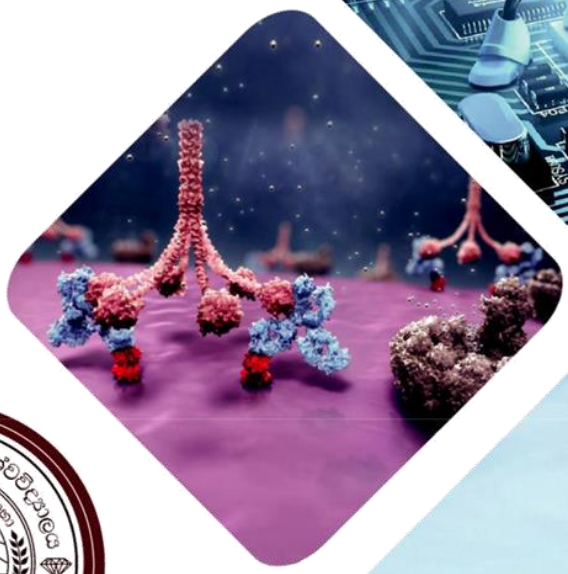
2019/2020



FACULTY OF TECHNOLOGY
SABARAGAMUWA UNIVERSITY OF SRI LANKA

UNDERGRADUATE HANDBOOK

FACULTY OF TECHNOLOGY

UNDERGRADUATE HANDBOOK

2019/2020

Sabaragamuwa University of Sri Lanka

1

Undergraduate Handbook — 2019/2020
Faculty of Technology, Sabaragamuwa University of Sri Lanka

First Revision : November, 2020
Second Revision : September, 2021

Disclaimer

The provisions of this document do not constitute a contract, expressed or implied, between any student, staff or faculty member and The Faculty of Technology, Sabaragamuwa University of Sri Lanka. This document is a general information publication only, and it does not contain all regulations that relate to students.

The Faculty of Technology, Sabaragamuwa University of Sri Lanka reserves the right to withdraw courses at any time and to change, rules, calendar, curriculum, degree programs, degree requirements, graduation procedures, and any other requirement affecting students, staff and faculty. The policies, regulations, and procedures stated in this handbook subject to change without prior notice, and changes become effective whenever the appropriate authorities so determine and may apply to both prospective students and those already enrolled.

Students are held individually responsible for meeting all requirements as determined by the Faculty of Technology, Sabaragamuwa University of Sri Lanka. Failure to read and comply with policies, regulations, and procedures will not exempt a student from whatever penalties he or she may incur.

CONTENTS

1. General Information

1.1. Sabragamuwa University of Sri Lanka

The University's Main Campus address is Sabaragamuwa University of Sri Lanka, P.O. Box 02, Belihuloya, 70140, Sri Lanka. The address of the Faculty of Medicine is P.O. Box 01, Hidellana, Rathnapura, Sri Lanka. The main telephone numbers are 045-228-0014 and 045-228-0087. Visit SUSL on the Web at ***http://www.sab.ac.lk/***

1.1.1. Introduction

The Sabaragamuwa University of Sri Lanka (SUSL) developed from the Sabaragamuwa Affiliated University College (SAUC) established in Belihuloya, in 1991, under the Sabaragamuwa Province Affiliated University College Ordinance No. 14 of 1992 by the government of Sri Lanka. SAUC was a diploma awarding body, which was affiliated with the University of Sri Jayawardenepura.

In 1995, SAUC was elevated to a national university status by amalgamating it with Uva Affiliated University College (UAUC) which was located in Rahangala and the Buttala Affiliated University College (BAUC) which was located in Buttala. As a result of this, UAUC became the Faculty of Agricultural Sciences of SUSL, and BAUC became the Faculty of Applied Sciences of SUSL, still located off SUSL main campus at Belihuloya. The Faculty of Agricultural Sciences and The Faculty of Applied Sciences were subsequently relocated within the main SUSL premises in 2001 and 2008 respectively.

Prof. Dayananda Somasundara served as the founding Director of SAUC and the first vice-chancellor of SUSL

At present, the university has eight faculties, namely, Agricultural Sciences, Applied Sciences, Geomatics, Management Studies, Social Sciences and Languages, Faculty of Graduate Studies, and the two recently established faculties; Faculty of Medicine and Faculty of Technology. The Faculty of Graduate Studies (FGS) offers postgraduate degree programs of SUSL while all other faculties offer undergraduate degree programs. All together these faculties offer 48 undergraduate programs, of which 13 are majors and 28 are honors. FGS offers more than 10 graduate programs. Most of these degree

programs are non-conventional, and provide up-to-date knowledge and leading-edge skills for the students. Bachelor's degrees in Surveying Sciences, Agri- Business Management, Food Science and Technology, Tourism Management, Physical Education and Sports Sciences Management, and Eco-Tourism Management are some examples of such unique undergraduate programs. In addition, Ayurvedic Hospital Management, Indigenous Community Studies, and Entrepreneurship and New Venture Creation are several of one-of-a-kind graduate programs offered by FGS of SUSL.

All along, during nearly three-decade of service, SUSL has been striving for academic excellence in undergraduate education in SL. It has been recognized as one of the fastest growing universities in the country, and highly promotive environment for learner centered education. For example, program reviews conducted by the QAAC of the UGC, on the General Degree Program of Faculty of Social Sciences and Languages in 2017, and on the General Degree Program of Faculty of Management Studies in 2018 have yielded highest grades. Also, SUSL acclaims one of the lowest students to faculty ratio among SL universities.

