.
2. Gill, P.S. (2000). Plant Physiology. S. Chand & Co., New Delhi.
3. Taiz, L. and Zeiger, E. (2006). Plant Physiology, 3rd Edition. Sinauer.

BT2132-Plant Genetics

Course Content: Introduction, Mendelian genetics & plant reproduction, variation in chromosome number and structure, polyploidy, replication of DNA, translation, transcription and genetic code, mutations, microbial genetics, genetic mapping, and population genetics.
Practical: Laboratory exercises based on the above topics.

Recommended Texts:

1. Stewart, C.N. Jr. (Ed.) (2008). Plant Biotechnology and Genetics: Principles, Techniques and Applications. Wiley and Sons, Hoboken, New Jersey.
2. Acquaah, G. (2012). Principles of plant genetics and breeding, 2nd Edition. Wiley Blackwell Publications.
3. Grotewold, E., Chappel, J. and Kellogg, E.A. (2015). Plant genes, genomes and genetics. Wiley Blackwell Publications.

6.4 300 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L / P / IL)	Credits	Prerequisite	BSc General	BScHons (Botany)
First Semester						
BT3012	Plant Pathology	15/30/55	02	BT2042	✓	✓
BT3022	Biochemistry	15/30/55	02	BT2092	⊗	⊗
BT3031	Analytical Techniques	00/30/20	01	-	⊗	⊗
BT3042	Microbiology	15/30/50	02	BT1032	⊗	⊗
BT3051	Plant Systematics	15/00/35	01	BT2051 BT2061	✓	✓
BT3061	Plant Systematics Practical	00/30/20	01	BT2051 BT2061	✓	✓
Second Semester						
BT3072	Economic and Industrial Botany	15/30/55	02	-	⊗	✓
BT3082	Sri Lankan Ecosystems and their Conservation	15/30/55	02	-	✓	✓
BT3092	Mangrove Ecology and Management	15/30/55	02	BT3082	⊗	⊗
BT3101	Plant Developmental Physiology	15/00/35	01	BT2111	⊗	⊗
BT3111	Developmental Physiology Practical	00/30/20	01	BT3101	⊗	⊗
BT3121	Plant Science Seminar	00/00/50	01	-	⊗	⊗

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol "⊗" denotes that course is elective for the Degree Programme.

BT3012-Plant Pathology

Course Content: Introduction, history and concepts of Plant Pathology, terms & definitions. Cause of plant disease, symptoms, the infection process and mechanism of symptom development. Diagnosis of plant disease. Plant defence

responses – constitutive and inducible defences, principles of plant disease control.

Practical: Systematic, laboratory examination of diseased specimens covering various diseases in food, plantation and ornamental plants and postharvest diseases of fruits and vegetables. Plant pathological techniques. Plant disease control.

Recommended Texts:

1. Agrios, G. N. (2005). Plant Pathology, 5th Edition, Academic Press, U.K.
2. Mehrotra, R.S. (1994). Plant Pathology, 10th Print. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
3. Persley, Denis M. (1982). Diseases of vegetable crops. Department of Primary Industries, Queensland.

BT3022-Biochemistry

Course Content: Bioenergetics, carbohydrate metabolism, gluconeogenesis, synthesis and degradation of starch, cellulose, sucrose, glyoxylate cycle, glucose synthesis from fatty acid, nitrogen metabolism, biology of nitrogen fixation, protein and amino acid metabolism, fatty acid metabolism and nucleic acid metabolism.

Practicals: Laboratory exercises from topics selected from above, involving the use of chromatography, PAGE, spectroscopy.

Recommended Texts:

1. Stryer, L., Tymoczko, J.L., Mark Jeremy and Berg, W. H. (2002). Biochemistry, 5th edition. Freeman Co.
2. Nelson, D.L., Lehninger, A., L., Cox, Michael M. (2000) Principles of Biochemistry, 3rd edition. Worth Publishing
3. Boyer, R. (2000). Modern Experimental Biochemistry. Wesley Longman, Inc. San Francisco, CA

BT3031-Analytical Techniques

Course Content: *Analytical Methods*: Paper Chromatography, Thin Layer Chromatography (TLC), Column Chromatography, Gas Chromatography, High Pressure Liquid Chromatography (HPLC). UV-visible spectrophotometry, Atomic Absorption Spectrophotometry (AAS). Kjeldahl Method: Theory, the

equipment, sample preparation, measurement and calculation of the N content of the sample. *Molecular Biological Techniques*: PCR, RAPD's, RFLP, AFLP and DNA sequencing.
Practical: Laboratory exercises using above instruments/techniques.

Recommended Texts:

1. Wilson, K. and Walker, J. M. (Eds.) (1994). Principles and techniques of Practical biochemistry, 4th edition, Cambridge University Press, UK.
2. Giinzler, H. and Williams, A. (2001). Handbook of Analytical Techniques. Wiley-Vch Verlag GmbH, D-69469 Weinheim, Germany.

BT3042-Microbiology

Course Content: Types of microorganisms and their interactions with their natural habitats, microbiology of air, soil (types, distribution, role in nutrient cycling), water - types, water pollution, coliform bacteria, microbiological analysis of water, water borne diseases, and food (microflora, spoilage, preservation and food borne diseases).
Practical: Methods of isolation (Pour, streak and spread plate method) of microbes from air, soil and water. Analysis of drinking water - Coliform test and membrane filter method. Antibiotics and assay techniques.

Recommended Texts:

1. Arora, D. R. (2007). Text book of Microbiology, 2nd Edition. New Delhi: CBS pub.
2. Michael, J. Leboffe, Burton E. Pierce and David Ferguson (2006). Microbiology Laboratory Theory & Application, 2nd Edition. Morton publishing Company, Englewood
3. McLaren, R. G. and Cameron, K. C. (1996). Soil Science: Sustainable production and environmental protection. Oxford University Press, UK.

BT3051-Plant Systematics

Course Content: Introduction, objectives and principles, taxonomic hierarchy, plant identification, systems of classification, phenetics and cladistics, Angiosperm Phylogeny Group system (APG), origin & evolution of Angiosperms, characters, sources of taxonomic evidence. Plant nomenclature. Plant collection, herbarium techniques and management; taxonomic keys,

description of a flower. Charavters of selected families. taxonomic keys; description of a flower. Characters of selected families.

Recommended Texts:

1. Stace, C.A. (1993). Plant taxonomy and biosystematics. Cambridge University Press, U.K.
2. Walter S., Christopher, J., Campbell, S., Kellog, E.A. Stevens, P.A. and Donoghue, M.J. (2007). Plant Systematics: A Phylogenetic Approach. Sinauer Associates Inc.
3. Simpson, M. (2010). Plant Systematics. Academic Press

BT3061-Plant Systematics Practical

Course Content: Botanical terminology, taxonomic description of plants and flowers representing selected families, Identifying plant characters and formulation of keys, plant identification, herbarium preparation. Student assignments involving collection and identification of plants from different climatic areas and preparation of a herbarium.

Recommended Texts:

1. Forman, L. and Bridson, D. Whitstable (1989). The Herbarium, Hand Book Litho Printers Ltd.

BT3072-Economic and Industrial Botany

Course Content: Introduction, plants encountered in our life, importance of plants in food, medicine, beverages and as spices, mushroom culture, oil, latex, forest products, processing of selected industrial products, rice, fibre, tea, paper and wood. Visit to plant-based industries.

Practical: Laboratory exercises based on topics selected from above, industrial visits.

Recommended Texts:

1. Samba Murthy, A.V.S.S. and Subrahmanayam, N.S.A. (1998).Text Book of Economic Botany, Wiley Eastern Ltd.
2. Jayaweera, D.M.A. (2006). Medicinal plants used in Ceylon, Part 1 – 5. The National Science Council of Sri Lanka.

3. A.F. Hill (adapted by O.P. Sharma) (1996). Hills Economic Botany. Tata McGraw Hill Co. Ltd., New Delhi.

BT3082-Sri Lankan Ecosystems and their Conservation

Course Content: Sri Lanka's physical features, climate and bio-climatic zones, distribution of vegetation of Sri Lanka (forests, grassland, fresh water, marine and maritime), agroforestry and home garden systems, biodiversity, conservation of ecosystems, and invasive plants.
Practical: Exploring different types of ecosystems (coastal, grasslands, forests, man-made) and their importance, current situation, threats and conservation, field visits to selected vegetation, preparation and submission of reports.

Recommended Texts:

1. Anon (2000). Natural Resources of Sri Lanka. The National Science Foundation, Sri Lanka.
2. Whitmore, T.C. (1990). An introduction to tropical rain forests. Oxford University Press, Oxford.
3. Survey Department of Sri Lanka (2010). The National Atlas of Sri Lanka, 2nd Edition.
4. Ashton, P. M. S., Singhakumara, B.M.P., Evans, A.E., Gunatilleke C.V.S., and I.A.U N Gunatillake (1997). A field guide to the common trees and shrubs of Sri Lanka. The Wildlife Heritage Trust, Sri Lanka.

BT3092-Mangrove Ecology and Management

Course Content: Introduction of Mangrove ecosystems and their importance, distribution both global and Sri Lanka perspectives, Mangrove species, their characters, adaptations and economic value, threats, conservation and management strategies.
Practical: Identification of mangrove species, development of identification keys, Field visit and student assignment.

Recommended Texts:

1. Tomlinson P.B. (1986). The Botany of Mangroves. Cambridge Tropical Biological Series, Cambridge University Press.
2. Hogarth, P.J. (2004). The Biology of mangroves, Biology of Habitats (reprinted). Oxford University Press.

3. A Field guide to mangroves of Sri Lanka (2007). Biodiversity Secretariat, Ministry of Environment and Natural Resources.

BT3101-Plant Developmental Physiology

Course Content: Plant movements, phytohormones and growth regulators - auxins, gibberellins, cytokinins, abscisic acid, ethylene and brassinosteroids. Sand and water culture, effects of temperature and light on plants, dormancy, photoreceptors, photoperiodism and vernalization, seed germination physiology, stress physiology, plant senescence.

Recommended Texts:

1. Salisbury, F.B. and Ross, C.W. (1996). Plant Physiology. Wadsworth Publishers, London.
2. Taiz, L. and Zeiger, E. (1999). Plant Physiology, Benjamin/Cummings Publishing Company, Inc.
3. Wilkins, B. (1992). Advanced Plant Physiology. Longman Singapore.

BT3111-Plant Developmental Physiology Practical

Course Content: Experiments demonstrating the action of phytohormones, auxins, gibberellic acid, cytokinins, abscisic acid and ethylene in plant growth and development. Different types of plant movements, response of plants to light and gravity. Measurement of growth as a function of time, temperature and light intensity. Seed-soil-water contact, testing seeds-viability and damage. Hydroponics.

Recommended Texts:

1. Salisbury, F.B. and Ross, C.W. (1996). Plant Physiology. Wadsworth Publishers, London.
2. Taiz, L. and Zeiger, E. (1999). Plant Physiology, Benjamin/Cummings Publishing Company, Inc.
3. Wilkins, B. (1992). Advanced Plant Physiology. Longman Singapore.

BT3121-Plant Science Seminar

Course Content: This course facilitates the students' independent learning, communication and presentation skills. Students should obtain an in-depth understanding of topics of botanical interest, given by staff member/s of the

Department, by means of literature and recommended research/scientific articles, write a summary and deliver a seminar.

6.5 400 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours* (L / P / IL)	Credits	Prerequisite	BScHon (Botany)
BT4013	Advanced Plant Pathology	30/30/55	03	BT3012	✓
BT4022	Postharvest Technology of fruits, vegetables and cut flowers	15/30/55	02	BT3012	⊗
BT4033	Molecular Applications in Plant Sciences	30/30/55	03	BT3031	⊗
BT4042	Experimental design and data analyses	15/30/55	02	BT2082	✓
BT4052	Research Methodology & Scientific Writing	30/0/70	02	-	⊗
BT4062	Limnology and Bio-indicators	30/0/70	02	BT1061 BT2011	⊗
BT4071	Limnology and Bio-indicators Practical	00/30/15	01	BT1071 BT2021	⊗
BT4083	Plant Tissue Culture Technology	30/30/90	03	BT1011 BT1021	✓
BT4093	Applied Microbiology	30/30/90	03	BT3042	⊗
BT4103	Advanced Plant Systematics	30/30/90	03	BT3051, BT3061	⊗
BT4113	Microbial Symbiosis	30/30/90	03	BT1032	⊗
BT4123	Biodiversity Conservation and Management	30/30/90	03	BT3082	⊗
BT4131	Plant Secondary Metabolites	15/00/35	01	BT2092	⊗
BT4142	Ornamental Horticulture	15/30/55	02	-	⊗
BT4152	Plant Population Biology	30/00/70	02	BT2031 BT4042	✓
BT4161	Experiments on plant population biology	00/30/20	01	BT2031 BT4042	✓
BT4173	GIS and Remote Sensing	30/30/90	03	-	⊗
BT4183	Molecular Genetics and Plant Breeding	30/30/90	03	BT2132	✓

BT4193	Seed Biology and Technology	30/30/90	03	BT3101	⊗
BT4202	Soil Fertility and Management	15/30/55	02	-	⊗
BT4212	Essay	100	02		✓
BT4222	Industrial Training #	200	02		✓
BT4236	Research Project #	600	06	BT2082 BT4042	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

Notional learning hours for course units in category 3.3 B.

BT4013-Advanced Plant Pathology

Course Content: Plant-pathogen interactions, mechanisms of pathogen attack and disease resistance in plants, constitutive and induced (localized and systemic) defences, plant disease diagnosis and management. Integrated Pest Management (IPM). Application of molecular tools Plant Pathology.
Practical: Laboratory exercises based on above topics.

Recommended Texts:

1. Agrios, G.N. (2005). Plant Pathology, 5th Edition, Academic Press, U.K.
2. Fox, R.T.V. (1992). Principles of diagnostic techniques in plant pathology. CAB International.
3. Bailey, J.A. & Jeger, M.J. (1992). *Colletotrichum*: Biology, Pathology & Control. CAB International.
4. Dikinson, M. (2003). Molecular Plant Pathology. BIOS Scientific Publishers.

BT4022-Postharvest Technology of Fruits, Vegetables and Cut-flowers

Course Content: Importance of postharvest technology of fresh produce, principles and methods of preservation of fresh produce, maturity indices, harvesting, handling, sorting, grading, storage, packaging and transport fresh produce, modified atmosphere (MA) and controlled atmosphere (CA) storage, import and export of fruits, vegetables and cut flowers.
Practical: Maturity indices for different crops, harvesting methods and postharvest treatment of fresh produce - physical and chemical methods, packaging and packing materials, methods of storage. Visit to markets, packaging houses and cold storage units.

Recommended Texts:

1. Paliyath, G., Dennis, P., Murr, Avtar K Handa and Susan Lurie (2008). Postharvest Biology and Technology of Fruits, Vegetables, and Flowers. Wiley-Blackwell.
2. Wills, R., McGlosson, B., Graham, D. and Joyce, D. (1998). Post-harvest – An Introduction to the Physiology and Handling of Fruits, Vegetables and Ornamentals. CAB International.
3. Mitra, S. (1997). Post-harvest Physiology and Storage of Tropical and Subtropical Fruits, CAB International.

BT4033-Molecular Applications in Plant Sciences

Course Content: Routine molecular protocols – isolation of DNA and sequencing, blotting (Southern, Northern, Western). Molecular identification of plants, pathogens and pests, phylogenetic analysis, estimation and measurement of genetic variation, plant genetic resources management, molecular markers in plant improvement for disease/pest/stress/herbicide resistance.

Practical: Laboratory exercises based on above topics.

Recommended Texts:

1. Hentry, R.J. (1997). Practical applications of Plant molecular biology, Nelson Thornes.
2. Hentry, R.J. (ed.) (2012). Molecular markers in plants, Wiley-Blackwell.

BT4042-Experimental Design and Data analysis

Course Content: Qualitative and quantitative assessment, sampling and sampling methods, statistical approach - selection of suitable statistical test, hypothesis testing, t-test, chi-square test, correlation and regression, Analysis of Variance (ANOVA). Detection of association and randomness. Experimental designs – CRD, RCBD, analysis of pattern in vegetation, statistical packages.

Practical: Identifying life forms, vegetation stratification, visual and quantitative estimation of plants, sampling techniques, statistical verification of

vegetation, instrumental usage to find vegetation parameters, experimental designs and analysis of variance (ANOVA), multivariate analysis.

Recommended Texts:

1. Kershaw, K.A. (1974). Quantitative and Dynamic Plant Ecology, 3rd Edition. Elsevier Pub. Co., USA.
2. Grieg-smith, P. (1983). Quantitative Plant Ecology, 3rd Edition. University of California Press.
3. Welham, S.J., Gezan, S.J. Clark, S.J. and Mead, A. (2015). Statistical methods in Biology. Design and analysis of experiments and regression. Taylor and Francis group.

BT4052-Research Methodology and Scientific Writing

Course Content: Literature survey, defining a research problem, formulation of hypotheses, experimental design, sampling techniques, and preparation of a questionnaire, data (qualitative and quantitative) collection, processing and analysis. Ethical issues in research. Writing research proposals, scientific writing, citation and listing references.

Recommended Texts:

1. Thomas, C. G. (2015). Research Methodology and Scientific Writing. Ane Books Pvt Ltd
2. Chawla, D. and Sondhi, N. (2011). Research methodology: Concepts and cases (2011). Vikas Publishing House Pvt. Ltd. Delhi.
3. Hofmann, A.H. (2010). Scientific writing and communication. Oxford University Press

BT4062-Limnology and Bio-indicators

Course Content: Introduction to Limnology and definitions. Physical, Chemical & Biological parameters, aquatic life zones – littoral, limnetic, profundal, aquatic organisms – plankton, nekton, neuston, periphyton, Benthon (Benthos), psammon and detritus. Lake and stream ecosystems, classification of Lentic and Lotic environments – wetlands, lakes, streams. Eutrophication. Threats and conservation.

Recommended Texts:

1. Wetzel, R.G. (2001). Limnology. Lake and river ecosystems, 3rd edition. Academic Press, London.
2. Lampert, W. and Sommer, U. (1997). Limnoecology: the ecology of lakes and streams. Oxford University Press, New York.
3. Stanly I. Dodson (2005). Introduction to Limnology. McGraw-Hill.
4. Jacob Kalff (2002). Limnology: Inland water ecosystems. Prentice Hall.

BT4071-Limnology and Bio-indicators Practical

Course Content: Morphometry of inland water bodies; composition of flora in different fresh water ecosystems, dominant species, physical and chemical properties of inland water bodies. Water quality analysis, identification and quantification of phytoplankton (bio-indicators).

Recommended Texts:

1. Brönmark, C. & Hansson, L. (1998). The Biology of lakes and ponds. Oxford University Press, New York.
2. Giller, P.S. & Malmqvist, B. (1990). The Biology of streams and rivers. Oxford University Press, New York.
3. Lampert, W. & Sommer, U. (1997). Limnoecology: the ecology of lakes and streams. Oxford University Press, New York.

BT4083-Plant Tissue Culture Technology

Course Content: Introduction to plant tissue culture and its applications; the tissue culture environment and tissue culture media and requirements - plant growth regulators, physical factors. Growth and differentiation in tissue culture, types of tissue cultures - callus and cell-suspension culture, anther, meristem culture. Commercial application of tissue culture in Sri Lanka.

Practical: Laboratory exercises on tissue culture environment, media and media preparation, visit to a tissue culture laboratory.

Recommended Texts:

1. Smith, Roberta H. (2012). Plant Tissue Culture, Techniques and Experiments 3rd Edition: Academic Press, USA.
2. Trigiano, Robert N. and Gray, Dennis J. (2010). Plant Tissue Culture, Development, and Biotechnology. CRS Press, New York.
3. Bhojwani, S., Saran, D. and Kumar, P. (2013). Plant Tissue Culture: An Introductory Text. Springer, India.

4. Neumann, K.H., Kumar, A. and Imani, J. (2009). Plant Cell and Tissue Culture – A tool in biotechnology, basics and applications. Springer.

BT4093-Applied Microbiology

Course Content: Microorganisms with industrial and environmental uses and their products, growth and product formation in industrial processes, large scale fermentation, food, alcoholic beverages, animal feed, single-cell proteins, antibiotics, organic acids, amino acids, enzymes, vitamins, fuel and energy, waste water treatment and utilization, assay methods for antibiotics.
Practical*:* Laboratory exercises based on above topics.

Recommended Texts:

1. Aneja, K.R., Jain Pranay, Aneja Raman (2015). A Textbook of Basic and Applied Microbiology. New Age International Publishers, New Delhi.
2. Glazer, A.N. and Nikaido, H. (1995). Microbial biotechnology. Fundamentals of Applied Microbiology. W.H. Freeman & Company, New York, USA.
3. Madigan, M.T., Martinko, J.M. and Parker. J. (2002). Brock Biology of Microorganisms, 10th Edition. Prentice Hall, USA.

BT4103-Advanced Plant Systematics

Course Content: Different types of data, morphological, anatomical, phytochemical, palynological and molecular. Convergence and Divergence, Cladistics. Angiosperm classification based on molecular data. Role of plant systematics and molecular data in biodiversity conservation and management.
Practical: Detailed study of selected plant orders and families, covering major clades.

Recommended Texts:

1. Judd, W. S., Campbell, C.S., Kellogg, E.A., and Stevens, P.F. (1999). Plant Systematics: A phylogenetic approach. Sinauer Associates, Inc., Sunderland, Massachusetts, U.S.A.
2. Simpson, M.G. (2010). Plant Systematics. 2nd edition, Elsevier-Academic Press.
3. Harris, J. G. and M. W. Harris (1994). Plant Identification Terminology, An Illustrated Glossary. Spring Lake Publ. Spring Lake, Utah.

4. Journal of Plant Systematics and Evolution. ISSN: 0378-2697 (Print) 2199-6881 (Online).

BT4113-Microbial Symbiosis

Course Content: Legume-*Rhizobium* symbiosis – N fixation, process and significance in agriculture.*Mycorrihizae* – plant-fungus symbiosis, types of mycorrhizae, benefits (e.g. acquiring PO_4^-).Lichens – fungi and algae symbiosis, lichen structure and types with examples, lichens as bio-indicators, bioactive lichen substances.

Practical: Laboratory exercises based on above topics

Recommended Texts:

1. Arora and Naveen Kumar (Ed.) (2013). Plant Microbe symbiosis, Fundamentals and Advances. Springer, India.

BT4123-Biodiversity Conservation and Management

Course Content: Introduction to biodiversity, Global biodiversity estimates, measurement of biodiversity and loss of biodiversity, threats to biodiversity, biodiversity conservation and sustainable development, conservation principles, species management, habitat management, indigenous knowledge and biodiversity, International conventions on biodiversity, Environmental law; Environmental impact assessment (EIA).

Practicals: Laboratory exercises based on above topics.

Recommended Texts:

1. Andel, J.V. and Aronson, J. (2006). Restoration Ecology. The New Frontier. Blackwell Science Limited.
2. Theodore, M. K. and Theodore, L. (2010). Introduction to Environmental management. CRC Press, Tailor & Francis Group.
3. Alexander, M. (2013). Management planning for Nature conservation. A theoretical basis and Practical guide, 2nd edition. Springer Dordrecht Heidelberg New York London.
4. National Wetland, Directory of Sri Lanka (2006). The Central Environmental Authority (CEA), IUCN and Natural Resources and the International Water Management Institute.

BT4131-Plant Secondary Metabolites

Course Content: Introduction, evolution of secondary metabolites, primary and secondary metabolites, major classes of secondary metabolites, terpenoids, phenolics, flavonoids and alkaloids, biosynthesis of secondary metabolites, role of secondary metabolites and their bioactivity.

Recommended Texts:

1. Harinder, P.S., Makkar, P., Sidhuraju and Klaus Becker (2007). Plant Secondary Metabolites. Humana Press
2. Seigler, D.S. (1998). Plant Secondary Metabolism. Springer, USA.
3. Crozier, A., Clifford, M.N. and Ashihara, H. (2006). Plant Secondary Metabolites: Occurrence, Structure and Role in the Human Diet. Wiley-Blackwell Publishing.

BT4142-Ornamental Horticulture

Course Content: Importance and scope of ornamental horticulture, elements of ornamental gardens, types and styles of ornamental gardens, use of trees, shrubs and herbs, climbers, palms and indoor plants, seasonal plants and flowers. Principles of landscaping and designs. Establishment and maintenance of lawns. Establishment and maintenance of hedges, edges and bonsai. Flower arrangement and bouquet. Packages of practices for major ornamental crops in the region. :***Practical:*** Identification of ornamental plants, layout and maintenance of lawns and indoor plants, preparation of bonsai, planning and layout of gardens; flower arrangements and bouquets, visit to public and private gardens.

Recommended Texts:

1. Ingels, J.E. (2010). Ornamental Horticulture: Science, Operations and Management, 4th Edition . Delmar Cengage Learning
2. Arora, J.S. (2010). Introductory Ornamental Horticulture, 6th Edition. Kalyani Publishers, India.
3. Bird, C. (Ed.) (2014). The Fundamentals of Horticulture, Theory and Practice. Cambridge University Press.
4. Bridwell, F.M. (2001). Landscape plants, 2nd Edition. Delmar Cengage Learning

BT4152-Plant Population Biology

Course Content: Principles of growth of population – different growth forms; R and K selection and calculation of growth rates; Plant as a population; Vegetative reproduction; Seed and seed dispersal; Seed dormancy; Seed bank; Effect of neighbours; Density effect in mortality; Species Mixture; Coexistence.

Recommended Texts:

1. Population Ecology. A unified study of Animals and Plants, 3rd Edition (1996). Michael Begon, Martin Mortimer and David J. Thomson, A Blackwell Publishing Company
2. Population Biology of Plants (2010). John L. Harper, The Black burn Press.
3. Introduction to Plant Population, 4th Edition (2001). Jonathan Silvertown & Deborah Charlesworth, Wiley-Blackwell.
4. Introduction to Population Biology, 1st Edition (2004). Dick Neal, Cambridge University Press

BT4161-Experiments on plant population biology

Course Content: Students are required to carry out projects to acquire the basic knowledge in population biology and will be required to submit report.

BT4173 GIS and Remote Sensing

Course Content: Introduction to Geographic Information System (GIS), Components of GIS and data models. Principles of Cartography and base map development. Spatial database management, spatial analysis with GIS; Introduction to Global Positioning System (GPS). Digital terrain analysis and modelling, aerial photography and interpretation. Introduction to Remote Sensing (RS). Image pre-processing, processing and post processing techniques. Trends in GIS, GPS and RS. Applications of GIS, GPS and RS in natural resource management. ***Practical*:** Hands on Practical sessions using GIS and RS software and visual interpretation of aerial photographs. Field session on GPS data collection and integration with GIS. Field excursion to an institute (e.g. Institute of Survey and Mapping) where GIS, GPS and RS are used.

Recommended Texts:

1. Keranen, K. and Kolvoord, R. (2013). Making spatial decisions. Using GIS and Remote sensing, A work book. Esri Press.
2. Bhatta, B. (2008).Remote Sensing and GIS. Oxford University Press.

3. Remote Sensing and GIS in Ecosystem Management, 1st Edition (1994). Al Sample, Island Press
4. Longley, P. (2005). Geographic Information systems and Science Willy Publishers.
5. Wegmann, M., Leutner, B. and S. Dech (Ed.) (2016). Remote sensing and GIS for Ecologists. (in print). Pelagic Publishing

BT4183 -Molecular Genetics and Plant Breeding

Course Content: Plant genome and its organization, molecular genetics of primary and secondary metabolism, biotic and abiotic stress resistance. DNA repair, recombinant DNA technology and vectors, genes and traits of interest, plant transformation, promoters and marker genes. ***Practical:*** Laboratory Exercises based on topics selected from above.

Recommended Texts:

1. Acquaah, G. (2012). Principles of plant genetics and breeding, 2nd Edition. Wiley Blackwell A John Wiley and Sons ltd., publications.
2. Grotewold, E., Chappel, G., Kellogg, E.A. (2015). Plant genes, genomes and genetics. Wiley Blackwell Publications
3. Hughes, M. A. (1996). Plant molecular genetics. Addison, Wesley and Longman Publishing Group, England.

BT4193-Seed Biology and Technology

Course Content: Development, chemical composition, water relation in seeds, seed germination, seed testing for viability and vigour, seed certification, seed dormancy and breaking, seed deterioration, seed storage and longevity, seed enhancement. Seed pathology; seed biotechnology, hybrid corn seed production. ***Practical:*** Seed structure of monocot and dicot seeds and important plant species, seed dormancy breaking methods, requirements for conducting germination test, tetrazolium test for seed viability, seed and seedling vigour tests applicable in various crops, examination of seeds for seed-borne microorganisms.

Recommended Texts:

1. Benech-Arnold, R. and Synche, R. (2004). Handbook of Seed Physiology: Applications to Agriculture (Seed Biology, Production, and Technology), 1st Edition, CRC Press.
2. Umarani, Jerlin and Ponnuswamy, N.M. (2006). Experimental Seed Science & Technology. Agrobios, India.
3. Agarwal, V.K. and Sinclair, J.B. (1997). Principles of Seed Pathology. Boca Raton.

BT4202- Soil Fertility and Management

Course Content: The nature and composition of soils, physical and chemical properties of soil, classification of soils. Soil nutrients, soil pH and management, organic fertilization, sustainable soil fertility management - use of cover crops, compost and animal manures, soil amendments and supplemental fertilizers, crop rotation. Soil erosion and control.
Practical: Studying and comparing physical and chemical properties of different soil types - texture, density, porosity, permeability, colour. Field visit to explore sustainable soil management practices.

Recommended Texts:

1. Troeh, F.R. and Thompson, M. (2005). Soil and Soil Fertility, 6th Edition. John Wiley & Sons Inc.
2. Power, J.F. and Rajendra, P. (1997). Soil Fertility Management for Sustainable Agriculture. CRC Press.
3. Benton Jones, J., Jr. (2012). Plant Nutrition and Soil Fertility Manual, Second Edition. CRC Press.
4. Miller, R. W. and Donahue, R. L. (1992). Soils: An introduction to soils and plant growth, 6th Edition. Prentice Hall of India Pvt. Ltd., New Delhi.

BT4212-Essay

Course Content: Essay topics will be given at the commencement of fourth year. The Faculty staff are responsible for selecting the relevant topics. A total of 6 topics will be given and students should write two essays on selected topics for the End-semester examination.

BT4222-Industrial Training

Course Content: Industrial Training aims to provide `supervised Practical training' within a specified timeframe, in a work place of either a government or private sector organisation. The placement will be decided by the Department. The student will write and submit a comprehensive scientific report on the organization, nature and the amount of work performed, the outcome, if any, and make an oral presentation.

BTS4236-Research Project

Course Content: Each student will carry out a research project during the final year under the supervision of a Faculty member. The student is required to deliver two seminars, (a) pre-project seminar, based on preparatory work and research plan and (b) end of the project seminar, based on the outcome of research and prepare a comprehensive report containing Title page, Abstract, Introduction and Literature Review, Objectives, Materials & Methods, Results, Discussion, Conclusion and References. The student may also be required to present the outcome in the form of a power point presentation.

7 Department of Chemistry

The Department of Chemistry has adequate infrastructure at the new science block. Approximately 350 students are offering chemistry from general degree programme and 24 students are following special degree programme in the year 2017. There are five permanent academic staff, six support staff, two Technical officers, three Laboratory attendants and a Labourer are working in the department at present. The Chemistry Department has three laboratories: organic chemistry laboratory, inorganic chemistry laboratory and physical chemistry laboratory and each laboratory has a working capacity of 35. The laboratories are used for seven hours per day for five days. In addition a preparation time of 2-3 hours is required for each practical session. Special degree and post degree students also use the laboratories simultaneously and during vacation. Practical demonstrations are also conducted for, G.C.E A/L students from various schools in Batticaloa and Kalmunai districts. The Department of Chemistry has close links with the National Science Foundation (NSF) and provides guidance to the research students selected by NSF from schools in national level. The Department of Chemistry is also the representative to conduct the Australian chemistry quiz in the Batticaloa district.

The educational objectives of the Department of Chemistry are as follows:

- Provide a fundamental understanding of chemistry.
- Provide prospective chemistry teachers with strong foundation in the application of chemistry principles that will enhance the quality of science teaching provided to schools in the region and state.
- Provide excellent researchers through special degree programme.
- Provide qualified graduates in gaining admission to and completing graduate programme in chemistry and related field.
- Provide qualified graduates for national benefits.

Head of the Department

Dr. M. Koneswaran
BSc(EUSL), MSc(UPDN), PhD(Manchester, UK)
Senior Lecturer (Grade II)
E-mail: head_chemistry_fos@esn.ac.lk

7.1 Academic Staff

Prof. M. Sithambaresan
BScHons(Jaffna), Grad.C.Chem, MPhil(UPDN), PhD(CUSAT, India)
Professor in Chemistry
E-mail: *sithambaresanm@esn.ac.lk/ msithambaresan@gmail.com*
Research Interest: *Synthesis and characterization of transition metal complexes. Single crystal X-ray studies on organic and inorganic metal complexes, Electron Paramagnetic Resonance (EPR) studies on transition metal complexes.*

Prof. S. Arasaretnam
BScHons(EUSL), MSc(USJP), PhD(USJP), A.I.Chem.C
Associate Professor in Chemistry
E-mail: *s_arasaretnam@esn.ac.lk, arasan2005@gmail.com*
Research Interest: *Polymer Chemistry, synthetic modification of natural products, absorption properties of tannin-based resins derived from locally available material, computational studies on the reactivity of polyphenolic compounds, and water quality and environmental Chemistry*

Mr. G. Parthiban
BScHons(Jaffna), MPhil(USJP)
Senior Lecturer (Grade I)
E-mail: *parthibang@esn.ac.lk, parthig24@yahoo.com*
Research Interest: *Computational quantum Chemistry, molecular modeling, surface Chemistry*

Dr. M. Koneswaran
BSc(EUSL), MSc(UPDN), PhD(Manchester, UK)
Senior Lecturer (Grade II)
E-mail: *koneswaran@esn.ac.lk, konesh26@yahoo.com*
Research Interest: *Development of optical sensors using different types of nanoparticles, Quantum dots, Nanoconcrete, development of superhydrophobic surfaces, Nanomaterials and Nanocomposites*

Dr. B.S.W. Karunarathna
B.Sc (USJ), PhD (USJ)
Senior Lecturer (Grade II)
Email: karunarathnabsw@esn.ac.lk
Research Interest: Computational Material Modelling and Simulation

Mr. R. Joy Ebenezer (on study leave)
BScHons (EUSL)
Lecturer (Probationary)
E-mail: *joye@esn.ac.lk, joyraja72@yahoo.com*
Research Interest: *Synthetic organic chemistry, extraction of organic compounds from natural sources.*

Mrs.Venujah Pratheep
BScHons (EUSL),
Lecturer (Probationary)
Email: *Venujahp@esn.ac.lk/ venujah29@gmail.com*
Research Interest: *Modification of functional groups in organic compounds and relevant applications*

7.2 100 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L/P/IL)	Credits	Prerequisite	BSc (General)	BScHons (Chemistry)
First Semester						
CH1013	Principles of Chemistry-I	45/0/105	03		✓	✓
CH1021	Elementary Chemistry Laboratory-I	0/30/20	01		✓	✓
Second Semester						
CH1033	Principles of Chemistry II	45/0/105	03		✓	✓
CH1041	Elementary Chemistry Laboratory II	0/30/20	01		✓	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

CH1013 - Principles of Chemistry I

Course Content: General Chemistry: Development of the atomic theory of matter. Quantum theory and electronic structure of atoms, Bohr theory, and quantum numbers. Lewis structure, VSEPR theory and shapes of molecules. Types of chemical bonding, Fajan's rules. Hybridisation and resonance. Non-valence cohesive forces. Organic reaction mechanism: Reaction intermediates, substitution reactions and their mechanism. Electrophilic substitution, elimination, addition and rearrangement reactions, acidity of simple aliphatic acids, basicity of ions. Thermodynamics and Electrochemistry: Thermodynamic functions, laws of thermodynamics, reversible and irreversible adiabatic expansion of an ideal gas. Heat capacities, entropy changes, Maxwell's thermodynamic relationships, Clausius-Clapeyron equation. Review of redox reactions, Electrochemical cells, Electrodes, Celldiagrams, Electrode potential and Standard electrode potential, Electrochemical series, Predicting feasibility of chemical reactions, Nernst equation.

Recommended Texts:

1. R. Chang. Chemistry, McGraw Hill, New York.
2. P.W. Atkins. Physical Chemistry, Oxford University Press. London.
3. J. McMurry. Organic Chemistry, Brooks/Cole Publishing Co., New York.
4. R.T. Morrison and R.N. Boyd. Organic Chemistry. Prentice Hall, New York.

CH1021 - Elementary Chemistry Laboratory I

Course Content: Qualitative Inorganic Analysis: Tests for known anions: carbonate, sulphite, thiosulphate, chloride, bromide, iodide, sulphate, arsenate, arsenite, phosphate, nitrate, chromate, dichromate andsulphide, Analysis of unknown anion mixtures and identification of cations. Quantitative Inorganic Analysis: Acid-base, precipitation and redox titrations: 87haracterizatio of hydrochloric acidusing standard sodium carbonate, 87haracterizatio of NaOH using standard HCl, determination of the percentage of CO_3^{2-} and OH^- ions in a mixture ,87haracterizatio of HCl using standard borax, 87haracterizatio of NaOH using standard borax, 87haracterizatio of potassium permanganate using oxalic acid, 87haracterizatio of a ferrous ion solution with standard potassium chromate, 87haracterizatio of $Na_2S_2O_3$ using standard potassium dichromate, determination of the percentage of Cu^{2+} using standard $Na_2S_2O_3$ solution.

Recommended Texts:

1. A.I. Vogel. A textbook of Qualitative Inorganic analysis, Longman Scientific, New York.
2. A.I. Vogel. A textbook of Quantitative Inorganic analysis, Longman Scientific, New York.

CH1033 - Principles of Chemistry II

Course Content: General Chemistry: Size and Energy factors: atomic and ionic radii, Energy factors in Chemistry, Lattice energy, bond strength, Born-Haber cycle, Fundamentals of Analytical Chemistry: Significant figures, precision and accuracy, dimensional analysis in problem solving, theory of titrations, indicators, buffers, solubility equilibria and chemical calculations involving the above concepts. Stereochemistry of organic compounds: Shapes of organic molecules: types of isomerism and nomenclature of isomers: Newman projections, Sawhorse representation, chirality and optical activity, symmetry elements, Fischer projection formulae, optical isomers: nomenclature of optically active compounds, erythro/threo and R/S System of nomenclature, E/Z nomenclature. Kinetic molecular theory and Chemical kinetics: Assumptions of kinetic molecular theory, derivation of kinetic gas equation, distribution of molecular velocities, 87haracte of real gases: effects of pressure and temperature, deviation of van der Waals equation: volume and pressure corrections. Theories

of reaction rates: collision theory, transition state theory, reaction rate,order of a reaction, differential rate equation for zero, first and second order reactions, molecularity of a reaction, determination of the order of a reaction, effect of temperature on reaction rate: Arrhenius equation,complex reactions, reversible reactions, consecutive reactions, chain reactions.

Recommended Texts:

1. F R. Chang. Chemistry, McGraw Hill, New York.
2. P.W. Atkins. Physical Chemistry, Oxford University Press. London.
3. J. McMurry. Organic Chemistry, Brooks/Cole Publishing Co., New York.
4. R.T. Morrison and R.N. Boyd. Organic Chemistry. Prentice Hall, New York.

CH1041 - Elementary Chemistry Laboratory II

Course Content: Elemental Identification and Functional Groups: Preliminary investigation, detection of elements present (flame test, Beilstein's test for halogens, tests for N, X, P and S), 88haracterization of the functional groups (such as aliphatic alcohols, aldehydes, ketones, esters, phenols, alkenes, amines, ammonium salts, amides and aromatic nitro compounds).
Apparatus and measurements, titration errors, Chemometrics.

Recommended Texts:

1. F F.G. Mannand, B.C. Saunders. Practical Organic Chemistry, Longmans, New York.
2. D.A. Skoog, D.M. West and F.J. Holler, Fundamentals of Analytical Chemistry, Sanders College Publishing, New York.

7.3 200 Level of Study

Course Units and Syllabus

Course code	Course Title	Hours♣ (L/P/IL)	Credits	Prerequisite	BSc (General)	BScHons (Chemistry)
First Semester						
CH2012	Inorganic Chemistry I	30/0/70	02	CH1013, CH1033	✓	✓
CH2021	Analytical Chemistry	15/0/35	01	CH1013, CH1033	⊗	✓
CH2032	Organic Chemistry I	30/0/70	02	CH1013, CH1033	✓	✓
CH2042	Inorganic Chemistry Laboratory-I	0/60/40	02	CH1021 CH1041	✓	✓
Second Semester						
CH2051	Special topics in Inorganic Chemistry–I	15/0/35	01	CH2012	⊗	✓
CH2061	Physical Chemistry I	15/0/35	01	CH1013, CH1033	✓	✓
CH2071	Introduction to Polymer Chemistry	15/0/35	01	CH1013, CH1033	⊗	✓
CH2081	Organic Chemistry Laboratory–I	0/30/20	01	CH2032	✓	✓
CH2091	Physical Chemistry Laboratory–1	0/30/20	01	CH2061	✓	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol "⊗" denotes that course is elective for the Degree Programme.

CH2012 - Inorganic Chemistry I

Course Content: Werner's theory of co-ordination compounds, factors of the metal and ligand, co- ordination numbers, classification of ligands, nomenclature of co-ordination compounds and isomerism of coordination compounds. Stability constants, inorganic reaction mechanism, Bonding theories: valence bond theory, crystal field theory and d-orbital splitting in octahedral, tetrahedral and square planar complexes. Crystal field stabilisation energy, Jahn-Teller effect, magnetic properties of transition metal complexes.

Spectra of d1 and d9 complexes. Charge transfer spectra.Main Group Chemistry: Physical and chemical characteristics and group trends of group I to group VII elements. Rare gases and their compounds. Solid state chemistry: crystalline state, crystal systems, diffraction techniques and their applications, Miller indices, determination of cell dimensions, ASTM cards.

Recommended Texts:

1. J.D. Lee. Concise Inorganic Chemistry, Wiley, New York.
2. S.F.A. Kettle. Coordination Compounds, Appleton Century, New York.
3. G.F. Liptrot. Modern Inorganic Chemistry. ELBS series with Collins Educational, Honley, UK.