SUSL is committed to create and sustain a culture of learning and research that provides equal educational opportunities for all qualified students without regard to race, color, national origin, religion, sex, disability or sexual orientation. Moreover, SUSL is keen on instilling students a sense of social responsibility, service and, commitment to the democratic values of the society, both locally and internationally.

1.1.2. Vision of SUSL

To be an internationally acclaimed center of excellence in higher learning producing dynamic leaders and nation builders to guide the destiny of Sri Lanka

1.1.3. Mission of SUSL

Our mission is to search for and disseminate knowledge, promote learning, research and training to produce men and women proficient in their respective disciplines possessing practical skills and positive attitudes enabling them to contribute towards the manpower requirements of the nation. The university will be a center of excellence for research and development for Sri Lanka in general and the Sabaragamuwa Province in Sri Lanka.

1.1.4. University Logo

The University logo comprises of gems, two paddy sheaves wreathing curved around, unfolded book, an illuminated traditional clay oil lamp, and Samanala mountains. The traditional oil lamp and the rays of light symbolize knowledge and the enlightenment; book represents education; the Samanala Mountains and gems stands for Sabaragamuwa Province and Rathnapura District respectively where the university is located; sheaves of paddy symbols prosperity.

1.1.5. University Flag

University flag comprises of two horizontal bands of equal height, and, center on these bands, the university logo sealed. Of the two bands, top one is maroon and the bottom one is gold; maroon color represents maturity and the gold color stands for knowledge.

1.1.6. The Alma Mater

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1.2. Officers and Administrative Staff of SUSL

1.2.1. Chancellor

Most Venerable Prof. Kamburugamuwe Vajira Thero

1.2.2. Officers

Vice Chancellor

Prof. R.M.U.S.K. Rathnayaka
vc@sab.ac.lk | Tel: 045-2280012, Fax: 045 - 2280128

Dean/ Faculty of Graduate Studies

Prof H.M.S. Priyanath
dean@fgs.sab.ac.lk | Tel : 045 - 2280042

Dean/ Faculty of Agricultural Sciences

Prof. P.M.A.S. Karunarathne
dean@agri.sab.ac.lk, magamage@agri.sab.ac.lk | Tel : 045 - 2280041

Dean/ Faculty of Applied Sciences

Dr. Rasangi Sabaragamuwa
dean@appsc.sab.ac.lk | Tel : 045 - 3454212

Dean/ Faculty of Geomatics

Mr. P.G. Vipula Abeyrathe
dean@geo.sab.ac.lk | Tel : 045 - 3453009

Dean/ Faculty of Management Studies

Prof. Athula Gnanapala
deanms@sab.ac.lk | Tel : 045 - 2280007

Dean/ Faculty of Medicine

Prof. Nirmali Wickramaratne
nirmaliw@appsc.sab.ac.lk | Tel: 045 - 2280013

Dean/ Faculty of Social Sciences and Languages

Dr. Sampath Fernando
dean@ssl.sab.ac.lk | Tel : 045 - 2280021

Dean/ Faculty of Technology

Prof. K. R. Koswattage
dean@tech.sab.ac.lk | Tel : 045 - 2280298

Registrar

Mr. S. Uyangoda
registrar@sab.ac.lk | Tel : 045 - 2280277, Fax: 045 - 2280015

Librarian

Mrs. T.N. Neighsoorei
library@lib.sab.ac.lk; nesu@sab.ac.lk | Tel : 045 - 2280045

Bursar

Mr. W.A.M.P. Senadheera
senadheerasab@gmail.com | Tel: 045 - 2280229

1.2.3. Administrative Staff

Deputy Registrar (Academic Establishments)	Mr. K. Gunawardana
Deputy Registrar (General Administrations)	Mr. J.G.P.U. Ratnayake
Senior Asst. Registrar (Capital Works and Planning)	Ms. R.T.S. Ranasinghe
Senior Asst. Registrar (CODL)	Ms. S.N. Priyadarshani
Senior Asst. Registrar (Examinations)	Mr. W.M.K.Upuldeniya
Senior Asst. Registrar (Student Affairs)	Mr. G.A.D.M. Thennakoon
Senior Asst. Registrar (Non Academic Establishments)	Ms. W.N.P.M.N.M. Karunarathne
Senior Asst. Registrar (Fac. of Medicine)	Mrs. A A S Priyadarshani
Senior Asst. Bursar (Salaries)	Mr. R.M.N.K. Rathnayake
Asst. Registrar (Fac. of Agricultural Sciences)	Mrs. N.D.R. Dharmapala
Asst. Registrar (Fac. of Applied Sciences)	Mr. M. Sutharsan
Asst. Registrar (Fac. of Geomatics)	Mrs. K.M. Poornima
Asst. Registrar (Fac. of Management Studies)	Ms. P.A.P. Gunasekara
Asst. Registrar (Fac. of Social Sciences & Languages)	Ms. Y.S. Chandrasekara
Asst. Registrar (Fac. of Technology)	Ms. A. Akalya
Asst. Registrar (Fac. of Graduate Studies)	Mrs. T.P.N.T. Guruge
Asst. Registrar (Office of Vice Chancellor)	Mrs. P.G.I. Dias
Asst. Registrar (Registrar's Office)	Ms.Y. Archana
Asst. Registrar (Library Services)	Ms. H.P.K.N.D. Siriweera
Asst. Registrar (Legal and Documentation)	Ms. P.B.N. Fernando
Asst. Bursar (Accounts)	Ms. N.W.M.I. Chamarie
Asst. Bursar (Fac. of Graduate Studies)	Mr. V.K.S. Chathumal
Asst. Bursar (Payments)	Ms. G.K.N. Udeshi
Asst. Bursar (CODL)	Ms. N.P. Wijendra
Asst. Bursar (Revenue)	Ms. G.K.M. De Silva
Asst. Internal Auditor	Ms. C.H. Pathirana
Curator	Mr. R.D. Rajapaksha
Works Engineer (Civil)	Mr. W.M.L.M.K. Wijesundara
Farm Manager	Mr. C.N.K. Balasooriya
Medical Officer	Dr. W.M.A.S. Wijerathne
Chief Security officer	Mr.W.M.K.R. Weerasinghe

1.3. Student Services

SUSL provides a number of services for students to ensure a healthy, safe, and entertaining environment in pursuing their academic and personal development at the university. Students can learn more about these by visiting web-pages listed below:

General services at ***:*** *http://www.sab.ac.lk/student-services*

Medical Services at ***:*** *http://www.sab.ac.lk/medical-services*

Centre for Computer Studies at : *http://www.sab.ac.lk/center-for-computer-studies*

The Career Guidance Unit at ***:*** *http://www.sab.ac.lk/career-guidance-unit*

The Centre for Gender Equity and Equality : *http://www.sab.ac.lk/centre-for-gender-equity-and-equality*

1.3.1. Counselling Services

Professional counselling services are available under confidential atmosphere, at students' request. To obtain this service, students have to contact their faculty advisors, deputy senior student counselor, or senior student counselor.

1.3.2. Accommodation

Accommodation with basic facilities is provided for all students.

1.3.3. Financial Assistance

Bursary and Mahapola scholarship payments will be made monthly at the bank. Exact date of payment is subjected to change from month to month but will be announced in advance.

1.3.4. Canteens

Breakfast, lunch, dinner, tea, cool drinks and various snacks are available in the canteens throughout the day. Main meals should be ordered in advance. You can also purchase groceries, stationeries etc., from the canteens or from the welfare center.

1.3.5. Sports Facilities

The university playground is available for sports activities. Outdoor courts are provided for Tennis, Basketball, Volleyball and Netball. Indoor facilities are available for Table Tennis, Squash, Badminton and Weights training. A 25 m long swimming pool is located at the sports complex. There are facilities available for many other sports.

1.3.6. Libraries

Students can use the central library that provides access for more than 65,000 printed publications and a diverse collection of periodicals. A dedicated library for the faculty has been planned to construct within the proposed Faculty of Technology (FT) building complex. Until that, majority of reading materials suggested in the BST and ET curricula are exclusively available for FT undergraduates through the central library.

Moreover the central library provides an online catalogue enabling students online searching and reservations. The library handles all the transactions through library-automated system.

Students can visit the central library online at: ***http://www.sab.ac.lk/lib/***

1.3.7. e-Learning Center

The central library provides e-learning facilities for both students and lecturers through this center. These facilities can be used to search articles, and for self-studies where students can connect with lecturers through e-learning portals.

http://lms.sab.ac.lk/

1.3.8. Bus Service

Buses between Kumbalgama and Balangoda pass the main university entrance. Buses on the Colombo-Badulla road pass the Pambahinna Junction frequently. CTB busses start for Colombo from the Campus every morning at 4.45 am., 10.00 am and 2.00 pm.

1.3.9. Banks

Bank of Ceylon has a branch office, and a BOC ATM by the main entrance to the university. The People's Bank operates at Pambahinna Junction.

1.3.10. Student Organizations

First batch of students of FT are welcomed to establish relevant and appropriate student organizations that provide opportunities for recreation, share and develop leadership skills, networking and gaining valuable experiences outside classroom. The activities of these organizations may be based on the major fields of study at the FT as well as interests of students. Specially, academic and educational organizations, community service organizations, media and publication organizations, recreation and sports organizations, are encouraged to be initiated, and operated by students.

1.3.11. Community and Neighborhood

SUSL embraces a diverse-interwoven-demographic profile in its neighborhood: all ethnic groups enjoy communal harmony, and all faiths are practiced in serenity. It has been the practice of SUSL students, to integrate in with the community, in their social, religious, and ethnic practices.

This area is endowed with religious landmarks, pre-historical sites, scenic views, and many other tourist attractions. Students are advised to practice extreme caution should they explore these attractions. There were several occasions that such endeavors ended up with sever accidents and even student-deaths due to negligence.

2. FACULTY OF TECHNOLOGY (FT)

2.1. Introduction

Faculty of Technology has been established as the seventh faculty of the Sabaragamuwa University of Sri Lanka. It is located in the main university premises of SUSL at Pambahinna. The faculty comprises of two academic departments, namely, the Department of Biosystems Technology, and the Department of Engineering Technology. The Faculty of Technology offers two degree programs: Bachelor of Biosystems Technology Honors degree through the Department of Biosystems Technology, and Bachelor of Engineering Technology Honors degree through the Department of Engineering Technology. From 2019, the faculty intends to accommodate 75 students annually, for each degree program. The first two years of the degree programs will be conducted at a temporary building facility which is fully equipped with lecture halls, laboratories, and administration offices. The construction of the state-of-the art, fully-fledged faculty complex will be commenced shortly under a loan worth of USD 31 million from the Asian Development Bank.