CH2021 - Analytical Chemistry

Course Content: Solvent extraction. Partition and adsorption chromatography: paper chromatography, thin layer chromatography, Column chromatography, gas chromatography, ion exchange chromatography. Spectrophotometric methods of analysis: colorimetry, atomic absorption spectrometry and flame photometry.

Recommended Texts:

1. D.A. Skoog, D.M. West and F.J. Holler, Fundamentals of Analytical Chemistry, Sanders College Publishing, New York.
2. D.C. Harris. Quantitative Chemical Analysis. Freeman, New York.

CH2032 - Organic Chemistry I

Course Content: Types of transitions, Principles and applications of UV and IR spectroscopy. Nuclear magnetic resonance spectroscopy (NMR:- ^{1}H-NMR,^{13}C-NMR), Principles and instrumentation, chemical shifts, spin-spin coupling(J and, applications.. Mass spectrometry: basic theory, instrumentation and applications. Chemistry of functional groups and Aromaticity: Electrophilic and nucleophilic addition to double bonds. Reactions of carboxylic acids and derivatives, oxidation-reduction reactions involving alcohols, alkenes, catalytic hydrogenation. Chemistry of carbonyl compounds: nucleophilic addition and elimination of carbonyl groups special reactions of carbonyl compounds. Chemistry of condensed or fused rings, chemistry of naphthalene and anthracene. Aromaticity: Huckel rule and Aromatic character, non-benzenoid and poly nuclear aromatic hydrocarbons.

Recommended Texts:

1.R.T. Morrison and R.N. Boyd. Organic Chemistry. Prentice Hall, New York.

2. R.J. Fessendon and J.S. Fessendon. Organic Chemistry, Brooks/Cole Publishing, New York.
3.R.M. Silverstein, G.C. Bassler and T.C. Morrill. Spectrometric Identification of Organic compounds, John-Wiley, New York.

CH2042 - Inorganic Chemistry Laboratory I

Course Content: Quantitative analysis: Titrations involving KIO_3. Determination of ascorbic acid in vitamin C. Determination of dissolved oxygen by Winklermethod. Complexometric titrations involving EDTA. Determination of nitrogen content of a fertilizer, determination of iodine and iodide in an aqueous solution, determination of salicylicacid (ASA) in aspirin tablets, determination of magnesium hydroxide in milk of magnesia, determination of the total capacity of an ion-exchange resin. Gravimetry: Gravimetric determinations of sulphate, manganese, nickel, calcium, aluminium and chromate.

Recommended Texts:

1. A.I. Vogel. A textbook of Quantitative Inorganic analysis, Longman Scientific, New York.

CH2051 - Special topics in Inorganic Chemistry I

Course Content: Electron deficient compounds, electronic structure and bonding in boron compounds (boron hydrides), structures of polyhedral boranes, Wade's rule, predicting the structures using Wade's rule, 'styx' number for neutral boranes, topology of boranes, preparation and reactions of boranes, carboranes, silicates, structures and their properties. Silicates: simple orthosilicates, non-cyclic silicates, cyclic silicates anions and infinite chain anions. Chemistry of the transition elements. Lanthanides and actinides, transuranium elements. Rare earths: chemistry and extraction.

Recommended Texts:

1. K. Wade. Electron deficient compounds, Springer, Berlin.
2. F.A. Cotton and G. Wilkinson. Advanced Inorganic Chemistry, Wiley, New York.

CH2061 - Physical Chemistry I

Course Content: Blackbody radiation and energy quantization, Quantum mechanics, time independent Schrodinger equation, Solutions of the Schrodinger equation for a particle in 1-, 2- and 3-dimensional systems.

Uncertainty principle. Probability functions. Molecular properties: dipole moment, polarisability and magnetic properties, rotational spectroscopy, vibrational spectroscopy, vibration-rotation spectra, Raman spectroscopy.

Recommended Texts:

1. P.W. Atkins. Physical Chemistry, Oxford University Press. London.
2. D.A. McQuarie, Quantum Chemistry, University Science Books, Mill Valley, CA.
3. P. W. Atkins. Molecular Quantum Mechanics, Oxford Univ. Press, Oxford

CH2071 - Introduction to Polymer Chemistry

Course Content: Introduction to polymers, polymer synthesis, copolymer, polymerisation techniques, basic principles of polymers, molecular weight, and kinetics of polymerisation.

Recommended Texts:

1. R.J. Young and P.A. Lovell. Introduction to Polymers. London: Oxford University Press

CH2081 - Organic Chemistry Laboratory I

Course Content: Separation of a mixture of a base and a neutral compound, separation of a mixture of an acid and a neutral compound, preparation of acetamide, hydrolysis of esters, synthesis of aspirin, preparation of oxime, interpretation of UV, IR, NMR and mass spectra of organic compounds.

Recommended Texts:

1. A.I. Vogel. Textbook of Practical Organic Chemistry, Longman scientific, New York.
2. F.G. Mann and B.C. Saunders. Practical Organic Chemistry, Longmans, New York.
3. R.J. Fessenden and J.S. Fessenden. Organic Laboratory Techniques, Brooks/ Cole Publishing Co, New York.

CH2091 - Physical Chemistry Laboratory I

Course Content: Determination of partition co-efficient of I_2 between CCl_4 and water, Determination of the activation energy of the reaction, Determination of stoichiometry by temperature variation method, paper chromatography, Construction of a phase diagram, determination of the solubility product of a sparingly soluble salt, Determination of the order, molecularity and rate

constant of the reaction, Determination of the extinction co-efficient by a colorimetric method.

Recommended Texts:

1. A. Finlay. Practical Physical Chemistry, Longmans, London.
2. D.P. Shoemaker, C.W. Garland, J.W. Nibler, Experiments in Physical Chemistry, McGraw-Hill, New York.

7.4 300 Level of Study

Course Units and Syllabus

Course code	Course Title	Hours♣ (L/P/IL)	Credits	Prerequisite	BSc (General)	BScHons (Chemistry)
First Semester						
CH3011	Chemistry of natural products-I	15/0/35	01	CH2032	⊗	✓
CH3021	Heterocyclic Chemistry and Rearrangement reactions	15/0/35	01	CH2032	⊗	✓
CH3031	Electrochemistry	15/0/35	01	CH2061	✓	✓
CH3043	Industrial Chemistry	45/0/105	03	-	⊗	⊗
CH3051	Special topics in Inorganic Chemistry-II	15/0/35	01	CH2012	⊗	✓
CH3062	Organic Chemistry Laboratory-II	0/60/40	02	CH2081	✓	✓
Second Semester						
CH3071	Special topics in Physical Chemistry –I	15/0/35	01	CH2061	⊗	✓
CH3081	Nanotechnology and its Applications	15/0/35	01	CH1013, CH1033	⊗	⊗
CH3091	Physical Chemistry Laboratory-II	0/30/20	01	CH2091	✓	✓
CH3101	Inorganic Chemistry Laboratory-II	0/30/20	01	CH2042	✓	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol "⊗" denotes that course is elective for the Degree Programme.

CH3011 -Chemistry of Natural Products I

Course Content: Primary and secondary metabolites, bio-synthesis of natural products, bio-synthetic pathways: polyketide and Shikimic acid pathways, basic structures of terpenoids, steroids and alkaloids, basic chemistry of carbohydrates, amino acids, and peptides.

Recommended Texts:

1. R.J. Fessenden and J.S. Fessenden (1993) Organic Chemistry, Brooks/ Cole Publishing Co., New York.
2. S.V. Bhat, B.A. Nagasampagi and M. Sivakumar. Chemistry of Natural Products,
3. Springer, Berlin.

CH3021 -Heterocyclic Chemistry and Rearrangement Reactions

Course Content: Heterocyclic Chemistry: Five membered heterocyclic compounds, Six membered heterocyclic compounds. Rearrangement reactions involving carbonium and carbanions, carbon free radicals, carbenes and nitrenes, nucleophilic rearrangement reactions, Other rearrangements, cyclo-addition and related reactions.

Recommended Texts:

1. R.J. Fessendon and J.S. Fessendon. Organic Chemistry, Brooks/Cole Publishing, New York.
2. T. Eicher, S. Hauptmann, The Chemistry of Heterocycles, Wiley-VCH, Weinheim
3. A.K. Bansal. Heterocyclic Chemistry, Anshan, Kent, UK.

CH3031 – Electrochemistry

Course Content: Faraday's law, properties of electrolytes, Debye-Huckel theory, electrode potential and thermodynamic functions, electrolytic conduction, molar conductivity, Kohlrausch's law of independent migration of ions. Arrhenius ionisation theory, Debye-Huckel Onsager theory, transport number and its determination. Conductiometric titrations, chemical and electrochemical reactions, types of cells, emf and electrode potentials, Application of emf measurements. Electrical energy sources.

Recommended Texts:

1. W.J. Moore. Physical Chemistry, Prentice Hal, New Jersey.
2. C.M.A. Brett and A.M.O. Brett. Electrochemistry: Principles, Methods and Applications, Oxford: Oxford University Press.
3. A.J. Bard & L.R. Faulkner. Electrochemistry: Fundamentals and Applications, Wiley, New York
4. D. Pletcher, R. Greff, R. Peat, L.M. Peter & J. Robinson. Instrumental methods in Electrochemistry, Horwood Ellis, Hertz, UK.

CH3043 - Industrial Chemistry

Course Content: Minerals found in Sri Lanka: occurrence, composition, current industrial use and potential future applications of minerals in Sri Lanka. Concentration, extraction and purification of ores, Ellingham diagrams Chemistry involved in the manufacture of cement, ceramics, glass, paints and varnishes. Industrial organic chemistry: Coal, Naphtha based chemical industry. Essential oils, pharmaceuticals, polymers, dyes. Basic Chemical Engineering, unit processes, reactor design, mass and heat transfer.

Recommended Texts:

1. P.G. Cooray. Geology of Sri Lanka, Ceylon Museum.
2. V. Karunaratne. Industrial Organic Chemistry, Science Education, Unit, University of Peradeniya.
3. C.A. Heaton. An introduction to Industrial Chemistry, Springer, Berlin.

CH3051 - Special Topics in Inorganic Chemistry II

Course Content: Chemistry and bonding of metal carbonyls, bonding in metal carbonyls, effective atomic number rule, Transition metal nitrosyls. Cyclopentadienyl complexes. Non-aqueous solvents, classification and properties. Levelling action, solvolysis, uses of non-aqueous solvents. Radioactivity: Types of radioactive decay, Detection of radioactivity, Rates of radioactive decay. Dating: Dating of rocks, Radiocarbon dating. Nuclear stability, biological effects of radiation, nuclear fission and nuclear fusion energy.

Recommended Texts:

1. F.A. Cotton and G. Wilkinson. Advanced Inorganic Chemistry, Wiley, New York.
2. D.H. Frisch and A.M. Thorndike. Elementary particles, Van Nostrand Co., New York.

CH3062 - Organic Chemistry Laboratory II

Course Content: Nitration of bromobenzene, preparation of phenyl urea, preparation of 5,5 diphenylhydentoin, preparation of benzil, preparation of benzilic acid, preparation of phenyl benzoate, preparation of benzanilide, preparation of dibenzylidene from aniline to tribromoaniline, hydrolysis of methyl salicylate, preparation of acetyl salicylic acid from salicylic acid.

Recommended Texts:

1. A.I. Vogel. Textbook of Practical Organic Chemistry, Longman scientific, New York.

2. F.G. Mann and B.C. Saunders. Practical Organic Chemistry, Longmans, New York.

CH3071 - Special topics in Physical Chemistry I

Course Content: Characteristics of physical and chemical adsorption, theories of adsorption: Langmuir, Freundlisch and Brunauer-Emmett and Teller adsorption isotherms (BET). Application of adsorption isotherms, measurement of surface and interfacial tension, physical properties of surfactants. Phase rule and phase diagrams: components and degrees of freedom, phase rule. Two component system: vapour pressure diagrams, temperature-composition diagrams, liquid-liquid phase diagrams, liquid-solid phase diagrams. Three component system: triangular phase diagrams, partially miscible liquids.

Recommended Texts:

1. P.W. Atkins. Physical Chemistry, Oxford University Press, London.
2. J.E. Ricci, The phase rule & heterogeneous equilibrium, Dover books, Kent, UK.
3. D.M. Ruthven. Principles of Adsorption and Adsorption Processes, Wiley, New York.

CH3081 - Nanotechnology and Its Applications

Course Content: Fundamental concepts of nanotechnology: History of nanotechnology. Properties of nanomaterials: physical, chemical, optical, mechanical and magnetic properties. Classification: quantum dots, Carbon based nanomaterials, graphene, fullerenes and carbon dots, nano-TiO_2, nanosilica and nanoclays. Fabrication methods of nanoparticles: top down and bottom up approaches. Characterisation methods: Spectroscopic techniques and imaging. Nanotechnology concepts in nature. Applications in various fields: Medical, Textiles, Energy, Electronics, Cosmetics, Construction, Military, Food and Agriculture, etc.

Recommended Texts:

1. M.J. Madou, Fundamentals of microfabrication, CRC Press, Boca Raton, USA
2. T. Pradeep. Nano, The Essentials, Understanding Nanoscience and Nanotechnology, Tata McGraw-Hill Publishing, New Delhi.
3. M. Rieth. Nano-Engineering in Science and Technology, An introduction to the world of Nano-Design, World Scientific, Singapore.
4. G.L. Hornyak, J. J. Moore, H.F. Tibbals and J. Dutta, Fundamentals of nanotechnology, CRC Press, Boca Raton, USA.

CH3091 - Physical Chemistry Laboratory II

Course Content: Determination of rate constant of reactions, order of the reaction with respect to methyl acetate and activation energy for the reaction, determination of the velocity constant of the inversion of sucrose by HCl at room temperature, determination of adsorption isotherm of acetic acid from aqueous solution by charcoal, spectrophotometric determination of the pKa value of an indicator, determination of the order of the reaction with respect to iodine and acetone and dissociation constant of a weak acid by a potentiometric titration, to construct the phase diagram of water–acetic acid-chloroform system, determination of the end point of weak acid vs weak base, strong acid vs strong base and precipitation reaction using conductometric titrations and the determination of the equilibrium constant of a reaction.

Recommended Texts:

1. A. Finlay, Practical Physical Chemistry, Longmans, London.

CH3101 - Inorganic Chemistry Laboratory II

Course Content: Preparation of tetraammine copper (II) sulphate, determination of dissolved oxygen by Winkler method, determination of total capacity of an ion-exchange resin, determination of ferric ions using colorimetry, preparation of pentamminechlorocobalt(III) chloride, determination of iron in a sample of soil by titration with $KMnO_4$, Determination of the chemical oxygen demand of a wastewater sample, separation of Ni^{2+} and Co^{2+} using paper chromatography.

Recommended Texts:

1. G. Pass. Practical Inorganic Chemistry, Netherlands: Springer.
2. W.L. Jolly. Preparative Inorganic reactions, Interscience, New York.

7.5 400 Level of Study

Course Units and Syllabus

Course code	Course Title	Hours* (L/P/IL)	Credits	Prerequisite	BScHons (Chemistry)
CH4012	Advanced Inorganic Chemistry-I	30/0/70	02	CH2012, CH2051	✓
CH4022	Advanced Organic Chemistry-I	30/0/70	02	CH2021	✓
CH4032	Advanced Physical Chemistry-I	30/0/70	02	CH2061	✓
CH4042	Environmental Chemistry	30/0/70	02	-	⊗
CH4052	Advanced Analytical Chemistry	30/0/70	02	CH2021	✓
CH4062	Advanced Inorganic Chemistry-II	30/0/70	02	CH3112	✓
CH4072	Advanced Organic Chemistry-II	30/0/70	02	CH3122	✓
CH4082	Advanced Physical Chemistry-II	30/0/70	02	CH3132	✓
CH4092	Medical and Pharmaceutical Chemistry	30/0/70	02	CH2021	⊗
CH4101	Food Chemistry	15/0/35	01	CH3122	⊗
CH4111	Nuclear Chemistry	15/0/35	01	CH3051	⊗
CH4122	Topics in Advanced Organic Chemistry	30/0/70	02	CH3122	⊗
CH4131	Chemical Ecology	15/0/35	01	CH2021	⊗
CH4141	Polymer Chemistry	15/0/35	01	CH2071	⊗
CH4152	Chemistry of Natural Products II	30/0/70	02	CH3011	✓
CH4161	Bioinorganic Chemistry	15/0/35	01	CH2012	⊗
CH4172	Solid State Chemistry	30/0/70	02	CH2012 CH4012	✓
CH4181	Computational Chemistry	15/0/35	01	CH4032	⊗
CH4193	Advanced Inorganic Chemistry Laboratory	0/90/60	03	CH3101	✓

CH4203	Advanced Organic Chemistry Laboratory	0/90/60	03	CH3062	✓
CH4213	Advanced Physical Chemistry Laboratory	0/90/60	03	CH3091	✓
CH4221	Seminar	6/0/44	01		✓
CH4236	Research Project #	600	06		✓
CH4242	Industrial training #	200	02		⊗

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol "⊗" denotes that course is elective for the Degree Programme.

Notional learning hours for course units in category 3.3 B.

CH4012 - Advanced Inorganic Chemistry I

Course Content: Symmetry elements and point groups. Derivation of crystal field theory using group theory. Russell-Saunders coupling. Energy terms of free ions and in different crystal fields. Molecular orbital theory. Magnetochemistry and types of magnetism spin-orbit coupling and orbital contribution to magnetic moments. Spectra of coordination complexes, selection rules, interpretation of spectra using Orgel and Tanabe-Sugano diagrams.Jahn-Teller effect. Physical methods in Inorganic Chemistry: X-ray, neutron and electron-diffraction techniques, Space groups, systematic absences and space group determination. Fourier and Patterson maps, structure determination and refinement. Photoelectron spectroscopy, Mossbauer spectroscopy, ESR, NMR and NQR.

Recommended Texts:

1. F.A. Cotton. Chemical Applications of Group Theory, New York: Wiley
2. D.F. Shriver, P. Atkins and C.H. Langford. Inorganic Chemistry, New York: Freeman.
3. R.S. Drago. Physical methods in Inorganic Chemistry, New York: Saunders.
4. G.H. Stout and L.H. Jenson. X-Ray Structure Determination: A Practical Guide, New York: Wiley.

CH4022 - Advanced Organic Chemistry I

Course Content: Reactive intermediates, radical reactions in synthesis. Functionalisation of C-H bonds, free radical cyclisations, Electron spin resonance in analysing radicals.Carbenes: Formation of carbenes, singlet and triplet carbenes, reactions of carbenes, Synthesis of grandisol (sexpheromone)

and nitrogen analogues of carbenes. Pericyclic Reactions: Frontier orbital description of thermal and photochemical cycloadditions, Diels-Alder reaction, Sigmatropic and electrocylic reactions. Conformational Analysis: A closer look at cyclopentane, cyclohexane, locking groups, decalins and steroids, cyclohexene and cyclohexanone and related molecules, Stereochemical control in six membered rings, E2 elimination reactions, Stereoselective and stereospecific reactions, Diastereoselectivity, Cramn's rule. Determining Reaction Mechanisms: Methods for investigating reaction mechanisms: Hammett relationships.

Recommended Texts:

1. S. Ege. Organic Chemistry, DC Heath and Co. New York.
2. R.T. Morrison and RN Boyd (1998) Organic Chemistry, Prentice Hall. New York.
3. E.L. Eliel & S.H. Wilen, Stereochemistry of Organic compounds, Wiley, New York.

CH4032 - Advanced Physical Chemistry I

Course Content: Quantum Mechanics (10L): Simple harmonic oscillator, rigid rotator; H atom and diatomic molecules; Approximate methods, variation and perturbation methods; Multi-electron atoms, Hartree-Fock self- consistent field method for molecules, Born-Oppenheimer approximation, Slater determinant, Huckel Molecular Orbital theory. Thermodynamics: Advanced of the first and second laws. Temperature dependence of internal energy and enthalpy, Joule-Thompson coefficients, inversion temperature, relationships between Cp and Cv. Third law and reaction entropies, Temperature dependence of Gibb's function, Gibbs-Helmholtz equation; Pressure dependence of Gibb's function, chemical potential of gases and fugacity, standard state of a gas; real solutions, activities, solvent and solute activities; Equilibrium constants for real gases, response of equilibrium constants to catalysts. Statistical Thermodynamics: Boltzmann distribution, molecular partition function, canonical ensemble, canonical partition, translational, relational, vibrational and electronic partition functions, Statistical entropy, Sackoor-Tetrode equation, calculation of thermodynamic functions from partition function data.

Recommended Texts:

1. P.W. Atkins and Julio de Paula, (2006), Physical Chemistry, Freeman and Co., New York.
2. D.A. McQuarrie, Quantum Chemistry, University Science Books, Sausalito, California, USA.
3. T.L. Hill. An Introduction to Statistical thermodynamics, Dover, New York.

CH4042 - Environmental Chemistry

Course Content: Air pollution: Structure of the atmosphere, Air pollutant generation and sources. Classes of air pollutants, photochemical smog, Air quality standards. Air pollution monitoring (automated, active, passive and biomonitoring methods). Indoor air pollution. Greenhouse effect and Global warming, Ozone layer depletion. Acid rain and its environmental consequences. Water pollution: Pollutants in water and their origin. Water quality standards, analysis of pollutants in water and water quality, water treatment, Eutrophication and algal blooms. Industrial pollutants, controlling industrial pollution etc., Soil chemistry, pollutants in soil, soil analysis, aluminium, lead and arsenic content in soils. Waste management: Types of wastes, waste disposal practices. Special types of wastes and their treatment: hospital, chemical, oil and radioactive wastes. Laboratory component: Determination of water quality parameters of a waste water sample.

Recommended Texts:

1. S. Manahan. Environmental Chemistry, Boston: Willard Grant.
2. C. Baird. Environmental Chemistry, New York: W.H. Freeman.
3. B. Bilitewski, G. Hardtle, K. Marek, A. Weissbach and H. Boeddicker. Waste management, Springer, Berlin.

CH4052 - Advanced Analytical Chemistry

Course Content: Advanced calculations as applied to chemical analysis, derivation and error calculations. Calculations involving polyprotic acids and complexometric titrations, solubility equilibria and Gran plots. Electroanalytical Chemistry: Potentiometric calculations, cyclic voltammetry and polarography, microelectrodes in chemical analysis and elctrochemical sensors. Spectroscopic instrumentation and spectochemical analysis. errors in spectrochemical analysis, sensitivity and detection limits. Advanced atomic spectral methods, Atomic fluorescence spectroscopy, inductively coupled spectrometry. Surface analytical techniques: X-ray and UV photoelectron spectroscopy. Advanced separation techniques- capacity ratio and selectivity ratio, high performance liquid chromatography. Size exclusion chromatography, supercritical fluid chromatography, capillary electrophoresis. Thermal methods of Analysis: Thermogravimetry, Differential scanning calorimetry.

Recommended Texts:

1. M.D. Ryan and Q. Fernando. Calculations in Analytical Chemistry, Harcourt: New York.
2. D.A. Skoog, D.M. West and F.J. Holler, Fundamentals of Analytical Chemistry, Sanders College Publishing, New York.

3. P. Kissinger and W.R. Heineman. Laboratory Techniques in Electroanalytical Chemistry; Freeman, New York.
4. A.J. Bard and L. Faulkner. Electrochemical Methods; Marcel Dekker, New York.
5. G.D. Christian. Analytical Chemistry, John Wiley, New York.

CH4062 - Advanced Inorganic Chemistry II

Course Content: Reaction mechanisms of d-metal complexes: Ligand substitution reactions: Rate laws and their interpretation, Base hydrolysis, Isomerisation reactions, Redox reactions and photochemical reactions. d-and f-block organometallic compounds: Bonding: valence electron count, oxidation numbers and formal charges, synthesis of d-block carbonyls, structure and reactions of carbonyls, complexes of carbenes and carbynes, complexes of cyclo-organic ligands containing 1-8 electrons. metal-metal bonding and metal clusters.Catalysis: general principles: homogeneous and heterogeneous catalysis.

Recommended Texts:

1. G.E. Coates, M.L.H. Green, P. Powell and K. Wade (1988) Organometallic Chemistry,Chapman and Hall, London.
2. F. Basolo and RG Pearson, Inorganic Reaction Mechanism, John Wiley, New York.
3. D.F. Shriver, P. Atkins and C.H. Langford. Inorganic Chemistry, Freeman, NewYork.

CH4072 - Advanced Organic Chemistry II

Course Content: Organic synthesis: Retrosynthetic analysis: one group disconnections and two group disconnections, synthons, choosing a disconnection, C-C disconnections, donor and acceptor synthesis, forward synthesis of selected compounds(5L). Asymmetric Synthesis: Nature's chiral pool, chiral auxiliaries, enantiomeric excess, chiral reagents and chiral catalysts, asymmetric hydrogenation, Sharpless asymmetric epoxidation and Sharpless asymmetric hydroxylation (6L). Conjugate addition of enolates: enamines, The Robinson annulation reaction (3L). The synthesis of crixivin (protease inhibitor). Structural elucidation of organic compounds using advanced spectroscopic techniques: ^{1}H-nmr, ^{13}C-nmr, ^{2}D nmr (cosy, Hetcor Etc), DEPT etc. Mass spectrometry, Spectroscopic problems involving IR, UV, MS and NMR spectra (8L).

Recommended Texts:

1. R.M. Silverstein, G.C. Bassler and T.C. Morrill (1991) Spectrometric Identification of organic compounds, John Wiley and Sons.
2. S. Ege. (1994) Organic Chemistry, DC Heath and Co.
3. E.J. Corey and X-M Cheng (1989) The Logic of Chemical Synthesis, John Wiley, New York.
4. R.K. Mackie and D.M. Smith (1990) Guidebook to Organic Synthesis, Addison, Wesley and Longman.
5. F.A. Corey & R.J. Sundberg. Advanced Organic Chemistry, Part A: Structure and Mechanisms, Springer, Berlin.
6. F.A. Corey & R.J. Sundberg. Advanced Organic Chemistry, Part B: Reactions and Synthesis, Springer, Berlin.

CH4082 - Advanced Physical Chemistry II

Course Content: Surface Chemistry: Adsorption-physisorption and chemisorption, factors affecting adsorption of gases on solids, catalysis, homogeneous and heterogeneous activity and selectivity, enzyme catalysis, colloidal state, distinction between true solutions, colloids and suspensions; lyophillic, lyophobic, multimolecular and macromolecular colloids, properties of colloids, Tyndall effect, Brownian movement, electrophoresis, coagulation, emulsions – types of emulsions. Electrochemistry: Nature of Electrolytes, Debye-Huckel theory, electrode/electrolyte interface, electro capillary phenomenon, models for the electrical double layer, kinetics of electrode reactions, Butler-volume equation and Tafel plots. Kinetics: Fundamental laws in Kinetics, collision theory and relaxation methods, potential energy surface, transition state theory (TST) for ideal gas and relation between TST and collision theory, Eyring equation, thermodynamics treatment of TST, experimental methods in studying surface reactions.

Recommended Texts:

1. P.W. Atkins and Julio de Paula, Physical Chemistry, Freeman and Co. New York.
2. A.J. Bard, Fundamentals of Electrochemistry, McGraw Hill, London.
3. A.J. Bard and L.R. Faulkner. Electrochemistry: Fundamentals and Applications, Wiley, New York.

CH4092 - Medical and Pharmaceutical Chemistry

Course Content: Mechanisms of drug action, rational drug design, drug receptors, structure activity relationship, 3-D shapes of enzymes, computer aided drug design, cardiovascular drugs, anti-AIDS drugs etc. Asthma drugs, antihistamines, Analysis of drugs.

Recommended Texts:

1. G. L. Patrick, An Introduction to Medicinal Chemistry fourth edition, Oxford University Press, New York.

CH4101 - Food Chemistry

Course Content: Origin of Food Chemistry, Composition and properties of fat, Carbohydrates, Proteins, Vitamins, Minerals, Antioxidants, Food analysis, Colloids, Food additives, Food preservation, Dairy products, Cereal products, Colours and flavours, Food hazards.

Recommended Texts:

1. L.H. Meyer. Food Chemistry, Litton, USA.
2. N.N. Potter, J.H. Hotkchkiss. Food Science, Chapman & Hall, New York.

CH4111 - Nuclear Chemistry

Course Content: Radiation detectors (Proportional and Geiger Muller counters). Particle accelerators (liner, cyclotron, synchrocyclotron, betatron). Nuclear models (Shell model, liquid drop model) Stability of isobars. Radio analytical techniques (Isotope dilution analysis, Neutron activation analysis). Chemistry of actinides. Synthesis of nuclear fuels, Breeder reactors. Radioactive waste disposal.

Recommended Texts:

1. S. Glasstone. Sourcebook on Atomic Energy, Chapman and Hall, New York.
2. D.A. Skoog, F.J. Holler and T.A. Neiman (1998), Principles of Instrumental Analysis, Saunders Golden Series, New York.
3. G. Friedlander, J.W. Kennedy, E.S. Macias & J.M. Miller. Nuclear and Radiochemistry, Wiley, New York.

CH4122 - Topics in Advanced Organic Chemistry

Course Content: Synthesis and reactions of five and six membered heterocyclic compounds and their derivatives, synthesis and reactions of fused ring heterocyclic compounds, selected synthesis of macro heterocyclic compounds, photochemical reactions & synthesis. Modern Reagents and protective groups: Uses of enzymes, silicon reagents, palladium reagents, transition metal catalysts (in alkene metathesis) in organic synthesis, protection/de-protection of functional groups in organic synthesis & functional group compatibility.

Recommended Texts:

1. J.A. Joule and K. Mills. Heterocyclic Chemistry, Wiley, New York.

2. T.W. Green, P.G.M. Wuts. Protective groups in organic synthesis, Wiley, New York.

CH4131 - Chemical Ecology

Course Content: Environmentally friendly pesticides (Insecticides, nematocides, fungicides), botanical pesticides, semio-chemicals (insect communications, pheromones, repellents/attractants, defense chemicals), techniques involved in isolations, detection and analysis of these chemicals including bio-assay methods.

Recommended Texts:

1. A. Kessler. Chemical Ecology, Oxford University Press, Oxford.
2. T. Eisner & J. Meinwald. Chemical Ecology: The chemistry of Biotic Interaction, National Academy Press, Washington.

CH4141 - Polymer Chemistry

Course Content: Introductory Concepts and Definitions; polymerization process; Polymer conformations; Kinetics and mechanism of polymerization; Basic Principles of Polymer Molecular Weight Distribution. Practical Aspects of Molecular Weight Measurements: Osmometry, Dilute Solution Viscometry, Light Scattering, Size Exclusion Chromatography and Gel permeation chromatography. Analysis and Testing of Polymers: Spectroscopic Methods; Morphology of Crystalline Polymers; Rheology and Mechanical Properties of Polymer Solids and Liquids; Melting point and glass transition temperature.

Recommended Texts:

1. R.J. Young and P.A. Lovell. Introduction to polymers, John Wiley, New York.

CH4152 - Chemistry of Natural products II

Course Content: Carbohydrates: Structures; Reactions at the anomeric centre; Reactions at the non-anomeric centre; Configuration assignments and conformational analysis of mono and disaccharides; chemical synthesis of oligosaccharides; Modification of carbohydrate moiety; Modification of heterocycle moiety; ring conformation. Steroids and terpenoids: Structures and reactions, classes of terpenoids, saponins. Alkaloids: spectral characterisation, structures, reactions and synthesis. Biosynthesis: Basic principles, mechanisms in biological chemistry, biosynthesis of morphine alkaloids, terpenoids, phenolic natural products, penicillins, cephalosporins and prostaglandins.

Recommended Texts:

1. P.M. Collins and R.J Ferrier Monosaccharide chemistry, Wiley, New York.
2. J Mann, RS Davidson, J.B. Jacobs, D.V. Banthorpe and J.B. Harborne. Natural Products, their Chemistry and Biological significance Addison, Wesley Longman Ltd. Boston.
3. J. Mann. Chemical Aspects of Biosynthesis, Oxford University Press, Oxford.
4. P.M. Derwick. Medicinal Natural Products, Wiley, New York.
5. S.V. Bhat, B.A. Nagasampagi & M. Sivakumar. Chemistry of Natural Products, Springer, Berlin.

CH4161 - Bioinorganic Chemistry

Course Content: Biological role of metals, electron-transfer catalysts in biology: cytochromes and iron-sulphur proteins. Role of molybdenum, zinc and copper in biology, Vitamin B_{12}: structure and model systems, oxygen carriers, nitrogen fixation, iron metabolism.

Recommended Texts:

1. D.E. Fenton (1997). Bio-coordination Chemistry, Oxford University Press, Oxford.
2. S.J. Lippard and J.M. Berg. Principles of Bio-inorganic Chemistry, University Science Books, Mill Valley California.
3. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Wiley, New York.

CH4172 - Solid state chemistry

Course Content: Inorganic polymers, conducting polymers and their applications, solid state batteries. Preparative techniques in solid state chemistry, solid-state synthesis, thermal techniques, sol-gel chemistry and hydrothermal synthesis. Bonding in solids, metallic elements, ionic solids, defects in solids, advanced ceramics, glasses, Chevural phases and solid-state electrolytes.

Recommended Texts:

1. I.S. Butler and J.F Harrod, Inorganic Chemistry, Benjamin/Cummings, Boston.
2. A.R. West. Basic Solid State Chemistry, John Wiley and Sons, New York.

CH4181 - Computational chemistry

Course Content: Visualisation: Representation of molecules and supra-molecular structures. Using computer generated images to emphasize structural features. Classical Methods: Molecular mechanics force fields, energy

minimisation, Molecular dynamics and Monte-Carlo Methods. Ab initio methods: Applying the Schrodinger equation to many-electron systems, Hatree-Fock self-consistent field calculations, Introduction to higher order methods. Calculation of molecular properties, predicting analytical spectra. Transitions states, and reactions. Case Studies: Applications of computational chemistry in research. Examples (case studies) of contemporary research which uses computational data to supplement experimental findings. Practicals: Drawing 2D and 3D structures of molecules and supramolecular assemblies, Interpreting quantum calculation data. Running a simple molecular dynamics simulation at different conditions (pressure, temperature).

Recommended Texts:

1. I.S. Butler and J.F. Harrod, Inorganic Chemistry, Benjamin/Cummings, Boston.
2. A.R. West. Basic Solid State Chemistry, John Wiley and Sons, New York.

CH4193 - Advanced Inorganic Chemistry Laboratory

Course Content: Synthesis of complex compounds, Determining the formula and stability of complex ions, Thermometric titrations, Quantitative analysis using colorimetry, measuring the magnetic properties of complex ions. Kinetics of substitution reactions of cobalt complexes. Advanced qualitative analysis: Analysis of rare earths and complex anions (silicates, silicofluorides, fluoroborates) analysis of insoluble mixtures and phosphate separation.

Recommended Texts:

1. A.I. Vogel. A textbook of Qualitative Inorganic analysis, Longman Scientific, New York.
2. A.I. Vogel. A textbook of Quantitative Inorganic analysis, Longman Scientific, New York.
3. G. Pass. Practical Inorganic Chemistry, Netherlands: Springer.
4. W.L. Jolly. Preparative Inorganic reactions, Interscience, New York.

CH4203 - Advanced Organic Chemistry Laboratory

Course Content: Multi step organic synthesis, Extraction of Natural products from plants, Determination of Structure of Organic compounds using spectroscopic methods.

Recommended Texts:

1. A.I. Vogel. Textbook of Practical Organic Chemistry, Longman scientific, NewYork.

2. F.G. Mann and B.C. Saunders. Practical Organic Chemistry, Longmans, New York.
3. R.J. Fessenden and J.S Fessenden. Organic Laboratory Techniques, Brooks/Cole Publishing Co, New York.
4. R.M. Silverstein, G.C. Bassler and T.C. Morrill. Spectrometric Identification of Organic compounds, John-Wiley, New York.

CH4213 - Advanced Physical Chemistry Laboratory

Course Content: Determining the relative molecular mass of substances using colligative properties (depression of freezing point, elevation of boiling point, osmotic pressure), Determination of latent heat of vaporization using Claisius-Clapeyron equation, Coulometric titrations, Measuring activity coefficient from electrode potentials, Polarography.

Recommended Texts:

1. D.P. Shoemaker, C.W. Garland, J.W. Nibler. Experiments in Physical Chemistry;
   McGraw-Hill, New York.
2. A. Findlay, Finlay's Practical Physical Chemistry; Oxford University Press., Oxford.
3. P. Mathews. Experimental Physical Chemistry; Oxford University Press, Oxford

CH4221 – Seminar

Each student is required to present a seminar on a topic assigned by the Department.

CH4236 - Research Project

Each student will carry out a research project during the final year under the supervision of a staff member on a topic assigned by the Department.

CH4242 - Industrial Training

Each student will undergo full-time training in an industry assigned by the Department for a period not less than six weeks and submit a report at the completion of training. They will be assessed based on the report of the supervisor at the industry and an oral presentation to the department.

8 Department of Mathematics

The Department of Mathematics offers the subjects Mathematics and Computer Science at the General Degree level under the credit based semester system. Department also offers Special Degree programme in Mathematics and in Computer Science. In addition, the Department conducts several Course Units in Mathematics and Statistics, specially formulated for the students of other Faculties. Department is planning to conduct M.Sc. programme in Computational Mathematics in the near future. Further, the Department actively involves in research in both Pure and Applied Mathematics.

Head of the Department

Mrs. T. Pio Jude Navinthan

BScHons (EUSL), MPhil (PGIS, UPDN)

Senior Lecturer (Grade I) in Mathematics

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8.1 Academic Staff

Prof. S. Thirukkanesh

BScHons (EUSL), MSc (Natal, South Africa), PhD (KwaZulu-Natal, South Africa), GKIHS

Professor in Mathematics

***E-mail**: thirukkanesh@esn.ac.lk*

***Research Interest:** General relativity: Exact solutions to the Einstein field equations, relativistic stars*

Prof. A. G. Johnpillai

BScHons (EUSL), MSc(University of the Witwatersrand, South Africa), PhD (University of the Witwatersrand, South Africa), Post Doctoral Fellow (North-West University, South Africa)

Professor in Mathematics

***E-mail:** agjohnpillai@esn.ac.lk / andrewgratienj@yahoo.com*

***Research Interest:** Symmetries and conservation laws, non local symmetries of differential equations and non classical and non classical potential symmetries of partial differential equations, approximate symmetries, potential symmetries and conservation laws of perturbed partial differential equations.*

Dr. P. Elango

BScHons (EUSL), MSc (Malaya), PhD (Macquare)

Senior Lecturer (Grade I) in Mathematics

***E-mail**: elangop@esn.ac.lk , elango6@gmail.com*

***Research Interest:** Category Theory and Biological Models*

Mr. P. Paramathevan

BScHons (EUSL), MSc (USJP), MPhil (PGIS, UPDN)

Senior Lecturer (Grade I) in Mathematics

E-mail: *paramadevanp@esn.ac.lk, paramdeve@yahoo.com.au*

Research Interest: *Optimization, linear programming*

Mrs. S. Sathaananthan

BScHons (EUSL), M.Phil (USJP)

Senior Lecturer (Grade I) in Mathematics

E-mail: *shiventhira@yahoo.com*

Research Interest: *Numerical analysis*

Mrs. J. Sriranganesan

BScHons (EUSL), MPhil (PGIS, UPDN)

Senior Lecturer (Grade I) in Mathematics

E-mail: *sriranganesanj@esn.ac.lk, tjeyanthini@yahoo.com*

Research Interest: *Numerical analysis*

Mrs. T. Pio Jude Navinthan

BScHons (EUSL), MPhil (PGIS, UPDN)

Senior Lecturer (Grade I) in Mathematics

E-mail: *thayamathyp@esn.ac.lk, thayanu1@yahoo.com*

Research Interest: *Complex analysis*

Mr. S. Sotheeswaran

BScHons (UJA), MPhil (UJA)

Senior Lecturer (Grade II) in Computer Science

E-mail: *sotheeswarans@esn.ac.lk, sothees143@gmail.com*

Research Interest: *Image processing, Pattern Recognition, Computer Vision and Machine Learning*

Mr. K. A. N. K. Karunarathna

BScHons (USJP), MSc(UPDN), MPhil(UPDN)

Senior Lecturer (Grade II) in Statistics

E-mail: *karunarathnak@esn.ac.lk, nkkarunarathna@gmail.com*

Research Interest: *Statistical Modeling, Inferential Statistics*

Dr. Ealasukanthan Thavanayagam
BScHons (EUSL), MSc(UPDN), MSc(Greenwich, UK), PhD(Canterbury, NZ)
Senior Lecturer (Grade II) in Mathematics
E-mail: *ealasukanthant@esn.ac.lk*
Research Interest*: Mathematical Biology & Medicine, Mathematical Modelling of Metal injection moulding, symmetries of Differential Equations*

Mrs. Sajeetha Thavareesan

BScHons (EUSL)

Lecturer (Probationary)

E-mail: *sajeethas@esn.ac.lk*

Research Interest: *Data mining and Android software development*

Mr. K. Vithyasangaran

BScHons (EUSL)

Lecturer (Probationary)

E-mail: *vithyasangarank@esn.ac.lk / kvithy83@gmail.com*

Research Interest: *Optimization, Forecasting*

Mrs. Shouthiri Partheepan

BScHons(EUSL), MSc(UPDN)

Lecturer (Probationary)

E-mail: *shouthirip@esn.ac.lk, shouthiris@gmail.com*

Research Interest: *Artificial Intelligence, Neural Network and Mobile Application Development*

Mrs. T. Nishatharan

BScHons(EUSL), MSc(UoM)

Lecturer (Probationary)

E-mail: *thushikav@esn.ac.lk, thushiv07@gmail.com,*

Research Interest: *Web Content Mining, Pattern recognition algorithms for data mining*

8.2. Mathematics 1

8.2.1 100 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L/P/IL)	Credit	Prerequisite	Compulsory	
					BSc (General)	B ScHons (Mathematics)
First semester						
MT1012	Foundation of Mathematics	30/0/70	02	-	✓	✓
MT1022	Ordinary Differential Equations	30/0/70	02	-	✓	✓
Second Semester						
MT1032	Limit Process	30/0/70	02	-	✓	✓
MT1042	Vector Analysis	30/0/70	02	-	✓	✓

♣ Hours are distinguished as (Lectures/ Practical/ Independent Learning) that cover time takes for assessments

- The symbol "✓"denotes whether the course is compulsory for the two Degree programmes.

MT1012-Foundation of Mathematics

Course Content: Mathematical Logic**:** Proposition and truth values, logical connectives, truth tables, tautology, contradiction, arguments, quantifiers. Set Theory: Definitions (finite, infinite and universal sets), set operations (union, intersection, difference, complement), laws connecting these operations, product of sets. Relation: Definitions (inverse, reflexive, symmetric, anti-symmetric transitive and composite relations), equivalence relations, equivalence classes, ordered relation, maximal and minimal elements of ordered sets, Zorn's lemma. Functions: Definitions (injective, surjective and bijective functions), inverse function, composition of functions, countable sets, images and inverse images of sets under a function.

Recommended Texts:

1. Seymour Lipschutz, Marc Lars Lipson and Varsha H Patil, Discrete Mathematics Third Edition, Tata McGraw-Hill Publishing Education Private Limited, New Delhi, (2010).
2. Seymour Lipschutz, Set Theory and Related Topics, Tata McGraw-Hill Publishing Company Ltd, (2005).
3. R.M. Somasundram, Discrete Mathematical Structures, Prentice-Hall of India, (2003).
4. I. Stewart and D. Tall, The Foundation of Mathematics, Oxford University Press, (1997).

MT1022-Ordinary Differential Equations

Course Content: Classification of DEs by their type, order and degree. Classes-of ODEs of the first order and first degree. Linear ODEs. Nonlinear ODEs: Bernoulli and Riccati ODEs. Homogeneous and nonhomogeneous linear-ODEs with constant and variable coefficients, simultaneous systems of linear ODEs with constant coefficients. Orthogonal trajectories, Clairaut's equations. ODEs with three variables: The simultaneous equations and the total differential equations.

Recommended Texts:

1. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems (10th Ed.), John Wiley and Sons, Inc., New Jersey, (2012).
2. Richard Bronson, Theory and Problems of Differential Equations (2nd Ed.), New York, (2006).
3. Dennis G. Zill, A First Course in Differential Equations (5th Ed.), Brooks Cole, Dallas, USA, (2000).

MT1032-Limit Process

Course Content : Real Number system: Algebraic and order properties of the real numbers, Infimum and Supremum, completeness properties of real numbers, dense property of rational numbers and irrational numbers. Sequence: limits, convergence, Cauchy sequence, Monotone convergence theorem, Cauchy's criterion for convergence, recurrence sequences. Series: Convergent series, Tests for convergence, absolutely convergent series, alternating series. Power series.

Recommended Texts:

1. Murray R. Spiegel, Seymour Lipschutz, Dennis Spellman, Vector analysis, McGraw-Hill Book Company, New York (2009).
2. Stroud, K.A. and Dexter J. Booth, Vector Analysis, Industrial Press, New York (2005).
3. Vector analysis, a text-book for the use of students of mathematics and physics, founded upon the lectures of J. Willard Gibbs.
4. Raisinghania, M.D, Saxena, H.C. and Dass, H.K., Vector Calculus, S.Chand's and company Ltd, New Delhi (1999).
5. Simons, S., Vector Analysis, Pergamon press, New York (1979).
6. Davis, H.F, and Snider, A.D., An introduction to Vector Analysis, C, Brown, New York (1992).
7. Chatterjee, D., Vector Analysis, Prentice Hall, India (2005).

MT1042-Vector Analysis

Course Content: Vector Algebra: Introduction to vectors; Product of vectors: Dot or scalar product, Cross or vector product, Triple product, Applications of scalar and vector product, Vector field and Scalar field. Vector differentiation: Ordinary derivatives of vectors, Space curve, Differentiation formula, Partial derivatives of vectors and Differential geometry; Gradient, Divergence and Curl, Formula involving del, The angle between two surfaces. Vector integration: Ordinary integrals of vectors, Line integrals, Surface integrals and Volume integrals. Integral theorems**:** The divergence theorem, Stoke's theorem, Green's theorem and their applications.

Recommended Texts:

1. Calculus by Robert T. Smith, Roland B. Minton, McGraw Hill Higher Education.

2. Mathematical Analysis by S.C. Malik, Savita Arora, New age international (Pvt) Ltd., Publishers, New Delhi.
3. Source Book on Real Analysis G.Rangan New Century Book House, Chennai.
4. Real Analysis by Dipak Chatterjee, Prentice Hall of India (Pvt) Ltd., New Delhi.
5. Mathematical Analysis by SatishShirali, Harkrishan, L. Vasudeva, NarosaPublishig House, New Delhi.
6. Mathematical Analysis by K.G. Binmore, Press Syndicate of the University of Cambridge.

8.2.2 200 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L/P/IL)	Credit	Prerequisite	Compulsory	
					BSc (General)	B ScHons (Mathematics)
First semester						
MT2012	Linear Algebra I	30/0/70	02	MT1012	✓	✓
MT2022	Calculus	30/0/70	02	MT1032	✓	✓
Second Semester						
MT2032	Numerical Analysis	30/0/70	02	MT1032	✓	✓
MT2042	Classical Mechanics I	30/0/70	02	MT1042	✓	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

MT2012 -Linear Algebra I

Course Content: Vector spaces and Subspaces**:** Definition of Vector Spaces and subspaces, Properties of subspaces, Linear independent sets and dependent sets, Spanning set and bases for vector space, Dimension of vector space and finite dimensional vector space, Linear transformations and their properties.

Introduction to Matrices; Matrices of linear transformation, matrix of change of bases, Echelon forms and row echelon forms of matrices, Row rank and Column rank of matrices, Canonical forms.

Recommended Texts:

1. Seymour Lipschutz, Schaum's Theory and Problems of Linear Algebra, (2011).
2. William L.Perry, Elementary Linear Algebra McGraw Hill (1988).
3. Hugh G.Campbell, Linear Algebra with Applications, Central Book Company (1971).
4. Devi Prasad, Elementary Linear Algebra (2nd Edition), Narosa Publishing House, New Delhi (2012).

MT2022- Calculus

Course Content: Real-valued functions of one real variable**:** Limits and Continuity of real-valued functions one real variable and their properties, Intermediate value theorem and extreme value theorem and applications. Differentiation**:** Differentiation of real-valued functions of one real variable and its simple properties, Rolle's theorem, Mean value theorem and applications, Cauchy-mean value theorem, Taylor's theorem, L'Hospital's rules and applications. Integration**:** Riemann Integral, integrability, fundamental theorem of calculus.

Recommended Texts:

1. Binmore K.G., Mathematical Analysis, Press Syndicate of the University of Cambridge (1997).
2. Dipak Chatterjee, Real Analysis, Prentice –Hall of India Private Limited New Delhi-110001, (2005).
3. William F. Trench., Introduction to real analysis, Free Hyperlinked Edition 2.04 (2013).

MT2032-Numerical Analysis

Course Content: Computer Arithmetic and type of errors in numerical computations. Solutions of Non-linear Equations**:** Methods of locating zeros,

Bisection methods, fixed point iteration, contraction mapping theorem, rate of convergence, Newton iteration and quadratic convergence**.** Interpolation; Lagrange's interpolation, divided differences, Newton's forward and backward formulas, uniform approximation, least square approximations. Numerical Differentiation and Integration**:** Simple formulae for approximating differential coefficients, Trapezoidal and Simpson's rules, composite rules, Gauss quadrature. Solutions of a System of Linear Equations: Gauss elimination method, partial pivoting, ill conditioned systems.

Recommended Texts:

1. Sastry S. S., Introductory Methods of Numerical Analysis, New Delhi, Prentice-Hall of India. (2001).
2. Mathews John H., Numerical methods for Mathematics, Science and Engineering, New Delhi, Prentice-hall of India (2003).
3. Richard L. Burden and J. Douglas Faires, Numerical Analysis (9th Ed), Brooks/Cole (2011).

MT2042- Classical Mechanics I

Course Content: Dynamics: Motion of a particle in Different Coordinate systems, Particle Dynamics; Linear momentum principle, Moment of a force, Angular momentum principle, Kinetic energy, Work done by a force, Potential energy, Motion of a particle on a smooth surface of revolution whose axis is vertical, Change of mass problem: Equation of rocket motion, Equation of gaining mass problem**.** Statics**:** Equilibrium of heavy strings and chains, Equation of equilibrium, Common catenary, Non-uniform chain; Bending of beams, Shearing stress, Bending moments, Bernoulli-Euler law, Claypeyron's equation.

Recommended Texts:

1. Humphery D., Intermediate Mechanics, Vol 2 Statics, Longman Group Ltd.(1971).
2. Loney S. L., An Elementary treatise on Statics, Maxford books Publishers (2003).

8.2.3 300 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L/P/IL)	Credit	Prerequisite	Compulsory	
					BSc (General)	B ScHons (Mathematics)
First Semester						
MT3013	Complex Analysis I	45/0/105	03	MT1032, MT2022	✓	✓
MT3022	Fluid Dynamics	30/0/70	02	MT1022,MT1042	✓	✓
Second Semester						
MT3033	Probability Theory	45/0/105	03		✓	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

MT3013-Complex Analysis I

Course Content: Complex numbers and Properties: Complex numbers and properties, Sequence, Cauchy sequence, Infinite series; Functions: Singled and Multiple-valued functions, Transformation, Limit, Continuity and uniform continuity; Differentiation: Differentiation of function, analytic function, Singular point, Cauchy-Riemann equations, Harmonic and Harmonic conjugate function; Integration: Contour, Line and Contour integrals, Linear, Polynomial, Exponential, Hyperbolic and Entire functions, Simply and multiply-connected region, Cauchy's, Cauchy-Goursat and Multiple-annulus theorems, Cauchy integral formula, Cauchy's inequality, Liouville's theorem, Fundamental theorem of algebra; Series: Power series, Radius of convergence, Taylor's and Laurent's theorem, Isolated singular point, Zeros, poles; Residues and Integrals: Residues, Essential singular point, Residue theorem, Argument and Rouche's theorem, Integrals of rational function of cosine and sine, Improper integrals.

Recommended Texts:

1. Murray R. Spiegel, Seymour Lipschutz, John J. Schiller, and Dennis Spellman, Schaum's Outlines: Complex Variables, McGraw-Hill, 2nd ed., (2009).
2. James W. Brown and R.V. Churchill, Complex Variables and Applications, McGraw-Hill, 8th ed., (2009).
3. J.H. Mathews & R.W Howell, Complex Analysis for Mathematics and Engineering, Jones and Bartlett 5th ed., (2006).
4. I. Stewart & D. Tall, Complex Analysis, Cambridge, (2004).
5. H.A. Priestley, Introduction to Complex Analysis, Oxford University Press, 2nd ed., (2003).

MT3022-Fluid Dynamics

Course Content: Ideal fluid, equilibrium of fluid, kinematics of flow fluids, continuity equation of motion, velocity potential, irrotational motion, Euler's equation, baratropic fluid, Bernoulli'sequation, Helmholtz equation for vorticity vector, circulation, Kelvin's theorem, expanding bubbles, two-dimensional motion and stream function, complex potential, source, sink and doublet in two-dimension and three-dimension, images with respect to a line and circular disc in two-dimension, images with respect to a plane and a rigid sphere in three-dimension.

Recommended Texts:

1. Frank Chorlton, Text book of Fluid Dynamics, CBS Publishers and distributors, New Delhi, (2004).
2. M.D. Raisinghania, Fluid Dynamics with Complete Hydrodynamics and Boundary Layer Theory, S. Chand & Company Ltd., New Delhi, (2006).

MT3033- Probability Theory

Course Content: Random experiment, outcomes, events, probability definitions, Bayes' theorem, Random variable, Probability and distribution functions, Expectation, Variance, Moments, Moment and Probability generating function, Discrete and continuous probability distributions, approximation for distributions, Random vector, Joint probability and distribution function, Marginal and Conditional distribution, Estimation methods: point and interval,

Statistic, Mean square error, Bias function, Unbiased estimate, Relative efficiency, Cramer-Rao in equality, Cramer-Rao lower bound , Consistency, Sufficiency, Efficiency, Simple linear regression, Testing Hypothesis.

Recommended Texts:

1. Crawshaw J. and Chambers J., A Concise Course in A level Statistics, Education Law Priced Book Scheme, Cheltenham (1984).
2. Hoel Paul G., Introduction to Probability Theory, United States of America (1991).
3. Seymour Lipschutz and Marclars Lipson, Probability, Tata McGraw Hill, New Delhi (2006).
4. Alexander M. Mood, Introduction to the theory of statistics, McGraw Hill (1982).
5. Veerarajan, T., Probability, Statistics and Random Processes, Tata McGraw Hill, New Delhi (2005).
6. Gupta, S.C. and Kapoor, V. K., Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi (2010).

8.3 Mathematics II

8.3.1 100 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L/P/IL)	Credit	Prerequisite	Compulsory	
					BSc (General)	BScHons (Mathematics)
First semester						
MT1212	Algebra	30/0/70	02	-	✓	✓
MT1222	Mathematical Software	0/60/40	02	-	✓	✓
Second Semester						
MT1232	Mathematical Methods	30/0/70	02	MT1022	✓	✓
MT1242	Mathematical Modelling I	30/0/70	02	MT1022	✓	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

MT1212-Algebra

Course Content: Number Theory: Introduction, Integers, factors and Euclidean Algorithm. Unique factorization. Linear congruence, Inverses, Chinese remainder theorem, Fermat's theorem. Group Theory: Axioms, Definitions and examples. Order of elements. Sub-groups, cosets and Lagrange's theorem. Cyclic groups.

Recommended Texts:

1. William Stein, Elementary Number Theory: Primes, Congruences, and Secrets, Springer (2008).
2. Oleg Bogopolski, Introduction to Group Theory, European Mathematical Society (2008).

MT1222-Mathematical Software

Course Content: Mathematica: Introduction**:** Starting Mathematica, Handling the notebook, Basic arithmetic operations, Logical operators, Built-in functions, Strings. Variable**:** assigning and replacing. User-defined functions, Operations on functions, Loops: For, do while and Timing loops**.** Symbolic Computation, Visualization and Graphics, Numerical Computation, Working with Data. Maple: Arithmetic Operations, solving equations, functions and function evaluation, plots, limits, derivative, integration, matrices and linear systems, loops, differential equations, roots of a polynomial, partial fraction decomposition, complex numbers, equation of a line, midpoint of a line segment, slope of a line, factorization of quadratics equation and functions and relations.

Recommended Texts:

1. Stephen Wolfarm., Third edition, The Mathematica, Wolfram media, Cambridge University Press.
2. Datta K. B., Matrix and Linear Algebra, Prentice-Hall of India Pvt. Ltd., New Delhi (2004).
3. Getting started with Maple (3rd edition) by Douglas B. Meade (ISBN-13 978-0470-45554-8).
4. Computing with Maple by Chapman Hall/CRC Mathematics (ISBN-13: 978-1584882367).
5. Discovering calculus with Maple by Kent Harris, Robert J.Lopez (ISBN-13 978-0471009733).

MT1232-Mathematical Methods

Course Content: Series solutions for linear differential equations with variable coefficients**:** ordinary points and singular points, power series solutions about ordinary points, regular singular points and the method of Frobenius. Special functions**:** Gamma and Bessel functions, Legendre polynomials and functions. Partial Differential Equations: solutions via separation of variables and elimination of arbitrary constants, Lagrange method for solving the P.D.E of order one, methods of finding complementary solutions and particular integrals for linear P.D.E. with constant coefficients. Laplace Transforms and its properties, methods of finding Laplace transforms and applications to differential equations.

Recommended Texts:

1. Mary. L. Boas, Mathematical Methods in the Physical Sciences (3rd ED), Kaye Pace (2005).
2. G. Stephenson, Mathematical Methods for Science Students (2nd ED.), Prentice Hall (1996).

MT1242- Mathematical Modelling I

Course Content: Role of mathematics in problem solving, the nature of mathematical modelling, the systems approach. Systems Characterization: Basic concepts, system/ variable/ parameter, system/ environment, relationships, static vs. dynamic, continuous time vs. discrete time, deterministic vs. stochastic: Mathematical formulations: Static formulations, dynamic formulations, difference equation formulations, ordinary differential equation formulations, partial differential equation formulations: Case studies: Models leading to difference equations. Models leading to partial differential equations. Economic and financial models.

Recommended Texts:

1. Kapur, J. N., Mathematical Modeling, Willy Eastern, New Delhi (2008).
2. Mark M. Meerschaert, Mathematical Modeling, Fourth Edition, Academic Press(2013).
3. Dilwyn E. and Mike H., Guide to Mathematical Modeling, Palgrave Macmillan (2001).
4. E. A. Bender, An introduction to Mathematical Modeling, Dover (2000).

8.3.2 200 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L/P/IL)	Credit	Prerequisite	Compulsory	
					BSc (General)	BScHons (Mathematics)
First semester						
MT2212	Metric Spaces	30/0/70	02	MT1032, MT2022	✓	✓
MT2222	Optimization	30/0/70	02		✓	✓
MT2232	Statistics	30/0/70	02		⊗	⊗
Second Semester						
MT2242	Linear Algebra II	30/0/70	02	MT2012	✓	✓
MT2252	Riemann-Stieltjes Integrals and Sequences and Series of Functions	30/0/70	02	MT1032, MT2022	✓	✓
MT2262	Differential Geometry	30/0/70	02	MT1042	⊗	⊗

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol "⊗" denotes that course is elective for the Degree Programme.

MT2212-Metric Spaces

Course Content: Definition of metric, Examples of metric spaces, Distance between two sets and diameter of sets, Interior, Limit, Closure and Frontier points of a set, Open and Closed sets, sub spaces of a metric space, sequences in a metric space and completeness of a metric space, continuity of a function between two metric spaces. Connectedness; connected sets, disconnected sets in a metric space and its properties, Compactness; Open coverings. Continuous maps on compact sets. Compactness in Euclidean space, sequentially compact sets.

Recommended Texts:

1. Wilson A. Sutherland, Introduction to Metric and Topological Spaces, Oxford University Press (Second Edition) (2009).
2. Micheal O'Searcoid, Metric Spaces, Springer (2006).

MT2222- Optimization

Course Content: The solution of Linear Programming problems: geometry of linear programming, extreme points and optimality, basic solutions, Simplex method: unbounded ness, degeneracy, Big-M method, duality, primal-dual relationship, dual simplex methods, the revised simplex methods, sensitive analysis, Transportation, Assignment and Transhipment problems: formulating transportation problems, finding basic solutions, simplex method for transportation problems, assignment problems, transhipment problems. Network Analysis: shortest route problems, maximum flow problems, project scheduling, spanning trees.

Recommended Texts:

1. Mariappan P., Operations Research Methods and Applications, New Center Book House (P) Ltd., Chennai (2001).
2. Tulsian P., Quantitative Techniques, Person Education (P) Ltd., Singapore (2002).
3. Panneerselvam R., Operations Research, PHI Learning Pvt. Ltd., Technology & Engineering (2006).

MT2232-Statistics

Course Content: Presentation of data**:** Frequency distributions, Graphical display of frequency distributions, Measures of central tendency, Measures of dispersion, Measures of relative dispersion, Shapes of the distributions, Skewness, Correlation and Regression Analysis: Correlation Analysis, Types of correlation, Measurement of correlations, Simple linear regression, Estimation of parameters, Properties of least square estimates, Forecasting, Hypothesis testing and confidence interval, Residual analysis. **Probability and probability models:** definitions, conditional probability, Bays' theorem. discrete Uniform, Bernoulie, Binomial, Poisson, continuous Uniform, Exponential, Normal, Standard Normal, approximations. **Hypotheses tests:** hypotheses tests on mean/s and variance/s for one sample and two samples.

Recommended Texts:

1. Murray R. Spiegel and Larry J. Stephens, Statistics, Tata McGraw Hill, New Delhi (2006);
2. Stephen Bernstein and Ruth Bernstein, Elements of Statistics, Tata McGraw Hill, New Delhi (2005);
3. Clarke G. M and Cooke D., A basic course in Statistics, Edward Arnold Ltd (1984);
4. Norman R. D. and Harry S., Applied Regression Analysis, John Willey and Sons, Inc.(1998);
5. Gupta, S. C. and Kapoor, V. K., Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi (2010);
6. John E. Freund, Mathematical Statistics, Prentice Hall, New Jersey (2006);
7. Harper, W. M., Statistics, Low Priced Edition, Singapore (1991).

MT2242-Linear Algebra II

Course Content: Determinant of square matrices and their properties, System of linear equations, Eigen space, Eigenvalue, Eigenvector, Characteristic polynomial, Similar matrices, Diagonalization, Positive definite, Negative definite, Hermitian matrices, Orthogonal matrices, Unitary matrices, Polynomial of matrices, Cayley-Hamilton theorem, Minimum polynomial, Irreducible polynomial, Quadratic form, Diagonalize the quadratic form, Simultaneous reduction of two quadratic forms where one is positive definite, Introduction to inner product space.

Recommended Texts:

1. Datta K. B., Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi – 110001 (2003).
2. Seymour Libschutz, Schaum's Outline of Theory and problems of Linear Algebra, McGraw – Hill Book Company (1974).
3. David Lay C., Linear Algebra and Its Applications, 4th edition, Pearson (Addison Wesley) Publication.

MT2252-Riemann-Stieltjes Integral and Sequences and Series of Functions

Course Content: The Riemann-Stieltjes integral: Definition of Riemann-Stieltjes integrability, properties of Riemann-Stieltjes integral, Improper integrals: type of integrals, properties of integrals, tests for absolutely convergence and

conditionally convergence, uniform convergence and integrals, Sequences and Series of Functions: Point-wise and uniform convergence of sequences of functions, convergence and uniform convergence of series of functions, consequences of uniform convergence, tests for uniform convergence of series of functions, power series and Taylor series with applications.

Recommended Texts:

1. D. Chatterjee, Real Analysis, Prentice-Hall of India, Prt. Ltd., (2005).
2. S. Abbott, Understanding Analysis, Springer, (2002).
3. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, Inc., (2000).

MT2262-Differential Geometry

Course Content: Curves on a space: unit tangent vector, tangent line and normal plane, curvature, principal normal unit vector, principal normal line and osculating plane, binormal, rectifying plane, torsion, Serret-Frenet formula, spin vector, Helix, Osculating Circle, Properties of osculating sphere, spherical curve, the fundamental existence and uniqueness theorem, Canonical representation of a curve involutes and evolutes, theory of contact. Concept of a Surface: Regular parametric representations. Definition of a simple surface, Topological properties of simple surfaces, first fundamental form and Second fundamental form, Normal curvature, Principal curvatures and directions, Gaussian and mean curvature, Rodrigues' formula, Conjugate families of curves, Asymptotic directions, Umbilic points, lines of curvature. Intrinsic Geometry: Mappings of surfaces, Isometric mappings, Geodesic curvature and coordinates, Arcs of minimum length, Surfaces with constant Gaussian curvature, Gauss-Bonnet theorem.

Recommended Texts:

1. Piragash N., Differential Geometry, Tata McGraw-Hill Publishing Company Ltd (1981).
2. Somasundaram D., Differential Geometry, Narosa Publishing house, New Delhi (2005).
3. Pressley, Elementary Differential Geometry, 2nd edition, Springer, (2010)
4. Chuan- ChihHsiung., A First Course in Differential Geometry, International Press of Boston, (2013).

8.3.3 300 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L/P/IL)	Credit	Prerequisite	Compulsory	
					BSc (General)	BScHons (Mathematics)
First Semester						
MT3213	Classical Mechanics II	45/0/105	03	MT1022, MT1042	✓	✓
MT3222	Graph Theory	30/0/70	02		⊗	⊗
Second Semester						
MT3232	General Topology	30/0/70	02	MT2212	✓	✓
MT3242	Financial Mathematics	30/0/70	02	MT1022	⊗	⊗
MT3253	Group Theory I	45/0/105	03	MT1212	✓	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol "⊗" denotes that course is elective for the Degree Programme.

MT3213-Classical Mechanics II

Course Content : Kinematical motion of a rigid body, Motion of a particle near the Earth surface, Equation of motion of a rigid body, moment of inertia, product of inertia; Euler's equations, Torque free motion of a rigid body, the invariable line and plane, the motion of a symmetrical rigid body, Eulerian angle, the motion of a Heavy symmetrical top with one point fixed, the condition for precession without nutation; Lagrange's Equation of Motion; Generalized momentum, impulsive motion, generalized impulse; Hamiltonian theory, Poisson brackets and its properties, the equation of motion in Poisson brackets, Poisson theorem; Small Oscillations.

Recommended Texts:

1. Sankara Rao K., Classical Mechanics, Prentice Hall of India (P) Ltd (2005).
2. Mondal C. R, Classical Mechanics, Prentice Hall of India (P) Ltd (2003).
3.

MT3222 - Graph Theory

Course Content: An Introduction to Graph Theory: Directed graphs, Isomorphism of graphs, Matrix representation of graphs; Paths and Cycles**:** Paths, Circuits, Eulerian graphs, Hamiltonian graphs, Shortest path problem, Travelling salesman problem, Chinese postman problem; Graph Coloring**:** Graph coloring, Four color Theorem, Brook's Theorem, Map coloring and Edge coloring, Planar graphs; Trees**:** Property of trees, Tree analysis of sorting algorithms, Spanning trees, Minimal spanning trees, rooted Trees; Hall's marriage theorem and Transversal theory; Line graphs.

Recommended Texts:

1. F. Harary, Graph Theory, Narosha Publishing House, (1988).
2. R.J. Wilson, Introduction to Graph Theory, Addison-Wesley Longman. (1996).
3. N. Ronald Gould, Graph Theory, The Benjamin/Cummings Publishing Comp, (2012).

MT3232- General Topology

Course Content: Topological spaces: Topology and topological spaces, open and closed sets, closure of a set, neighbourhood system, fundamental system, interior, exterior, boundary, dense set, coarser and finer topologies; Subspaces of a topological space: Subspaces of a topological space, bases; Continuity: continuous functions; Connectedness, Compactness and Hausdorff spaces; Separation axioms: T0- space, T1-space, T2-space.

Recommended Texts:

1. Seymour Lipschutz , General Topology, McGraw-Hill Company, New York (2011).
2. Armstrong, M. A, Basic Topology, Springer International Ed. (2005).
3. Joshi, K.D., An introduction to general topology, Wiley Eastern Ltd. New Delhi (2002).

4. Munkres, J. R., Topology, J. R. Prentice-Hall of India Ltd., New Delhi(2000).
5. Kelley, J. L., General Topology, Springer Verlag, New York (1990).

MT3242 -Financial Mathematics

Course Content: Financial markets, market indices, Zero coupon bonds, coupon bonds, bond pricing, yield, yield curve, forward rates, Annual rate of return, notions and assumptions on market dynamics, No-arbitrage principle, Forwards and Futures contracts, equity, call and put options; Valuation**:** Bonds and their valuations, sensitivity of prices to the yield, Forward contracts and futures, arbitrage free pricing, Capital Asset Pricing Model (CAPM) and applications to the equity markets, Binomial Option Pricing Model (BOPM) and applications to European and American options; Basics of Risk; risk exposures in the fixed income securities and mitigation, concept of bond duration an applications, equity markets and equity portfolio construction, risk measures of equity portfolio, applications of options in risk management.

Recommended Texts:

1. Marek Capinski and Tomasz Zastawniak, Mathematics for Finance, Springer Verlag London Limited (2011).
2. Giuseppe Campoliete and Roman N. Makarov, Financial Mathematics, CRC Press, UK (2014).

MT3253- Group Theory I

Course Content: Group, Symmetric group, Abelian groups, Sub-groups, Cyclic groups, Order of a group, Cosets, Lagrange's Theorem, Normal subgroup, Factor group, Homomorphism, Isomorphism, Centre of a group, Centralizer, Normalizer, Isomorphism theorems, Commutator subgroups, Automorphism, Conjugate classes, Simple group, p-group, Direct product, Permutation group, Alternative groups.

Recommended Texts:

1. Group Theory, Schaum's out lines, Tata McGraw Hill Publishing Company (1968).
2. C R Jordan, D.A Jordan, Groups, Butterworth-Heinemann (1994).
3. John B. Fraleigh, A First Course in Abstract Algebra (7th Ed), available in online (2003).

8.4 400 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L/P/IL)	Credit	Prerequisite	BScHons (Mathematics)
MT4014	Functional Analysis II	60/0/140	04	MT1032, MT1242	✓
MT4023	Measure Theory	45/0/105	03	MT2252	✓
MT4033	Algebraic Topology	45/0/105	03	MT3232	✓
MT4044	Partial Differential Equations	60/0/140	04	MT1232	⊗
MT4054	Numerical Theory of Ordinary Differential Equations	60/0/140	04	MT1022	⊗
MT4063	Approximation Theory	45/0/105	03	MT1032, MT1242	⊗
MT4074	Ring Theory	60/0/140	04	MT3033	⊗
MT4084	Relativity	60/0/140	04	MT3022	⊗
MT4093	Mathematical Modelling II	45/0/105	03	MT2222	⊗
MT4103	Numerical Linear Algebra	45/0/105	03	MT2032, MT2242	⊗
MT4114	Data Structure and Design and Analysis of Algorithms	60/0/140	04	CS2013	⊗
MT4123	Multivariable Calculus with Applications	45/0/105	03	MT1032, MT1242	⊗
MT4134	Operator Theory	60/0/140	04	MT1032	⊗

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

MT4144	Differential Equations and Dynamical Systems	60/0/140	04	MT1232	⊗
MT4153	Parallel Processing	45/0/105	03	-	⊗
MT4163	Number Theory	45/0/105	03	MT1212	⊗
MT4173	Lie Group Analysis of Ordinary Differential Equations	45/0/105	03	MT1022	⊗
MT4183	Lie Group Analysis of Partial Differential Equations	45/0/105	03	MT1232	⊗
MT4193	Complex Analysis II	45/0/105	03	MT3013	✓
MT4203	Galois Theory	45/0/105	03	MT3033	⊗
MT4214	Group Theory II	60/0/140	04	MT3033	⊗
MT4226	Research Project #	600	06	-	✓

The symbol "✓" denotes that course is compulsory for the Degree Programme.
The symbol "⊗" denotes that course is elective for the Degree Programme.
Notional learning hours for course units in category 3.3 B.

MT4014-Functional Analysis II

Course Content: Normed linear Spaces and Banach spaces: Norms, Normed linear spaces, Banach spaces, Finite dimensional normed linear spaces, Riesz Lemma, schauder basis, Separable normed linear spaces; Linear operators and Bounded linear operators; Linear functionals and Dual spaces: Linear functionals and Bounded linear functionals, Hahn-Banach theorems, Consequences of Hahn-Banach theorem, Dual spaces; Fundamental Theorems for Normed and Banach spaces: Uniform Boundedness theorem, Open mapping theorem, Closed linear operators and Closed graph theorem and their applications; .Reflexive spaces; Strong and weak convergence of sequences; Inner product and Hilbert Spaces: Properties of inner product spaces, Orthonormal sets and sequences, Series related to Orthonormal sequences, Total Orthonormal sets and sequences. Representation of functionals on Hilbert spaces, Hilbert-Adjoint operators, Self-Adjoint operators.

Recommended Readings:

1. D. Lax, Functional Analysis, Wiley lnterscience, New York, 2002;
2. W. Rudin, Functional Analysis, McGraw-Hill, 1991;
3. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, 1989;
4. N. Young, An Introduction to Hilbert Space, Cambridge University Press, 1988.

MT4023-Measure Theory

Course Content: σ – algebras of sets; Additive set functions and measures; Lebesgue outer measure; Measurable sets and Lebesgue measure; Borel sets; Non-measurable sets; Measurable functions; Structure of measurable functions; Lebesgue integration; Fatou's lemma; Monotone convergence theorem; Dominated convergence theorem; Modes of convergence; Connection between Riemann and Lebesgue integrals. Lp spaces.

Recommended Readings:

1. H.L. Royden, Real Analysis, Macmillan, 1988;
2. G. De Barra, Introduction to Measure Theory, Van Nostrand Reinhold Company, 1974.

MT4033-Algebraic Topology

Course Content: Quotient topology, groups acting on spaces, compact spaces, Hausdorff spaces, connected spaces, Manifolds and surfaces, Paths and path connected spaces. The Jordan curve theorem, Homotopy of continuous mappings, Homotopic, contractible, retract, deformation retract, Fundamental group. Multiplication of paths, simply connected, fundamental group of a circle, covering spaces, the fundamental groups of a covering space, the fundamental group of an orbit-space, Introduction of singular homology.

Recommended Readings:

1. W.S. Massey, A Basic Course in Algebraic Topology, Springer Science & Business Media, 1991;
2. Fred H. Croom, Basics concepts of Algebraic Topology, Springer- Verlag, 1978.

MT4044 -Partial Differential Equations

Course Content: Introduction, quasi-linear first-order PDEs, integral surfaces passing through a given curve, Cauchy initial value problem. Non-linear waves, first order quasi-linear PDEs, kinematic waves, non-linear waves-more general quasi-linear equations. Non-linear first-order PDEs, the Monge's cone, characteristic equations, Cauchy initial value problem. Second-order PDEs, classification of second- order linear PDEs and reduction to canonical form, Cauchy problem, the Riemann function. Diffusion equation: Introduction, Dirac delta function and Heaviside step function, Fundamental solution of diffusion equation, initial value problem on the infinite domain, initial and boundary value problems on the semi-infinite domain. Green's function of the first and second kind, Burger's equation.

Recommended Readings:

1. J. Ockendon, S. Howison, A. Lacey and A. Movchan, Applied Partial Differential Equations, Oxford University Press, 1999;
2. W. E. Williams, Partial Differential Equations, Oxford University Press, 1980.

MT4054-Numerical Theory of Ordinary Differential Equations

Course Content: Introduction: The initial Value Problems (IVP), Existence and uniqueness for the solution of IVP. Euler Methods: Numerical methods, Convergence, Explicit and Implicit Euler Methods. Local and Global truncation errors of the methods, order, error bounds; Linear Multistep Methods: General methods, order and error constant, Convergence, Consistency and Stability, Derivation of method; Runge–Kutta Methods: General methods, Explicit and implicit methods, order, Derivation of method, order conditions; Stability of the methods: A-Stability, B-Stability and Algebraic Stability; Iterative schemes for Implicit Runge–Kutta methods; Boundary value problems of ODE: Finite Difference Methods, Shooting Methods, Error estimation, convergence and stability.

Recommended Readings:

1. Lambert J.D., Numerical Methods for ODE system, John Wiley and Sons, Chichester 1991;
2. Butcher J.C., Numerical Analysis of ODEs, John Wiley and Sons, 1987.

MT4063-Approximation Theory

Course Content: Best Approximation, Existence and Uniqueness of Best approximants, Chebyshev or Uniform Approximation by Polynomials, The Wierstrass and Bohman-Krovkin Theorems, General Linear families and Uniqueness Problems, Jackson and Bernstein Theorems, Schur-Type Inequalities, Jackson and Bernstein Theorems for Trigonometric and Ordinary Polynomials, Muntz Spaces and Related Theorems.

Recommended Readings:

1. M.J.D. Powell, Approximation Theory and Methods, Cambridge 1981;
2. P.J. Davis, Interpolation and Approximation, Dover Publications, 1975;
3. E. W. Cheney, An Introduction to Approximation Theory, McGraw-Hill, 1966.

MT4074-Ring Theory

Course Content: Rings: Definition and Examples; Integral Domains; Field of Quotients of an Integral Domain; Subrings and Ideals; Mappings in Rings; Quotient Rings; Prime and Maximal Ideals. Domains: Factorization; Euclidean Domains; Principal Ideal Domains; Unique Factorization Domains; Polynomials: Polynomial Rings; Roots of a polynomial; Factorization of polynomials; Generalizations; Ring of Gaussian Integers. Modules: Definitions and Properties; R-homomorphism; Completely Reducible and Free Modules; Noetherian and Artinian Modules; Wedderburn-Artin Theorem; Finitely generated Modules over a PID.

Recommended Readings:

1. J B Fraleigh, *A First Course Abstract Algebra*, Addison-Wesley, 2003;
2. Paul M. Cohn,Introduction to Ring Theory, Springer Science & Business Media, 2000.

MT4084 -Relativity

Course Content: Special Relativity: Einstein Postulates, Lorentz transformation, Relativistic addition of velocities, Simultaneity, Time dilation, Length contraction, Relativistic mechanics, Some standard 4-vectors, Compton effect, Doppler effect. General Relativity: Introduction, Definition of tensors, General transformation law of a tensor, Contravariant, covariant and mixed tensors,

Kronecker delta, Fundamental operators with tensors, Symmetric and skew symmetric tensors, Quotient theorem, Metric tensor and conjugate metric tensor, Christoffel symbols, Covariant derivative, Absolute derivative, Geodesics, The stress tensor and fluid motion, The curvature tensor and related tensors, Bianchi identity, Einstein tensor, Einstein's field equations, The Schwarzchild solution, Physics in the vicinity of a massive object (Length and time, Radar sounding, Spectral shift, General particle motion, Perihelion advance, Bending of light and Geodesic effect), Robertson-Walker line element, Field equation, The Friedmann models.

Recommended Readings:

1. J. Foster and J. D. Nightingale, A SHORT COURSE IN General Relativity, Springer-Verlag Berlin Heidelberg, 1998;
2. R d'Inverno, Introducing Einstein's Relativity, Oxford University Press (paperback), 1992;
3. R. Spiegel Murray, Vector Analysis and introduction to Tensor Analysis, McGraw-Hill book Company, 1959.

MT4093-Mathematical Modeling II

Course Content: Steps in mathematical model building process, Categories of mathematical formulations suitable for modelling deterministic systems, Systems approach to real-world problems, System characterization, and Mathematical technique for modelling process. Case studies in deterministic systems Rocket motion, World population model (continuous and discrete time models), Combat models, Traffic model, Modelling interactive species, Models leading to partial differential equations, Malaria spread models, Economic models, Cobweb model etc. Modelling stochastic problems: Techniques for modelling probabilistic model, Queuing process formulation, Renewal process formulation, Modelling super market checkout counters, Modelling failure properties of large complex machine such as computers or rockets etc.

MT4103-Numerical Linear Algebra

Course Content: Direct Method for Linear Systems: Elementary triangular matrices and Gauss elimination, Elementary permutation matrices and pivoting, Elementary Hermitian matrices and matrix factorization, Iterative refinement; Matrix Theory: Canonical forms and positive definite matrices, Norms and

Spectral radius, condition of problems and scaling; Norm Reducing Methods for Linear Systems: Iterative methods (Successive over-relaxation) and error bounds, convergence results for special matrices, choice of relaxation parameter. Similarity Reduction for Eigensystems: Elementary Hermitian matrices and House holder's method. Elementary triangular and permutation matrices, Eigensystems of Hessenberg and tri-diagonal matrices, Power Methods for Eigensystem: The direct power method and the Rayleigh quotient, Shift of origin and deflation, Inverse iteration.

Recommended Readings:

1. Gene H. Golub and Charles F. Van Loan, Matrix Computations, 4th Ed., Johns Hopkins University Press ,2013;
2. Lloyd N. Trefethen and David Bau III, Numerical Linear Algebra, SIAM, 1997;
3. James W. Demmel, Applied Numerical Linear Algebra, SIAM, 1997.

MT4114-Data Structure and Design and Analysis of Algorithm

Course Content: Data Structures: Arrays, Lists, Skip list, Stacks, Queues, Trees, Graphs, Files and their applications, Recursion. Design of Algorithms: Characteristics of algorithm; Designing, Devising and expressing algorithms. Greedy Method: Graph algorithms such as spanning tree and single source shortest path algorithms, Knapsack problem etc. Divide and Conquer: Binary search, Merge sort, Quick sort etc. Backtracking: N-queen problem, Sum of subsets, Graph colouring etc. Dynamic Programming: All pairs shortest path; Travelling sales person problem etc. Graph/Tree Algorithm: Breadth-first search in graph, Tree traversals, AVL trees, B+ tree and disk memory management, Heap sort, Tree sort etc. Symbol table Algorithm: Dynamic tree tables, Hash tables. Analysis of Algorithm: Order notations, Complexity analysis of sorting and searching algorithms, Analysis of tree/graph algorithms.

MT4123-Multivariable Calculus with Applications

Course Content: R^n as a normal linear Space, limits and continuity of functions from R^n to R^m , Topology of R^n, partial differentiation, directional derivatives, differentials, the chain rule, tangents and normals to implicity defined hypersurfaces, local maxima, minima, and saddle points of functions from R^2 to R^2, Lagranges multipliers, Tayler's formula in several variables, the

multivariable mean value theorem, contraction-mapping theorem, the inverse and implicit mapping theorem, multiple integrals, repeated integrals and Fubini's theorem, change of variable-Jacobian, Introduction to differential forms.

Recommended Readings:

1. C.H. Edwards, Jr., Advanced Calculus of Several Variables, Dover Publications 1994;
2. H.M. Edwards, Advanced Calculus: a Differential Forms Approach, Birkhauser 1994;
3. Wendell Fleming, Functions of Several Variables (Second Ed.), Springer, 1991.

MT4134-Operator Theory

Course Content: Introduction: Bounded linear operators, and closed operators. Closed range theorem. Spectral theory of bounded operators in Banach space, Hilbert spaces: adjoint operators, normal operators, basic ordinary differential operators in Hilbert space, self-adjoint operators, unitary operators, compact operators, Hilbert-Schmidt operators, Nevanlinna functions, integral representation of the resolvent, spectral resolution of self-adjoint, unitary, and normal operators, examples of spectral resolutions.

Recommended Readings:

1. John. B. Conway, A Course in Operator Theory, American Mathematical Society, 2002;
2. Kehe Zhu, Operator Theory on Functions spaces (2nd Ed.), American Mathematical Society, 1990;
3. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, 1989.

MT4144-Differential Equations and Dynamical Systems

Course Content: Ordinary Differential Equations: Equivalence and matrix notation, Existence and uniqueness- Gronwall's inequality, Picard's Theorem, General solution of first order scalar systems, solutions to second order systems, Linear systems- Wronskian and linear independence of solutions, constant coefficients: variations of constants, annihilator method, variable coefficients: reduction of order, analytic coefficients: series solutions, Legendre equations,

equations with regular singular points: Bessel equations, Boundary value problems and Green's function. Stability of Ordinary Differential Equations: Equilibria and types of stability, Autonomous systems- linearization, Routh Hurwitz conditions, classification of equilibria, Phase plane analysis, Poincare-Bendixon Theory, Lyapunov stability- concept, theory and applications. Dynamical Systems: Discrete dynamical systems and chaos, one and two dimensional flows, bifurcations, Hopf bifurcation, the Lorenz equations and chaos.