Faculty of Technology is dedicated to provide a unique student-centered teaching and learning environment where students will be given more opportunities for practice and to develop skills to create and develop science and technology based new products and solutions for possible industrial applications.

The core areas covered by these degree programs include bioenergy generation, bio-based products, development of sustainable and environmentally safe products, bio-waste management, drug discovery, automobile, mechanical and electrical engineering technology, which are globally emerging and evolving areas. It is expected that these degree programs will be able to produce readily employable graduates who can make significant contributions to the economic development of Sri Lanka.

2.1.1. Vision of FT

To be an internationally recognized center of excellence in teaching and research of science and technological subjects.

2.1.2. Mission of FT

The Faculty of Technology is committed to produce graduates with sound knowledge in science and technology through teaching and learning, research, and internship. These graduates will be highly employable, dynamic, and potential inventors who can actively participate for the socioeconomic, scientific and technological advancement of the nation.

2.2. Aims and Objectives

The aim of the Faculty of Technology is to deliver globally recognized student-centered, industry – oriented programs that will produce professionals with ability and skills for creation, innovation and product development with entrepreneurial skills for building their careers in industrial marketplaces related to Biosystems Technology and Engineering Technology which will result in positively contributing to the development of the economy of Sri Lanka.

2.2.1. Specific Objectives

- Provide student-centered degree programs which will ensure that graduates are accomplished in technical expertise, business venture creation, industrial management, soft skills, social awareness and ethical responsibility.
- Provide the students with hands-on experience in the state-of-the-art laboratory skills to ensure applied experiential learning.
- To engage the students in applied research and in developing partnerships with stakeholders as a means of providing solutions to industrial problems.
- To provide a novel program to promote professional development and applied research skills of the graduates.

2.2.2. FT Color

FT color is rose red. It is the hexadecimal color #c21e56, has RGB values of R:194, G:30, B:86 and CMYK values of C:0, M:0.85, Y:0.56, K:0.24.

2.2.3. FT Logo

Yet to be designed. Students are welcome to put forward prospective designs for FT Logo to AR for consideration

2.3. Academic Administration

2.3.1. Academic Officers

Dean/ Faculty of Technology - Prof. K.R. Koswattage

Head/Department of Biosystems Technology - Dr. W.G.M. Sandun Perera

Head/Department of Engineering Technology - Dr. N.P. Liyanawaduge

2.3.2. Administrative Staff

Assistant Registrar - Ms. A. Akalya

2.4. Academic Staff

2.4.1. Department of Biosystems Technology

Head of the Department

Dr. WGM Sandun Perera
Senior Lecturer

Postdoctoral Research Fellow (Organic Synthesis and Medicinal Chemistry) Moffitt Cancer Center, Tampa, FL, USA, 2016–2017

Postdoctoral Research Fellow (Organic Synthesis and Radiochemistry) The University of Texas MD Anderson Cancer Center, Houston, TX, USA, 2014–2016

Postdoctoral Research Fellow (Organic Synthesis and Organometallic Chemistry) Texas Tech University, Lubbock, TX, USA, 2013–2014

Ph.D. (Organic Chemistry, 2013) The University of Texas at San Antonio, San Antonio, TX, USA

B.S. (Special Honors in Chemistry 2006) Peradeniya University, Sri Lanka

Dr. AD Ampitiyawatta
Senior Lecturer

Doctor of. Engineering (D.Eng.) in Hydrology and Water Resource Engineering College of Water Resources and Hydropower, Wuhan University, P.R. China, 2008.

M.Sc. Agric. (Specializing in Crop Science) Post Graduate Institute of agriculture, University of Peradeniya, Sri Lanka, 2003

B.Sc. Agric. (Specializing in Agriculture Engineering) Faculty of Agriculture, University of Ruhuna, Sri Lanka, 1999 (Second Class Upper Division (honors).

Dr. Sarath Bandara
Senior Lecturer

Ph.D. (Plant Molecular Biology) Hokkaido University, Japan. 2011

M.Sc. (Natural Products Chemistry) Hokkaido University, Japan.

2008 B.Sc. (Agric.) University of Peradeniya, Sri Lanka. 2005

Ms PM Attanayake
Lecturer (prob.)

B.Sc. Green Technology, Faculty of Agriculture, University of Ruhuna, Sri Lanka. 2016 (First Class Honors)

Mr. Dasith Wijesekara
Lecturer (prob.)

B.Sc. Eng. Hons (Chemical and Process Engineering) University of Moratuwa, Sri Lanka.2014

In-reading M.Sc. (Sustainable Process Engineering) University of Moratuwa. Sri Lanka.

Ms. Y. P. Manawadu
Lecturer (prob.)

B.Sc. (Special) in Computer Science, University of Sri Jayewardenepura, Sri Lanka. 2018

In-reading M.Phil. (Computer Science), University of Sri Jayewardenepura, Sri Lanka.

Mr. T.W.K. Sanith Sri Jayashan
Lecturer (prob.)

B.Pharm. (Hons) University of Ruhuna, 2019

Mrs. J.D. Thilagam
Lecturer (prob.)

M.Sc. (Experimental Biotechnology), University of Peradeniya,

2015 B.Sc. (Biotechnology), Bharathidasan University, 2008

Mr. E.P.R.H.H.W. Nilmalgoda
Lecturer (prob.)

M.Sc. (Biosystems Engineering), University of Peradeniya, 2019

B.Sc. (Sp) in Agricultural Sciences and Management, Sabaragamuwa University of Sri Lanka, 2015

Mr. A.M.P.C. Amarasinghe
Lecturer (Unconfirmed)

M.Sc. (Sustainable Process Engineering),University of Moratuwa, 2020

B.Sc. (Hons) in Chemical and process Engineering, University of Moratuwa, 2015

Dr. M.D.K.M. Gunasena
Lecturer (Unconfirmed)

Ph.D. (Plant Biotechnology),University of Sri Jayewardenepura, 2020

B.Sc. (Special in Plant Biotechnology), University of Sri Jayewardenepura, 2015

2.4.2. Department of Engineering Technology

Head of the Department

Dr. N.P. Liyanawaduge
Senior Lecturer

Ph.D (Superconducting Materials), 2014-University of Peradeniya M.Phil (Dye sensitized solar cells), 2005 -University of Ruhuna B.Sc (Honors), 2000-University of Ruhuna

Prof. K.R. Koswattage
Senior Lecturer

Ph.D., Kobe University, Japan, March 2012

M.Sc., Kobe University, Japan, March 2009

B.Sc. (Honors), Special degree in Physics, University of Colombo, 2004

Mrs. W.L.T. Peiris
Lecturer (Probationary)

B.Sc. Eng (Honors) in Electrical Engineering, University of Moratuwa, 2017

In-reading M.Sc (Electronics) University of Bremen, Germany

Mr. A.P.G. De Alwis
Lecturer (Probationary)

B.Sc. Eng (Honors) in Mechanical Engineering, University of Moratuwa, 2016

In-reading M.Sc (Control, Microsystems and Microectronics) University of Bremen, Germany

Mr. G D K V Maduwantha
Lecturer (Probationary)

B.Sc. (Sp.) Applied Sciences, Sabaragamuwa University of Sri Lanka, 2018

Ms. N.D. Hettiwatta
Lecturer (Probationary)

B.Sc. in Electrical Engineering, University of Moratuwa, 2017

Mr. S.P.S.N.B.S. Kumara
Lecturer (Probationary)

B.Sc. in Mechanical Engineering, University of Moratuwa, 2017

Mr. H.V.V. Priyadarshana
Lecturer (Probationary)

M.Sc. in Electrical Engineering, University of Moratuwa, 2020

B.Sc. in Electrical Engineering, University of Moratuwa, 2017

Mr. S.V.A.A. Indupama
Lecturer (Probationary)

B.Sc. in Mechanical Engineering, University of Moratuwa, 2020

Mr. W.H.H.A. Kariyawasam
Lecturer (Probationary)

B.Sc. in Mechanical Engineering, University of Moratuwa, 2018

2.4.3. Faculty Board (FB)

The Faculty Board has been constituted to improve academic, executive, and administrative governance of the faculty in accordance with principles and polices established by the senate and the council of SUSL. It provides oversight of academic and related matters, mediates strategic and operational planning, and responsible for decision making and implementation of the faculty.

Indicated below is the current faculty board of the FT. The following internal and external members will serve a three-year term from Jan 1, 2019. The student representative would serve for a term of maximum two years.

Chairman

Prof. K.R. Koswattage	(Dean) Senior Lecturer

Members

Dr. N.P. Liyanawaduge	(Head/ET) Senior Lecturer
Dr. W.G.M.S. Perera	(Head/BST) Senior Lecturer
Dr. P.K.G.S.S. Bandara	Senior Lecturer
Ms. P.M. Attanayake	Lecturer (Prob.)
Mr. E.R.J.M.D.D.P. Wijesekara	Lecturer (Prob.)
Ms. A. Akalya	(Secretary) Asst. Registrar/ FT

ExternalMembers

Eng. (Dr). Lionel Pinto	
Mr. S.M.C.P. Siriwardhane	Asst. Director of Agriculture, Balangoda
Mr. M.G.A.P. Aberatne	Area Electrical Engineer, Kahawaththa

Student Representatives

Two students nominated by the students, participate representing whole student population of FT

2.4.4. Registration for Courses

From year II onwards, each student must register for the courses he or she intends to follow in during the academic year, before the semester is started at the assistant registrar of FT. Student may add or drop courses, and change the course schedules before the end of the **second week** of that semester. Any changes sought after this deadline would require FT board approval.

2.4.5. Registration for End-Semester Examinations

Each student must register for the **End-Semester Examination** of every semester, indicating all of the courses he or she intends take during that examination before the end of the **tenth week** of that semester at the assistant registrar of FT.

2.4.6. Attendance Policy

Faculty of Technology requires that each student participates all the classes of each course that he or she registers, regardless of the course type; that compulsory, non-credit compulsory, electives, research, internship etc. all expect a 100% attendance. Should a student miss a class, he or she is encouraged to provide a legitimate reason to the relevant lecturer/instructor. Those who fall short of 80% attendance for a theory course/practical course/theory component/practical component that student will not be allowed to sit for the End-Semester-Examination of that theory course/practical course/theory component/practical component during the same semester unless faculty board decides otherwise.

Students who fall short of 80% attendance are advised to follow guidelines prescribed below.