Recommended Readings:

1. Gerald Teschl, Ordinary Differential Equations and Dynamical Systems, American Mathematical Society, 2012;
2. Stephen L. Campbell, Richard Haberman, Introduction to Differential Equations with Dynamical Systems, Princeton University Press, 2008;
3. John H. Hubbard, Beverly H. West, Differential Equations: A Dynamical Systems Approach, Springer, 1995.

MT4153-Parallel Processing

Course Content: Issues in designing parallel algorithms and architectures. Parallel computer architecture and models of parallel computers. Interconnection networks, Hypercube, Perfect shuffle, Mesh etc. Embedding of Hypercube into other models. Performance measures of parallel algorithms, scalability and iso-efficiency function. Communication mechanisms for various parallel models, point-to-point and collective communication. Parallel algorithm design for linear algebra; striped partitioning, checkerboard partitioning, Cannon's, Fox's algorithms for matrix multiplication, Gaussian Elimination for parallel computers, sparse matrix algorithms. Sorting algorithm; bitonic sorting, sorting network, Parallelizing Quick Sort. Parallel algorithm to Fast Fourier transforms, recurrence evaluation and graph problems. Data parallel algorithms and programming, Load balancing technique. Parallel programming Languages. Parallel programming using MPI/ PVM.

Recommended Readings:

1. Ananth Grama, George Karypis, Vipin Kumar, Anshul Gupta, Introduction to Parallel Computing (Second Ed.), Addison-Wesley, 2003;
2. Behrooz Parhami, Introduction to Parallel Processing: Algorithms and A rchitectures, Pelenum Press, 1999;

3. David E. Culler and Jaswinder Pal Singh, with Anoop Gupta, Parallel Computer Architecture: A Hardware/Software Approach. Morgan Kaufmann, 1998.

MT4163-Number Theory

Course Content: Linear Congruence and its applications, The Theorem of Fermat and Wilson and their applications, Prime Numbers, Pseudo Primes, The Mobius Function, The Euler Totient Function, Merten's Conjecture, The Dirichlet product of Arithmetical Functions, Dirichlet Inverses and the Mobius Inversion Formula, The Mangoldt Function, Multiplicative Functions and Dirichlet Multiplication, Liouville's Functions, The Divisor Function, Generalized Convolutions, Perfect Numbers and Mersenne Primes, The Fermat Numbers, quadratic residues, and quadratic reciprocity, Primitive roots, continuous fractions and Fibonacci numbers.

Recommended Readings:

1. Richard A. Mollin, Advanced Number Theory with Applications, Chapman and Hall/CRC, 2009;
2. Harvey Cohn, Advanced Number Theory, Dover Publications, Inc, 1980.

MT4173-Lie Group Analysis of Ordinary Differential Equations

Course Content: What is symmetry, the group concept, transformations of coordinates and points, transformations in R^2 , discrete and continuous groups, continuous one parameter groups of transformations in the plane, group generators and Lie equations, exponentiation of generator X, invariant points, orbits of groups, invariant functions, similarity and canonical variables, group of extended transformations, and symmetries of differential equations. Lie algebra, integration of first-order and higher-order equations (second and third order equations by symmetries, further notions on Lie algebra. Linearization of y''= f (x, y, y') via a point transformation, Noether symmetries and integration of equations, canonical forms of second-order equations admitting two symmetries.

Recommended Readings:

1. G. W. Bluman and S. C. Anco, Symmetry and Integration Methods for Differential Equations, Springer-Verlag, 2002;

2. P. E. Hydon, Symmetry Methods for Differential Equations, Cambridge University Press,1999;
3. N. H. Ibragimov, Elementary Lie Group Analysis and Differential Equations, John Wiley and Sons, 1999;
4. P. J. Olver, Applications of Lie Groups to Differential Equations, Springer-Verlag, New York, 1993.

MT4183-Lie Group Analysis of Partial Differential Equations

Course Content: What is symmetry, the group concept, transformations of coordinates and points, transformations in R^n discrete and continuous groups, continuous one parameter groups of transformations in R^n, group generators and Lie equations, exponentiation of generator X, invariant points, invariant functions, similarity and canonical variables, invariant surfaces and equations, invariant representation of invariant surfaces, prolongation formulas, prolongation of groups in R^n, symmetry groups of differential equations, definitions of symmetry group, example: heat equation, sine-Gordon equation etc., construction of exact solutions by groups.

Recommended Readings:

1. G. W. Bluman and S. C. Anco, Symmetry and Integration Methods for Differential Equations, Springer-Verlag, 2002;
2. N. H. Ibragimov, CRC Hand book of Lie Group Analysis and Differential Equations, Vol. I-III: Symmetries, Exact Solutions and Conservation Laws, CRC Press, 1994;
3. P. J. Olver, Applications of Lie Groups to Differential Equations, Springer-Verlag, New York, 1993.

MT4193-Complex Analysis II

Course Content: Elementary properties and examples of analytic functions, Fourier integral transforms, conformal mapping, Mobius transformation, the identity theorem, Montel's Theorem, logarithms and argument principle, Riemann mapping theorem, Weierstrass factorization theorem, special factorization, harmonic functions, entire functions, singular integrals, Poisson integrals and Dirichlet's problem, Hardy spaces, The maximum modulus

principle; The Schwarz lemma, The phragmen-Lindelof method, An interpolation theorem, A converse of the maximum modulus theorem.

Recommended Readings:

1. James W. Brown and R.V. Churchill, Complex Variables and Applications, McGraw-Hill, 8th ed., 2009;
2. H.A. Priestley Introduction to Complex Analysis, Oxford University Press, 2nd ed., 2003;
3. Elias M. Stein & Rami Shakarchi, Complex Analysis, Princeton University Press, 2003.

MT4203-Galois Theory

Course Content: Factorization of Polynomial: Irreducibility, Gauss Lemma, Einsentein's Irreducibility criterion, cyclotomic polynomials, Examples; Field Extension: Simple extension, Minimum polynomials, Algebraic extension, transcendental extension, Classifying simple extension, Algebraic numbers; Galois group (of extension and polynomial); action on roots; order equal degree of splitting-field; towers of subfields and subgroups; solvable groups; roots of unity; radical extension implies solvable Galois group; insolvability of the quintic; Galois correspondence; normal extensions; Fundamental Theorem of Galois Theory.

Recommended Readings:

1. Ian Stewart, Galois Theory, 3rd ed. Chapman & Hall, 2003;
2. Emil Artin, Galois Theory, New ed. Dover, 1998;
3. D. J. H. Garling, A Course in Galois Theory, Cambridge University Press, 1986.

MT4214-Group Theory II

Course Content: Group Actions: The notion of a group action, Obits and Stabilizer; Series of groups: Subnormal and Normal series, Jordan-Holder theorem, The ascending central series, Nilpotent groups; Sylow's Theory: p-groups, The Sylow's theorems, Application of Sylow's theorems, Application of p-groups; Solvable and Simple Groups: Solvable groups, Simple groups, Examples; Generator and Relations: Finitely generated and related groups, Free groups.

Recommended Readings:

1. John B. Fraleigh , A First Course in Abstract Algebra(7th Ed), available in online, 2003;
2. C R Jordan, D.A Jordan, Groups, Butterworth-Heinemann, 1994;
3. Thomas A. Whitelaw, Introduction to Abstract Algebra (2nd Ed) Springer, 1990;
4. I.N. Herstein, Topics in Algebra (2nd Ed), Wiley & Sons, Inc., 1975;
5. Group Theory, Schaum's out lines, Tata McGraw Hill Publishing Company, 1968.

8.5 Courses of Computer Science

8.5.1 100 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L/P/IL)	Credits	Prerequisites	BSc (General)	BScHons (Computer Sc)
First Semester						
CS1013	Introduction to Programme Design and Programming	30/30/90	03		✓	✓
CS1021	Introduction to Information Systems	15/0/35	01		✓	✓
Second Semester						
CS1032	Object oriented programming	15/30/55	02	CS1013	✓	✓
CS1042	Computer systems	30/0/70	02		✓	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

CS1013 - Introduction to Programme Design and Programming

Course Content: Basic syntax and semantics of a higher-level language, Variables and Primitive data types (e.g., numbers, characters, Booleans), Simple

I/O including File I/O, Control Structures, Functions and Parameter Passing, The concept of Recursion.

Recommended Texts:

1. Java: The Complete Reference TM, Eighth Edition by Herbert Schildt, Tata McGraw-Hill Edition 2011.
2. Computer Program Design by Elizabeth A. Dickson, Tata McGraw-Hill Edition 2002.

CS1021: Introduction to Information Systems

Course Content: Introduction to Information Systems, Organizing Data and Information, Role and Importance of Information System. Different types of Business Information Systems, Security, Privacy and Ethical Issues.

Recommended Texts:

1. Stair, R., & Reynolds, G. Principles of information systems. 8th Edition: Thomson Course Technology. (Indian Edition)
2. O'Brien, J. (2005). Introduction to information systems. 12th Edition: Tata McGraw-Hill Publishing Company Limited.

CS1032 - Object Oriented Programming

Course Content: Object-oriented design, Definition of classes: fields, methods, and constructors. Subclasses, inheritance, and method overriding. Dynamic dispatch: definition of method-call: Polymorphism. Subtyping (cross-reference PL/Type Systems): Object-oriented idioms for encapsulation, Using collection classes, iterators, and other common library components.

Recommended Texts:

1. Java: The Complete Reference TM, Eighth Edition by Herbert Schildt, Tata McGraw-Hill Edition 2011.
2. Computer Program Design by Elizabeth A. Dickson, Tata McGraw-Hill Edition 2002.

CS1042: Computer Systems

Course Content: Digital logic and digital systems, Number System and Computer Arithmetic Binary Number System, Assembly level machine organization, Memory Hierarchies**,** Interfacing and communication**,** Pipelining.

Recommended Text:

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware and Software Interface Morgan Kaufmann Publishers, Fourth Edition.
2. Peter Norton, Peter Norton's Intro to Computers, 6th Edition, McGraw-Hill/Irwin, 2004.

8.5.2 200 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L/P/IL)	Credits	Prerequisites	BSc (General)	BScHons (Computer Sc)
First Semester						
CS2013	Data Structures and Algorithms	30/30/90	03	CS1032	✓	✓
CS2022	Introduction to Database Management Systems	15/30/55	02		✓	✓
CS2032	Computing Mathematics	30/0/70	02		⊗	✓
Second Semester						
CS2042	Fundamentals of Software Engineering	30/0/70	02		✓	✓
CS2051	Rapid application development	15/0/35	01	CS2042 CS1032	⊗	⊗
CS2062	System analysis and design	30/0/70	02	CS2022	⊗	✓
CS2071	Case Study based Programming Project #	100	01	CS1032 CS2022 CS2042	✓	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol "⊗" denotes that course is elective for the Degree Programme.

The symbol # denotes notional learning hours for course units in category 3.3B.

CS2013- Data Structures and Algorithms

Course Content: Complexity analysis of algorithms, Recursion, Searching, Sorting, Basic algorithm design techniques, Basic data structures and operations on them (Arrays, Linked lists, Stacks, Queues, Sets, Trees, Hash tables, Graphs).

Recommended Texts:

1. Michel T. Goodrich and Roberto Tamassia, Data Structures and Algorithms in Java, Fourth Edition, Jone Wiley and Sons,Inc.
2. Sedgwick R., Algorithms in C, Addition Wesley, 1998 2. Standish T. A.
3. Data Structures in Java; Addison-Wesley; 1998 3. Gregory L., Heilemen
4. Data Structures, Algorithms, & Object-Oriented programming; McGraw-Hill
5. Deitel, H. M.; Deitel, P. J.; Java how to Program; Prentice Hall; 1999

CS2022- Introduction to Database Management Systems

Course Content: Introduction to Database, Database design, Relational algebra and calculus**,** Introduction to SQL, Advanced Features: Transaction, concurrency control and recovery; Security levels, Integrity constraints. Modern databases**:** Object Oriented Databases and Relational Object Database design, Persistence Objects, Query languages.

Recommended Texts:

1. Database System Concepts by Abraham Silberschatz, Henry Korth, and S. Sudarshan
2. Fundamentals of Database Systems, 5th Edition by RamezElmasri, ISBN-13: 978-0321369574.
3. Fundamentals of Database Systems, 6th ed., Elmasri & Navathe, Addison-Wesley, 2011, ISBN: 978-013-608620-8

CS2032-Computing Mathematics

Course Content: Propositional logic**:** Logical connectives, Truth tables, Normal forms, Logical Equivalences, Propositional satisfiability. Predicate Logic**:** Universal and existential quantification, Logical equivalences involving quantifiers, Negating quantified expressions, Nested quantifiers, Negating nested quantifiers, Using Quantifiers in system specifications, Valid arguments,

Rules of inference for propositional and predicate Logic, Using rules of inference to build arguments. Limitations of propositional and predicate logic. Proof Techniques**.** Introduction to Complexity and Computability Theory.

Recommended Texts:

1. Elements of Discrete Mathematics, second edition,C.L.Liu, Published by Mc Craw Hill (2012), Reprinted 2000.
2. Discrete Mathematics and Its Applications, Seventh Edition ,Kenneth H. Rosan Published by Mc Craw Hill (2012).
3. Discrete Mathematics for Computer Scientists and Mathematicians, second edition 1986, J.L.Mott, A.Kandel, T. P.Baker, Published by Prentice Hall of India.

CS2042- Fundamentals of Software Engineering

Course Content: Introduction to Software Engineering, Software Requirements and Specifications, Software Design Techniques**,** Software Validation and Verification, Software Evolution**.**

Recommended Texts:

1. Introduction to the Team Software Process, by Watts Humphrey
2. Engineering Software as a Service: An Agile Approach Using Cloud Computing, by Armando Fox and David Patterson, Strawberry Canyon Publisher, 2013.

CS2051- Rapid Application Development

Course Content: Introduction to Rapid Application Development, Key elements of RAD, Agile Software Development, RAD best practices and tools: Architectural patterns (Introduction to software patterns, Multi-tier, Model-Controller-View, Service-Oriented-Architecture), Software patterns: Design patterns (Creational patterns, Structural patterns, Behavioral patterns), Software Version Controlling, Software libraries and frameworks for RAD.

Recommended Texts:

1. Andrew Stellman and Jennifer Greene, Learning agile: Understanding scrum, XP, lean, and kanban. O'Reilly Media, Inc., 2014.

2. Steve McConnell, Rapid development: taming wild software schedules, Pearson Education, 1996.
3. Erich Gamma, Design patterns: elements of reusable object-oriented software. Pearson Education India, 1995.

CS2062- System Analysis and Design

Course Content: The Context of Information Systems Development: Process of System Analysis, Fact-Finding Techniques for Requirements Discovery, Processing Modelling, Feasibility Analysis and the System Proposal: Feasibility Analysis and the System Proposal, Four Tests for Feasibility, Cost-Benefit Analysis Techniques. Process of System Design, Output and Input Design for Prototyping.

Recommended Texts:

1. Whitten J.L., Bently L.D., Systems Analysis and Design Methods, 7th Edition, Tata Mc Graw-Hill, India, 2007.
2. Whitten J.L., Bently L.D. and Dittman K.C, Systems Analysis and Design Methods, 6th Edition, Tata Mc Graw-Hill, India, 2004.
3. Kendall E. and Kendall J.E., System Analysis and Design, 5th edition, Prentice Hall, India, 2003.
4. Hoffer J.A., Georage J.F. and Valacich J.S. Modern Systems Analysis & Design, 3rd edition, Pearson Education, 2003.
5. Hawryszkiewycz I., System Analysis and Design, 5th edition, Prentice Hall, India, 2001.

CS2071- Case Study based Programming Project

Course Content: Analysis of Case Study, Identification of the system and organization requirements, Documentation on system analysis and design, Design of application web application interface, Design of system database, Development of a Prototype application, Evaluation of the prototype application.

Recommended Texts:

1. Dragan Z., Milosevic, P. Patanakul and S. Srivannaboon, Case Studies in Project, Program, and Organizational Project Management 1st Edition, Kindle Edition.

8.5.3 300 Level of Study

Course Units and Syllabus

Course code	Course Title	Hours♣ (L/P/IL)	Credits	Prerequisite	BSc (General)	BScHons (Computer Sc)
First Semester						
CS3012	Introduction to Computer graphics	15/30/55	02	CS1032	✓	✓
CS3022	Computer Networks	15/30/55	02	-	✓	✓
CS3032	Logic Programming	15/30/55	02	-	✓	✓
CS3042	User Interface Design	30/0/70	02	-	⊗	⊗
Second Semester						
CS3052	Web Based Application Development	15/30/55	02	-	✓	✓
CS3062	Introduction to Mobile Computing	15/30/55	02	CS1032	⊗	⊗
CS3072	Advanced Database Management Systems	15/30/55	02	CS2022	⊗	✓
CS3082	Theory of Computation	30/0/70	02	CS2032	⊗	✓
CS3092	Software Project Management and Professional Issues	30/0/70	02	CS2042	⊗	⊗

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol "⊗" denotes that course is elective for the Degree Programme.

CS3012 - Introduction to Computer Graphics

Course Content: Overview of Graphics Systems, Output Primitives: Points and lines, Line-drawing algorithms, Circle-generating algorithms, Filled-area primitive. Two-Dimensional Geometric Transformations: Basic transformations (Translation, Rotation, Scaling, Reflection, Shear), Matrix representations and homogeneous coordinates, Composite transformations, Transformations between coordinate system. Two-Dimensional Viewing, Three-Dimensional Geometric and modeling Transformations, Three-dimensional viewing.

Recommended Texts:

1. Peter Shirley, Michael Ashikhmin, and Steve Marschner: Fundamentals of Computer Graphics, 3rd Edition.
2. Computer Graphics with OpenGL, Hearn and Baker (3rd Edition).

CS3022 - Computer Networks

Course Content: Introduction to Computer Networks, Classification of Computer Networks, ISO OSI architecture. Data Communication Data transmission, Transmission media, Transmission and switching, Data link Layer Error detection and correction technique, Framing, Protocols, HDLC, LAN Techniques, CSMA/CD, Ethernet, IEEE standard 802 Cabling, MAC sublayer, token ring, token bus, Cambridge Ring, FDDI. Network layer and Internetworking, Network Security, Cryptographic algorithms, Security Mechanisms.

Recommended Texts:

1. Computer Networks, 5th edition, Andrew S Tanenbaum.
2. Data and Computer Communications, 10th edition, William Stallings
3. Computer Networks: A Systems Approach, 4th Edition Larry L. Peterson, Bruce S. Davie.

CS3032 - Logic Programming

Course Content: Introduction to Prolog, Arithmetic and lists, Backtracking, cut, and negation: The cut operator for controlling backtracking, Negation as failure and its uses. Searching and sorting methods: Graph searching exploiting

Prolog's built-in search mechanisms, sorting a list: Bubble sort, merge sort and quick sort, Example programs to solve some classic problem in AI.

Recommended Texts:

1. Bratko, I., PROLOG programming for artificial intelligence. Addison-Wesley, 4th Ed., 2001.
2. Clocksin, W., and Mellish, C.S., Programming in Prolog: Using the ISO Standard, 5th Ed.,2003.
3. Sterling, L. and Shapiro, E., The art of Prolog. MIT Press, 2nd Ed., 1994.

CS3042 - User Interface Design

Course Content: Characteristics of good design, Methodologies, Testing & evaluation, Contemporary interactive technologies: Knowledge and understanding of mobile computing, PDAs, screen readers, voice recognition, touch screens and game peripherals Application domains, User centered design, Technological constraints, Components of design.

Recommended Texts:

1. David Benyon, Designing Interactive Systems: A comprehensive guide to HCI, UX and interaction design, Pearson, 2013.
2. F.E. Ritter, G.D. Baxter, and E.F. Churchill Foundations for Designing User−Centred Systems: What System

CS3052 - Web Based Application Development

Course Content: Programming via platform-specific APIs. Overview of web platforms. Web page development with HTML including tables, frames, images and cascading style sheets. Application development with javascripts and object-oriented programming paradigm. Application development with PHP. Web-based database application development with mySQL.

Recommended Texts:

1. PHP and MySQL Web Development (4th Edition) by Luke Welling (Author), Laura Thomson (Author)
2. Learning Web App Development by Semmy Purewal

CS3062 - Introduction to Mobile Computing

Course Content: Short History of Wireless Communications: Radio transmission and Wireless signals, Motivation for specialize MAC (Hidden and exposed terminals, Near and far terminals, Multiple access with collision avoidance, CDMA). Telecommunication Systems: Cellular telephony, Global system for mobile communication, Mobility management and handoff. Wireless LAN, Mobile Network and Transport Layer.

Recommended Texts:

1. "Mobile Communications", Jochen Schiller, Second edition, Addison Wesley, 2002.
2. **"**Wireless and Mobile Network Architecture", Yi Bang Lin and Imrich Chlamtech, Wiley, 2000.
3. "Professional Mobile Application Development", Jeff McWherter and Scott Gowell, Wrox Publications, 2012.

CS3072 - Advanced Database Management Systems

Course Content: Relational database design and conceptual model: EER diagram, Relational database design, Normalization. Database Programming, Advanced concepts and technologies in DBMS: Query Optimisation, File organization, Security and Integrity, Concurrency control and recovery. Distributed Databases.

Recommended Texts:

1. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 7th edition, Addison-Wesley, 2015.
2. C.J. Date, An Introduction to Database Systems, 8th edition, Addison-Wesley 2003
3. Ramakrishnan and Gehrke, Database Management Systems, 3rd edition, McGraw-Hill 2003.

CS3082 - Theory of Computation

Course Content: Introduction and Mathematical preliminaries. Finite Automata and Regular languages: Deterministic finite automata (DFAs), Regular operations, Nondeterministic finite automata (NFAs) Equivalence of DFAs and NFAs, Closure under the regular operations, Regular expressions, Equivalence of regular expressions and regular languages, The pumping lemma and non-

regular languages. Context-Free Languages: Context-free grammars, Chomsky normal form, Pushdown automata, Equivalence of pushdown automata and context-free grammars, The pumping lemma for context-free languages. Turing Machines and the Church-Turing Thesis: Definition of a Turing machine and application, Constructing Turing machines, Multi-tape Turing machines, The Church-Turing Thesis.

Recommended Texts:

1. Introduction to the Theory of Computation by Michael Sipser, Course Technology – 3rd edition
2. Lecture Notes - Introduction to Theory of Computation, Anil Maheshwari & Michiel Smid, School of Computer Science, Carleton University, Ottawa, Canada.

CS3092 - Software Project Management and Professional Issues

Course Content: Introduction to Project Management, Project Planning, Project Quality Management. Project Human Resources Management, Project Risk Management, Project Procurement Management.

Recommended Texts:

1. Kathy Schwalbe, Information Technology Project Management, Course Technology Publishers, 8th edition, 2015.
2. Jack T. Marchewka, Information Technology Project Management, Wiley Publishers, 5th edition, 2015.

8.5.4 400 Level of Study

Course Units and Syllabus

Course Code	*Course Title*	Hours♦ (L/P/IL)	Credits	Prerequisite	BScHons (Computer Sc)♦
CS4013	Computer Architecture and Operating Systems	30/30/90	03	CS1042	✓
CS4023	Intelligent Systems and Knowledge bases	30/30/90	03	CS3032	✓
CS4037	Research Project #	700	07	-	✓
CS4043	Bio informatics and computational biology	30/30/90	03	-	⊗
CS4052	Research Methods	30/0/70	02	-	✓
CS4062	Information System Security	30/0/70	02	-	✓
CS4073	Advanced Software Engineering	30/30/90	03	CS2042	⊗
CS4082	Systems and Network Administration	15/30/55	02	CS3022	⊗
CS4093	Parallel and Distributed Computing	30/30/90	03	-	⊗
CS4102	Software Quality Assurance and Verification	30/0/70	02	-	⊗
CS4112	Machine Learning	30/0/70	02	-	✓
CS4123	Image Processing and Computer Vision	30/30/90	03	CS4112	✓
CS4133	Data Mining and Data Analytics	30/30/90	03	-	⊗
CS4143	Advanced Data Structures and Algorithms	30/30/90	03	CS2013	⊗
CS4152	Compiler Theory and Programming Languages	30/0/70	02	CS3082	✓
CS4163	Advanced Networking, Virtualization and Cloud Computing	30/30/90	03	CS3022	✓

CS4173	Robotics and Embedded Systems	30/30/90	03	-	⊗
CS4182	Advanced Topics in Computing Mathematics	30/0/70	02	CS2032	✓
CS4192	Middleware Architecture	30/0/70	02	-	⊗

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol "⊗" denotes that course is elective for the Degree Programme.

The symbol # denotes notional learning hours for course units in category 3.3B.

CS4013 - Computer Architecture and Operating Systems

Course Content: Introduction to computer architecture: Architectural development, Technological development, Processor performance measures. Instruction set architecture models: Memory operations, Addressing modes and instruction types. Processor architecture. Introduction to Operating Systems: Evolution of Operating System, Architecture of modern operating systems, OS operations and functionalities. Processes management. Memory management. Assembly language programming: Instructions mnemonics and syntax, Assembler directives and commands, Execution of assembly programs.

Recommended Texts:

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware and Software Interface, Morgan Kaufmann Publishers, 5th Edition, 2013
2. William Stallings, Computer Organization and Architecture, Prentice Hall Publishes, 10th Edition, 2015
3. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, 9th edition, 2013.
4. William Stallings, Operating systems: internals and design principles, 8th edition, Pearson, 2014.

CS4023 - Intelligent Systems and Knowledge Bases

Course Content: Introduction: Artificial Intelligence, The Foundations of Artificial Intelligence. Intelligent Agents: Agents and Environments, Intelligent behavior, Rational behavior & Turing test. Problem solving by Searching: Problem-Solving Agents, Solution space and searching for solution, Uninformed Search Strategies, Informed Search Strategies. Knowledge representation and reasoning: Review of propositional and predicate logic, Description logics, Ontology engineering, Semantic networks.

Recommended Texts:

1. Artificial Intelligence: A Modern Approach (Third Edition), Stuart J. Russell and Peter Norvig, Prentice Hall, 2010.

CS4043 -Bioinformatics and computational biology

Course Content: Introduction to Bioinformatics: History and scope of bioinformatics and its applications, Bioinformatics databases. Structural Bioinformatics: Protein structure basics, Protein structure visualization, Protein secondary structure prediction, Protein tertiary structure prediction, RNA structure prediction. Sequence Alignment: Pairwise sequence alignment, Multiple sequence alignment, Hidden Markov Models. Pattern Recognition: Clustering and Visualization. Genomics and Proteomics: Genome mapping, Genome assembly, Genome comparison, Functional genomics, Proteomics and metabolomics.

Recommended Texts:

1. B. Bergeron, Bioinformatics Computing, Prentice Hall, 2002.
2. Krawetz. Stephen A: Introduction to Bioinformatics: A Theoretical and Practical Approach, 2003.
3. F. Azuaje and J. Dopazo, Data Analysis and Visualization in Genomics and Proteomics, John Wiley, 2005

CS4052 - Research Methods

Course Content: Introduction to research and identifying a study topic: Steps in the process of research, identifying a hypothesis and/or research problem, framing the problem with the correct research methodology, Ethics of research

and informed consent. Introduction to research proposal writing: conduct a literature review and formulate research questions, expected test results, implications of the research, timeline of the research. Conduct a literature review and formulate research questions, Research methodologies: Familiarizing both qualitative and quantitative methodologies, Experimental designs, Evaluation and problem analysis. Citation format and references, Use of ICT tools for checking plagiarism and introducing LaTeX for scientific writing.

Recommended Texts:

1. Zobel, J., Writing for Computer Science, 2nd Ed., Springer, 2004.

CS4062 - Information System Security

Course Content: Introduction: Concepts of risks, threats and vulnerabilities, Types of attacks, Attacker goals, capabilities and motivations. Basic Security Concepts: Confidentiality, Integrity, Availability, Security policies, Security mechanisms and Assurance. Concepts of Authentication, Authorization and Access control; Cryptography: Basic number theory, Secret key cryptosystems, Public key cryptosystems, Key management. Defensive Programming: Input validation and data sanitization, Handling of exceptions and unexpected behaviours. Information system security governance: Risk management, Business continuity and disaster recovery planning.

Recommended Texts:

1. Michael Jang, Security Strategies In Linux Platforms And Applications (Information Systems Security & Assurance), 1st edition, Jones & Bartlett Learning, 2010.
2. Charles P. Pfleeger and Shari Lawrence Pfleeger, Analyzing Computer Security: A Threat / Vulnerability / Countermeasure Approach, 1st Edition, Prentice Hall, 2011.

CS4073 - Advanced Software Engineering

Course Content: Software modeling**:** Structural diagrams, Behavioral diagrams. Software Quality Assurance: Quality models and metrics, Software Quality Assurance process, Software testing: Software functional testing, Software non-functional testing including security, performance and reliability testing. Advanced Project Management and Delivery.

Recommended Texts:

1. OMG Unified Modeling Language specification v2.5, http://www.omg.org/spec/UML/2.5/PDF.
2. Murali Chemuturi and Thomas M. Cagley. Mastering software project management: Best practices, tools and techniques. J. Ross Publishing, 2010.
3. William Stallings and Lawrie Brown, Computer Security: Principles and Practice (2nd Edition), 2011.
4. Jezz Humble and David Farley, Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation (Addison-Wesley Signature Series), Addison-Wesley Professional; first edition, 2010.

CS4082 -System and Network Administration

Course Content: Introduction to System and Network Administration, Host Management, Network Management: Network connectivity devices, Host Network configuration, Routing and Router configuration, Switch configuration, VLAN, Inter-VLAN routing, Wireless Access Point and Firewall configuration. Server Management: Installing and managing Server OS, Web Server, e-mail server, Caching/Proxy Server, DNS Server deployment.

Recommended Texts:

1. Mark Burgess, Principles of Network and System Administration, 2nd Edition,Wiley Publications 2004.
2. Nemeth, Snyder, Hein and Whaley, UNIX and Linux System Administration Handbook, 4th Edition, Prentice Hall, 2010.
3. Thomas A. Limoncelli, Christina J. Hogan, Strata R. Chalup, The Practice of System and Network Administration, Pearson Education, 2007.

CS4093 -Parallel and Distributed Computing

Course Content: Introduction to parallel and distributed computing: cluster, grid, cloud, parallel vs. distributed computing, Fault tolerance, concurrency, non-determinism, locality, Architectures: Taxonomy, Data versus control parallelism: SIMD/Vector, Pipelines, MIMD, Multi-core, Heterogeneous, shared versus distributed memory: SMP, NUMA, Message passing, Interconnection Networks for Parallel Computers. Algorithms: Parallel and distributed models and their complexity, Algorithmic Paradigms, Algorithmic Problems. Concepts

of Programming: Parallel programming paradigms, Parallel programming notations.

Recommended Texts:

1. Peter S. Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann Publishers, 2011
2. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar. "Introduction to Parallel Computing, (Second Edition)", Addison-Wesley, 2003.

CS4102 - Software Quality Assurance and Verification

Course Content: Introduction to software quality assurance**:** Software quality, Quality assurance and quality engineering. Software testing: Software testing principles, Origins of defects, Functional Vs. Structural Testing. Testing design strategies: Introduction to testing design strategies, Test case design strategies, Black box approach to test case design, White box approach to test design, Levels of testing. Evaluating Software Quality: Review of quality concepts, Quality costs and quality control, Quality assurance.

Recommended Texts:

1. "Software Testing and Quality Assurance: Theory and Practice", Kshirasagar Naik and Priyadarshi Tripathy, 1st ed., ISBN: 978-0471789116, Wiley publications.
2. "Software Quality Assurance: from Theory to Iimplementation", Daniel Galin, 1st Ed., ISBN: 978-0201709452, Pearson Education Publishers. 2003.
3. "Handbook of Software Quality Assurance", G. Gordon Schulmeyer, 4th Ed., ISBN: 978-1596931862, Artech House publishers, 2007.

CS4112 - Machine Learning

Course Content: Introduction to machine learning: Machine intelligence and applications, Input: concepts, instances and attributes, Preparing input: Gathering data, sparse data, attribute types, missing values and inaccurate values. Decision Tree Learning: Learning trees from training examples, Entropy and information gain, ID3 algorithm. Supervised learning: Rule-based learning, Naive Bayes, K-nearest neighbor, Neural networks. Unsupervised learning: K-means clustering, Gaussian mixture models, Hierarchical clustering. Experimental setup and evaluation: Training and testing, Cross-validation,

Confusion matrices and ROC graphs. Use of Weka Tool in machine learning tasks.

Recommended Texts:

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, 2007.
2. Richard O. Duda, Peter E. Hart, David G. Stork, Pattern Classification, 2nd Edition, Wiley, 2000.
3. Mitchell,T., Machine Learning, McGraw Hill, 1997.

CS4123 -Image Processing and Computer Vision

Course Content: Basic image processing, Image Enhancement in the spatial domain. Intensity transformations. Histogram Processing: Histogram equalisation and specification, Filters and convolution: First order and second order operators for smoothing and sharpening. Morphological Image Processing. Feature extraction. Frequency domain processing: The Fourier Transform and its important properties, Fast Fourier Transform, Filtering images in frequency domain. Understanding image data and performing classification and recognition: Introduction to biometric applications. Approaches to object recognition: Bag-of-features approach, Human vision: Human eye-brain system as a model for computer vision.

Recommended Texts:

1. Burger, W., and Burge, M.J., Principles of Digital Image Processing: Fundamental Techniques, Springer, 2009.
2. Sonka, Hlavac and Boyle, Image Processing, Analysis and Machine Vision, 3rd Ed., PWS Publishing, 2008.
3. Gonzalez et al., Digital Image Processing, 3rd Ed., Pearson, 2008.
4. Stockman and Shapiro, Computer Vision, Prentice Hall, 2001.

CS4133 -Data Mining and Data Analysis

Course Content: Introduction: Describing structural patterns, Machine learning and Data mining, Example case studies, Obtaining data, Understanding Data, Preprocessing and Visualisation. Data mining algorithms and evaluating the output: Constructing decision trees, rules and association rules, Instance-based learning, Statistical modelling, Clustering. Introduction to Bigdata Analysis: Current challenges, trends, and applications, Algorithms for Big Data analysis, Technologies for Big Data management: Map-Reduce paradigm and Hadoop

ecosystem. Advanced techniques and applications: Text mining: classifying text, extracting attributes, structural approaches, Web mining: classifying web pages, extracting knowledge from the web.

Recommended Texts:

1. Data Mining: Practical Machine Learning Tools and Techniques (Third Edition), Ian H. Witten & Eibe Frank, Morgan Kufmann Publishers.

CS4143 - Advanced Data Structures and Algorithms

Course Content: Elementary Graph Algorithms: Representation of graphs, Graph search algorithms. Greedy Algorithms: Minimum spanning tree, Union find, Set cover, Huffman coding. Dynamic Programming: Elements of dynamic programming, Longest common subsequence. Linear programming: Problem definitions and solution techniques, Reductions, Maximum matching. NP-complete Problems: Basic NP-complete problems, Novel approaches to NP-complete problems.

Recommended Texts:

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein, Introduction to Algorithms, 3rd Edition, MIT Press, 2009.
2. Mark A. Weiss, Data Structures and Algorithm Analysis in Java, Pearson Education, 3rd Edition, 2012.
3. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, Data Structures and Algorithms, 1st edition, Pearson Education, 1983.

CS4152 - Compiler Theory and Programming Languages

Course Content: Introduction: Compilers and Interpreters, The phases of a compiler. Lexical Analysis: Regular expressions and their properties, Nondeterministic finite automata, Converting a regular expression to an NFA, Deterministic finite automata, Converting an NFA to a DFA. Syntax Analysis: Context-free grammars, Syntax trees and ambiguity, Top-down parsing methods, bottom-up parsing methods. Scopes and Symbol Tables: Symbol tables and their Implementations. Interpretation: The structure of an interpreter, Advantages and disadvantages of interpreters over Compilers. Type Checking: The design space of types, Attributes, Environments for type checking. Code Generation: Intermediate-Code Generation, Machine-Code Generation.

Memory management: Run-time stack, heap, dope vectors, garbage collection

Recommended Texts:

1. Engineering a Compiler (2nd Edition), Keith Cooper, Linda Torczon, Elsevier 2012.

CS4163 -Advanced Networking, Virtualization and Cloud Computing

Course Content: Key concepts in Computer Networks. Advanced transport and routing protocols: TCP congestion control; modern congestion control; multipath TCP; TCP performance monitoring; BGP features; BGP policies; BGP security, Elements of Modern Networking. Virtualization: Network Functions Virtualization: needs; concepts; types; issues; concepts and architecture, Cloud computing: Definition; assessing value proposition; cloud architecture services; and applications by type; deployment models, Managing clouds: Objectives; issues; solutions, Virtualization for Cloud Computing: Virtualization on cloud computing; role of hypervisor and types, Issues in virtualization of cloud computing: Software deployment; compatibility; copyright patent; hardware assisted virtualization.

Recommended Texts:

1. William Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud, Addison-Wesley Professional, 2015: ISBN-13: 978-0-13-417539-3

CS4173 - Robotics and Embedded Systems

Course Content: Introduction to robotics and embedded systems, Microcontrollers and cross compilers: Organization and Attributes of Microcontrollers; Attributes and utilization of cross compilers; Introductions to Microcontroller trainee kit such as AVR Atmel/Arduino/Microchip PIC, Embedded C programming: Libraries, memory pointers, and pointer arithmetic compiling mixture of assembly and C files, interrupt handling, driver programs, I/O port configuration and programming interfaces: Serial port; interfacing of I/O components, Busses and other communication channels: Attributes and classification of buses; Different protocols for communication Ex: types of busses, Peripherals of a microcontroller**:** Timers, Robotics: Autonomous systems; robotics; wireless robotics, Remote controlling**:** GSM/GPS interface with tools/software such as MATLAB

Recommended Texts:

1. Thomas Bräunl, Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems 3rd Ed, Springer, 2008, ISBN-13: 978-3540705338
2. Jean J. Labrosse, Embedded Systems Building Blocks: Complete and Ready-to-Use Modules in C 2nd Edition, CRC Press, 1999. ISBN-13: 978-0879306045.

CS4182 - Advance Topics in Computing Mathematics

Course Content: Basic Counting Techniques. Binomial coefficients and identities, Advanced Counting Technics: Recurrence Relations and Generating functions **(**Modeling with recurrence relations, solving linear homogeneous & nonhomogeneous recurrence relations with constant coefficients, Divide-and-Conquer algorithms and recurrence relations, Theorems related to analyze the computational complexity of divide-and-conquer algorithms, Generating functions, Exponential generating functions, Solving advanced counting problems using generating functions, Proving identities via generating functions, The Principle of Inclusion–Exclusion and its application, combinations with repetition, Derangements), Special Counting Sequences

Recommended Texts:

1. Discrete and Combinatorial Mathematics – An Applied Introduction. R.P. Grimaldi, B.V. Ramana Pearson Education (2007).
2. Discrete and Combinatorial mathematics – An applied introduction. R.P. Grimaldi, B.V. Ramana Pearson Education (2007).
3. Introduction to Enumerative Combinatorics Miklos Bona Mc Graw Hill (2007).
4. Discrete Mathematics and Its Applications, Seventh Edition Kenneth H. Rosan Published by Mc Craw Hill (2012).

CS4192 - Middleware Architecture

Course Content: Principle of middleware. Categories of middleware**.** choreography and orchestration, Middleware Architectures: Cross-platform integration challenges; opportunities; and inhibitors; middleware architecture, technologies; and development; transactional and messaging middleware; object-oriented middleware; publish-subscribe middleware; service-oriented middleware, Data-oriented middleware: Data and content integration

challenges; XML content-based routing; enterprise database middleware from major vendors; emerging web services enabled database middleware, Middleware for mobile computing: Issues and challenges of mobile computing; role of middleware; data and computing adaptation; context –aware middleware, Middleware performance.

Recommended Texts:

1. Judith M. Myerson, The Complete Book of Middleware, CRC Press, 2002, ISBN-13: 978-0849312724
2. The Handbook of Mobile Middleware edited by Paolo Bellavista and Antonio Corradi, Auerbach Publications, 2006, ISBN-13: 978-0849338335

9 Department of Physics

Physics is at the core of our intellectual understanding of natural phenomena and the foundation of many scientific disciplines, and contributes immensely to scientific and technological advances. Moreover, physics is both a theoretical and practical discipline which continually evolves with profound scientific questioning; for example, theories of relativity and quantum mechanics has revolutionised the way of thinking of mankind.

The Department of Physics in the Eastern University, Sri Lanka (EUSL) endeavours to provide an excellent and conducive intellectual, social and physical environment in which learning and research ma*y flourish so that both the students and staff exploit their potential to promote themselves and to establish a noble status to the University at national and international levels. The department offers both three year and four year courses in physics, which form the two basic routes to B.Sc. general and special degrees. The three year course in physics is one of three main subjects of the general degree programme, and the four year course is designed for students who wish to pursue a professional career in physics. In both three and four year courses our aim is to impart a sound knowledge of the fundamental elements of physics by providing learning experiences such as how to identify the appropriate physical principles; how to turn a physics problem into a mathematical form and have an understanding of mathematical modelling and of the role of assumptions and approximations; how to plan, execute and report the results of an experiment or investigation with a measure of limitations and limits of uncertainty; how to compare results critically with predictions from theory; etc. The department strives to impart a range of transferable skills through its teaching, learning and evaluation strategies such as investigative, analytical, problem solving, IT, communication, interpersonal and ethical skills. Therefore, a physics graduate from EUSL would be better equipped to address issues from first-principles and deliver innovative, robust and holistic solutions.

Head of the Department

Dr. (Mrs.) Queenie Y. Soundararajah
BScHons(EUSL), M.Phil (UPDN), PhD (UOB, UK)
Senior Lecturer (Grade I)
E-mail: head_physics_fos@esn.ac.lk

9.1 Academic Staff

Prof. F. C. Ragel

BScHons (EUSL), PhD. (Witswatersrand, South Africa), Accredited Teacher in HE (SEDA, UK), C.Phys.(SL).