1. Students who fail to maintain a minimum of 80% attendance for a particular subject/s will not qualify for the semester examination of that subject/s except under special circumstances stipulated below;

    a) If a student has maintained at least a 60% attendance and has a chronic illness, he/she can make an appeal to the Faculty Board. The appeal should be supported with a medical certificate from a specialist doctor and a report from a student counselor in the Faculty.
    b) If a student has maintained at least a 60% attendance and has obtained

prior approval from the Faculty Board through the University Sports Advisory Committee to participate in university sports activities.

2. Students with less than a 80% attendance, but have maintained at least a 50% attendance for a particular subject/s will have to fulfill the following requirements in order to qualify the subsequent semester examinations as first attempt students.
    c) They have to meet the relevant subject coordinator an undertake make-up work.
    d) Submit the prescribed form confirming completion of the make-up work available at the Office of the Dean.

3. Students who fail to maintain a minimum of 50% attendance for a particular subject/s to qualify as first attempt students for subsequent semester examination will have to complete the full course in order to be eligible to sit for the examination of the particular subject.

2.4.7. Student Code of Conduct

FT adheres, SUSL-student code of conduct, described in the booklet provided to each student at the first day of university orientation, which is also available at the Assistant Registrar of FT for reference, to the fullest legal and administrative jurisdictions granted. This sets minimum standards on ethical and behavioral practices expected from each and every student, all student organizations, and all students of FT as a group, in pursuit of academic excellence. FT believes that each student should be accountable, and hold responsibility for own actions. These rules apply for all student activities where FT students represent FT and SUSL including internships, research conducted at off campus locations/other institutes.

2.4.8. Laboratory Safety

All laboratories of FT of SUSL are obliged to practice appropriate safety measures to ensure a healthier and safer environment to learn, teach, and work. Most appropriate general safety practices for each laboratory course will be delineated at the first meeting of that course/laboratory session. At the beginning of each laboratory class/ experiment, specific safety measures will be introduced by the instructor when such prudent practices are required. In addition, all these safety measures are included in the relevant lab manuals, and are generally be made available for students in ahead of

time. Students may obtain these materials form the relevant instructor. It is mandatory, and is the student's responsibility to adhere to and strictly follow all necessary safety protocols recommended for each laboratory experiment. The personal protecting equipment (PPE) such as lab coats, safety glasses or chemical goggles, gloves, and masks, etc. must be bought at students' expense if recommended.

2.4.9. Internship

This is a mandatory six-month (24 week) long full-time placement in relevant industry worth of 6 credits. The Department of Biosystems Technology offers the industry placement during Semester I of Year IV while the Department of Engineering Technology offers that course during Semester II of Year III. In general, these internships are formalized through the respective department, and the University Business Linkage Cell (UBLC) of SUSL. However, if a student wishes to find his/ her internship opportunity, he/she may do so with prior approval from the head of the respective department. Each student will be assigned an internal supervisor/s from the department and supervisor/s form the industry. The former is directly responsible for what you do during your stay in industry and both supervisors contribute equally in evaluation of students' performances and grading. It is expected form each student to be proactive and sound in extracting maximum competencies of industry related techniques, procedures, equipment, and make the maximum contribution to solve real problems. It is imperative that students adhere FT student code of conduct and thrive for success for the entirety of the internship.

2.4.10. Research

The Department of Biosystems Technology offers its undergraduate research training as a compulsory one-semester long full-time, eight-credit-worthy undertake in the Semester II of year IV, usually in the field of student's specialization, On the other hand, the Department of Engineering Technology conducts its undergraduate research training as a compulsory six-credit-worthy program, spanning over Semester I and II of year IV. The research project will be conducted in a dedicated laboratory on campus or, at a reputed national laboratory, or in industry outside the university. In general, this is coordinated by the relevant department of FT. Each student will be assigned an internal supervisor/s from the department and an external/on site supervisor if required. Students may progress his or her internship project or will be assigned a different project by the supervisors. Students may also propose plausible projects or work in conjunction with supervisors in formulating the project. The ultimate goal of this endeavor is to provide opportunities for students to contribute in creating new

knowledge through scientific inquiry. Each student is expected to make mindful and serious efforts for discovery, innovation, and new product development since to be successful in "research" is very challenging. Successful research projects, besides their new findings, may open up important career prospects for pursuant undergraduate researcher/s as well. For example, such projects may be further continued as graduate-level research work, grant publications license, or patents etc.

2.4.11. Graduation

2.4.11.1. Curriculum of Graduation

Student must complete within 8 years of initial registration at FT. relevant curriculum is what had registered for at the beginning. If a new curriculum has been introduced, can take most appropriate course with approval of FB and senate. In general, the curriculum which is considered for awarding the degree is the curriculum the student had registered at the beginning of studies at FT. If a new curriculum has been introduced thereafter the student may have the option to change the curriculum with prior approval of FB and the senate.

The FT reserves the right to withdraw or modify courses at any time and to change rules, calendar, curriculum, degree programs, degree requirements, graduation procedures, and any other requirement affecting students, staff and faculty, following SUSL approved procedures.

2.4.11.2. Graduation Dates

Degrees are awarded at the end of each academic year. Commencement ceremonies are held once a year, usually in December-January.

2.4.11.3. Degree Effective Date

Degree Effective Date is considered to be the very next day after the final year dissertation defense date. Students have to officially apply to obtain a statement of Degree effective date at the registrar's office

2.4.11.4. Applying for the Conferment of the Degree and Graduation

It is the student's responsibility to apply for his or her Conferment of the Degree and Graduation by submitting the duly filled "Supplication for The Conferment of Degree" form at the Registrar's office.

2.4.12. Statement of Gender Equity and Equality

Discrimination on the basis of sexual orientation, gender identity and gender expression are prohibited pursuant to SUSL policy on Gender Equity and Equality. For more details on this follow The Centre for Gender Equity and Equality of SUSL at http:// www.sab.ac.lk/centre-for-gender-equity-and-equality

2.4.13. Accreditation

Faculty of Technology of Sabaragamuwa University of Sri Lanka has been authorized by the University Grants Commission of Sri Lanka for awarding Bachelor of Biosystems Technology Honors and Bachelor of Engineering Technology Honors degrees.

The Bachelor of Biosystems Technology Honors (BBST Hons) degree is expected to be accredited by the National Biotechnology Industry Association (NBIA) through Sri Lanka Accreditation Board (SLAB). On the other hand, the Bachelor of Engineering Technology Honors (BET Hons) degree is expected to be accredited under the Sydney Accord of Engineering Technologists.

2.4.14. Faculty Orientation Program

In general, this program consists of scientific lectures and sessions on essential academic skills.

Main goals of this program include, but not limited to;

- Raise students' awareness on scientific research and its impacts on humankind
- Delineate undergraduate education and its inevitable high impacts on entrepreneurship

Scientific lectures may cover most recent developments in relevant disciplines of science to the degree programs offered at FT and could include topics from Nanotechnology, Measurement Technology, Energy Technologies, Drug Discovery Processes, Biotechnology, etc.

Sessions on essential academic skills would fill the gaps in students' knowledge on fundamentals of academic note taking, conducting laboratory experiments and safety, students' role and responsibilities in relation to learner-centered instructional strategies, research communications, assessment skills, and all that would assure them a head start on undergraduate education.

2.4.15. Intensive English Program

The Faculty of Technology conducts a rigorous English program, called "Intensive English Program" for incoming new students each academic year, before they start their first-year academic courses. This program focuses on all aspects of English language learning which includes grammar, listening, speaking and writing. At the end of the program, there is an exit-exam. It is the Faculty of Technology policy that, each student required to obtain a minimum C grade to be able to graduate from the faculty. Students who obtains lower grades than, C are required to re-take the exam during the very next time it is offered.

2.4.16. Surveys

FT conducts various surveys that include gathering various information from, entering undergraduate students, graduating students and alumni. Main objectives underling these surveys can be one or several of following:

- To generate insights into program quality improvements
- Measure expectations, experiences, and satisfaction across all areas/entire range (quality of lecturers, department; curriculum; facilities; campus life; extracurricular activities; community engagement) of their undergraduate education at FT.

Data gathered by these instruments are kept anonymous, confidential and will not be disclosed to a third party.

At FT, we mindfully utilize this information to improve overall quality of our program and to ensure our graduates are up-to-date and highly employable globally.

Moreover, FT expect to keep in touch with each and every graduate it produces and cordially requests to leave contacts (current email, phone, skype, mailing address) with the department office upon your graduation. FT also, expect it's graduates to share their employment details, and graduate or postdoctoral etc. qualifications with us.

2.4.17. Student Feedback

FT takes student feedback very positively yet seriously. Therefore, FT issues a student feedback questionnaire for every course (lectures, laboratories, field visits, etc.) at all levels in each semester through quality assurance cell of the faculty. These

questionnaires are expected to be completed only in a few minutes in class by students anonymously; However, they will lead to immediate fixes of the ongoing course and or improvements in subsequent offerings. Students are kindly requested to fill out these feedback forms accurately, responsibly, and legibly.

2.5. Current Status and Future Perspectives of FT

At present, FT occupies the buildings, which had been occupied by the Faculty of Geomatics before it moved to its new building complex in 2015. The FT will be relocated in its own premises, next to the library of the Faculty of Applied Sciences, once the constructions are adequately completed in about two years. At the current location, administrative offices including Dean's office, Faculty Board room, Assistant Registrar's office, Department offices, and Project Implementation office, faculty and staff offices have already been established. In addition, Z-6, and Z-7 halls have been dedicated as lecture hall facilities for students of FT. Building Z-10 hosts, Biology and Chemistry labs, for first and second year students. The IT/Computer laboratory is situated inside the Y building while Main Building hosts first and second year Physics Lab.

The proposed building complex of FT will be built-in above-mentioned location, in a plot of land of about 4 acres (fully equipped under Asian Development Bank[ADB] Grant). Total floor area of buildings of this complex, excluding parking, would be whopping 13,000 square meters approximately. The construction of this new FT complex has been planned as a three phase-sequence. Phase-I constructions, which has been planned to finish the earliest, builds administrative offices, faculty and staff offices, and lecture hall and laboratory facilities for third year and fourth year studies. This would allow, to best expectations, the 2017-2018 cohort of students to continue their third and fourth years at the new premises. Likewise, FT will be gradually relocated in the new premises in a spaced-out transition over a period of several years as all phases of constructions come to completion.

This facility is designed to host dedicated spaces such as administrative block, academic block, laboratory block, workshop building, library, auditorium, cafeteria, and new-types-of-spaces for University-Industry collaboration center, conference and journal office, and research center. All in all, there will be 24-lecture rooms, 12-teaching labs, 4-workshops, and 6-research labs available to students.