Professor of Physics
E-mail: *chalmusragel@esn.ac.lk / chalmusragel@gmail.com*

Research Interest: *Strongly correlated electron systems (SCES): f-electron magnetism, Kondo effect, f-moment dilution, Heavy Fermions, non-Fermi-liquids, quantum criticality and superconductivity; General Relativity: Einstein's field Equations.*

Prof. P. Peratheepan

BScHons(EUSL), MSc(UPDN), PhD (Johannesburg, South Africa)

Professor in Physics

E-mail: *peratheepanp@esn.ac.lk, peratheepan2002@yahoo.com*
Research Interest: *Investigation of thermoelectric phenomena via low-temperature thermal, electronic, and magnetic properties of the rare-earth based strongly correlated cage compounds, Bamboo value-addition, development of solar drying system.*

Dr. (Mrs.) Queenie Y. Soundararajah

BScHons(EUSL), M.Phil (UPDN), PhD (UOB, UK)

Senior Lecturer (Grade I)

E-mail: *queenieys@esn.ac.lk, queenie_soundararajah@yahoo.com*

Research Interest: *Using transmission electron microscopy to characterize nanomaterials, in particular the semiconductors that are used to make solar cells and light emitting devices. Imaging, electron diffraction and analytical studies*

that include energy dispersive X-ray microanalysis (EDX), electron energy loss spectroscopy (EELS) and cathodoluminescence (CL) to characterize nanomaterials and defects are also of interest.

Dr. P. Rodney Fernando
BScHons(EUSL), MSc (UPDN), PhD (Johannesburg, South Africa)
Senior Lecturer (Grade I)
***E-mail**: rodneyp@esn.ac.lk, piusrf@gmail.com*
***Research Interest**: Research related to Material Science, polymers and Superconducting Materials.*

Mrs. Sanjeevadharshini Aynharan
BSc(Hons) (EUSL)
Lecturer (Probationary)
E-mail: aynharans@esn.ac.lk

***Research Interest**:* Nano physics: developing the higher efficiency, *effectively*, low cost Dye Sensitized Solar cells by using the nano particle and different types of dyes and electrolyte.

Mrs. Hamigah Anton Tharshanth

BSc(Hons)(EUSL)

Lecturer (Probationary)

E-mail: hamigaha@esn.ac.lk

***Research Interest:** Medical Physics, Magnetic Susceptibility measurements by developing an apparatus in low temperature.*

9.2 100 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L / P / IL)	Credits	Prerequisite	BSc General	BScHons. (Physics)
First Semester						
PH1013	General Physics –I	45/0/105	03	-	✓	✓
PH1021	Elementary Physics Laboratory – I	0/45/05	01	-	✓	✓
Second Semester						
PH1033	General Physics –II	45/0/105	03	-	✓	✓
PH1041	Elementary Physics Laboratory – II	0/45/05	01	-	✓	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol # denotes notional learning hours for course units in category 3.3 B.

PH1013 - General Physics

Mechanics, Thermal Physics, Waves and Optics

Course Content: Fundamentals of Classical Mechanics: Newton's laws of Motion, Work and Energy, Momentum and Impulse, Centre of Mass, Conservation of Momentum, Kinetic and Potential Energy, Conservation of Energy, Conservative and Non-conservative Forces, Rotational Motion, Rotational Kinetic Energy and Angular Momentum, Gravitation, Fluids, Introduction to Special Theory of Relativity; Temperature and Kinetic Theory, Thermal equilibrium and the Zeroth Law of Thermodynamics, The Gas Laws and Absolute Temperature, Avogadro's Number; Types of Waves, Oscillatory Motion, Simple Harmonic Motion, The Simple Pendulum and the Vertical Spring, Sound Waves, Intensity, Amplitude, Interference and Beats, Resonance, Doppler Effect; Interference, Diffraction and Polarization of Waves, Scattering of Light, Fraunhofer Diffraction by Single and Double Slits, The Laser (Basic Introduction).

Recommended Texts:

1. Fundamentals of Physics, Volumes 1 & 2 (2013), by D. Halliday, R. Resnick, J. Walker, John Wiley & Sons, New York.
2. Physics, Principles with Applications, by D.C. Giancoli, (2014), Addison-Wesley, New York.
3. Physics for Scientists and Engineers, R.A. Serway, 9th Edition, (2013), Elsevier, USA.

PH1021 - General Physics Laboratory

Course Content : Use of Analytical Balance, Vernier Caliper, Micrometer Screw Gauge, Spherometer, Travelling Microscope, Simple Pendulum, Vertical Spring, Sonometer, Resonance and Beat Phenomena, Surface Tension and Viscosity, Thermal Conductivity, Specific Heat, Newton's Law of Cooling, Spectrometer, Measurement of Wavelength of Light, Single Slit and Double Slit Diffraction, Polarized Light, Simple Experiments with Laser Light.

PH1033 - General Physics - II

Electricity and Magnetism, Electronics and Modern Physics

Course Content: Electric charge and Electric field, Coulomb's Law, Electric Potential and Potential Difference, Relation between Electric Potential and Electric Field, The Electron Volt as the Unit of Energy, Electric Dipoles, Capacitors and Dielectrics, Magnetic Field, Magnetism in Matter, Electric Current, Ohms Law and Resistance, Electric Power, Electromagnetic Induction and Faraday's Laws, Lenz's Law, AC Circuits, EM waves; Semiconductors, p-n Junctions, Diodes and Solar Cells, LEDs, Transistors, Op-Amps and Digital circuits; Modern Physics, Plancks' Hypothesis and Introduction to Quantum Theory, Photoelectric effect, Compton Effect, Wave Particle Duality and De Broglie Relation, Wave Nature of Matter, Bohr Theory of the Hydrogen Atom, Atomic Spectra, Origin of X-rays, Atomic Nucleus, Nuclear Fission and Fusion, Elementary Particles, and Quarks (introduction).

Recommended Texts:

1. Fundamentals of Physics, Volumes 1 & 2 (2013), by D. Halliday, R. Resnick, J. Walker, John Wiley & Sons, New York.

2. Physics for Scientists and Engineers, R.A. Serway, 9th Edition, (2013), Elsevier, USA.
3. Introduction to Electronics (2011), by Earl Gates, 6th Edition, Delmar Cengage Learning, New York.

PH1041 - General Physics Laboratory - II

Course Content: Electrostatics, Coulomb Force, Potentiometer, Van de Graaff Generator, Measurement of DC Current and Voltage, Meter Bridge and Potentiometer, Temperature Dependence of Resistivity, DC and AC Circuits, Use of the CRO, Rectification and Diode Characteristics, Solar Cells and LEDs, Op Amps, Basic Digital Circuits, Atomic Spectra, Interactive Simulation Demonstration, Photoelectric Effect and Compton Effect. Interactive Student Centred Experiments.

9.3 200 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours* (L / P / IL)	Credits	Prerequisite	BSc General	BScHons (Physics)
First Semester						
PH2012	Mechanics	30/0/70	02	PH1013	✓	✓
PH2021	Thermodynamics	15/0/35	01	PH1013	✓	✓
PH2031	Statistical Physics	15/0/35	01	PH1013	⊗	✓
PH2042	Physical Optics	15/30/55	02	PH1013	⊗	✓
PH2051	General Physics Laboratory –I	0/45/05	01	PH1021 PH1041	✓	✓
Second Semester						
PH2062	Electromagnetic Phenomena	30/0/70	02	PH1033 MT1032	✓	✓
PH2073	Electronics-I	30/30/90	03	PH1033	⊗	✓
PH2081	Special Theory of Relativity	15/0/35	01	EN1011$	⊗	✓
PH2091	Quantum Mechanics-I	15/0/35	01	MT1032 MT1042	✓	✓

PH2101	Introduction to Astronomy	15/0/35	01		⊗	⊗
PH2111	General Physics Laboratory-II	0/45/05	01	PH1021 PH1041	✓	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol "⊗" denotes that course is elective for the Degree Programme.

$ For Biological Science Stream Students

PH2012 - Mechanics

Course Content: Inertial frames, Newton's Laws of Motion, Variable Mass Problem and the Motion of a Rocket; Central Forces, Two Particle Systems, Rotating Coordinate Systems, Inertial Forces, Motion of Rigid Bodies, Rotational Kinetic Energy, Momentum and Impulse, Conservation of Angular Momentum, Kepler's Laws, Motion of Satellites, Newton's Law of Gravitation, Gravitational Potential Energy, Motion of Planets and Satellites, Escape Velocity, Elastic and Inelastic Collisions.

Recommended Texts:

1. An Introduction to Mechanics (2013), by D. Kleppner and R. Kolenkow, Cambridge University Press.
2. Classical Mechanics: a Critical Introduction (online book). by M. Cohen, Professor Emeritus, Department of Physics and Astronomy, University of Pennsylvania, USA with Solutions Manual by Larry Gladney, Edmund J. and Louise W. Kahn Professor for Faculty Excellence, Department of Physics and Astronomy, University of Pennsylvania.

PH2021 - Thermodynamics

Course Content: Zeroth Law and the Concept of Temperature, Work, Heat and Internal energy, First and Second Laws of Thermodynamics, Heat Engine, Thermal Efficiency, Reversible and Irreversible Engine, Carnot's Theorem, Temperature, Entropy, Equation of State; Maxwell's Thermodynamic Relations

and their Application to Simple Systems, Production of Measurement of Low Temperatures, The Third Law of Thermodynamics.

Recommended Texts:

1. Fundamentals of Statistical and Thermal Physics, F. Reif, McGraw-Hill/ Levant Book Publishers (1967).
2. Thermodynamics, H.B. Callen, John Wiley & Sons, 2nd Edition (1985).

PH2031 - Statistical Physics

Course Content: Kinetic Theory of Gasses, Van der Wall's Equation, Theories of Specific Heats of Gasses and Solids, Transport Phenomena; Introduction to Statistical Physics, Classical Statistical Mechanics and Thermodynamics, Statistical Equilibrium of a Thermodynamic System, Partition Function, Thermal Equilibrium, Boltzmann Distribution, Maxwell's Distribution of Velocities in Gases; Quantum Statistics, Fermi-Dirac and Bose-Einstein Statistics and their Applications.

Recommended Texts:

1. Fundamentals of Statistical and Thermal Physics, F. Reif, McGraw-Hill/ Levant Book Publishers (1967).
2. Thermodynamics, H.B. Callen, John Wiley & Sons, 2nd Edition (1985).

PH2042 - Physical Optics

Course Content: Interference of Light, Young's Double Slit Experiment, Fresnel's Bi-prism, Two Beam Interference, Fringes of Equal Thickness/Inclination, Newton's Rings, Michelson and Fabry-Perot Interferometers, Stokes Treatment of Reflection, Fraunhofer Diffraction, Huygens's Principle, Single- and Double-Slit Diffraction Patterns, Diffraction Grating, Resolving Power of Telescopes and Microscopes, Polarization of Light, Lasers and Fibre Optics, Optical Fibre Communication, Holography, Modern Display Devices, Neon Tubes, LEDs, Electrochromic and Photochromic Devices.

Recommended texts:

1. Fundamental of Optics, F.A. Jenkins, H E. White, 6th Edition (1976) McGraw-Hill international.

2. Modern Optics, G.R. Fowles, 2nd Edition (1989) Dover Publishers, New York (1989).

PH2051 - General Physics Laboratory - I

Course Content: Kater's Pendulum, Couple Pendulum, Maxwell's Needle, Elastic Constant of a Spiral Spring, Rigidity Modulus, Young's Modulus, Understanding the Laws of Transverse Vibrations, Thermal Expansion and Thermal Conductivity of Metals, Specific Heat Capacity of a Liquid, Lens Combination, Use of the Spectrometer, Fraunhofer Diffraction by a Single Slit, Interference by Two Beams, Transmission Grating, Cauchy Equation, I vs D Curve, Polarization of Light, Resolving Power of Telescope, Stefan's Fourth Power Law, Wavelength Division Multiplexing, The Optical Time Division Reflectometer, Particle Size Determination using Laser, Diode Characteristics, RC Filters, LCR Resonance Circuit, Transistor Characteristics, Tangent Galvanometer.

PH2062 - Electromagnetic Phenomena

Course Content: ***Electrostatics:*** Gauss's Law in a Dielectric, Permittivity and Susceptibility, Electric Displacement and Electric Filed as Vectors, Electric Polarization and its Relation to Electric Field, Laplace's and Poisson's Equation, Capacitance in Various Capacitors, ***Magnetostatistics****:* Magnetic Field due to a Current Carrying Conductor, Gauss's law, Magnetic Dipole Moments, Magnetic Scalar Potential, Magnetic Vector Potential, Biot-Savart Law, Ampere's Law, Magnetic Materials, Magnetization, Permeability, Magnetic Susceptibility, Diamagnetism and Paramagnetism in Materials, Curie-Weiss Law, Magnetic Hysteresis, Superconductivity, ***Time Varying EM Fields****:* Electromagnetic Induction, Faraday's Laws, Vector Algebra, Maxwell's Equations in Free Space, Poynting's Theorem, Radio and TV Transmission, Polarization of EM Waves, Dipole Antenna, Wireless Communication, Transmission Lines, Superconductivity and its Applications Including High Temperature Superconductors.

Recommended texts:

1. Electromagnetic Fields and Waves: Including Electric Circuits**,** by P. Lorrain and F. L. Freeman (1988).

2. Electricity and Magnetism, Volumes 1 and 2, by B.I. Bleaney and B. Bleaney, 3rd Edition (2013), Oxford University Press.
3. Introduction to Electrodynamics, by D.J. Griffiths, Pearson (2013).

PH2073 - Electronics - I

Course Content: N-type and p-type Semiconductors, p-n Junction, Forward and Reverse Bias Characteristics, Different Types of Diodes, Zener Diode, LEDs, Photodiodes and Solar Cells, Application of Diodes, Transistors, Field Effect and Bipolar Junction Transistors, Transistor Circuits and Configurations, Transistor Characteristics, Applications of Transistors; Op-amps and their Applications; The 741 Op-amp, The use of Op-amps to perform Mathematical Operations, Feedback Amplifiers, Digital Electronics: Binary Numbers, Truth Table, Logic Gates, Boolean Algebra and De Morgan' Theorem, Flip-flop and Sequential Circuits.

Recommended texts:

1. The Art of Electronics, by P. Horowitz and W. Hill, Cambridge University Press (2006).
2. Electronic Principles, by A.P. Malvino, Glencoe, McGraw-Hill international (1999).

PH2081 - Special Theory of Relativity

Course Content: Special Theory of Relativity (STR): Invariance of the Velocity of Light in Vacuum, Maxwell's Equations and Galilean Transformation, The Doppler (red) Shift, Einstein's Postulates of STR, Lorentz Transformation of Space and Time Coordinates, Time Dilation, Length Contraction and their experimental confirmation; Mass-velocity and Mass Energy Relationships, Transformation of Momentum and Energy; Application of STR to Simple Systems; Twin Paradox, Meson Decay, Four Vectors.

Recommended Texts:

1. Introduction to Special Relativity, by Resnick, Wiley India Pvt. Limited (2007)
2. Special Relativity by A.P. French, 2nd Edition, Chapman & Hill (1990).
3. Introductory Special Relativity, by W. G. V. Rosser, CRC Press (1992)

PH2091 - Quantum Mechanics-I

Course Content: Heisenberg's Uncertainty Principle, Schrödinger Wave Equation, Wave Function, Probability Density; Expectation Value; Application of Time Independent Schrodinger Equation to Step Potential, Finite Potential Well and Infinite Potential Well, Barrier Penetration, Outline the Solutions of the Hydrogen Atom in Spherical Polar Coordinates, Wave-functions and Energy Levels, Simple Harmonic Oscillator, Outline the Solution, Lattice Vibrations in Solids.

Recommended texts:

1. Introduction to Quantum Mechanics (2nd Edition) David J. Griffiths, Pearson (2004).
2. Basic Concepts in Relativity and Early Quantum Theory, by R.Resnick, Wiley (1985).
3. Quantum Mechanics for Applied Physics and Engineering, by A T. Fromhold Courier Corporation (2012).

PH2101 - Introduction to Astronomy

Course Content: Newton's Theory of Gravitation and its Applications, Properties and structure of Solar System and Planets, Planets, Stars and the Sun. Star Classifications, H-R diagrams and Main sequence stars, Post-Main-Sequence Stars, Relativity and Black Holes, Galactic Structure, properties and Classification, Cosmology: Hubble Expansion, Big Bang Cosmology, Cosmic Microwave, Cosmological Parameters, Early Universe Physics.

Recommended Texts:

1. The Cosmic Perspective (7th Edition), by Bennett, Donahue, Schneider and Voit, published by Benjamin Cummings.
2. An Introduction to Modern Astrophysics (2nd Edition), by B.W. Carroll and D.A. Ostlie , Pearson Addison-Wesley, 2007.
3. Discovering the Universe, by N.F. Comins, and W.J. Kaufmann, W.H. Freeman & Co., (2011).

PH2111: General Physics Laboratory - II

Course Content: Equipotential Lines and Electric Fields, Magnetic Fields of a Bar Magnet and Helmholtz Coil, Forces and Torques on Magnetic Dipoles, Electric and Magnetic Fields of a Power Line, Velocity of Waves along Transmission Lines, Microwave Experiments on Electromagnetic Evanescent Waves and Tunneling Effect, Magnetic Susceptibility, Interactive Lecture Demonstration Experiments; Quantum Mechanical Tunneling Problem.

9.4 300 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L / P / IL)	Credits	Prerequisite	BSc General	BScHons (Physics)
First Semester						
PH3011	Solid State Physics –I	15/0/35	01	EN1011$	✓	✓
PH3021	Atomic Physics	15/0/35	01	PH2091	✓	✓
PH3032	Physics Education	15/30/55	02	Physics (A/L)	⊗	⊗
PH3042	Medical Physics	15/30/55	02	EN1011$ Physics (A/L)	⊗	⊗
PH3051	General Physics Laboratory –III	0/45/05	01	PH2051 PH2111	✓	✓
Second Semester						
PH3061	Nuclear Physics	15/0/35	01	PH2091	✓	✓
PH3072	Electronics-II	30/0/70	02	PH2073	⊗	✓
PH3082	Nanoscience and Nanotechnology –I	30/0/70	02	PH1033	⊗	✓
PH3091	Energy and Environment	15/0/35	01	Physics (A/L)	⊗	⊗
PH3101	Biophysics	15/0/35	01	Physics (A/L)	⊗	✓
PH3111	Physics Laboratory Project #	100	01	PH3051	✓	⊗

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol "⊗" denotes that course is elective for the Degree Programme.

The symbol # denotes notional learning hours for course units in category 3.3B.

PH3011 - Solid State Physics-I

Course Content: Types of crystal structure, unit cell, crystal planes, Miller indices, crystal symmetry; Types of bonding; XRD methods for determination of crystal structure, Brillouin Zone, Atomic Structure Factor and calculations, Structural Characterization, Lattice vibrations and phonons, Density of states; Heat capacity of solids, Einstein model and Debye model; Electrons in solids, metals, semiconductors, Structure of glasses and polymers, Free electron theory of metals; AFM, SEM and STM for microstructure determination of solids.

Recommended Texts

1. Introduction to Solid State Physics, by 63.3h, Wiley (2004).
2. Elementary Solid State Physics by Ali Omar, Pearson Education India (1999).
3. Solid-State Physics: An Introduction to Principles of Materials Science by H. Ibach, H.Lüth, Springer Science & Business Media (2009).
4. Elements of Solid State Physics, Fourth edition by J. P. Srivastava, PHI Learning, India.

PH3021 - Atomic Physics

Course Content: Angular momentum and quantization of orbital angular momentum, Pauli exclusion principle, Electron spin, L-S coupling, Selection rules, fine structure and hyperfine structure of spectral lines, Atomic magnetic moments, Zeeman effect, Effect of external electric and magnetic fields on atomic spectral lines. Absorption and emission of radiation by atoms, Stimulated emission and the principle of the laser.

Recommended Texts*:*

1. Atoms, Molecules and Photons: An Introduction to Atomic-, Molecular- and Quantum Physics, by W. Demtröder, Springer (2011).
2. Atomic Physics by C. J. Foot, Oxford University Press, (2005).

PH3032 - Physics Education

Course Content: ***Introduction to Science Education:*** Use of constructive approach; **The nature of Physics, Physics curriculum at primary and secondary levels,** Physics and society; Importance of physics in Engineering, Electronics technology, Medical diagnostic equipment and biomedical engineering, Medical therapeutic uses. Physics in Energy and environment, Nuclear energy, Solar energy, Astronomy, etc. ***Student-centered teaching:*** Paradigm shift from teacher-centred teaching to student-centred teaching, problem-based learning, Active learning strategies/tools, Use of educational technologies to enhance the teaching and learning of science. ***Introduction to Physics education research.*** Physics teaching through observation and understanding of nature, ***Use of computers in Teaching Physics (Interactive Teaching):*** Computer Assisted Learning (CAL), Interactive lecture demonstrations (ILD), internet, and audio visual aids.

Recommended texts:

1. Learning to Teach Science in the Secondary School, A companion to school experience, 4th Edition Edited by R. Toplis, Taylor and Francis (2010).
2. Rethinking the Way We Teach Science, The Interplay of Content, Pedagogy, and the Nature of Science By L. Rosenblatt, Taylor and Francis (2011).
3. Improving Secondary Science Teaching, by J. Parkinson Taylor and Francis (2003).
4. Principles & Practice of Physics by E. Mazur.

PH3042 - Medical Physics

Course Content: Biomechanics, Biofluid mechanics, Senses, Mechanoreceptors, thermoreceptors, Anatomy and physiology of the ear and eye, vision; Biocompatible materials; Effect of ionizing radiation and nuclear radiation, Does and exposure and their measurements, Geiger Muler counters, Scintilation counters, Film dosimeters; Exposure to UV light and its effect on bio molecules and human body; Radio isotopes and Nuclear medicine, Magnetic resonance imaging (MRI), Computer Tomography (CT) imaging, X rays and Lasers in medicine, Optical fibres, Laser surgery, Electrophysiology (ECG, EKG), Pace makers.

Recommended Texts:

1. Medical Physics and Biomedical Engineering by B.H Brown, R.H Smallwood, D.C. Barber, P.V. Lawford, D.R Hose, CRC Press (1998).
2. Introduction to Medical Imaging: Physics, Engineering and Clinical Applications by N. B. Smith, A. Webb, Cambridge University Press (2010).
3. Physics With Illustrative Examples From Medicine and Biology: Statistical Physics by G. B. Benedek, F.M.H. Villars, Springer Science & Business Media (2000).
4. Biomechanics of the Human Body, Undergraduate Lecture Notes in Physics series, ed. *Okuno, Emico, Fratin, Luciano (2014) Springer.*

PH3051 - General Physics Laboratory – III

Course Content: Experiments in Electronics, Solid State Physics, Atomic Spectra, Nuclear Physics, Solar energy Conversion, Interactive Lecture Demonstration type experiments on Physics Education and Medical Physics, and Biophysics. Nano materials: synthesis and their characterization.

PH3061 - Nuclear Physics

Course Content: Rutherford's alpha particle scattering experiment and the structure of the atomic nucleus, Nuclear binding energy, liquid drop model, semi-empirical mass formula, Stability of the nucleus; Nuclear decay and Radioactivity: Alpha decay, beta decay and gamma decay and the energy release in radioactive decay, Nuclear fission and Nuclear fusion and calculation of energy released in the reactions, Thermonuclear fusion and Nuclear reactors.

Recommended Texts:

1. Elements of Nuclear Physics by W.E. Burcham, published by English Language Book Society (1988).
2. Nuclear and Particle Physics by W. E. Burcham, Longman Scientific & Technical (1995).

PH3072 - Electronics II

Course Content: Circuit Theory Fundamentals, Semiconductor Materials and PN Junctions, Diodes and Diode Circuits, Power Supply Circuits, Bipolar Junction Transistors, BJT amplifier and equivalent circuits, Filters, Oscillators and Multivibrators, Optoelectronics, Field Effect Transistors and Circuits, FET

Characteristics and Amplifiers, Multiplexes, MOSFET logic switches, CMOS Logic Gates,. NAND and NOR circuits, MOSFET Power Switching; Operational Amplifiers, Logarithmic amplifier, Schmitt Trigger, Instrument amplifiers and power supplies, AC to DC converters, IC regulators, DC to DC converters, Batteries, solar cells, supercapacitors, Oscillators: Wien bridge, LC, IC and crystal types, and the Timer chip 555.

Recommended Texts:

1. The Art of Electronics by P. Horowitzand W. Hill, Cambridge University Press (2006).
2. Electronic Principles by A. P.Malvino, Glencoe/McGraw-Hill (1999).

PH3082 - Nanoscience and Nanotechnology -1

Course Content: ***Scaling Laws****:* Dependence of physical properties of materials and systems on their size. Nanoscale materials and devices, Techniques and tools of nanostructure fabrication and characterization, Properties and applications of low-dimensional materials, Semiconductor nanostructures, metallic nanoparticles, carbon nanotubes, organic molecules, quantum dots; ***Scanning Probe Microscopy****:* AFM, Force-distance curves, STM, SEM, TEM; ***Nanofabrication techniques****:* Top down and Bottom up techniques; Fabrication of nanomaterials; synthesis and properties of ***Carbon Nanotubes*** (CNT) and ***Graphene, Quantum dots*** (Quantum mechanics of confined systems, Plasmon resonance in metallic q-dots, semiconductor quantum dots), applications of Quantum dots; ***Nanolithography;*** Photonics crystals and their applications. Nano-biotechnology; Environmental and health effects of nanomaterials.

Recommended Texts:

1. Textbook of Nanoscience and Nanotechnology, B.S. Murty, P. Shankar, B. Raj, B.B. Rath, J. Murday, Springer (2013).
2. The Physics and Chemistry of Nanosolids, Frank Owens and C. Poole, John Wiley, 2008.
3. Nano-The essentials, T. Pradeep, McGraw Hill, 2008.
4. Fundamentals of Nanoelectronics, G. Hanson, Pearson, 2008.

PH3091 - Energy and Environment

Course Content: Earth's atmosphere structure and composition, Energy from fossil fuels, their limitations and their environmental impact, Atmospheric

pollution and global warming, Ozone Depletion and its effects, Greenhouse effect, Renewable energy sources: Hydro, Solar, wind, bio, geothermal, ocean thermal, tidal etc. Solar thermal and solar photovoltaic energy conversion. Energy from electrochemical power sources, Nuclear energy and its environmental effects. Built Environment: urban environment, transportation, lighting, etc.

Recommended Texts:

1. Environmental Physics: Sustainable Energy and Climate Change by E. Boeker and R. van Grondelle, John Wiley & Sons (2011).
2. Energy, Ecology and Environment, S. V. S. Rana, I. K. International Pvt Ltd (2008).
3. Renewable Energy: Its Physics, Engineering, Use, Environmental Impacts, Economy, and Planning Aspects by B.Sørensen, Academic Press (2004).

PH3101 - Biophysics

Course Content: Elementary structure of DNA, proteins, membranes, and cells, and the physical principles, influence of physical quantities in biological systems, transport of matter in biosystems, diffusion, Fick's Law, Flow of fluids, Stoke's law, Hagen-Poiseuill's law, Reynold's number; Thermodynamics of biosystems, Gibbs Free energy, chemical potential; Neurophysics, neurons, action potential; Bioenergetics: Photosynthesis, Radiation biology: Biological effects of radiation, Physics of sensory systems and its mechanisms in vision, olfaction, and hearing.

Recommended Texts:

1. Biophysics: An Introduction by R. Glaser, Springer 2012.
2. Elementary Biophysics by P.K. Srivastawa, Narosa Publishing House, 2005.
3. Biological Physics by P. Nelson, Paperback, W.H. Freeman & Co.,2013

PH3111 - Physics Laboratory projects

Pre-requisites: General Physics Laboratory - I (PH2051), General Physics Laboratory - II (PH2111). For B.Sc. general/special degree students Group Projects.

9.5 400 Level of Study

The following courses are offered for BScHons degree in Physics at 3rd and 4th years of study.

Course Units and Syllabus

Course Code	Course Title	Hours* (L / P / IL)	Credits	Prerequisite	BScHons (Physics)
PH4011	Mathematical Methods in Physics	15/0/35	01	MT1032 MT1042	✓
PH4022	Classical Mechanics	30/0/70	02	PH2012 MT1032 MT1042	✓
PH4033	Quantum Mechanics-II	45/0/105	03	PH2091 MT1012	✓
PH4042	Advanced Statistical Physics	30/0/70	02	PH2031 MT1012	✓
PH4051	Independent Study (Report and Seminar)	15/0/35	01	-	✓
PH4062	Particle Physics	30/0/70	02	PH2091 PH2081 MT1012	✓
PH4073	Electromagnetic Theory and Waves	45/0/105	03	PH2062 PH2081 MT1032 MT1042	✓
PH4083	Advanced Physics Laboratory-I	0/90/60	03	PH3051	✓
PH4092	Advanced Electronics	30/0/70	02	PH3032	⊗
PH4102	Advanced Nuclear Physics	30/0/70	02	PH3082	✓
PH4113	Advanced Optics, Lasers and Photonics	45/0/105	03	PH2042 MT1032 MT1042	⊗
PH4123	Solid State Physics-II	45/0/105	03	PH3011 MT1012	✓

PH4132	Magnetism and Superconductivity	30/0/70	02	PH2031 PH3021	✓
PH4142	Materials Characterization Techniques	30/0/70	02	PH3011	⊗
PH4154	Advanced Physics Laboratory – II	0/120/80	04	PH3083	✓
PH4167	Research Project #	700	07	PH3051	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.
The symbol "✓" denotes that course is compulsory for the Degree Programme.
The symbol "⊗" denotes that course is elective for the Degree Programme.
The symbol # denotes notional learning hours for course units in category 3.3B.

PH4011 - Mathematical Methods in Physics

Course Content: Algebra of complex numbers, integration of complex functions, calculus of residues; Solutions of ordinary differential equations including series solutions and special functions; Solutions of partial differential equations and Sturm-Liouville theory; Integral Transforms (Fourier, Laplace); Operational methods: Green functions.; Integral equations; Asymptotic behavior. Nonlinear differential equations; Delta functions; Series: asymptotic series. Borel Summation. Pade approximants.

Recommended texts

1. Mathematical Methods for Physicists, A. Weber and Brown.
2. Advanced Mathematical Methods for Scientists and Engineers, Bender & Orszag.
3. Mathematical methods for physicists (1995) 2nd edition, Arfken George, Academic Press.

PH4022 - Classical Mechanics

Course Content: ***Mechanics of a system of particles***, centre of mass, conservation laws of angular momentum and energy of a system of particles; Equation of constraints, Degree of Freedom; ***Generalized coordinates***, Virtual work, D'Alembert's Principle of virtual work; Lagrange's equation for a free particle and for a conservative system, ***Lagrange's equation*** from Hamilton's principles; Generalized momentum, Conservation of energy, Hamilton's formulation of Mechanics, ***Hamilton's canonical equations***, Hamilton's canonical equations from variation principle; Hamilton-Jacobi Theory; Poisson

Brackets; ***Central force motion***, Energy of a particle under central force field, Variation of effective potential energy; equation of orbit motion under ***inverse square law of force***, equations of orbits with inverse square law forces, classification of orbits; ***Rigid Body Motions***: Euler Angles, Euler Equations of motion.

Recommended Texts:

1. Classical Mechanics (3rd Edition Hardcover) by H. Goldstein and, C. P. Poole Jr. (2001), Addison-Wesley publishing.
2. Mechanis by L.D. Landau & E.M. Lifshitz Mechanics (Volume 1 of A Course of Theoretical Physics Pergamon Press (1969).
3. *An Introduction to Mechanics*. D. Kleppner and R.J. Kolenkow. : McGraw-Hill, New York (1973).

PH4033 - Quantum Mechanics – II

Course Content : ***Brief review of basic quantum mechanics***, Uncertainty relations, position-momentum and energy-time; Schrodinger Wave Equation, probability interpretation, expectation vales, momentum operator, equation for a particle in a box, Eigen functions and eigenvalues; ***Brief review of one dimensional problems*** : potential step and reflection and transmission coefficients, potential well and bound states, Potential barrier, tunneling, Delta function potential, ***The Linear Harmonic Oscillator*** and its eigenfunctions and eigenvalues; ***Operator methods*** in quantum mechanics, Harmonic oscillator problem, operators, Interpretation of wavefuction and probability amplitude; ***The Time-independent Schrodinger equation in three-dimensions*****:** Separation of CM motion and relative motion, Separation of angular motion and radial motion; ***Solution of the angular motion***, spherical harmonics and angular momentum quantum numbers; Ladder operators; ***Solution of the radial equation*** for a radial potential; square well potential and bound states; ***The solution to hydrogen atom***, wave functions and energy eigenvalues, quantum numbers and their physical meaning and the degeneacy; ***Matrices as operators***, Hermitian and Non-Hermitian operators, spin operators, Matrix representation of harmonic oscillator operators, Matrix representation of angular momentum operators, addition of angular momenta, Direc's notation of a scalar product of two vectors; ***Time-independent perturbation theory,*** First order energy shift, Degenerate perturbation in the hydrogen atom, Anomalous Zeeman Effect. Time-dependent Perturbation theory and radiative transitions, Einstein coefficients; identical particles and Pauli exclusion principle, parity.

Recommended texts:

1. A Modern Approach to Quantum Mechanics, J. Townsend, 2nd Edition.
2. Quantum Physics by S. Gassiorowicz, John Wiley, New York.
3. A Modern Approach to Quantum Mechanics, J. S. Townsend, University Science Books (2000).
4. MIT Open Physics courseware is an excellent website for both teachers and students: http://ocw.mit.edu/courses/physics/
5. **Introduction to Quantum Mechanics by D. Griffiths**, Prentice-Hall (1995).
6. The Feynman Lectures on Physics, Volume III by R. Feynman. Addison-Wesley (1965). Also at: http://www.feynmanlectures. caltech.edu /III_toc. html

PH4042 -Advanced Statistical Physics

Course Content: Probabilities and Random Walks, Binomial distribution; Central Limit Theorem, Microcanonical Ensemble, Ergodicity, Counting Microstates, Interactions between systems, Temperature and Entropy, entropy from Boltzmann formula, partition function and grand partition function Quasi Static Processes, Heat Capacity, Thermodynamics: ideal gas, Heat Engine, Maxwell relations, Liquid Vapor Phase Transition, Chemical Potential, Discontinuous Phase Transitions, Continuous Phase Transitions, Order Parameters & Critical Phenomena, Canonical and Grand Canonical Ensembles, Equipartition theorem, Kinetic Theory of Gases, Polyatomic Molecules, Van der Waals Gas, Law of Mass Action, Magnetism, Heat Capacity, Ising Model, Classical Maxwell-Boltzman statistics, quantum statistics, Bose Einstein Statistics, Fermi Dirac Statistics, Particle in a Box, Black Body Radiation, bosons and fermions.

Recommended texts:

1. Statistical Mechanics for Beginners, by L. G. Benguigui, World Scientific (2010)
2. Matter in Equilibrium: Statistical Mechanics and Thermodynamics, 2nd ed. S. R. Berry, S. A. Rice, and J. Ross Oxford University Press (2001).
3. Fundamentals of Statistical and Thermal Physics, F. Reif, McGraw-Hill (1965).
4. Modern Thermodynamics with Statistical Mechanics, R. P. Baumann Macmillan (1992).

PH4051 -Independent Study (Report and Seminar)

PH4062 - Particle Physics

Course Content: Charge particle accelerators: Linear accelerator, cyclotron, Synchrotron, Betatron, Linear Hadron Collider, CERN, Fermi Labs and other High Energy accelerator facilities. Particle detectors: Bubble chamber, cloud chamber, scintillation counter, Geiger counter, Cerenkov counter; Particle energies in laboratory frame and centre of mass frames, Classification of elementary particles: Fermions and bosons, Introduction to the Standard model, Fundamental forces, leptons, hadrons and quarks. Quark model and the Eightfold way, Anti particles, Feyman diagrams, Introduction to Quantum Chromodynamics (QCD).

Recommended Texts:

1. Introduction to Elementary Particles (Paperback), D. Griffiths, Wiley-VCH (2008).
2. Introduction to Elementary Particle Physics (2nd Edition), A.Bettini, online edition.
3. Subatomic Physics (Paperback), E. M. Henley, A. Garcia, World Scientific (2007).

PH4073 - Electromagnetic Theory and Waves

Course Content: Electrostatics: Integral and differential forms of Gauss's Law. Examples of 1D, 2D, 3D charge distributions, Potential. Poisson's Equation; Calculation of electric fields; Solution of electrostatic problems, Method of images. Dipole field, Quadrupole field. Multipole expansion, Electrostatic boundaries, Polarisation in dielectrics, Surface charges. Biot-Savart Law. ***Magnetostatics:*** Magnetic vector potential, Calculation of magnetic fields, Integral and differential forms of Ampere's Law, Examples of 1D, 2D current distributions, Magnetostatic boundaries, Magnetisation. Surface currents, ***Time-varying fields***, Faraday's Law, Induction. Calculation of self and mutual inductance, Displacement current, ***Maxwell's equations*** and their solution in vacuo. Introduction to Electromagnetic waves and their propagation; Plane electromagnetic waves; Solution of Maxwell's equations in dielectrics, Equation of continuity, Conservation laws, Wave equations for magnetic scalar potential and magnetic vector potential, Lorentz condition and guage transformations;

Poynting vector. Energy storage & transport by waves. ***Wave guides*** and transmission lines, Generation of EM waves.

Recommended Texts:

1. Introduction to Electrodynamics (3rd ed.), Griffiths, David J. (1998). Prentice Hall
2. Classical Electrodynamics (3rd ed.), Jackson, J. D. (1999), Wiley
3. Classical Electricity and Magnetism (2nd ed.). Panofsky, Wolfgang K. H.; Phillips, Melba (2005).Dover
4. Essential Electrodynamics by Raymond John Protheroe, E-book: http://www.e-booksdirectory.com/details.php?ebook=9222
5. Electromagnetism: Principles and Applications by by P. Lorrain and D.R. Corson (1990) W.H. Freeman & Co.

PH4083- Advanced Physics Laboratory-I

4-6 hour advanced experiments covering Mechanics, Heat, Sound, Electricity and Magnetism, Electronics.

PH4092 - Advanced Electronics

Course Content: Logic families, RTL, DTL, TTL, CMOS, etc; Combinational logic; TTL/CMOS characteristics, TTL/CMOS interfacing; Optoelectronics devices; CCDs, 7 segment, 16 segment and 5×7 dot matrix displays, LED display drivers, Opto couplers, Data acquisition, noise and signal processing, A/D and D/A converters, Digital filters; microprocessors and microcomputers, Computer architecture, microprocessor support chips, programmed input/output interrupts, bus signals and interfacing, data communication.

Recommended Texts:

1. The Art of Electronics by P. Horowitzand W. Hill, Cambridge University Press (2006).
2. Electronic Principles by A. P.Malvino, Glencoe/McGraw-Hill (1999).

PH4102 - Advanced Nuclear Physics

Course Content: The structure of the nucleus, its formation, stability, and decay, Fundamental nuclear forces in nature, their symmetries, interactions between

protons and neutrons in nuclei and among quarks inside hadrons, including the proton. Nuclear decay and radioactivity; Nuclear Spins and Nuclear Magnetic Moments, Nuclear Magnetic Resonance (NMR); Applications of Nuclear Physics:**,** ***Nuclear fission,*** Introduction to neutron Physics and nuclear reactors, Nuclear power generation and safety issues; ***Nuclear fusion,*** Nuclear Astrophysics, Thermonuclear Plasma, Fusion reactors. Biological effects of nuclear radiation, Introduction to nuclear medicine; Use of radioisotopes in medicine, agriculture, industry.

Recommended Texts:

1. Introductory Nuclear Physics, 3rdEdition K.S. Krane, John Wiley & Sons (1987)
2. Nuclear Physics, Burcham, Longman Group (1995).

PH4113 - Advanced Optics, Lasers and Photonics

Course Content: ***Semiconductor optoelectronic materials and devices***; Electronic band structure; carriers; optical characteristics of p-n Junction photodiodes; Light emitting diodes (LED): semiconductor diode lasers, Charge coupled detectors (CCDs); Photodetectors: operation and noise considerations, Solar cells; ***Dielectrics and wave propagation***: linear devices; waveguides, electrooptics, Light modulation with electro-optic devices, Integrated optical circuits, Emerging materials (carbon nano tubes, grapheme) for displays; ***Lasers***: properties of lasers, laser action, stimulated emission, population inversion, light amplification in a medium, Einstein's coefficients, Optical resonators, Coherence length, Frequency doubling, Types of lasers, Medical applications of lasers; continuous and pulsed lasers; ***Lasers in optical communication*****:** principles and design of fiber-optic communication systems including the integrated-optic and optoelectronic devices, Properties and manipulation of laser light, physical effects and operating principles of photonic components and devices; Elements of photonic telecommunication.

Recommended texts:

1. Photonics, A Short Course by V. Degiorgio and I. Cristiani, Springer (2014)
2. Optical Physics by A. Lipson, S.G. Lipson, H. Lipson, 4th Edition, Cambridge University Press (2010).
3. Introduction to Laser Physics by B.A. Lengyel, John Wiley (1966).

PH4123 - Solid State Physics-II

Course Content: Energy band structure of solids, conductors, insulators and semiconductors, Density of states, thermal equilibrium, equilibrium distribution functions, carrier statistics in equilibrium; Free-electron theory of metals, Drude model; Electrons in a periodic potential, Bloch's theorem, Nearly free electron model, Energy band gaps, Energy band structure of solids, density of states, Fermi surfaces, Tight binding model, Semi classical model for electron dynamics in solids, motion of electrons in a solid under external electric and magnetic fields, Effective mass, concept of holes and excitons, cyclotron motion, De Hass-van Alphen effect, Quantum Hall Effect, Lattice dynamics and phonon modes. Intrinsic and extrinsic semiconductors, Drift and diffusion current, Hall effect, Generation and recombination of carriers, Continuity equations, p-n junction, Electrostatic analysis, capacitance, work function, Current in pn junction, Junction breakdown, Optoelectronic devices, Schottky diode, Electrostatic analysis, Current in Schottky diode, Ohmic contact, homo and hetero junctions, Introduction to LED, photodiodes and photodetectors, p-n junction solar cells, Density of states, Elemental and compound semiconductors, III-IV, II-VI and ternary compounds, Growth and characterization of semiconductor materials, Quantum well structures, semiconductor quantum dots and core-shell structures, Bipolar junction transistor, JFET, MOS device, Operating principle, MOS under bias, MOS analysis, MOSFET operation, Threshold voltage, MOSFET circuits, Advanced MOSFET circuits.

Recommended texts:

1. Introduction to Solid State Physics, Charles Kittel, 7thedn. (1996), John Wiley & sons.
2. Solid State Physics, N.W. Ashcroft and N.D. Mermin (1976), Saunders College Publishing Co.
3. Introductory Solid State Physics, 2nd Ed., H.P. Myers (1997), Taylor & Francis Publishers
4. Solid State Physics: Essential Concepts, D.W. Snoke, Addison-Wesley (2009)
5. Semiconductor Physics and Devices, 3rd Ed, D. A. Neamen, McGraw Hill (2003).
6. Solid State Electronic Devices, 5th Ed., B. G. Streetman, Prentice Hall (2000).
7. Device Electronics for Integrated Circuits, 3rd Ed., R. S. Muller, John Wiley & Sons, (2002).
8. Principles of Semiconductor Devices, B. Van Zeghbroeck, Web edition:

PH4132 - Magnetism and Superconductivity

Course Content: ***Magnetic materials***: Atomic theory of magnetism; Ferromagnetic domains, Applications of ferromagnetic materials, magnetic data storage, magnetic bubbles and their application; Magnetic phase transitions, Curie's Law and Curie-Weiss Law; Magnetic resonance, paramagnetic resonance, magnetic relaxation, Nuclear Magnetic Resonance (NMR) and its applications, Ferromagnetic resonance and spin waves; Magnetic nanoparticles and their uses. ***Superconductivity***: Superconductivity in Hg, cuprates, MgB_2 and Fe pnictides, Basic properties of metals in normal state, Phenomenon of superconductivity: Zero resistance, persistent currents, superconducting transition temperature T_C, isotope effect, perfect diamagnetism and Meissner effect, penetration depth and critical field, First-order and second-order superconducting transition, specific heat above and below T_C, thermal conductivity. Phenomenological theory of superconductivity: Free energy, order parameter, Ginzburg-Landau equations, predictions of Ginzburg-Landau equations, flux-quantization, penetration depth. Microscopic theory of superconductivity: Electron-phonon interaction, Cooper pairs, Bardeen-Cooper-Schrieffer (BCS) Hamiltonian, Variational approach, canonical transformation, finite temperatures, properties of the BCS ground state, macroscopic properties of superconductors. Tunnelling and the energy gap: Tunnelling phenomenon, energy-level diagram, Josephson effect, quantum interference. Type-I and Type-II superconductivity: Type-I and type-II superconductors, intermediate states, mixed states. Experimental methods for probing the nature of the superconducting state: Nuclear magnetic resonance and Knight shift, planar, scanning and point-contact spectroscopy. Unconventional superconductors: Heavy-fermion superconductors, metal-oxide superconductors, organic superconductors, magnesium diboride, iron pnictides. Basics of High-T_C superconductivity.

Recommended Texts:

1. Introduction to Solid State Physics, C. Kittel, 7th edn. John Wiley & sons (1996),
2. Introduction to Superconductivity, M. Tinkham, McGraw Hill, Singapore (1996)
3. Superconductivity of Metals and Alloys P.G. De Gennes, P.G., Addison-Wesley (1999).
4. Solid State Physics, N.W. Ashcroft and N.D. Mermin (1976), Saunders College Publishing Co.

5. Elementary Solid State Physics, Ali Omar, Addison-Wesley (1975).
6.

PH4142 - Materials Characterization Techniques

Course Content: Introduction Optical Microscopy, Scanning Electron Microscopy (SEM), Field Emission SEM (FESEM), Transmission Electron Microscopy (TEM), Optical and Stylus Profilometry, Atomic Force Microscopy (AFM)/Scanning Probe Microscopy (AFM/SPM), Energy/Wavelength Dispersive Spectroscopy (EDS/WDS), Electron Energy Loss Spectroscopy (EELS), X-Ray Diffraction (Powder and single crystal); X-Ray Fluorescence (XRF), Auger Electron Spectroscopy (AES), X-Ray and Ultraviolet Photoelectron Spectroscopy (XPS/UPS), Secondary Ion Mass Spectrometry (SIMS), Photoluminescence (PL), Optical Monochromators spectrophotometers and detectors, Reflective spectroscopy, Absorption spectroscopy, Modulation techniques, UV-VIS Absorption, Transmission and Reflection spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), Raman Spectroscopy, Ion Scattering Spectroscopy (ISS) and Inductively Coupled Plasma Mass Spectrometry (ICPMS), Neutron Diffraction,; Electrical conductivity, Four probe techniques, Complex Impedance spectroscopy, I-V, C-V techniques, Differential Scanning Calorimetry (DSC), Differential Thermal Analysis (DTA) and Thermogravimetric Analysis (TGA); High vacuum techniques and cryogenics.

Recommended Texts:

1. Characterization of Materials, by J.B. Wachtman,
2. Characterization of Materials, by E.N. Kaufmann
3. The Physics and Chemistry of Materials, by J.I. Gersten and F.W. Smith, Chapter 22 on Characterization of Materials (available online: ftp://ftp.wiley.com/public/sci_tech_med/materials)

PH4154 - Advanced Physics Laboratory – II

4-6 hour experiments covering Optoelectronics: Basics of semiconductor optoelectronic devices including photodiodes, light-emitting diodes, laser diodes, CCDs. Applications include solar cells, displays, photodetection, and optical communications, lasers, optical fibre communication, Superconductivity, Physics of materials including Nano materials and materials characterization by XRD, SEM, etc.

PH4167 - Research Project

10 Department of Zoology

Department provides wide range of sound academic and practical knowledge in Animal Diversity, Cell Biology & Biochemistry, Ecology, Development Biology, Genetics, Parasitology, Animal behaviour and Evolution, Fisheries, Fish Biology, Applied Entomology, Human Biology, Aquaculture, Fish and Shell fish diseases, Laboratory Techniques, Environmental Science, Marine Biology, Mammalian Biology, Comparative Anatomy, Natural Resource Management and Developmental Planning and Advanced Pest Management. It produces students specialized in wide range of laboratory and field based research annually. Further the department provides diploma in aquatic resource management and other courses which depends on demand and postgraduate courses leading to M. Phil and PhD. Department has a commitment to team work in sprit of cooperation and openness while building on past achievements; fostering a stable and community-oriented research and training. Department is committed to working closely with relevant industries and create more effective partnership with national institutions, private sector along with civil society to achieve long-term sustainability in fisheries and aquaculture.

Head of the Department

Dr. (Mrs.) M. Vinobaba

BScHons(Jaffna) DPhil. (Sussex-UK)

Senior Lecturer (Grade I)

E-mail: head_zoology_fos@esn.ac.lk

10.1 Academic Staff

Prof. P. Vinobaba

BScHons (Jaffna),PhD.(Stirling-UK), CBiol(UK), MIBiol (U.K)

Senior Professor in Zoology

E-mail: *vinobaba@esn.ac.lk, vino_peria@yahoo.co.uk*

Research Interest: *Aquaculture, Fisheries Biology, Fin fish and Shell fish disease, Ecology, Environmental Biology and Conservation of Biological resources, Aquatic Vet Parasitology/ Pathology*

Prof. (Mrs.) C. G. Devadasan

BScHons(Jaffna), MSc(Stirling-UK), MPhil(Aberdeen-UK), PhD(WUSL)

Associate Professor in Zoology

E-mail: *stanley@esn.ac.lk*

Research Interest: *Aquatic pathology, fish and shellfish diseases, fish microbiology, fish immunology and bio chemistry, fish biology and fisheries*

Dr. (Mrs.) M. Vinobaba

BScHons(Jaffna) DPhil. (Sussex-UK)

Senior Lecturer (Grade I)

E-mail: *laxmi@esn.ac.lk, vinobamuthu@yahoo.com*

Research Interest: *Developmental Genetics, Developmental Biology and Entomology*

Dr. A. J. M. Harris

BScHons(EUSL)

Senior Lecturer (Grade I)

E-mail: *harrism@esn.ac.lk, harriseusl@gmail.com*

Research Interest: *Environmental Science,Water Quality, Animal Diversity, Ecology and Conservation.*

Dr. R. M. T. B. Ranathunge

B.Sc (Kelaniya), Ph.D (Kelaniya)

Senior Lecturer (Grade II)

Email: ranathungermtb@esn.ac.lk

Research interests: *Medical and Veterinary Parasitology, Medical and Agricultural Entomology, Molecular Entomology, Infectious Diseases*

Ms. Nilani Kanesharatnam

BScHons (Jaffna), MPhil(UPDN)

Lecturer (Probationary)

E-mail: *nilanik@esn.ac.lk***,** *nilanik4@yahoo.com,*

Research interests: *Molecular Biotechnology, Bioinformatics, Molecular Biodiversity*

.Ms. Lakshani Weerasekara

BScHons (UPDN)

Lecturer (Probationary)

E-mail: *lakshaniw@esn.ac.lk, lakshanizoo100@gmail.com*

Research interests: *Primatology, Animal behavior, Wildlife ecology and Conservation management*

10.2 100 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L/P/IL)	Credits	Prerequisite	BSc General	BScHons (Zoology)
First Semester						
ZL1011	Cell biology & Histology	15/0/35	01		✓	✓
ZL1022	Invertebrate diversity	30/0/70	02		✓	✓
ZL1031	Invertebrate diversity (Practical)	0/30/20	01		✓	✓
Second semester						
ZL1041	Cell biology & Histology (Practical)	0/30/20	01		✓	✓
ZL1052	Vertebrate diversity	30/0/70	02		✓	✓
ZL1061	Vertebrate diversity (Practical)	0/30/20	01		✓	✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

ZL1011-Cell biology and Histology

Course Content: Introduction to cell biology and histology; Cell structure and types; Bio molecular architecture of cell: Proteins, DNA and chromosomes. Cell organelles: Plasma membrane, Nucleus, Cytoplasm, Cytoskeleton; Energy extraction; Intracellular transport; Cell-cell communication; Cell division: Cell cycle control and cancer; Cell migration and metastasis; Stem cells; Cell differentiation; Germ layers and embryonic origin of basic tissues; Types of animal tissues: Epithelial tissue: Surface and glandular; Connective tissue:

Adipose tissue, cartilage and bones, blood, muscle, Neural tissue; Organization of tissues in cardiovascular, lymphatic, digestive, respiratory, urinary and reproductive systems; Introduction to cell/tissue culture and applications.

Recommended Reading:

1. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell (2000) Molecular Cell Biology.New York.W.H.freeman
2. Alberts, Bruce; Johnson, Alexander; Lewis, Julian; Raff, Martin; Roberts, Keith; Walter, Peter (2002) New *Molecular Biology of the Cell.* NewYork and London: Garland Science
3. Alberts, *et al*.(2009). *Essential Cell Biology* (3rd ed.), Garland Science

ZL1022- Invertebrate Diversity

Course Content: Evolution and phylogeny: Protozoa, Porifera, Cnidaria, Platyhelmenthes, Annelida, Mollusca, Arthropoda and Echinodermata; Ecological role of invertebrates; The diversity and invertebrate taxa; Adaptations to the environment: Anatomical, physiological and ecological characteristics; Economic importance of invertebrates: Pests and pollinators; parasites and vectors of disease.

Recommended reading:

1. J.A. Pechenik (1985). Biology of invertebrates. PWS Publishers, Boston
2. R.E. Barnes, (1987). Invertebrates Zoology. Saunders Publisheres
3. C .P. Hichmens, L.S. Robert and F.N. Hickmen, (1988). Integrated principles of Zoology, Times mirror-mosby college publishing, USA

ZL1031- Invertebrate Diversity Practical

Course Content: Introduction to the laboratory techniques and methods to study invertebrates in laboratory and field; Different classes of Phylum Protozoa: Permanent slide preparation of *Paramecium*; Different classes of Phylum Porifera; Phylum Cnidaria: Examination of Jelly fish and nematocysts function; Different classes of Phyla Platyhelminthes and Nematoda; Different classes of Phylum Annelida: Dissection of Earthworm Annelida; Different classes of Phylum Mollusca: Dissection of cuttlefish; Different classes of Phylum

Arthropoda: General dissection of Cockroach, Dissection of Nervous system of shrimp; Different classes of Phylum Echinodermata; Phylum Hemichordata: Evolutionary linkages to Phylum Chordates.

Recommended reading:

1. J.A. Pechenik (1985). Biology of Invertebrates. PWS Publishers, Boston
2. R.E. Barnes, (1987). Invertebrates Zoology. Saunders Publishers
3. C .P. Hichmens, L.S. Robert and F.N. Hickmen, (1988). Integrated principles of Zoology, Times mirror-mosby college publishing, USA

ZL1041-Cell Biology and Histology Practical

Course Content: Introduction to laboratory practices and lab safety; Microscopy; Comparative study of cells; Cell division; Functions of cell membrane; Separation techniques: Detection, separation and isolation of specific macromolecules, chromatography, electrophoresis, laboratory centrifuges type, Examination of different animal tissues; Preparing cells and tissues for light microscopy; Staining, histological interpretations of tissue sections.

Recommended Reading:

1. W. Richard and M.D.Brown (Editor) (2009) Histologic preparations. CAB press and publication
2. J.D.Bancroft and G.Marilyn (2007) Theory and Practice of Histological Techniques. Churchill Livingstone

ZL1052-Vertebrate Diversity

Course Content: Causes and significance of diversity in morphology; Physiology and behaviour among the major groups of vertebrates; Taxonomic diversity; Chordate plan of organization: Variations in chordate plan and general features of chordate group animals; Diversity of Protochordates: Urochordata and Cephalochordata; Vertebrate diversity as illustrated by Cyclostomes; Gnathostomes: Pisces, Amphibia, Reptilia, Aves and Mammalia; Basic feeding, respiratory and locomotory adaptations of the fish before moving on to land; Evolution of land vertebrates via the lobe-fined fishes and early amphibians; Evolutionary history of birds; Mammals: Rise of endothermy, their primary reproductive and locomotory adaptations.

essed: 1, 2, 3

Recommended reading:

1. J. Z. Young, (1991). Life of Vertebrates, Oxford University, Press, Oxford
2. D.A. Kershaw, (1993). Vertebrate diversity, University Tutorial Press Limited
3. G.C. Kent, (1973). Comparative Anatomy of Vertebrates, CV-mosby company, USA.

ZL1061- Vertebrate Diversity Practical

Course Content: Identification of the morphology of preserved specimens of Hemichordata, Urochordata and Cephalochordata; Transverse sections of Amphioxus; General dissection of Bony fish, Types of fish; Agnatha, Gnathostomata fishes; General dissection of Class Amphibia; Orders of Class Amphibia; Orders of Class Reptilia; Skeleton; wings and beaks of birds; Orders of Class Mammalia (Prptotheria, Metatheria, Eutheria); Terrestrial and Aquatic mammals; Microscopical examination of different sections of *Branchiostoma* sp; Identification of the morphology of different types of fishes; General dissection: Cartilaginous fish, Bony fish; Different orders of class Amphibia; General dissection of Toad; Different orders of Class Reptilia; General dissection of *Calotes*; Different orders of Class Aves; General dissection of Pigeon; Different orders of class Mammalia; General dissection of rabbit/rat.

Recommended reading:

1. J. Z. Young, (1991). Life of Vertebrates, Oxford University, Press, Oxford
2. D.A. Kershaw, (1993). Vertebrate diversity, University Tutorial Press Limited
3. G.C. Kent, (1973). Comparative Anatomy of vertebrates, CV-mosby company, USA.

10. 3 200 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L / P / IL)	Credits	Prerequisite	BSc General	BScHons (Zoology)
First Semester						
ZL2012	Animal Ecology	30/0/70	2	ZL1022, ZL1052	✓	✓
ZL2021	Animal Ecology (Practical)	0/30/20	1	ZL1031, ZL1061	✓	✓
ZL2031	Insect taxonomy & Insect biology	15/0/35	1	ZL1022	⊗	⊗
ZL2041	Insect taxonomy & Insect biology (Practical)	0/30/20	1	ZL1031	⊗	⊗
Second Semester						
ZL2052	Molecular Genetics(T+P)	15/30/55	2	ZL1011, ZL1041	✓	✓
ZL2062	Introductory Evolutionary Biology	30/0/70	2	ZL1022, ZL1052	✓	✓
ZL2071	Parasitology	15/0/35	1	ZL1022	⊗	⊗
ZL2081	Parasitology (Practical)	0/30/20	1	ZL1031	⊗	⊗

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.
The symbol "✓" denotes that course is compulsory for the Degree Programme.
The symbol "⊗" denotes that course is elective for the Degree Programme.

ZL2012 - Animal Ecology

Course Content: Nature of ecosystem; Abiotic an biotic parameters; Gaseous cycle: Carbon cycle, Nitrogen cycle, Oxygen cycle; Sedimentary cycle: Phosphorous cycle; Water cycle; Renewable and non-renewable resources with special reference to Sri Lanka; Population and resource exploitation; Pollution: Terrestrial, Aquatic, Atmospheric, Thermal, Radioactive, Noise and Light;

Global ecological issues: Eutrophication, Deforestation, Acid rain, Green house effect, Global warming, Ozone layer depletion; Ecological concepts in animal conservation.

Recommended reading:

1. Abeywickrama, B.A. (1991). Natural resources of Sri Lanka,: Conditions and Trend. A report prepared for the natural resources, Energy and science of Sri Lanka.
2. Anderson, J.M. (1992). Bioresources Ecology, McGrawhill publication
3. Cooray, P.G. (2000). Natural Resources of Sri Lanka, National Science Foundation
4. Odum, E.P. (1971). Fundamentals of Ecology, Sauders college publishers.

ZL2021- Animal Ecology Practical

Course Content: Equipments used to estimate the population; Devices used for collecting and transferring small organism; Equipments used to measure environmental parameters; Preservation techniques of animals and their importance: Wet preservation, Stuffing, Insect pinning, Preparing museum label for animals and Slide preparation; Sums related to measure of central tendency and population ecology; Different sampling methods used in aquatic and terrestrial system to estimate population; Mark- release and recapture Method; Sampling and mounting of planktons; Productivity of phytoplankton in a fresh water environment; Winkler's method of dissolved oxygen determination.

Recommended reading:

1. Abeywickrama, B.A. (1991)**.** Natural resources of Sri Lanka,: Conditions and Trend. A report prepared for the natural resources, Energy and science of Sri Lanka.
2. Anderson, J.M. (1992). Bioresources Ecology, McGrawhill publication
3. John, F.F. (2000**).** Practical manual – Animal ecology, Willey-sons publication
4. Odum, E.P. (1992). Modern practical approach, Sauders college publishers.

ZL2031- Insect Taxonomy and Insect Biology

Course Content: Characteristic features of insects; Classification of class Insects up to Orders and important families; Characteristic features of insect taxa; Adaptation of insects for their feeding habit and habitat; Structure and functions of insect cuticle and moulting; Body segmentation; Structure and modifications of insect antennae; mouth parts and legs; Wing: venation, Modifications and wing coupling apparatus; Sensory organs; Metamorphosis and diapause in insects; Types of larvae and pupae; Structure and functions of digestive system; Circulatory, Excretory Respiratory, Nervous and Reproductive systems in insects; Types of reproduction in insect

Recommended Reading:

1. Richards O.W, Davis, R.G (1977) Imms' General text Book of Entomology, Vol 1. structure Physiology and Development, Vol 2 Classification and Biology, Springer Publication, ISBN-10:04 12152207 / ISBN 30:9780412152207
2. Chapman , R.F (2012) The Insects Structure and Function, 5th Edition ISBN: 9780521113892

ZL2041-Insect Taxonomy and Insect Biology Practical

Course Content: External morphology of insects; Modification of mouthparts, legs, wings and post abdominal structures; General dissection of insect to study the internal morphology: Digestive system, Excretory system, Tracheal system, Circulatory system and Reproductive system etc; Identification of economically important species; Collection; preservation and mounting of insects; Laboratory rearing of selected insects; Use of taxonomic keys to sort insect orders; Preparation of insect keys for some insects studied in the laboratory.

Recommended Reading:

1. Bell, W.J. The laboratory Cockroach
2. Burgess. N.K.H & Cowan G.O. Medical entomology
3. Hill. D.S (1987) Agricultural insect pests of tropics and their control.
4. Trigunayat M.M (2002) A manual of practical entomology. Scientific publishers

ZL2052- Molecular Genetics (T+P)

Course Content: Central dogma of Molecular biology: DNA Replication, transcription and translation; Molecular organization of chromosomes; Gene regulation; Genetic mapping and Human Genome project; Cloning and sequencing of DNA; PCR and DNA fingerprinting; Recombinant DNA and Genetic engineering; Extra nuclear Inheritance; Transposable elements; Retrovirus and AIDS; Genetic analysis and Preserving genetic diversity; Prenatal diagnosis of genetic disorders; Laboratory based exercises of molecular genetics.

Recommended reading:

1. Griffiths, A.J.F, Miller, J.H., Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2000). An Introduction to Genetic Analysis, 7th edition; W. H. Freeman, New York:
2. Brown, T. A. (2015, Gene Cloning and DNA Analysis: An Introduction , 7th Edition, Wiley Blackwel Publisher.
3. Primrose, S.B and Twyman, R. (2006). Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell Publishing.
4. Gerald Karp, (2013). Cell and Molecular Biology: Concepts and Experiments, 7th Edition, Wiley Publisher.
5. Mertens, T.L. and Hammersmith, R.L. (2014) Genetics laboratory Investigations, 14th Edition, Benjamin Cummings Publisher.

ZL2062- Introductory Evolutionary Biology

Course Content: Historical background of Darwin's theory of evolution; Other theories of Evoltuion; NeoDarwinism; Origin of species; Formation of universe: Theories to origin of life, Chemical evolution, Biological evolution, Origin of protocell and heterocell, Origin of eukaryotic cells and Aerobic respiration; Evidence for Evolution: Fossils; Biogeographical regions and continental drift; Comparative anatomy and biochemistry; Artificial selection and patterns of evolution; Evolutionary process; Introduction to population genetics; Variations and natural selection; Speciation and reproductive isolation; Extinction.

Recommended Reading:

1. Campbell N.A. and Reece J.B. (2005) Biology. 7th edition. Pearson, Benjamin Cummings, San Francisco.
2. Campbell, NA. Reece, JB., Simon, E.J. (2007). Essential biology with physiology. Pearson Benjamin, Cummings London.
3. Ellis, J. (2010). How science works: Evolution. A student primer. Springer, Berlin
4. Raven P.H, Evert R.F. and Eichhorn S.E. (2005). Biology of Plants. 7th edition. Freeman, New York.
5. Raven P.H., Johnson G.B., Losos J.B. and Singer S.R. (2005). Biology. 7th edition. McGraw Hill, New York.

ZL2071- Parasitology

Course Content: Heterotrophic association among animals; General principles of parasitology; Association between organisms: Phorosis, Mutualism, Commensalism, Symbiosis, Parasitism; Different types of parasites; Different types of hosts; Adaptations for parasitism; Protozoan, Nematode and platyhelminthes life cycle and control managements; Arthropod parasites: Life cycle and control managements; Fish and human parasites: Life cycle and control managements; Types of immunity; Immune reactions against parasites; Immunological techniques.

Recommended reading:

1. Anderson, R.C. (2000). Nematode parasites of vertebrates, CABI Publishing
2. Schmidt, C. D. (1988) Essentials of Parasitology, WmC Brown publishers
3. Zuckerman. (1971). Plant parasitic Nematode, Academic Press, London

ZL2081-Parasitology Practicals

Course Content: Life cycles, symptoms, diagnosis and control methods of Protozoa, Platyhelminthes and Nematode parasites; Life cycles symptoms, diagnosis and control methods of Arthropod parasites; Life cycles symptoms, diagnosis and control methods of Fish and human parasites; Ecto and endo parasitic survey from fish and shellfish; Survey of parasites from frog and Calotes; Bird and Mammals Screening and immunological techniques of parasites.

Recommended reading:

1. Anderson, R.C. (2000). Nematode parasites of vertibrates, CABI Publishing
2. Post, G. (1987) Textbook of fish health, TFH Publishers.
3. Patak, K.M.L. (1987). Parasitic zoonoses. Agrobotanical Publishers, India
4. Zuckerman. (1971). Plant parasitic Nematode, Acedamic Press, London

10. 4 300 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours♣ (L / P / IL)	Credits	Prerequisite	BSc General	BScHons (Zoology)
First Semester						
ZL3011	Animal Physiology	15/0/35	01	ZL2031	✓	✓
ZL3021	Animal Physiology (Practical)	0/30/20	01	ZL2041	✓	✓
ZL3032	Animal Behavior (T+P)	15/30/55	02	ZL2012, ZL2021	✓	✓
ZL3041	Applied Entomology	15/0/35	01	ZL2031	⊗	⊗
ZL3051	Applied Entomology (Practical)	0/30/20	01	ZL2041	⊗	⊗
Second Semester						
ZL3061	Fish biology	15/0/35	01	ZL1052	⊗	⊗
ZL3071	Fish biology (Practical)	0/30/20	01	ZL1061	⊗	⊗
ZL3082	Environmental Science(T+P)	15/30/55	02	-	✓	✓
ZL3091	Developmental Biology	15/0/35	01	ZL2052	✓	✓
ZL3101	Developmental Biology (Practical)	0/30/20	01	ZL2052	✓	✓
ZL3111	Fisheries	15/0/35	01	-	⊗	⊗
ZL3121	Fisheries (Practical)	0/30/20	01	ZL3111	⊗	⊗

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.
The symbol "✓" denotes that course is compulsory for the Degree Programme.
The symbol "⊗" denotes that course is elective for the Degree Programme.

ZL3011- Animal Physiology

Course Content: Cellular energetic; Metabolic strategies; Pattern of thermoregulation; Musculoskeletal system and movements; Digestion and nutrition; Respiration and gas exchange; Blood Circulation; Immunity; Hormonal control; Endocrine system; Nervous system; Sensory physiology; Excretion and homeostasis; Osmoregulatory mechanism; Reproductive mechanism of Invertebrates and Vertebrates.

Recommended Reading:

1. Harrison, G.A., Tanner, J.M., Pilbeam, D.R., Baker, P.T. (1988) Human Biology An Introduction to Human Evolution Variation Growth & Adaptability Oxford Science Publications Oxford
2. Prosser, C.L. (1985) Comparative Animal Physiology (3rd Edition), Satish Book Enterprice Book sellers & Publishers Moti Katra, Agra
3. Ross & Wilson (1981) Foundation of anatomy and Physiology (5th Edition) English Language Book Society / Churchill Livingstone, Medical Division of Longman Group UK Ltd.
4. Sylvia & Mader (2000) Human Biology (6th Edition) Mc Graw Hill
5. Wilson, J.A. (1979) Principles of Animal Physiology (2nd Edition) Mc Millan Publishing Co. Inc. New York
6. Wood, D.W. (1983) Principles of Animal Physiology (3rd Edition) Contemporary Biology, Edward Arnold (Publishers) Ltd.

ZL3021- Animal Physiology Practical

Course Content: Practical work on structure and function of selected organ systems of vertebrates with special reference to organ systems of human; Histological structure of tissues and organs; skeletal systems; Physiology of nervous system; Nerve impulses and cardiac muscles, Cardiovascular physiology; Respiratory and immunological functions of blood; Blood grouping; Aquatic and aerial respiration; Digestive enzymes and its relationship to substrate/ temperature, Endocrine organs.

Recommended Reading:

1.Harrison, G.A., Tanner, J.M., Pilbeam, D.R., Baker, P.T. (1988) *Human Biology An Introduction to Human Evolution Variation Growth & Adaptability* Oxford Science Publications Oxford
2.Prosser, C.L. (1985) *Comparative Animal Physiology* (3rd Edition), Satish Book Enterprice Book sellers & Publishers Moti Katra, Agra
3.Ross & Wilson (1981) *Foundation of anatomy and Physiology* (5th Edition) English Language Book Society / Churchill Livingstone, Medical Division of Longman Group UK Ltd.
4.Wilson, J.A. (1979) *Principles of Animal Physiology* (2nd Edition) Mc Millan Publishing Co. Inc. New York
5.Wood,D. W. (1983) *Principles of Animal Physiology* (3rd Edition) Contemporary Biology, Edward Arnold (Publishers) Ltd.

ZL3032 -Animal Behaviour

Course Content: History of animal behavior; Proximate and ultimate causes of behavior; The concepts of classical ethology and current approaches to study of behavior; Perception and sensory filters; Brain organization and behavior; Hormones and behavior; Movement; Biological rhythm; Biological clocks; Introduction to learning; simple learning; Associative learning; Complex learning and memory; Introduction to behavioural Ecology; Ecology of habitat selection; Ecology of feeding; Ecology of Antipredator behavior; Ecology of Reproduction; Parent offspring interaction; Ecology of Social organization; Complex type of communication and Language in primates; Applied Animal Behaviour: Applications in agricultural, veterinary, animal welfare and conservation; Measuring behaviour: Insect grooming behaviour; Handedness and eyedness in human; Associative learning in fish; Learning in Human; Habitat selection; Movement; Factor affecting distress call in chicks; Mini Project.

Recommended Reading:

1. Alcock, J.,(2013) *Animal Behavoiur: An evolutionary Approach*, 10th edition,. Sinauer Associates Inc. publishers, Sunderland. Massachusetts
2. Davies, N.B., Krebs, J.R. & West, S.A. (2012) *An Introduction to Behavioural Ecology*, 4th edition. Wiley-Blackwell Scientific Publications.
3. McFarland, D., (1999), *Animal Behaviour, Psychology*, Ethology and Evolution, 3rd Edition, Longman Publisher.
4. Manning, A. and Dawkins, M.S. (2012) An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press.

5. Martin, P and Bateson, P. (2007). Measuring Behaviour: An Introductory Guide, 3rd Edition,

ZL3041- Applied Entomology

Course Content: Insect population dynamics and life tables; Insect as pests of agriculture, stored products and forestry; Basic concepts of pest management; Different methods of pest management: Cultural control, Biological control, Chemical control; Integrated Pest Management; Thresholds for insect management; Insecticides and their modes of action; Insecticide toxicity and environmental fate; Insecticide resistance; Neonicotinoid insecticides; Host plant resistance to insects; Issues associated with transgenic crops; Introduction to Apiculture and Seri culture; Insects of medical and veterinary importance; Different vector control strategies with special reference to mosquito control.

Recommended Reading:

1. Pedigo, L.P. & M.E. Rice. 2009. Entomology and Pest Management. Sixth Edition. Prentice Hall, Upper Saddle River, N.J. 749 pp.
2. Medical and Veterinary Entomology. Gary R. Mullen & Lance A. Durden (2009) Elsevier Inc.
3. Medical Entomology for students. Mike Service (2008) Cambridge University Press

ZL3051- Applied Entomology Practical

Course Content: Insect pests of economic crops and stored products; Pest Control measures; Identification and Laboratory rearing of selected bio control agents of agricultural pests; Searching efficiency of predators/ parasitoids; Efficiency of pesticides on pests; insecticide bioassays; Insects of medical and veterinary importance; Vectors of major mosquito borne diseases; Different techniques in vector control.

Recommended reading:

1. Hill. D.S (1983) Agricultural insect pests of the Tropics and their control. CUP Archive-Science
2. Dent. D: *Insect Pest Management.* (2001) 2nd Edition. Wallingford, UK: CABI Publishing

3. Medical and Veterinary Entomology. Gary R. Mullen & Lance A. Durden (2009) Elsevier Inc.
4. Medical Entomology for students. Mike Service (2008) Cambridge University Press

ZL3061- Fish Biology

Course Content: Taxonomy of Fish; External and Internal morphology of fish and their modifications; Locomotion – swimming. Efficient floating mechanism; Food and feeding habit of fish; Circulatory system of fish; Respiratory system of fish; Osmoregulatory mechanism; Excretion; Reproduction and parental care in fish; Sensory and endocrine system and Growth of fish; Fish of Sri Lanka and fish of economic importance of Sri Lanka; Conservation of fish of Sri Lanka.

Recommended Reading:

1. Balon, E.K., D.L.G. Noakes, R. Danzmann & M.. T. Rush. 2014. Ichthyology Primer. Department of Integrative Biology, College of Biological Science, University of Guelph, Guelph, Ontario, Canada.
2. Bone, Q., Marshall, N. B. (1982) *Biology of Fishes*, Blackie, Glasgow and London, USA
3. Nelson, J.S. 2006. Fishes of the World. 4th edition. John Wiley & Sons, Hoboken, New Jersey.
4. Moyle & Cech An introduction to Ichthyology. 5th edition.
5. Webb, J.E., Wallwork, J.A., Elgood, J.H. (1981) *Guide to Living Fishes*, The Mac Millan Press Ltd. London

ZL3071- Fish Biology Practical

Course Content: External and internal anatomy of generalized bony fish; Identification of fishes; Adaptive radiation of fishes; Meristic and morphometric character of fish; Food and feeding habits; Internal and external anatomy of shrimps, crabs and bivalves; Identification of commercially important fish, shrimps and other aquatic organisms.

Recommended Reading:

1. Balon, E.K., D.L.G. Noakes, R. Danzmann & M.. T. Rush. 2014. Ichthyology Primer. Department of Integrative Biology, College of Biological Science, University of Guelph, Guelph, Ontario, Canada.

2. Bone, Q., Marshall, N. B. (1982) Biology of Fishes, Blackie, Glasgow and London, USA
3. Nelson, J.S. 2006. Fishes of the World. 4th edition. John Wiley & Sons, Hoboken, New Jersey.
4. Moyle & Cech An introduction to Ichthyology. 5th edition.
5. Webb, J.E., Wallwork, J.A., Elgood, J.H. (1981) Guide to Living Fishes, The Mac Millan Press Ltd. London.

ZL3082- Environmental Science

Course Content: Introduction to environment; Types of environment: Terrestrial, Aquatic and Atmosphere; Types of waste, Waste management: solid waste and aquatic effluents; Human population issues; Regulating hazardous material, Environmental policy and decision making; Environmental Impact Assessment; Pollution studies and monitoring methods; Identification of environmental pollutants; Laboratory and field studies for assessment of water quality; Assessment of pollution indicating organisms in water, Terrestrial and air pollution, Soil analysis; Pollution monitoring; Application of Environmental Impact Assessment; Mini project.

Recommended Reading:

1. Allport, D.C., Gilbert, D.S, Outterside, S.M. (2003). Safety, Health and the Environment: A Source Book and Practical Guide, John Wiley & Sons.
2. Kemp, David D. (2004). Exploring environmental issues: an integrated approach, Routledge London.
3. Miller, G.T. and Spoolman, S.E. (2011). Living in the Environment: Principles, Connections, and Solutions: 864 pages, Brooks Cole Publisher
4. Odum, P and Barrett, G.W. (2004), Fundamentals of Ecology, 5th Edition, Cengage Learning, Inc.
5. Richard T. Wright, Bernard J. Nebel. (2010). Environmental Science: Toward A Sustainable Future (8th Edition): 681 pages, Publisher: Prentice Hall

ZL3091- Developmental Biology

Course Content: Historical development of embryology; Structure and function of gametes; Gametogenesis; Fertilization; Principles and concepts of different embryonic stages and processes; Cleavage; Blastula; Gastrulation; Neurulation

and organogenesis; Early embryonic development of amphioxus, frog, chick, human and selected invertebrates; Induction and Competence; *in-vitro* fertilization and embryo transfer; Aging, Birth control, Metamorphosis and Regeneration; Animal cloning.

Recommended reading:

1. Balinsky. B. I and Fabian .B.C (1981) An introduction to Embryology. Saunders College publication
2. Scott F. Gilbert and Susan Singer (2006) Developmental Biology. 8th edition ISBN-13: 978-0878932504 ISBN-10: 087893250X

ZL3101- Developmental Biology Practical

Course Content: Reproductive organs of different animal groups; Practical sessions to demonstrate Gametogenesis, Fertilization, Cleavage patterns, Gastrulation, Neurulation. Organogenesis of Amphioxus, Frog, Chick, Human and selected invertebrates with the aid of models, permanent slides and sections; Chick embryo preparation; Birth control measures; Experiments on metamorphosis and regeneration.

Recommended reading:

1. Mary S. Tyler (2000)Developmental Biology, A Guide for Experimental Study, Second Edition, Sinauer Associates, Inc. Publishers, Sunderland, MA ISBN 0-87893-843-5
2. *Wright, S. J.(2005), A Photographic Atlas of Developmental Biology,* 6th edition. Morton Publishing. Company ISBN-13: 978-0895826299

ZL3111- Fisheries

Course Content: Marine fishery resources; Current status of capture of fisheries of Sri Lanka; Ornamental fisheries; Fishing gears; Fishing methods; Fish farming; Shrimp and seaweeds farming, Crab farming and fattening; Mollusk farming; Fisheries regulations; Fisheries management; Sustainable fisheries; Continued productivity (biological) of the target species; Impacts of fishing on the physical environment and on non-target (by-catch); Associated and dependent species (ecological); Participating fishers (economic) and Employment opportunities for those dependent on the fishery for their livelihoods (social)

Recommended Reading:

1. Banerjea, S.M. (1967). Water qulity and Soil Condition of Fish Ponds in Some Stages of India in Relation to Fish Production
2. De Bruin G.H.P.; Russell B.C. and Bogusch A. (1994). The Marine Fishery Resources of Sri Lanka. Food and Agriculture Organization of the United Nations. Rome
3. Fisheries and aquatic resources act- 1996.
4. Rothschild, B. J. (1983). Global fisheries: perspectives for the 1980s. Springer-Verlag, New York
5. Walters, C., and S.J.D. Martell. (2004). Fisheries ecology and management. Princeton.

ZL3121- Fisheries – Practical

Course Content: Different fishing gear and crafts; Different fish preservation methods; Site selection criteria for different aquaculture practices; Different aquaculture farming practices; Fish disease diagnosis.

Recommended Reading;

1. King M. (2007). Fisheries Biology, Assessment and Management, Blackwell, U.S.A.
2. Pillai, V. K., and C. E. Boyd. (1985). A simple Method for calculating Liming rates for fish Ponds.
3. MFARD (1995) fishing vessels and fishing gear types of Sri Lanka. UNDP/FAO/SRL/91/022
4. Jayakody D.S. and S.A. Sugathasirilal (1998). Catalogue of fishing gear in Sri Lanka. NARA, Colombo, Sri Lanka, 80p.
5. Sainsbary J.C. (1986). Commercial fishing methods- an introduction to vessels and gears. Second edition

10.5 400 Level of Study

Course Units and Syllabus

Course Code	Course Title	Hours* (L/P/IL)	Credits	Prerequisite	BScHons (Zoology)
ZL4011	Avian and Mammalian Biology	15/0/35	1		✓
ZL4022	Aquaculture	30/0/70	2	ZL3061, ZL3111	⊗
ZL4031	Aquaculture (Practical)	0/30/20	1	ZL3071, ZL3121	⊗
ZL4041	Marine Biology	15/0/35	1		⊗
ZL4051	Marine Biology (Practical)	0/30/20	1		⊗
ZL4062	Wildlife management	30/0/70	2		⊗
ZL4071	Herpetology	15/0/35	1		✓
ZL4082	Fish population dynamics and Management	30/0/70	2	ZL3061	⊗
ZL4093	Developmental genetics	45/0/105	3		⊗
ZL4102	Advanced biotechnology	30/0/70	2		⊗
ZL4111	Advanced biotechnology (Practical)	0/30/20	1		⊗
ZL4121	Fish pathology	15/0/35	1	ZL2071	⊗
ZL4131	Fish pathology (Practical)	0/30/20	1	ZL2081	⊗
ZL4143	Natural resource Management & Development planning	45/0/105	3		⊗
ZL4152	Coastal environment management	30/0/70	2		⊗
ZL4163	Ecotourism	45/0/105	3		⊗
ZL4172	Advanced pest management	30/0/70	2	ZL3041	⊗
ZL4181	Advanced pest management (Practical)	0/30/20	1	ZL3051	⊗
ZL4192	Evolutionary biology and Systematics	30/0/70	2		⊗
ZL4202	Environmental Impact assessment	30/0/70	2		⊗

ZL4213	Conservation biology	45/0/105	3		⊗
ZL4222	Nutritional Biochemistry	30/0/70	2		⊗
ZL4231	Nutritional Biochemistry (Practical)	0/30/20	1		⊗
ZL4243	Laboratory techniques	45/0/105	3		✓
ZL4252	Applied animal Behavior & welfare	30/0/70	2		⊗
ZL4262	Scientific writing & Presentation	30/0/70	2		✓
ZL4272	Seminars & Essays	10/0/90	2		✓
ZL4288	Research Project#	800	8		✓

♣Hours are distinguished as (Lecture/practical/independent learning) that cover time taken for assessments.

The symbol "✓" denotes that course is compulsory for the Degree Programme.

The symbol "⊗" denotes that course is elective for the Degree Programme.

The symbol # denotes notional learning hours for course units in category 3.3B.

ZL4011- Avian and Mammalian Biology

Course contents: Origin and evolution of birds; Adaptation for aerial life; Dynamics of avian flight; Biology of birds; Migration and navigation of birds; Bird song and territory; Darwin's finches; Avi fauna of Sri Lanka; Avian Conservation Projects; Origin and evolution of mammals; Mammalian characteristics; Egg- laying mammals; Biology of kangaroos; Carnivorous mammals; Herbivorous mammals; Aquatic mammals; Insectivorous mammals; Flying mammals; Echolocation; Coping with cold and heat; Mammalian biology: basic morphology, physiology, ecology, behavior and reproduction in selected families. Mammals of Sri Lanka; The economic importance of mammals and their conservation; endangered species; Field techniques of trapping, specimen preparation and identification of birds and mammals.

Recommended Reading;

1. D.R. Khanna and P.R. Yadav (2005) Biology of Birds. Discovery Publishing House Pvt. Ltd, New Delhi,
2. I. Newton (2003) Speciation and Biogeography of Birds, Academic Press, New Delhi.
3. K. Kazimierczak (2000) A Field Guide to the Birds of India, Sri Lanka, Pakistan, Nepal, Bhutan, Bangladesh and the Maldives, New Delhi, Om Book Service.

4. Sutherland, W. J. (1996). Ecological Census Techniques: A Handbook. Cambridge University Press, London.
5. Vaughan, T. A Ryan,, J.M. and (Author), Czaplewski , N.J. (2013). Mammalogy, (Jones & Bartlett Learning Titles in Biological Science) 6th Edition. Jones & Bartlett Learning
6. Feldhamer, G.A, Drickamer, L.C., Vessey, S.H., Merritt, J.F. and Krajewski, C, (2015) Mammalogy: Adaptation, Diversity, Ecology JHU Press.

ZL4022-Aquaculture

Course Content: Need for aquaculture; Culture methods; Site selection; Pond construction; Effluent water treatment; Increasing production; Food and feeding; Biology and culture of selected species belonging to Pisces, Crustacean, Mollusca and Seaweeds; Hatchery production of post larvae and fry; Aquaculture industry: extensive, semi-intensive and intensive cultures; small scale rural aquaculture and large scale industrial aquaculture; Aquaculture and environment

Recommended Reading:

1. Ackefors H., Huner J., Konikoff M. (1994) Introduction to the General Principles of Aquaculture
2. Blakeley, D.R. and Hrusa, C.T. (1990). Inland aquaculture development handbook. Blackwell Scientific. 192 pp.
3. Boyd, C.E. (1991). Water quality in ponds for aquaculture. Auburn University. 486 pp.
4. Colt, J. (1984). Computation of Dissolved Gas Concentrations in Water as Functions of Temperature, Salinity, and Pressure. Amer, Fish, Soc., Spec, Publi
5. Chen, K. and Ramos, S. (1989). Prawn farming: hatchery and grow-out operations. McGraw-Hill. 186 pp.
6. Ellis, A.E. (Ed.) (1985). Fish and shellfish pathology. Academic Press, London. xxvi, 412 pp

ZL4031- Aquaculture – Practical

Course Content: Classification and identification referred to in different culture and aquaculture systems; Growth study of farming species; Breeding trials in different conditions; Study the biology of farmed species; Field study; Preparation of reports on either team or individual study.

Recommended Reading:

1. Abbott, I. A. and Norris, J.N. (Eds.) (1984). Taxonomy of economic seaweeds with reference to some Pacific and Caribbean species.167 pp
2. Ahne, W. (Ed.) (1980). Fish diseases: Third COPRAQ- Session. Springer-Verlag. 252 pp. New York.
3. Alabaster, J.S. and Lloyd, R. (1982). Water quality criteria for freshwater fish. 2nd. ed. Butterworth.
4. Anon. (1982). Ponds - planning, design, construction. Agriculture handbook, Department of Agriculture. Soil Conservation Service (U.S.A.). 51 pp
5. Bagenal, T. (Ed.) (1978). Methods for assessment of fish production in fresh waters. Blackwell Scientific. 365 pp

ZL4041-Marine Biology

Course Content: History of oceanography; Ocean currents; Marine zonation; Marine ecosystems; Adaptations of marine organism; Biotic and abiotic interaction of marine ecosystems; Biology of coral reefs; Marine plankton productivity; Marine energy budgets; Marine pollution; Deep sea biology; Sensitive area in marine ecosystem; Preventive measures to marine pollution; Laws and regulations to mitigate marine pollution.

Recommended Reading:

1. George K., Richard T., James S., (2000). Introduction to Marine Biology: 512 pages, Publisher: Brooks Cole.
2. Paul, V. J., (1992). Ecological roles of Marine natural products. 245 Pages, Comstock, Ithaca, NY
3. Jeffrey Levinton. (2000). Marine Biology, 4th Edition, Oxford University Press, UK
4. Peter C., Michael E. Huber, (2005), Marine Biology, 688 pages, Publisher: McGraw-Hill
5. Thurman, Harold, (2001) Introduction to Oceanography, 712 pages, Prentice Hall Inc.New Jerse

ZL4051- Marine Biology – Practical

Course Content: Measurement of physical and chemical parameters of marine ecosystems; Identification of plankton, nekton, algae and sea grasses of marine

ecosystem; Marine invertebrates and vertebrates fauna; Population estimation techniques of fish, Plankton counts; Calculation for diversity indices to determine the aquatic health; Design the experiments to find out changes in marine ecosystem and pollution.

Recommended Reading:

1. Michael J. Kennish. (2000). Practical Handbook of Marine Science, Third Edition, 896 Pages, CRC Press.
2. Newell, G.E.; Newell, R.C. (1996). Marine Plankton - A Practical Guide, 221 Pages, Hutchinson, London.
3. Sylvia A. Earle (1996). Sea Change: A Message of the Oceans, 384 Pages, Ballantine Books, UK

ZL4062-Wildlife Management

Course Content: Introduction ; history of wildlife management; Basic ecological principles; Population: Growth and Regulation; Animal behavior and wildlife management; food and cover; Water, disease, farmlands, forests,and rangelands; Wetland habitat; Consumptive and non-consumptive uses of wildlife; Exotic species; Endangered species; Wildlife economics and politics,quantitative techniques used in wildlife management. Use of computer-based geographic information systems (GIS) in a natural resource context. Management of threatened Wildlife; Wildlife and Society; Minimum Viable Population; Island Biogeography; Field work related to wildlife management.

Recommended Reading:

1. Bailey, J.A. (1984).Principles of Wildlife Management, Wiley.
2. John M. Fryxell, Anthony R. E. Sinclair, Graeme Caughley, 2014, Wildlife Ecology, Conservation, and Management, third Edition, Wiley,
3. Krausman, P.R. (2002). Introduction to Wildlife Management: The Basics, Prentice Hall,
4. Silvy, N.J. (2012) The Wildlife Techniques Manual: Volume 1: Research. Volume 2: Management 2-vol. Set.,7th Edition, JHU Press.

ZL4071- Herpetology

Course Content: Introduction to herpetology; Transition from water to land and the evolution and adaptive radiation of amphibians; Biology of amphibians;

Metamorphosis and paedomorphosis; Parental care and behaviour; Communication in frogs and toads; Systematics, biogeography, reproduction and life histories of amphibians and reptiles; Diets and foraging, Interaction with predators and parasites; Communication; Ecological techniques for amphibians and reptiles; Marking and individual recognition techniques of amphibians and reptiles; Conservation and the future of amphibians and reptiles; Thermal biology; Water balance and gas exchange; Sensory perception; Dispersal/movement; Biophysical ecology and conservation; Habitat modification Climate change Invasive Species; Amphibians as bio-indicators; Global and local threats to amphibians; Conservation of amphibians; Life on land: The evolution and radiation of reptiles; temperature dependent- sex-determination; Cleidoic egg and its significance; K/T extinction of the dinosaurs; Conservation and management of endangered reptiles.

Recommended Reading:

1. Conant, R., Collins, J.T., Conant, I.H., Johnson, T.R., Collins, S.L. 1998. Peterson Field Guide: Reptiles and Amphibians of Eastern & Central North America, 4th Edition. Houghton Mifflin Harcourt.
2. Elsevier Conant, R. and J.T. Collins. 1998. Reptiles and Amphibians: Eastern/Central North America. Houghton Mifflin Company
3. Ferner, J.W. 2007. A review of marking and individuals recognition techniques for amphibians and reptiles. Society for the study of amphibians and reptiles, Herpetological Circular No. 35, Salt Lake City, Utah, USA, 72 pp.
4. Herpetology, 3rd Edition, Pearson Education, Inc, Pearson Prentic Hall, Upper saddle river, NJ, USA 726 pp.
5. Laurie J. Vitt & Janalee P. The Peterson Field Guide to Western Reptiles and Amphibians by Stebbins. ISBN: 0395982723
6. Pough, F.H., Andrews, R.M, Cadle, J.E., Crump, M.L, Savitzky, A.H., and Wells, K.D. 2004.
7. Pough, F.H., Andrews, R.M., Cadle, J.E., Crump, M.L., Savitsky, A.H., Wells, K.D. 2004. Herpetology, 3rd Edition. Pearson Prentice Hall.
8. Stebbins, R.C. 2003. A Field Guide to Western Reptiles and Amphibians (3rd Ed.). Houghton Mifflin, Boston, MA.
9. Sutherland, W.J. 1996. Ecological census techniques: A hand book. Cambridge University Press, Cambridge, United Kingdom, pp 205-226

10. Vitt & Caldwell Herpetology: An Introductory Biology of Amphibians and Reptiles, Third Edition, by, ISBN: 9780123743466Vitt, L.J. and J. P. Caldwell. 2009. Herpetology, 3rd Ed.

ZL4082- Fish Population Dynamics and Management

Course Content: Recent trends in world fisheries; Tuna and tuna like fisheries; Effects of anthropogenic activities on world fisheries; Legal regime of the sea on fisheries; Shared stocks; Untapped resources; Enhancement strategies; Fisheries of the Indian Ocean, Marine, Estuarine, Freshwater fisheries of Sri Lanka; Concept of unit stock; Methods of fish stock identification, Age and growth of fish; Gear selection; Recruitment: stock-recruitment relationships, mortality, estimation of population size; Using virtual population analysis and cohort analysis; Concepts of Maximum sustainable yield; Surplus yield models; Maximum Economic Yield and Maximum Social Yield; Yield per recruit models; Semi-quantitative methods in fish stock assessment; Introduction to fisheries management; Issues associated with the management of fisheries; Community-based fisheries management; Fisheries co-management.

Recommended Reading:

1. King, M. (2007), Fisheries Biology, Assessment and Management, Wiley-Blackwell.
2. Pitcher, T.J. and Hart, P.J.B. (1982), Fisheries Ecology, Croom Helm, London.
3. Pauly, D. (1984) Fish Population Dynamics in Tropical Waters: A manual for use with
   programmable calculators, ICLARM, Manila.
4. Sparre, P. and Venema, S.C. (1999), Introduction to tropical fish stock assessment, Parts 1 and FAO Fisheries Technical Paper 306/1 and 306/2 (Rev. 2), FAO, Rome.
5. Gayanilo, Jr., F.C. and Pauly, D. (1997), FAO-ICLARM stock assessment tools: Referencemanual. FAO Computerized Information Series, Fisheries. FAO, Rome.

ZL4093- Developmental Genetics

Course Content: Pattern formation, Positional information and polarity, Determination of segments, Molecular basis of polar coordinate model, Selector genes and homeotic transformation, Spacing patterns, Pattern formation and

epigenetics, Morphogenesis, Genetic mosaics, Developmental mutants, Bristle formation and lateral inhibition, Neurogenesis in Drosophila and Vertebrates, Transgeneic technology in development, Cell cycle and apoptosis, Pattern formation in imaginal discs. Role of transcription factors in eye development, Determination and trans determination, Signal transduction in the development, Gene Regulation, Analysis of Developmental pathway, Sex determination, Oncogene regulation, Transcriptional control by transcription factors, Erythroid differentiation, Expression and control of globin genes, Antibody synthesis and its regulation, Abzymes, Egg production and egg white protein gene organization and synthesis.

Recommended Reading:

1. Lawrence P.A (1992) The making of a fly. Blackwell scientific Publication.
2. Miglani.G.S (2006) Developmental Genetics.I.K International Publishing Pvt Ltd New Delhi
3. Twyman.R.M (2001) Developmental Biology Vivabooks private Ltd, New Delhi.

ZL4102- Advanced Biotechnology

Course Content: Recombinant DNA Technology: Vectors, gene transformation, Recombinant screening, Protein engineering, Molecular markers: RAPD, RFLP, SCAR, microsatellites and SNPs, molecular breeding, DNA forensics, Microbial and Medical Biotechnology, Gene therapy, Stem cell research, Molecular diagnostics, Pharmacogenomics and recombinant pharmaceuticals, Environmental biotechnology and its applications, Agricultural biotechnology; production of transgenics, genetically modified (GM) organisms, GM food, Processed products, biotechnology and biosafety, nanobiotechnology and other diverse applications.

Recommended Reading:

1. Lesk, A.M. (2014) Introduction to Bioinformatics, (Fourth Edition). Oxford University Press.
2. Dehlinger, C.A. (2014) Molecular Biotechnology, Jones and Bartlett Learning.
3. Brown, T.A. (2010) Gene Cloning and DNA Analysis: An Introduction, (Sixth Edition). Wiley-Blackwell.
4. Soetaert, W., Vandamme, E.J. (2010) Industrial Biotechnology: Sustainable Growth and Economic Success, (First Edition). Wiley-UCH.

5. Evans, G.M., Furlong, J.C. (2010) Environmental Biotechnology: Theory and Application. Wiley-Blackwell.

ZL4111- Advanced Biotechnology Practical

Course Content: Isolation and purification of DNA and RNA, isolation of plasmids, electrophoresis, PCR amplification, restriction digestion, Southern transfer technique, preparation of competent cells, transformation and screening, determination of copy number of plasmids, construction of genomic library, determination of promoter activity, ELISA techniques. Introduction to bioinformatics: Molecular databases, bioinformatics and computational biology software, sequence retrieval, sequence submission tools, sequence alignment, protein structure analysis, phylogenetic analysis and construction of phylogenetic trees, Field visits to gain knowledge on biotechnological applications in various fields.

Recommended reading:

1. Lesk, A.M. (2014) Introduction to Bioinformatics, (Fourth Edition). Oxford University Press.
2. Yang, Z. (2014) Molecular Evolution: A Statistical Approach, (First Edition). Oxford University Press.
3. Green, M.R., Sambrook, J. (2012) Molecular Cloning – A Laboratory Manual, (Fourth Edition). Cold Spring Harbor Laboratory.
4. Pevsner, J., (2009) Bioinformatics and Fundamental Genomics, (Second Edition). Willey Blackwell.
5. Ninfa, A.J., Ballou, D.P., Benore, M. (2009) Fundamental Laboratory Approaches for Biochemistry and Biotechnology, (Second Edition). John Wiley and Sons, Inc.
6. Baxevanis, A. D., Ouellette, B.F. (2004) A Practical Guide to the Analysis of Genes and Proteins, (Third Edition). Wiley-Interscience.

ZL4121- Fish Pathology

Course Content: Pathogenic, Parasitic diseases of shell fish and fin fish from the tropical and temperate countries**.**

Recommended Reading:

1. R. J Roberts(1978) Fish Pathology

2. P. T. K. Woo,(1995) Vol I, Vol II and Vol III - Fish Diseases and Disorders CAB International , Oxon, UK.
3. Janis Kuby 1992 Immunology By W H Freeman and Company
4. Kennedy, C. R. (1994) Parasitic Diseases of Fish. Samara Publishers, Tresaith, Dyfed, UK.

ZL4131- Fish Pathology Practical

Course Content: Identification of common ecto and endo parasites of shell fish and fin fish from tropical and temperate countries. Isolation and identification of bacteria and fungal. Histopathological study, examination of health of fin fish and shell fish with the environmental condition.

Recommended Reading:

1. R. J Roberts,(1978) Fish Pathology
2. P. T. K. Woo,(1995) Vol I, Vol II and Vol III - Fish Diseases and Disorders CAB International , Oxon, UK,
3. Identification of parasitic Crustaceans, Natural History Museum, UK.

ZL4143 - Natural Resource Management and Development planning

Course Content: Biological and chemical resources available in Sri Lanka, Sustainable usage of resources, Coastal marine resources (finfish, shellfish, sea mammals, fossil fuels, minerals, nuclear resources), Resources from terrestrial environment (forest, water shed, mangrove and coal), Environmental sociology, Environmental impact assessment and management, Sustainable development and policy planning, Wild life conservation and management, Resource budgeting, Role of natural resources for regional planning and development, Renewable resource management, Cost benefit analysis in resource planning and management, Management implication of resources, Conservation Vs Preservation, optimal extraction of resources, Historical perspective of resource degradation, property rights.

Recommended Reading:

1. McClanahan, T. R, Sheppard, C. and Obura, D. O. (Ed.) (1996). Coral Reefs of the Indian Ocean: Their Ecology and Conservation Oxford University Press.

2. Sesabo, J. (2007). Marine Resource Conservation and Poverty Reduction Strategies in Tanzania. Publisher: Springer
3. Sherman, K; Okemwa, E and Ntiba, M. (1998). Large Marine Ecosystems of the Indian Ocean. Assessment, sustainability and management. Blackwell Science
4. Foot, M., and Hook, C. (2008). Introducing Human Resource Management. 5th Edition. Pearson Prentice Hall.

ZL4152- Coastal Environmental Management

Course Content: Critical appraisal of marine and coastal production systems such as open sea, coral reefs, mangroves, sea grass beds, estuaries, lagoons, marshes and associated marine and terrestrial forests; Impacts of anthropogenic (i.e. coastal tourism, sewage outfalls, oil spills, aquaculture, global warming, maritime transport and ballast water disposal, coral mining and over fishing) and natural disturbances (i.e. Tsunamis and tidal waves) on coastal production systems; United Nations Convention on Law of the Sea; Remote sensing, mapping, evaluation and assessment of coastal resources; Environmental impact assessment on marine and coastal systems; Participation and role of the government, NGOs and the coastal communities (i.e. stake net fishery in Sri Lanka) in the sustainable utilization, management and governance of coastal resources; Economics and environmental politics of coastal natural resources. Revenue-generation mechanisms for services such as coastal erosion prevention and marine protected areas; Principles and practice of integrated coastal zone management and conservation programs and reinforcing linkages with other aspects of natural resources management practices (i.e., watershed management); Incentives for coastal resources management and conservation.

Recommended Reading:

1. Central environmental Authority, Sri Lanka (1994), Wetlands are no wastelands; A manual and strategy for conservation and development of wetlands. Wetlands conservation project, Central environmental Authority, Sri Lanka.
2. Haq, B.U., Kullenberg, G., and Stel, J.H (2013). Coastal Zone Management Imperative for Maritime Developing Nations, Springer Science & Business Media.
3. Le Tissier M, Roth D, Bavinck M, Visser L. (2011). Integrated Coastal Management: from post-graduate to professional coastal manager. Eburon Academic Publishing.

4. Sarkar, D. (2015). An Integrated Approach to Environmental Management, John Wiley & Sons.
5. UN, (1995). Planning Guidelines on Coastal Environmental Management Coastal zone management.

ZL4163- Ecotourism

Course Content: Types of tourism; Potential for ecotourism: Landscapes (ecosystems), Man-made ecosystems, Cultural background, Biological diversity, Protected Areas, Coral reefs, Elephant orphanage; Ecotourism services: Sources of information; Potential for joint ecotourism with nearby countries; Constraints to tourism; Ancillary benefits of ecotourism; Negative impacts of tourism; Improvement of ecotourism facilities. Ecological principles applied to tourism; principles of human behavior related to eco-tourism issues; the relationship between natural resources and tourism; planning and management of natural, cultural resources; the environment, conservation, protected areas, and economic benefits; Community-based ecotourism; Monitoring the success and impacts of community-based tourism; Ecotourism practices; Transportation; Facilities; Services; The ecotourists (types, and code of ethics); Eco-labeling and green-washing

Recommended Reading:

1. Beeton, S. (1998). Ecotourism: A Practical Guide for Rural Communities, Landlinks Press.
2. David A. Fennell, D.A. and Dowling, R.K. (2003), Ecotourism Policy and Planning, CABI
3. Hill, J and Tim, G. (2012).Ecotourism and Environmental Sustainability: Principles and Practice, Ashgate Publishing Ltd.
4. Honey, M. (2008). Ecotourism and Sustainable Development, Second Edition: Who Owns Paradise?, Island Press,

ZL4172- Advanced Pest Management

Course Content: Insect Pests and the damage they cause; Insect population dynamics and pest status; Insect pests of agriculture, stored products, plantation crops, forestry, horticultural and export crops; Factors affecting the abundance of insects, Physical methods of pest control, Chemical control, different types of

insecticides and their target sites, Development of insecticide resistance, mechanisms underlying insecticide resistance, Pest outbreaks, Biological control, Examples of successful biological control, Techniques of microbial pesticides, Pheromones for monitoring pest populations, Plant resistance mechanisms, Cultural and legislative control, Other control methods, Genetic control, Repellents , attractants and growth regulators, Integrated pest management practices.

Recommended Reading:

1. David Dent (2011) Insect Pest management ISBN: 9780851986678 from Amazon's Book store.
2. Heikki M.; Hokkanen T., Lynch J.M. (Eds.) 1996 "Biological Control - Benefits and Risks", Cambridge University Press, UK, 326 pp. ISBN: 9789048126651.
3. Agricultural Insect Pests of the Tropics and Their Control. D.S. Hills (1983) Cambridge University Press

ZL4181- Advanced Pest Management Practical

Course Content: Identify the insect pests of economic importance and their natural enemies, Assessment of economic threshold level of insects, Classification and mode of action of insecticides, Insecticide bioassays to monitor insecticide resistance, Culturing of insects on artificial diet, Assess searching capacity, fecundity of insects, study the successful examples for insect pest management.

Recommended Reading:

1. Hill. D.S (1986) Agricultural insect pests of the Tropics and their control
2. Raveendranath. S (2003) Recent Trends in Pest Management

ZL4192-Evolutionary Biology and Systematics

Course Content: Major phases of theories of Evolution; Major aspects of Evolutionary Biology; Evolutionary forces; Variation among organisms; Natural Selection: Adaptation; Camouflage; Mimicry; Coevolution; Coadaptation; Exaptation; Reproductive isolation mechanisms and Speciation; Extinction in evolution: Causes and consequences; Molecular evolution and genetic variation; Principles of Cladistics. Essentials and principles of systematics in animal

kingdom; Morphological, cytological, chemical and molecular techniques applied in taxonomy.

Recommended Reading:

1. Futuyma, D.J. (2006). Evolutionary Biology, Sinauer Associates.
2. Goodman, M. (2012). Macromolecular Sequences in Systematic and Evolutionary Biology**,** Springer Science & Business Media
3. Hennig, W., Davis, D.D. and Zangerl, R. (1999). Phylogenetic Systematics, University of Illinois Press
4. National Academy of Sciences. (2005). Systematics and the Origin of Species: On Ernst Mayr's 100th Anniversary, National Academies Press.
5. Pontarotti, P. (2011). Evolutionary Biology – Concepts, Biodiversity, Macroevolution and Genome Evolution, Springer Science & Business Media.

ZL4202- Environmental Impact Assessment

Course Content: Introduction to Environmental Impact Assessment (EIA), Steps in EIA, EIA methods, EIA process, Problems associated with EIA process in developing countries and potential solutions, Myths about EIAs, Incorporation of impacts and their mitigation into the process, Use of EIA as a decision making tool for achieving sustainable development. Case studies. Importance of environmental monitoring for environmental impact assessment, Main parameters to be monitored in key environmental issues: physical parameters, chemical parameters, biological parameters, socio-economic parameters, legal aspects of EIA, design of a monitoring programme, Techniques commonly used in chemical and biological monitoring of the environment, Environmental sampling and analysis, Quality assurance and Safety procedures.

Recommended Reading:

1. Hennanayake, S.K., Hewage A., Wijeratne M.S. and Yasaratne S.E. (1997) Environmental Impact Assessment, The Sri Lankan Experience. Centre for Environmental Studies, Peradeniya.
2. Jamil, K. (2001) Bioindicators and Biomarkers of Environmental Pollution and risk assessment, Science Publishers Inc. Plymouth
3. Morris, P. and Therivel, R. (2009). Methods of Environmental Impact Assessment, Routledge,
4. Troma, S. (2012). Environmental Impact Assessment, Bloomsbury Publising.

5. Wathern, P, (2013). Environmental Impact Assessment: Theory and Practice, Routledge, Feb 1, 2013.

ZL4213- Conservation Biology

Course Content: Introduction to conservation biology, Biological diversity and its values, Current methods used in conservation, Biological diversity conservation in Sri Lanka, Units of conservation, Species concepts and conservation biology, New habitats and species, Species Richness, Species diversity, Endemism, Mega diverse nations, Concept of global hot spots, Classification of threats, Types of extinctions, Rarity and conservation priority, IUCN categories for the conservation status of taxa, Red data book, Population viability analysis and concept of minimum viable populations, Protecting species; In-situ conservation and sustainable utilization, Ex-situ conservation and captive breeding with re-introduction, Legal and international aspects of conservation biology, Protected areas, captive breeding and reintroduction, management of endangered species, International trade and CITES, Ecotourism,.

Recommended Reading:

1. Dyke, F.V. (2008). Conservation Biology: Foundations, Concepts, Applications Springer Science & Business Media.
2. Fa, J.E., Funk, S.M. and O'Connell, D. (2011). Zoo Conservation Biology, Cambridge University Press.
3. Lindenmayer, D. and Burgman, M.A. (2005). Practical Conservation Biology Csiro Publishing,
4. Sodhi, N.S. and Ehrlich, P.R. (2010). Conservation Biology for All. Oxford University Press.
5. Soulé, M.E. and Orians, G. (2001). Conservation Biology: Research Priorities For The Next. Decade Island Press.

ZL4222-Nutritional Biochemistry

Course Content: The energetics of metabolism; the structure and metabolism of proteins, carbohydrates, lipids, nucleotide and cholesterol and the integration of metabolic systems. Food macronutrients; structure, function, digestion, assimilation of protein, lipids, carbohydrates, dietary fibre and water soluble

and fat soluble vitamins. Blood plasma lipoproteins, Role of CRP and prostaglandins and its metabolism with special reference to non- communicable diseases. Tissue specific metabolism: the fed fast cycle; metabolism during the fed, postabsorptive, fasting and starvation states.

Recommended Reading:

1. Lubert Stryer, John L. Tymoczko, Jeremy Mark Berg (2002). Biochemistry, 5th Edition, W.H.Freeman Company, ISBN: 0716730510

2. Christopher K. Mathews, Kensal E. van Holde, Kevin G. Ahern (1999). Biochemistry, Pearson Benjamin Cummings Publication, ISBN: 08005330666
3. Maria .C.Linder (1991).Nutritional Biochemistry and Metabolism : Clinical applicataions,2nd Edition, Elsevier Publication,UK
4. Susan ,S. Lanham-New , Ian .A.Macdonald and Helen ,M.Roche (2010), Nutrition and Metabolism ,2nd Edition, Willey –Blackwell.

ZL4231-Nutritional Biochemistry Practical

Course Content: Practical work related to basic experiments in biochemistry: Protein, Lipid, Carbohydrates, and Vitamin. Isolation and identification of the nutrition: Extraction of lipids and proteins using biochemical assays. Use of biochemical equipment: chromatrography (paper and column). Short project work parallel to practical work. Critical analysis and interpretation of the experiment results, and writing of the report.

Recommended Reading:

1. David .J. Hole and Hazel Peek (2000), Analytical Biochemistry, 2nd Edition, Longman Scientific and Technical Publication.Uk
2. Robet Switzer and Liam Garrity (1999), Experimental Biochemistry: Theory and Excercises in Fundermental methods , 3rd Edition, W.H Freeman & CO, USA
3. Keith Wilson and John Walker (2000). Practical Biochemistry : Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press, UK
4. Joshi A. Rashmi , (2002) A Textbook of Practical Biochemistry , Jain Publishers.

ZL4243 - Laboratory Techniques

Course Content: Use of different microscopes and microphotography, photograph by digital camera and scale bar calculation, Culture methods of invertebrates and vertebrates organisms, Whole mount preparations, Different techniques of slide preparations, single, double staining, cartilage, blood smear, Insect larval cuticle mounting, Polytene chromosome preparation, Museum preparation of insects, mounting techniques of organs such as salivary gland, reproductive system of Sitophilus sp, Chick embryo preparation, cell division stages, preservation methods of skeleton, taxidermy, Formalin preparation, herbarium preparation, preservation of mollusks, Microtome sectioning, & permanent slide preparation of sections, sampling techniques of terrestrial ecosystem and aquatic ecosystem, basic statistical analysis, Culturing methods of microbes such as bacteria and fungi, Basic biochemical analysis (carbohydrates, proteins and fats), Water analysis (Salinity, Ph, BOD, Nitrate, COD, Phosphate, Turbidity, Plankton count),Dissection of selected animals, artificial breeding of fish, , basic laboratory health and safety measures.

Recommended Reading:

1. Phillip.L. R.Bonner; Alan J. Hargreaves. Basic Bioscience laboratory techniques: a pocket guide ISBN 978-0-470-74309-6
2. Cappuccino G. James and Sherman Natalie. Microbiology, a laboratory manual. 7th edition. Pearson Education publication.
3. Kenneth Hardong and Edward Zalisko .Comparative Vertebrate Anatomy: A laboratory dissection guide.6th edition
4. S.B.Pal (1990) (editor) handbook of laboratory health and safety measures.

ZL 4252- Applied Animal Behaviour and Welfare

Course Content: Concepts of animal behaviour on welfare issues in modern husbandry of productive and companion animals. Major questions related to modern applied animal behaviour and welfare in a given environment. A review of affective states and concepts of animal welfare, human-animal relations, husbandry animals respond to their captive environment. Theory on motivation and organization of behavior, Abnormal behaviour, Experience stress, regulation of abnormal behavior, assessment, evaluation and monitoring of animal welfare, ongoing welfare issue, Human–animal interface model, Dominance concept, Flight distance, Crowding and over-crowding, Social facilitation, Stress and its measurements.

Recommended Reading:

1. Applied Animal Behaviour Science, (1996) Behaviour and Welfare of Extensively Farmed Animals, Volume 49, Issue 1 of Applied animal behaviour science, Elsevier.
2. Broom, D.M. and Fraser, A.F, (2015), Domestic Animal Behaviour and Welfare, 5th Edition, CABI
3. Hosey, G, Melfi,V, and Pankhurst, S. (2013), Zoo Animals: Behaviour, Management, and Welfare, 2nd Edition, OUP Oxford,
4. Mills, D.S. and Marchant-Forde, J.N.(2010). The Encyclopedia of Applied Animal Behaviour and Welfare CABI.

ZL4262- Scientific writings and Presentation

Course Content: Writing Scientific Papers and Project Proposals; Organization and Content; Guidelines for writing under different headings; Developing Tables and Figures, Data analysis and interpretation, Referencing using the number system and Harvard referencing system, Ethics in scientific writing and publishing, Making oral presentations of scientific material; Guidelines for preparation of presentations; Effective use of visual aids; Delivery and presentation style.

Recommended Reading:

1. Robert A. Day and Barbara Gastel (2006) How to write and publish a scientific paper. 6th Edition
2. A. Gillett, A. Hammond & M. Martala (2009) Successful Academic Writing.
3. K.L. Turabian (1996) A Manual for Writers.

ZL4272- Seminar and Essays

Course Content: Make a presentation of an assigned topic after literature survey and produce a written article on the topic critically analyzing primary literature; Write three essays in the class on given topics after due preparation and literature survey.

Recommended Reading:

1. Primary Literature relevant to the topic.
2. The Craft of Scientific Presentations; Critical Steps to Succeed and Critical Errors to Avoid (2003) Michael Alley Springer-Verlag New York, Inc. (Available online).

3. Designing Science Presentations: A Visual Guide to Figures, Papers, Slides, Posters, and More (2013). Matt Carter 1st Ed. Elsevier Inc.

ZL4288- Research Project

Course Content: A research project on a given zoological topic shall be carried out under the supervision of staff members at the beginning of the 4th academic year. The student is expected to write the Research Proposal and present it, carry out a literature survey and, on completion of the project, make an oral presentation of the work and submit a written report. The projects may be carried out in the areas of Animal Behaviour, Ecology, Conservation biology, Entomology, Environmental toxicology, Physiology, Fish biology, Fisheries Management, Genetics, Entomology, and Parasitology. Before commencement of the research work, plan and the methodology of the project should be presented at a seminar. A dissertation should be submitted before the end of the academic year. Results should be presented at a seminar.

Recommended Reading:

1. Briscoe, M.H. (1996) Preparing Scientific Illustrations. Springer, Amsterdam.
2. Zar, J.H. (1999) Biostatistical Methods. Prentice-Hill, New Jersey.

11 Auxiliary, Enhancement and Supplementary Courses

11.1 Auxiliary Course Units

11.1.1 100 Level of Study

Course Units and Syllabus

Course Code	Course Titles
ENG100	English Level-I
CPD100	Motivation for self-development and adaptability
SLV100	Ethnic Cohesion and Social Harmony

ENG100 - English Level-I

Course Content: Parts of speech: Noun, adjective, adverb, articles, pronouns, verb, tenses, voices, infinitive and gerund, preposition, conjunction, interjection. Time and tenses: present, past, and future. Active and passive voice. If conditional sentences. Reported speech. Reading and speaking.

Recommended Texts:

1. Allyn and Bacon. Doing Grammar. 2nd ed. New York: Oxford University Press, 1997.
2. Wren, P.C. and Martin, H. High School Grammar and Composition. S. Chand and Company, New Delhi. 2005.
3. Kennedy, J. Everyday Grammar for the Beginners. Sri Lanka, 2009.
4. Alderson, J.C. Assessing Reading. Cambridge: Cambridge University Press, 2000.
5. Dudley-Evans, T. &St John, M. J. Developments in ESP: a multidisciplinary Approach. Cambridge: Cambridge University Press, 1998.
6. Urquhart, A. H. & Weir, C. J. Reading in a second language: Process, product, and practice. London and New York: Longman, 1998.

CPD100 - Motivation for self-development and adaptability

Course Content: Transition from school to university: objectives of higher education, university rules, regulations and procedures; role of university students: awareness and understanding of students to promote mutual respect and confidence amongst students and teachers; psychological support such as mentoring, personal tutoring and counseling, Provides students with clear and current information that specifies the learning opportunities and support available, and assists them to understand their responsibilities to engage in the learning; current and emerging trends of job opportunities; vision for life and goal setting; taking personal responsibility for career and personality development: Scientific motivation to spirituality, concept of self-reflection by maintaining logbook.

Recommended Webs:

1. https://www.managementstudyguide.com/role-of-personal- development-in-career-growth.htm
2. https://www.viralnovelty.net/path-self-awakening/
3. https://positivepsychologyprogram.com/introspection-self- reflection
4. https://www.psychologytoday.com/us/blog/the-new-resilience/201204/awakening-your-true-self-within-your-false-self

SLV100 - Ethnic Cohesion and Social Harmony

Course Content: Mutual understanding: How do I define my own identity? What is the meaning and value of diversity? How can we go beyond our preconceived ideas of "the other" to appreciate and understand the similarities and differences between us? What is the impact of social exclusion? How can we build an inclusive community? What do we mean when we speak of "social harmony"? Communication: How does perception affect the way we relate with others? How can I improve my verbal and nonverbal communication? What is the difference between assertive and aggressive communication? Basic language competence in Singhalese / Tamil: Introduction to alphabet, constructing simple words using the alphabet, introduction to Nouns and their different varieties, simple sentence structure, basics in sentence patters, simple reading and writing exercises, further into Grammer and usage (passive voice, case, etc.), practical language training, introduction to simple literature, practical listening and comprehension, further study on grammer. Report on Lessons Learnt and Reconciliation Commission (LLRC).

Recommended Texts:

1. Keshab Dahal, (2012). Inter-Ethnic Cohesion In Post War Sri Lanka: Assessing Communal Tolerance In No War No Peace. LAP LAMBERT Academic Publishing.
2. Merlin Schaeffer. (2016). Ethnic Diversity and Social Cohesion: Immigration, Ethnic Fractionalization and Potentials for Civic Action (Research in Migration and Ethnic Relations Series). Routledge.
3. Margaret Wetherell and Michelynn Lafleche, (2014). Identity, Ethnic Diversity and Community Cohesion. SAGE Publications Ltd.
4. Frans Wijsen, (2013). Religious Discourse, Social Cohesion and Conflict: Studying Muslim–Christian Relations (Religions and Discourse). Peter Lang AG, Internationaler Verlag der Wissenschaften;.
5. Bhikkhu Bodhi and His Holiness the Dalai Lama. (2016). The Buddha's Teachings on Social and Communal Harmony: An Anthology of Discourses from the Pali Canon (The Teachings of the Buddha). Wisdom Publications.
6. Narendra Modi. (2016). Social Harmony, Prabhat Prakashan

11.1.2 200 Level of Study

Course Units and Syllabus

Course Code	Course Titles
ENG200	English Level-II
CPD200	Career Prospects and personality development
SLV200	Community Outreach: Scientific Engagement

ENG200 - English Level-II

Course Content: Paraphrasing, Making quotations, Referring to sources, Expressing reasons and explanations / cause and effect. Describing a sequence of events / time relations. Punctuation, Writing introductions and conclusions, Report and proposal writing, Academic writing style, Revising the essay-proofreading.

Recommended Texts:

1. Arnold, J., & Harmer, J. Advanced Writing skills. London: Longman, 1978.
2. Campbell, A. F. Organize your English. London: Hodder and Stoughton, 1983.
3. Hamp-Lyons, L., & Heasley, B. Study writing. Cambridge: Cambridge University Press, 1987.
4. Johnson, K. Communicate in writing. London: Longman, 1981.
5. Jordan, R. R. Academic Writing course. London: Collins, 1980.
6. Kennedy, J. Writing Techniques. Sri Lanka, 2009.

CPD200 - Career Prospects and Personality Development

Course Content: Introduction to Career: Concepts of career, job vocation, profession and career guidance. Career Goals, Distinguish Career Planning from Career Management and guidance, Understand the role of career guidance and career counseling. Career Fields and career requirements: Requirements of the job, Requirements of job market, Match the job requirement with career life; Future trends of employability, threats and opportunities due to 4th generation technologies; Organizational culture, Roles and functions of managers, management styles, leadership theories, personality attributes for leadership, Influencing and persuasive skills, effective teamwork; Getting to know yourself: Skills, Talents, Strengths and Weaknesses, Interests. Personality Development theories: Definition, Factors influencing Personality Development, Process of Personality Development. Career Development Theories: Theories of career development and career choices. Personality development through scientific spirituality; encourage and facilitate engagement in yoga/meditation/ aerobatics/sports/aesthetics. Documentation of experiences and reflections via e-portfolio†

Recommended Texts:

1. Werner. J.M. & Desimone., R.L. (2006), Human Resource Development (4th Ed), pp 454- 503.
2. Greenberg. J., & Baron. R.A., (2003), Behavior in organization; Understanding and managing the human side of worker (8th ed), 99 227-269.
3. Jetfery. H,., Greenhaus, Gerard A. Callanan, Veronica M. Godshalk (20120), Career Management (SAGE).
4. Brad Harrington, Pouglas T. Hall, (2007), Career management and work-life integration: using self-assessment to negative contemporary careers, (SAGE).

SLV200 - Community Outreach: Scientific Engagement

Course Content: Reporting identified problem, time management skills (planning), Developing an environment for the effective team work, Community-based problem identification, Project design and implementation, Effective communication with stakeholders, Identification of scientific methods and problem solving, Preparation of e-Portfolio using a software, Report Writing.

Recommended Texts:

1. Colin Robson, How to Do a Research Project: A Guide for Undergraduate Students, 2nd ed., John Wiley & Sons, 2014.
2. Denis Reardon, Doing an Undergraduate Project, 1st ed., Sage Publications Ltd, 2006.
3. Richard Hand, Thomass W. Bell, Derrin Kent, Mahara ePortfolios: Beginner's Guide (Open Source: Community Experience Distilled), 2nd ed., Packt Publishing, 2012.

11.1.3 300 Level of Study

Course Units and Syllabus

Course Code	Course Titles
CPD300	Career Skills and Professionalism
SLV300	Science of Indigenous Knowledge and Practices
ENG300	English Level-III

CPD300 - Career Skills and Professionalism

Course Content: Motivate and guide to develop leadership qualities (honest, principled, self-motivated, proactive, responsible, autonomous, independent, confident, accountable, impartial, work towards common objective, etc.); provide guidance for making effective presentations, preparation of CV, facing job interviews, etc.; facilitate professional experiences/industrial visit; encourage and facilitate engagement in yoga/meditation/ aerobatics/sports/aesthetics. documentation of experiences and reflections via e-portfolio†

Recommended texts:

1. Norman Vincent Peale,(1992), Three Complete Books: The Power of Positive Thinking; The Positive Principle Today; Enthusiasm Makes the Difference
2. James Allen, & Charles Conrad, (2013), As a Man Thinketh.
3. Maxwell Maltz, (1970). Psycho-Cybernetics: A New Technique for Using Your Subconscious Power
4. Brendon Burchard (2012). The Charge: Activating the 10 Human Drives That Make You Feel Alive
5. Robbins, S.P. and Judge, T.A. (2013), Organizational Behaviour, (15 ed), Pearson Education Inc., Publishing as Prentice Hall: India.
6. Robbins, S.P., Judge, T.A. & Vohra, N (2012), Organizational Behaviour, (4th ed), Pearson Education Inc., Publishing as Prentice Hall: India.

SLV300 - Science of Indigenous Knowledge and Practices

Course Content: Scientific understanding/realization of the value of indigenous practices/wisdom via lecture/seminar sessions, independent learning; presentation / e-portfolio† based on a guided independent study (reporting realizations on scientific ground)

Possible directed studies: Indigenous therapy and healing practices, prediction of future and ritual practices of prevention; indigenous practices in farming, fishing, irrigation, environment management, healthy food consumption, security / subsistence system/ preparation, Security and Protection: Martial art, Education: Inter-generational / Papers and paper products/printing/ writing, Home utensil/ Kitchen , Transport system, Dresses: Apparel/ornaments/ Clocks and watches/shoes/ luggage/ Threads,/fiber/ batik/waiving, Enjoyment: tools/drama/songs/instruments/ movies/ music/dances/ Sports/games, Communication, Astrology, Government: Constitution/Laws/ rules/ procedures, Mining: Gems/ extraction of iron from soil.

Recommended Webs:

1. http://repository.kln.ac.lk/handle/123456789/6495
2. https://www.academia.edu/15385731/Indigenous_Agricultural_Knowledge_in_Sri_Lanka
3. https://www.dilmahconservation.org/arboretum/traditional-agriculture.html
4. http://www.ciksl.org
5. https://lanka.com/about/indigenous-people

11.2 Enhancement course

11.2.1 100 Level of Study

Course Units and Syllabus

Course Code	Course Titles	Hours♣ (L /P/IL)	Credits
First Semester			
EN1011	Basic Mathematics♥	15/00/35	1
EN1032	Basic Biologyς	15/30/55	2
EN1042	Introduction to Computing-I	15/30/55	2
Second Semester			
EN1021	Basic Statistics♥	15/00/35	1
EN1052	Introduction to Computing-II	15/30/55	2

♥only for biological science students
ς only for physical science students

EN1011- Basic Mathematics

Course Content: Basic trigonometry, Real numbers and complex numbers, Indices and logarithms, Coordinate systems, Differentiation and integration, Exponential and logarithm functions, Matrices.

Recommended Texts:

1. Serge Lang. (1998). Basic Mathematics, Springer
2. R. Shankar. (1995). Basic Training in Mathematics: A Fitness Program for Science Students. Springer.
3. Nicholas F. Britton. (2005). Essential Mathematical Biology (Paperback), Springer.
4. Mike Aitken and Bill Broadhurst (2009). Mathematics for Biological Scientists. Garland Science.

EN1021- Basic Statistics

Course Content: Basic definitions in statistics. Data types. Variables types. Scales of measurements. Basics in Planning, collections, organization and

representation of data. Summary measures: measures of central tendency, measures of dispersion, measures of skewness, measure of kurtosis. Linear correlation analysis: correlation measures, significance tests. Simple linear regression analysis: least square estimation, properties of estimates, forecasting, significance tests of parameters, confidence intervals, Residual analysis. Probability models: Binomial, Poisson, Normal, Standard Normal. Hypothesis tests: one sample tests on mean and variance, two samples (independent, dependent) tests on means and variances.

Recommended Texts:

1. The Foundations of Statistics, Leonard J. Savage, Courier Corporation, 1972,ISBN: 0486623491, 9780486623498
2. Basic Statistics, Basant Lal Agarwal, New Age International, 2009,ISBN: 8122424724, 9788122424720
3. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd Edition, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer Science & Business Media, 2009, ISBN: 0387848584, 9780387848587
4. Text Book Of Elementary Statistics, A.K. Sharma, Discovery Publishing House, 2005,ISBN: 8171419534, 9788171419531,
5. Principles of Biostatistics, Marcello Pagano and Kimberlee Gauvreau, 2nd Edition, Ceneage Learning India Pvt Limited, 2000, ISBN: 9812435174, 9789812435170
6. Biostatistical Analysis, Jerrold H. Zar, 5th Edition , Prentice Hall, 2010, ISBN: 0132065029, 9780132065023

EN1032- Basic Biology

Course Content: Cell structure and function, ecosystem and its interactions, food chain-food webs-energy pyramids, renewable and non-renewable energy, Biogeochemical cycles, diversity of plants and animals (habitat, life forms, special characteristics), Mendel's Law and its application, Nomenclature of plants and animals, biotechnological applications, Pollution and control measures, water quality and its assessment.

Practical: Basic laboratory instruments and their applications, Basic structure of plant and animal cells and cell organelles, plant forms and functions, Mendel's Law and its application, Application of biotechnology, measuring basic water quality parameters.

Recommended Texts:

3. Odum, E.P. and Barrett, G.W. (2005). Fundamentals of Ecology. Thomson Learning Academic Resource Centre
4. Chapman, J.L. and Reiss, M.J. (2000). Ecology, 2nd Edition. Cambridge.
5. Herman, K. (2017). Best practices for environmental health: Environmental pollution, protection, quality and sustainability. 1st Edition, Routledge.
6.

EN1042- Introduction to Computing-I

Course Content: Overview of computer systems: Computing past, present, and future – Evolution from ENIAC to laptops to smart devices, Key terminology – Bits, bytes, data, information, software, hardware, ICT. Overview of computer architecture and organization: Coverage of key hardware components, High-level design, Components – Motherboard, input/output, and other ports; central processing unit; memory; storage devices and formats; graphics card, power supply; other essential network and interface systems, Interaction between components, Coverage of digital systems and binary representations of data. Hardware in practice: Practical study of purchasing a modern personal/laptop computer, Discussion of potential options, hardware risks, and troubleshooting. Overview of computer software: Process of executing a program – Linkage of computer hardware to software including the computer boot-up processes, Basics of Operating Systems (OSs) – Modern OSs, role of an OS, components of an OS, choosing an OS for a given system.

Recommended Texts:

1. Introduction to Computers (7th Edition) by Peter Norton, Tata McGraw-Hill Edition, ISBN 9780070671201
2. Introduction to Information Technology by V. Rajaraman, 2nd Edition, 2013, PHI Learning Pvt. Ltd., ISBN 978-81-203-4731-1

EN1052 - Introduction to Computing-II

Course Content: Fundamentals of computer networks and Internet:Introduction to Internet and World Wide Web (WWW), Overview of web contents development – HTML, CSS, XML, WiKi, and CMS, Networks types and standard protocols – Topologies, TCP/IP, HTTP, FTP, SSH, Internet access options and trade-offs – Wired and wireless, dial-up, ADSL, FTTx, Wi-Fi, 3G, 4G. Introduction to database design: Relational databases, entities and relationships, attributes, table design, Introduction to SQL . Computer security

and best practices: Security, privacy, ethical, intellectual property, and safety issues, Protection of users and networked computers – Online privacy, antivirus, firewalls, IT policies, Best practices – Strong passwords, browser settings, backup and restore. Impacts of computers and computing on individuals and on the society: Effect of computers on the society – From technology consumers. technology creators, Use of computers in natural sciences, e-commerce, education, e-governance, and other modern settings including case studies. Laboratory sessions: Graphics and Web Development, Spreadsheets, Databases.

Recommended Texts:

1. Introduction to Computers (7th Edition) by Peter Norton, Tata McGraw-Hill Edition, ISBN 9780070671201
2. Introduction to Information Technology by V. Rajaraman, 2nd Edition, 2013, PHI Learning Pvt. Ltd., ISBN 978-81-203-4731-1

11.2.2 200 Level of Study

Course Units and Syllabus

Course Code	Course Titles	Hours♣ (L / P / IL)	Credits
Second Semester			
EN2013	Visual Application Development	30/30/90	3

EN2013- Visual Application Development

Course Content: Introduction to software design: Program life cycle, source code to machine code conversion and Rapid application development. Fundamentals of visual programming: Variables and data types – Integers, floating point, Boolean, strings, arrays, and data structures , Operators – Arithmetic, binary, and logical, Control flow – If-else, switch-case, loops. GUI design and event handling: Forms, windows, responding to keyboard, mouse, and touch events, Input controls (radio buttons, check boxes, list boxes, drop down, datatime control, icons, menu). IDEs, tools, and debugging environments: Error detection and handling, Debugging. User Interface (UI) and User Experience (UX) design, File handling: Text and binary files. Introduction to

object-oriented programming: Introduction to object-oriented design, Functions, classes, objects, and inheritance. Database access: Database design, SQL. Packaging software: Creating an installable application.

Recommended Texts:

1. Beginning Visual Basic 2012 by Bryan Newsome, Wiley India, 2012, ISBN 978-1118-31181-3
2. Murachs Visual Basic 2010 by Anne Boehm, Shroff Publishers, 2010, ISBN 9789350230961

11.2.3 300 Level of Study

Course Units and Syllabus

Course Code	Course Titles	Hours♣ (L / P / IL)	Credits
First Semester			
EN3012	Resource Efficiency and Cleaner Production	30/0/70	2

EN3012- Resource Efficiency and Cleaner Production

Course Content: Global environmental issues, Environmental movement in timeline, Environmental footprints; Global environmental Agenda for Sustainable development. Cleaner Production: Introduction to concepts, contemporary approaches, cleaner production assessment methodology; Analyzing processes; Option generation, feasibility evaluation of cleaner production options; implementation of sustainable cleaner production; barriers, constrains and enabling measures. Environmental management systems (EMS) ISO 14,001; Life Cycle Assessment; Waste Management and Disposal; Eco-design and Eco-innovation; Green Procurement and Sustainable Public Procurement; Green productivity and industrial ecology; National Policy and Regulatory framework.

Recommended Texts:

1. Florian Flachenecker and Jun Rentschler. (2019). Investing in Resource Efficiency: The Economics and Politics of Financing the Resource Transition. Springer.

2. Bruce Lankford. (2013). Resource Efficiency Complexity and the Commons: The Paracommons and Paradoxes of Natural Resource Losses, Wastes and Wastages. Routledge.
3. Dave Osborne . (2013). The Coal Handbook: Towards Cleaner Production: Volume 2: Coal Utilisation (Woodhead Publishing Series in Energy). Woodhead Publishing.
4. Nicholas P Cheremisinoff and Paul E. Rosenfeld . (2009). Handbook of Pollution Prevention and Cleaner Production Vol. 2: Best Practices in the Wood and Paper Industries. William Andrew.
5. Encouraging industry to assess and implement cleaner production measures [An article from: Journal of Cleaner Production]
6. Ruth Hillary, (1997). Environmental Management Systems and Cleaner Production. Wiley

11.3 Supplementary Courses

11.3.1 200 Level of Study

Course Units and Syllabus

Course Code	Course Titles	Hours♣ (L/P/IL)	Credits
First Semester			
SP2012	Principles of Management	30/00/70	2
SP2022	Fundamentals of Economics	30/00/70	2
Second Semester			
SP2032	Financial Accounting	30/00/70	2

SP2012- Principle of Management

Course Content: Introduction to management: Management and organization, Evolution of management thoughts. Integrative managerial issues: environment and culture of organizations, managing in a global environment, social responsibility, managerial ethics and diversity. Planning: basic elements of planning and decision making, managing strategy and strategic planning, managing decision making and problem solving. Organizing: Basic elements of

organizing, managing organization design, managing groups and teams. Leading: managers and communication, motivating employees, managers as leaders, elements of controlling.

Recommended texts:

1. Robins, S and Coulter, M(2011), Management, 1th Edition, prentice-Hall, ISBN 10:0-13-216384-5
2. Richard L. Daft (2003). Management, Sixth edition, first reprint 2005 by Thomson Asia Pte. Singapore, ISB:981-265-634-0
3. James A. F. Stoner, R. Edward Freeman, Dniel R. Gilber, Jr (1995). Management, Sixth edition, prentice_hall, Inc, ISBN:81-203-0981-2
4. Robbins and De Cenzo (2008), Fundamentals of Management, 6th edition, Prentice Hall.
5. Chandan J. S. (2004), Management Theory and Practice, Viskas Publishing House (Pvt) Ltd.
6. Stoner A. F. James, Edward R., Freeman Daniel R., Albert J. R. (2003), Management, 6th Edition, Prentice Hall.

SP2022- Fundamentals of Economics

Course Content: Nature, Definitions, Scope and importance of economics, Economics as a science. Market forces; Demand and Supply and Equilibrium determinants. Elasticity; Elasticity measures and determinants, and classifications. Utility Theories; Cardinal Vs Ordinal utility theories. Theory of Production; Production Functions, Factors of Production and pricing of products. Theory of Costs; Classifications of costs, Profit maximization and cost, Returns to Scale and Economies of Scale. Market Structure; Classifications of market, Major characteristics of different market structure, Total revenue and pricing decisions of markets. Nature and Scope of Macroeconomics. National Income; Circular flow models of economy, Elements of National Income, Measurement of National Income, Money and Inflation; Kinds and Functions of Money, Effects of inflation, Measuring inflation. Unemployment; Types of unemployment, Consequences of unemployment. Economic Growth; Measuring economic growth, Factors in economic growth. Currency Exchange rate; Foreign Exchange Market and Exchange rate determination, Currency appreciation and depreciation, and consequences. Trade and Foreign Direct Investment; Theories of Absolute and comparative advantages, Determinants of trade, Foreign Direct Investment and the role of Multinational companies.

Recommended Texts:

1. Principles of Microeconomics, 22nd Edition, H.L.Ahuja, Publisher: S.Chand
2. Principles of Microeconomics, 5th Edition, Dominick Salvatore, Publisher: Oxford University Press
3. Macroeconomics, 7th Edition, N.Gregory Mankiw, Publisher: Worth Publishers
4. Principles of Macroeconomics, 6th Edition, N.Gregory Mankiw, Publisher: South-Western Cengage Learning
5. Macroeconomics, 4th Edition, Paul Krugman and Robin Wells,Publisher: Worth Publishers

SP2032- Financial Accounting

Course Content: Uses of Accounting information, Users of accounts and their information needs, Role of accounting standards, Concept of stewardship, The accounting equation, Double-entry bookkeeping rules, Record sales, purchase, income and expense transactions in cash book (single, double and triple), sales day book, purchase day book, returns books, journal, petty cash, ledger account, trial balance, Nature of accounting errors, Correction of errors, Calculations and journals for accruals and prepayments (income and expenses), Journals for irrecoverable debts and allowances for receivables, Manufacturing accounts, Income Statement; Statement of Financial Position, Reconciliation of the cashbook to the bank statement.

Recommended Texts:

1. Frank Wood, (2010), Business Accounting, Vol. II, 12th Edition, Pitman Publication.
2. Maheshwari, S. N., Maheshwari S. K., (2005), An Introduction to Accounting, 9th Revised Edition, Vikas Publishing House Pvt. Ltd.
3. Needles, B. E. and Powers, M. (2012) Financial Accounting, 11th Ed. USA: Cengage Learning
4. Warren. C. Reeve, J. M. and Duchac, J (2018) Financial Accounting, 15th Ed. USA: Cengage Learning

11.3.2 300 Level of Study

Course Units and Syllabus

Course Code	Course Titles	Hours♣ (L/P/IL)	Credits
First Semester			
SP3011	Entrepreneurship skills Development	15/00/35	1
SP3023	Object-Oriented Analysis and Design	30/30/90	3
Second Semester			
SP3032	Science Education	25/10/65	2
SP3042	Science of Consciousness and Spirituality	15/30/70	2
SP3052	Data Analysis and Report Writing	10/40/50	2

SP 3011- Entrepreneurship Skill Development

Course Content: Introduction to Entrepreneurship; Concept of Entrepreneurship, Nature and characteristics of Entrepreneurship, Kinds of Entrepreneurial opportunities or Routes to Entrepreneurship, Importance of Entrepreneurship, Rewards of Entrepreneurship, Drawbacks of Entrepreneurship, Phases of Entrepreneurship Development, Causes of slow growth of Entrepreneurship, Entrepreneurship stimulants. Entrepreneur Concept and Percept; Introduction, Concept of Entrepreneur, Characteristics of an Entrepreneur, Qualities of an Entrepreneur, Functions of an Entrepreneur, Types of an Entrepreneur, Personal Entrepreneurial Competencies (PEC). Identification of Business Opportunities, generating a New Business, Generate Your Business Idea, what is a business idea? Are you right kind of person to start a business, generate your own business idea, Analyze your business ideas and select the best one, Environment Impact Assessment. Starting a New Business; Start your business (Preparation of Business Plan). Improving an Existing Business; Marketing, Buying, Stock Control, Record Keeping, Costing, Business Planning. Role of Entrepreneurship in National Development; Introduction, Employment Creation, Gross Domestic Product (GDP), Gross National Product (GNP), National Income.

Recommended texts:

1. Anil Kumar S., Poornima S.C., Mini K. Abraham, Jayashree K. Entrepreneurship Development Generate Your Business Idea Manual; Start and Improve Your Business Association of Sri Lank
2. Longenecker. Moore, Petty Small Business Management- An Entrepreneurial Emphasis;
3. Paul Burns and Jim Hal. Dewhurst Small Business and Entrepreneurship; Start Your Business Manual; Start and Improve Your Business Association of Sri Lanka. The Open University, Managing of a Small business venture.

SP3023 - Object-Oriented Analysis and Design

Course Content: Fundamentals of object orientation: Abstraction, Encapsulation and information-hiding, Separation of behaviour and implementation, Division of a system into manageable components, Reuse of components and simple interfaces. Object-oriented programming: Classes and objects, Subclasses, inheritance, and class hierarchies, Polymorphism. Object-oriented application development: Introduction to object-oriented programming languages and APIs, Instance creation and scope control, Basic data structures and iterable collections, File handling, stream based I/O, and object serialization, Event handling for interactive programs, Software testing and test cases. Introduction to software engineering: Requirements specification and analysis, design, and testing, Reusable technologies and use of frameworks and APIs, Software design principles. Unified Modelling Language (UML): Object oriented analysis and design using UML, UML class, package, and component diagrams, User-centred design and use cases, Software behaviour representation with sequence diagrams, state machines, and activity diagrams, Design patterns, Evaluation of designs. Concurrent processes and threads. Database access. Packaging software.

Recommended Texts:

1. Object-Oriented Analysis and Design with the unified process (4th edition or latest) by John W. Satzinger, Robert B. Jackson, and Stephen D. Bud, Course Technology Edition, ISBN-10 81-315-0269-4, ISBN-13 978-81-315-0269-3
2. An Introduction to Object-Oriented Programming (3rd edition or latest) by Timothy Budd, Pearson Education, ISBN 9788131717264
3. Object-Oriented Analysis and Design with Applications (3rd edition or latest) by Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J.

Young, Jim Conallen, and Kelli A. Houston, Pearson Education, ISBN 9788131722879

SP3032- Science Education

Course Content: Introduction to Education, Education for Development, Philosophy of Education, Different mode of Education, Approaches of Education, Concept of Education for all, Teaching as a Profession, Education and Human / Children's right, Fundamental aspects of Sri Lankan Education System. Present Education System in Sri Lanka, Vocational Education, Higher Education

Recommended Texts:

1. Aggarwel, J.C., Theory and Principle of Educational and philosophical and Sociological bases of Education. Vikas publishing house PVT Ltd – 1996.
2. Raymont,T., The Principle of Education, Orient Longman Limited – 1989.
3. Maria Montessori, Education for a New World, , Akalakshetra pub, India – 1998
4. Halsey,A.H., Education- Culture, Economy, and Society, Hugh Lauder, Philip Brown, Oxford University Press, New York – 2001
5. Chaube, S.P., and Chaube,A., Foundation of Education, Vikas publishing house PVT Ltd – 2008.

SP3042- Science of Consciousness and Spirituality

Course Content: The convergence of modern science and *Perennial philosophy:* Macroscopic scale (Classical Physics) to fundamental building blocks of matter (quantum scale, unified field/ superstrings); the fabric of cosmos, illusory reality (*Maya*), holographic universe; the origins of Consciousness, biocentrism, the source of consciousness (mind/soul-*jiva*) and related scientific studies; three basic modes of energy, goodness (*sattva-guna*), passion (*rajo-guna*) and inertia/ignorance (*tamo-guna*); the system of cosmic justice (*Dharma-Karma-Samsara*); Transcendental Meditation and Techniques, Yoga**.** Students exposure to environments that stimulate selflessness and spirituality (strive to attain common grounds in understanding reality), and thereby compile self-reflections with related evidence on experiences/ practices (reflective diary and portfolio).

Recommended Texts:

1. The Elegant Universe: Superstrings, Hidden Dimensions, and the Quest for the Ultimate Theory by Brian Greene; Publisher: W. W. Norton & Company; Reprint edition (October 11, 2010); ISBN-10: 039333810X, ISBN-13: 978-0393338102.
2. Quantum Enigma: Physics Encounters Consciousness by Bruce Rosenblum and Fred Kuttner, Publisher: Oxford University Press; 2 edition (August 1, 2011); ISBN-10: 0199753814, ISBN-13: 978-0199753819.
3. Origins of Consciousness: How the Search to Understand the Nature of Consciousness is Leading to a New View of Reality by Adrian David Nelson; Publisher: lulu.com (June 4, 2016); ISBN-10: 1329298772, ISBN-13: 978-1329298774.
4. Beyond Biocentrism: Rethinking Time, Space, Consciousness, and the Illusion of Death by by Robert Lanza (Author), Bob Berman (Contributor); Publisher: BenBella Books (May 3, 2016), ISBN-13: 978-1942952213, ISBN-10: 194295221X.
5. Biocentrism: How Life and Consciousness are the Keys to Understanding the True Nature of the Universe by Robert Lanza; Publisher: BenBella Books; 1 edition (May 18, 2010); ISBN-10: 1935251740, ISBN-13: 978-1935251743.

SP3052- Data Analysis and Report Writing

Course Content: Presentation of data. Summary measures: Measures of central tendency, dispersion, relative dispersion, skewness, and kurtosis. Correlation and simple regression analysis. Use of probability models. Hypothesis tests. Basic statistical designs. Analysis. Report preparation. Use of statistical packages.

Recommended Texts:

1. Patrick F Dunn and Michael P. Davis. (2017). Measurement and Data Analysis for Engineering and Science. CRC Press.
2. Gabe T. Wang and Keumjae Park . (2016). Student Research and Report Writing: From Topic Selection to the Complete Paper. Wiley-Blackwell.
3. Charles E. Hawkins. (1987). Data Analysis Graphing and Report Writing. Mohican Pub.
4. Matthew B. Miles and A. Michael Huberman . (2019). Qualitative Data Analysis: A Methods Sourcebook. SAGE Publications, Inc.

12 Examination Rules, Offences, Punishments and Legal Procedures

12.1 Examination Rules

1. A candidate is expected to be outside the examination hall at least 15 minutes before the commencement of each paper, but shall not enter the hall until he/she is requested to do so by the Supervisor.

2. A candidate is permitted to carry into the examination hall only the pen, pencil and eraser. All other material/documents will be considered as unauthorized and it is an offence.

3. On admission of the hall, a candidate shall occupy the seat allotted to him/her and shall not change it except on the specific instruction of the Supervisor.

4. Candidates shall maintain silence from the entrance until they exit from the examination hall.

5. Candidates shall not be permitted to communicate with other candidate any means during the examination.

6. A candidate shall not be allow entering examination hall after 30 minutes of the commencement of the examination and allow leaving the examination hall before 30 minute to the closure of the examination. However candidate shall not be permitted to leave the examination hall 15 minutes prior to the closure of the examination.

7. A candidate shall have his/her student record book/student identity card/admission card with him/her in the examination hall on every occasion he/she presents himself/herself for a paper. His/her candidature is liable to be cancelled, if he/she does not produce the student record book/ student identity card/admission card when requested to do so. The student's identity should be clearly visible during the time of the examination.

8. A candidate shall not have on his/her person or in his/her cloths or on the admission card, time-table, student record book/ student identity card, any notes, signs of formulae, etc., except those item that are permitted. All

unauthorized items which a candidate has brought with him/her should be kept at a place indicated by the Supervisor/Invigilator.

9. No candidate shall copy or attempt to copy the scripts of another candidate. A candidate shall neither help another candidate nor obtain help from another candidate or any other person.

10. If any candidate was found to have copies from another candidate by an examiner at the time of marking, he/she would be treated as having committed a punishable offence.

11. No candidate shall submit a practical book or field book or dissertation/thesis or project study or answer script or assignment which has been prepared wholly or partly by anyone other than the candidate himself/herself. This section, however does not apply to group projects of students.

12. A candidate is permitted to bring authorized materials only.

13. Examination stationery (i.e. writing paper, graph paper, drawing paper, ledger paper, precise paper etc.) will be supplied in the Examination Hall, as and when necessary. No sheet of paper or answer book supplied to a candidate may be torn, crumpled, folded or otherwise mutilated. No papers other than those supplied to him/her by the Supervisor/Invigilator shall be used by a candidate. Log tables or any other material provided shall be used with care and left behind on the desk. All material supplied whether used or unused other than the answer scripts, shall be left behind on the desk and not removed from the examination halls.

14. Every candidate shall enter his/her Index Number at the appropriate place on the answer book and on every continuation paper. He/she shall also enter all necessary particulars as indicated in the cover of the answer book. A candidate who inserts on his/her script an Index number other than his/her own is liable to be considered as having attempted to cheat. The supervisor/Invigilator has the authority to check the answer scripts of the candidate.

    A script that bears no Index Number or an Index Number which cannot be identified is liable to be rejected. No candidate shall write his name or any other identifying mark on the answer scripts.

15. All additional work such as rough work, calculation shall only be done on the additional scripts given by the supervisor or invigilator at the time of examination. otherwise it shall be treated as examination offence.

16. Any answer or part of the answer which is not to be considered for the purpose of assessment shall be neatly crossed out. If the same question has been attempted in more than one place the answer or answers that are not to be considered shall be neatly crossed out.

17. Candidates found copying, communicating with another candidate, or using any unauthorized materials may be expelled from the examination hall. A written report on the incident will be submitted by the invigilator through the Supervisor to the Examination Offence Committee.

18. Candidates are under the authority of the Supervisor and shall assist him/her by carrying out his/her instructions and those of the Invigilators, during the examination and immediately before and after it.

19. Every candidate shall conduct himself/herself in the examination hall and its precincts so as not to cause disturbance or inconvenience to the Supervisor or his/her staff or to the other candidates. In entering and leaving the hall, he/she shall conduct himself:/herself as quietly as possible. A candidate is liable to be excluded from the examination hall for disorderly conduct.

20. Candidate shall stop work promptly when ordered by the Supervisor/Invigilator to do so. If this instruction is not strictly followed, the Supervisor/Invigilator has the authority to make an endorsement to this effect on the answer scripts.

21. Absolute silence shall be maintained in the examination hall and its precincts. A candidate is not permitted for any, reason whatsoever to communicate or to have any dealings with any person other than the Supervisor/Invigilator. The attention of the Supervisor/Invigilator shall be drawn by the candidate by raising his hand from where he is seated.

22. During the course of answering a question paper, no candidate shall be permitted to leave the examination hall even temporarily. In case of an emergency, the Supervisor/Invigilator shall grant him permission to do so but the candidate shall be under his constant surveillance.

23. No person shall impersonate a candidate at the examination, nor shall any candidate allow himself/herself to be impersonated by another person.

24. Any candidate receiving unauthorized assistance from any person shall be deemed to have committed an examination offence.

25. If circumstances arise which in the opinion of the Supervisor render the cancellation or postponement of the examination necessary, he/she shall stop the examination, collect the scripts already written and then report the matter as, soon as possible to the Dean of the relevant Faculty.

26. The Supervisor/Invigilator is empowered to request any candidate to make a statement in writing on any matter which may have arisen during the course of the examination and such statement shall be signed by the candidate. No candidate shall refuse to make' such a statement or to sign it. If such a candidate refuses to make such a statement or refuse to sign it, the Supervisor/Invigilator shall make his/her own statement and report the matter to the Dean of the relevant Faculty.

27. No candidate shall contact any person other than the Vice-Chancellor, Dean, Head of the Department, the Registrar or the relevant Senior Assistant Registrar regarding any matter concerning the examination.

28. Every candidate shall hand over the answer script personally to the Supervisor/Invigilator or, remain in his/her seat until it is collected. On no account shall a candidate hand over his/her answer script to an Attendant, a minor employee or another candidate.

29. A candidate who has handed over his/her answer script shall under no circumstances be entitled to call it back.

30. Any candidate who wishes to leave the examination early must have their script collected by the invigilator before they leave their desk.

31. No candidate shall remove his/her or any other candidate's answer script from the examination hall.

32. Every candidate who registers for a course/course unit shall be deemed to have sat the examination of that course/course unit unless he/she withdraws from the course/course unit within the prescribed period of dropping course/course units. He/she should submit a medical certificate in support of his/her absence, prior to the commencement of the examination. If such a document cannot be submitted before the commencement of the examination, a candidate shall inform of his/her inability to attend the examination, to the Dean of the Faculty within a week

after the commencement of the examination. The medical certificate shall conform to the Senate regulations.

33. When a candidate is unable to be present for any part/section of an examination of a course/course unit, he/she shall notify or cause to be notified this fact to the Dean of the Faculty and the relevant Senior Assistant Registrar immediately. This should be confirmed in writing with supporting document by registered post within two weeks.

34. A candidate will be eligible for honours if all requirements for the award of honours are met within the prescribed period for the degree. However, candidates found guilty of an examination offence shall not be eligible for honours.

35. No candidate shall sit an examination of a course/course unit, if he/she has exhausted the number of attempts that he/she is allowed to sit that particular examination, unless he/she has been granted special permission to do so by the Dean of the relevant Faculty.

12. 2 Examination Offences and Punishments

Examination offences may be classified as follows:

a. Possession of unauthorized documents
b. Copying
c. Cheating
d. Removal of stationery.
e. Disorderly conduct
f. Impersonation
g. Unauthorized assistance
h. Aiding and abetting in the commission of above offences
i. Other offences.

Examination offence and relevant punishments are explained separately below.

1. Any candidate who violates Examination Rule 08 shall be deemed guilty of the offence of possession of unauthorized documents/items and his/her candidature for the examinations of the Semester shall be cancelled and he/she shall be prohibited from sitting any examination of this University for a period varying from 1-5 semesters.

2. Any candidate who violates Examination Rule 09 or 10 shall be deemed guilty of the offence of copying and therefore his/her candidature shall be cancelled from the examinations of that semester and he/she shall be prohibited from sitting any examination of this University for a period of Five semesters.

3. Any candidate who violates Examination Rule 11 shall be deemed guilty of the offence of having cheated at the Examination and his/her candidature for the examinations of that semester shall be cancelled and he/she shall be prohibited from sitting any examination of this University for a period varying from 1-9 semesters.

4. Any candidate who is detected removing examination stationary and other materials provided for the examination (Rule 13) shall be deemed guilty of en examination offence and his/her candidature for the examination of that

semester shall be cancelled and he/she shall be liable to be prohibited from sitting any examination of this University for a period of Three semesters.

5. Any candidate who violates any one or more of the rules in 12, 18, 29, 20, 21 and 22 shall be deemed guilty of the offence of disorderly conduct and his/her candidature shall be cancelled from the examinations of that semester and he/she shall be prohibited from sitting any examination of this University for a period of Three semesters.

6. Any candidate who violates Examination Rules 23 shall be guilty of the offence of impersonation and his/her candidature for the examinations of that semester shall be cancelled and he/she shall be prohibited from sitting any examination of this University.

   Impersonator/s may also be liable to any punishment under the Penal Code/Criminal Law. In the event of the impersonator is found to be the Graduate of this University, his/her degree shall be withdrawn.

7. Any candidate who violates Examination Rule 24 shall be guilty of an examination offence and his/her candidature for the examinations of that semester shall be cancelled and he/she shall be prohibited from sitting any examination of this University for a period of 1-5 semesters.

8. Any candidate found aiding and abetting in the commission of any of the above examination offences shall be deemed to have committed that offence and shall be punished in respect of the offence in accordance with the provisions of the relevant section.

9. Any other offence which is not covered in this section alleged to have been committed by a candidate and reported to the relevant authority by a Supervisor/ Examiner shall be inquired into and appropriate action taken.

12.3 Legal Procedures for Violation of Exam rules

1. There shall be an Examinations Disciplinary Committee of not less than 03 members of whom at least one member is from outside the Faculty, appointed for each case by the dean of the respective Faculty to inquire into of make recommendation (including punishments) on examination offences report to it.

2. In all cases of violation of examination rules detected by the Supervisor he/she shall take action and forward his/her report to the Registrar.

3. In cases of disorderly conduct the Supervisor shall in the first instance warn the candidate to be of good behaviour. Disorderly conduct shall be considered grave, only if such conduct in the opinion of the Supervisor is considered as causing a disturbance in the conduct of the Examination. Where the candidate persists in unruly or disorderly conduct and the Supervisor is of opinion that it was creating a disturbance in the conduct of the examination shall exclude the candidate from the examination hall and issue him/her a letter with the copy to the relevant Dean/Senior Assistant Registrar/Assistant Registrar, canceling his/her candidature from the examination.

4. In all other cases of examination offences detected, the Supervisor shall send a report to the relevant Dean along with any materials taken into custody. Materials taken into custody shall be authenticated by placing the signatures of the candidate and the Supervisor/Invigilator and the date, time and place of detection. The supervisor's report should be countersigned by one of the invigilator.

5. The Dean after preliminary inquiry shall place all reports of examination offences submitted by the Supervisors for action of the relevant Examination Disciplinary Committee for further action.

6. Supervisor, Examiner, Head of Department, or any other official of the University who detects an examination offence, shall report the matter in writing to the Dean, who shall after preliminary inquiry submit his findings to the relevant Examination Disciplinary Committee for further action.

7. The punishments recommended by the Examination Disciplinary Committee shall be submitted to the relevant Faculty Board for the decision shall be refers to the Senate for ratification.

12.4 Appeals Board

There shall be an Appeal Board, consisting of three members, appointed by the Vice-Chancellor to consider appeals regarding the decision referred to in Section 11.3.7 above. Any student on whom a punishment has been imposed may, within a period of 2 weeks from the date of communication to him/her of such punishment, appeal against such punishment to the Vice-Chancellor.

The Appeals Board shall have the power to review the decision referred in Section 11.3.7 above regarding the punishment imposed and may either affirm, vary as deem necessary or set aside the decision regarding the punishment.

13 Memorial Awards

The following Memorial awards are offered by the Faculty of Science.

1. **V. NALLIAH MEMORIAL AWARD**
   This is given for the best performance at the first year of examination of the General degree in Physical Science.

2. **S. DHARMARATHNAM MEMORIAL AWARD**
   This is given for the best performance at the first year of examination of the General degree in Biological Science.

3. **STELLA ASEERWATHAM MEMORIAL AWARD**
   This is given for the best performance at the final year examination of the General Degree in Physical Science.

4. **RATHINI ANANTHAMOORTHY MEMORIAL AWARD**
   This is given for the best performance at the final year examination of the General Degree in Biological Science.

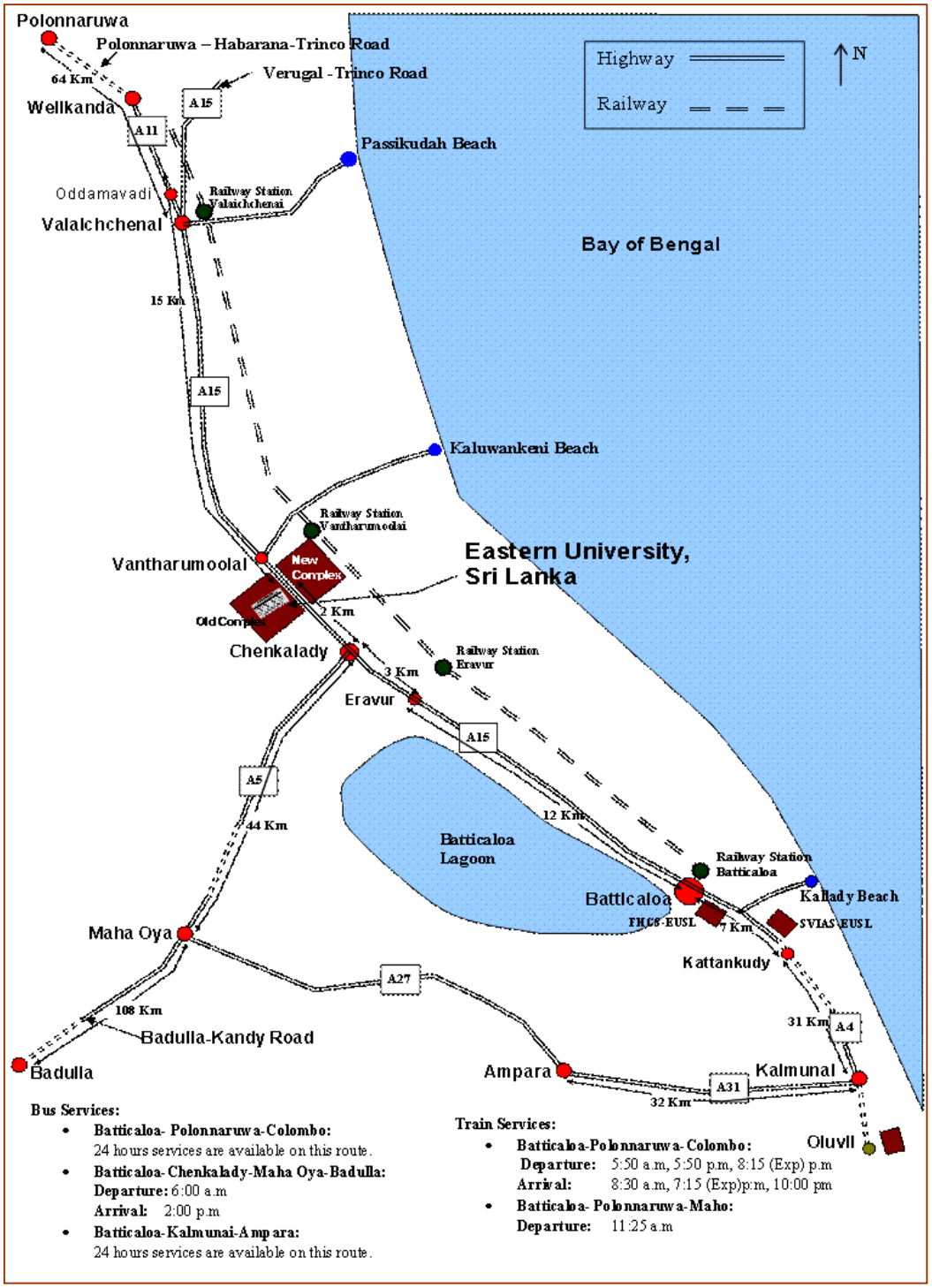
5. **KANAPATHIPILLAI KARUNAIRAJAH MEMORIAL AWARD**
   This is given for the best research conducted by the final year students of Faculty of Science.

6. **SIVANESAM THAMBIPILLAI MEMORIAL AWARD**
   This is given for the overall best performance in the Special Degree in Botany.

7. **VELUPILLAI SAMUEL ARIYARATHNAM AWARD**
   This is given for the overall best performance in the Special Degree in Zoology.

8. **VANNAMANI KIDDNAN MEMORIAL AWARD**
   This is given for the overall best performance in the Faculty of Sciences.

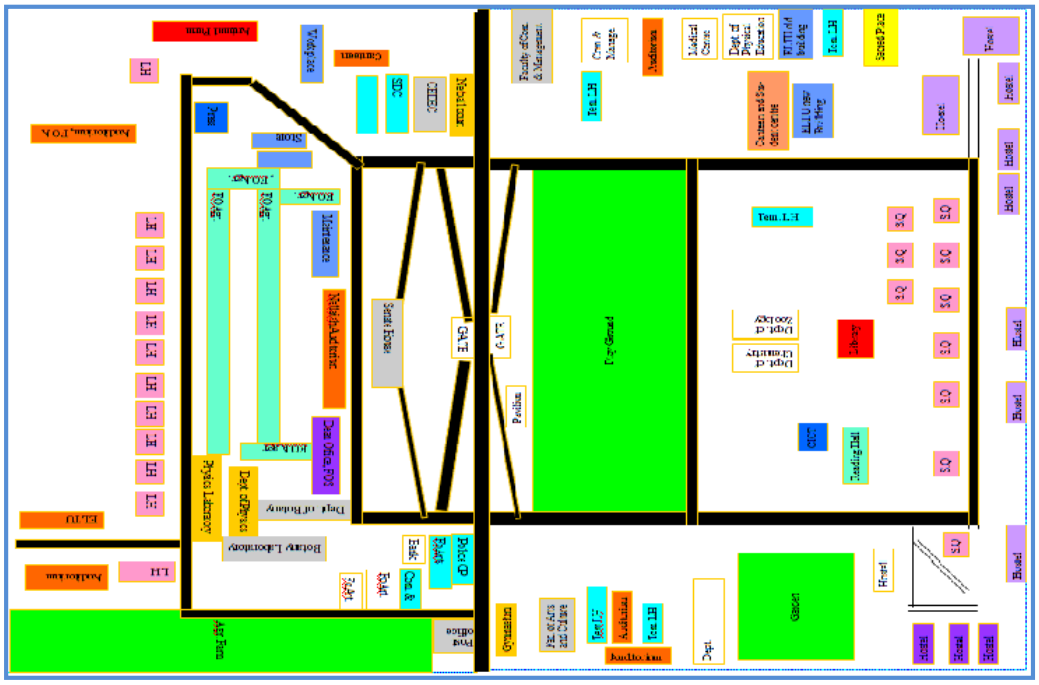
Road Map


Polonnaruwa
Polonnaruwa – Habarana-Trinco Road
64 Km
Verugal - Trinco Road
Wellkanda
A15
A11
Passikudah Beach
Oddamavadi
Railway Station Valaichchenai
Valaichchenal
Highway
Railway
N
Bay of Bengal
15 Km
A15
Kaluwankeni Beach
Railway Station Vantharumoolai
Vantharumoolai
New Complex
Old Complex
Eastern University, Sri Lanka
2 Km
Chenkalady
Railway Station Eravur
3 Km
Eravur
A15
A5
44 Km
12 Km
Batticaloa Lagoon
Railway Station Batticaloa
Batticaloa
Kallady Beach
FHCS-EUSL
7 Km
SVIAS-EUSL
Maha Oya
Kattankudy
A27
108 Km
31 Km
A4
Badulla-Kandy Road
Badulla
Ampara
A31
Kalmunai
32 Km
Oluvil
Bus Services:
Batticaloa- Polonnaruwa-Colombo:
24 hours services are available on this route.
Batticaloa-Chenkalady-Maha Oya-Badulla:
Departure: 6:00 a.m
Arrival: 2:00 p.m
Batticaloa-Kalmunai-Ampara:
24 hours services are available on this route.
Train Services:
Batticaloa-Polonnaruwa-Colombo:
Departure: 5:50 a.m, 5:50 p.m, 8:15 (Exp) p.m
Arrival: 8:30 a.m, 7:15 (Exp)p.m, 10:00 pm
Batticaloa- Polonnaruwa-Maho:
Departure: 11:25 a.m

Site Map

Eastern University, Sri Lanka

Senate House Side **Ground Side**



Curriculum Matrix – BSc(General) & BScHons

Level of offered Courses		No. of Credits in Principal Subjects			Compulsory Auxiliary Courses*	Compulsory Enhancement(EN) courses & Credits		Supplementary (SP) courses & Credits		Total Credi Awa
		X	Y	Z						
100		8	8	8	ENG 100 CPD 100 SLV 100	(EN 1011, EN1021)/ EN 1032 EN 1042 EN 1052	2 2 2	-		(24P+6EN)
200	Op-I	≥ 8	≥ 8	≥ 8	ENG 200 CPD 200 SLV 200	EN 2013	3	SP 2012 SP 2022 SP 2032	2 2 2	(≥24P + 3EN) + (≥16P +3EN) +
	Op-II	≥ 8	≥ 8	< 8						
300	Op-IA	≥8	≥ 8	≥ 8	ENG 300 CPD 300 SLV 300	EN 3012	2	SP 3011 SP 3023 SP 3042 SP 3052 SP 3062	1 3 2 2 2	(≥24P+2EN) + (≥16P +2EN) + Accumulated c 100, 200 & 300 [≥42P(X) + ≥16 ≥8P(Z) + 11EN ≤13(P†+SP)
	OP-1B	≥8	≥8	< 8						
	Op-II	≥8	≥8	< 8						
300		≥ 8	≥8	< 8						
400		10	-	-						
		M-I	M-II							
300		≥ 8	≥ 8	< 8						
400		10								
400		30	-	-	-	-				30P(
ral) EE	Op-IA	**≥ 24**	**≥ 24**	**≥ 24**	Pass (S) in ENG 100 & ENG 200;	11		≤ 12		(≥72P+11EN)+ Min 90 credits, with no E grad
	THREE Principal Subjects X, Y & Z									
	OP-IB OP-II	**≥ 24**	**≥ 24**	< 24						(≥48P+11EN)+

ral) **D**	TWO Principal Subjects X & Y			Pass (S) at least one course each in CPD & SLV		Min 90 credits, with no E grad
X)	**≥ 72**	≥ 16				Min 120 credits OGPA 2.00; gra better in 96 cre in each year; no
s(Math)	**≥ 88**					

P – Course Units from Principal Subjects X, Y, Z **P† - Course Units from any Principal Subject, provided prerequisites are met and time-table permits**