According to preliminary designs the proposed building complex will be innovatively designed to suit 21st century undergraduate educational needs in general, and specifically to cater new practices integrated in to FT offering curriculars (vide infra). Evidently, this will bring novel features, such as flexible classrooms and labs, spacious student lounges with seating and learning aids etc., into existence, all conducive to "flipping the classroom" approach (vide infra).

The first batch of FT, which is the 2017/2018 cohort, comprises of 75 students for BST and 75 students for ET. It is planned to continue to admit the same numbers of student to each department, in its next four intakes, before it re-evaluates the possibility of increasing student intake of each discipline. On the other hand, at present, all approved faculty positions have been filled. In parallel with annual student intakes, it is scheduled to recruit appropriate number of faculty members each year for the next three years, until totaling 600 students get onboard occupying all four academic levels. Concurrently, other essential non-tenure-track academic appointments such as demonstrator/instructor, teaching assistant and etc. will be gradually recruited in such a way that it ensures a lower student to teacher ratio of about 10. Analogously, all other facilities and services will be incrementally expanded to cater the growing student and faculty populations.

FT has developed, and obtained approval of senate of SUSL and UGC for, two undergraduate curriculars, namely, BBST curriculum and BET curriculum. The both curriculars shares many common features; They aim to produce technology oriented, science-backed graduates via an outcome-based strategy. To foster them with cognitive and noncognitive skills, such as analytical thinking, problem solving, communications, and teamwork, dedicated practical oriented course-work have been included. Flexibility and ability to continuously learn and to upgrade skills have been identified world-wide as most need competencies of technology graduates to survive and lead the ever-changing technological landscapes. Both curricular provides ample opportunities for undergraduates to acquire and excel these qualities. Also, to foster aforementioned signature features in curricular, FT has introduced new practices, in pedagogy; student-centered learning, Problem-Based Learning (PBL), and Team-Based Learning (TBL) methods have been introduced, student guidance bodies, and industry linkages (university business linkage cell) have been established. All in all FT diligently follow the "flipping the classroom" approach. This strategy allows students to work on problems in small groups where they can interact and learn from each other while receiving guidance from the instructor, during the regular class time. On the other hand, students are required to complete much of their learning – whether it's watching a video lecture, researching information online or completing reading assignments – with the use of modern technology before entering the classroom.

2.5.1. Laboratories

At present Faculty of Technology operates four laboratories namely Biology Lab, Chemistry Lab, Physics Lab, and Computer Lab.

2.5.1.1. Biology Lab, Chemistry Lab and Physics Lab

These three labs are dedicated to facilitate the laboratory component of courses that require its use. All Laboratories are equipped with necessary equipment to conduct the relevant laboratory classes. Laboratory Hours: Students are allowed to conduct laboratory experiments only during the allotted time for the specified experiment. Students are highly advised to complete the lab during the assigned week. A lab experiment may be made up the week the experiment is missed or the week following the missed experiment. Students are not permitted to conduct any experiment without supervision of a competent instructor.

2.5.1.2. Computer Lab

The computer lab is equipped with 45 computers. The primary use of this lab is to facilitate the practical components of courses, which require IT facilities, offered at the Faculty of Technology. However, students are welcome to use it for academic purposes when classes are not held. Computer Lab Hours: Monday – Friday 8 a.m. – 7 p.m. (*Hours vary on Holidays and between semesters)*

2.5.2. Mail

All incoming mail for students, is kept in the student mailbox at the Faculty office. The postal address for students to receive mail should be as follows;

Name of the student, Faculty of Technology, Sabaragamuwa University of Sri Lanka, P.O. Box 02, Belihuloya, 70140, Sri Lanka.

2.5.3. Extra-Curricular Activities

FT students are highly encouraged to involve in extra-curricular activities, available at SUSL, outside their academic work. These activities will be very useful and empowering to improve leadership, communication, self-reliance, etc. ultimately uplifting their employability. Also, FT faculty believe that such activities might have a positive impact on entrepreneurial abilities of our students. As the first batch of students of FT, 2017/2018 students are expected to establish FT chapters of university wide societies during their first year such as explorers club and art circle. In addition,

students are welcome to launch on new initiatives such as Academic Teams and Clubs, The Debate Team, Internships, Culture Clubs/ anti-bullying campaigns, Volunteer Work and Community Service, The Student Newspaper, A Part-time Job, Athletics, etc. which will be relevant, and conducive to the graduate profile of FT.

3. DEPARTMENT OF BIOSYSTEMS TECHNOLOGY (DBST)

3.1. Introduction

The Department of Biosystems Technology offers Bachelor of Biosystems Technology Honors degree: BBST(Hons). The BBST(Hons) degree is designed to prepare students for professional careers in the biological sciences, medical and health service fields, research, industry, and education. Its prime goal is to integrate biology and technology of production systems and multi-disciplinary amalgamation for sustainable production of bioenergy, pharmaceutical-drugs, and biotechnology products with minimal environmental impacts to enormously support the self-sustainability of the country; for this the department provides comprehensive training for students on three indispensable disciplines, bioenergy, biotechnology, and drug discovery.

3.1.1. Aims and Objectives

Specific educational objectives of the Department of Biosystems Technology are,

1. Develop the competence of students in methods of analysis involving use of mathematics, physics, chemistry, biology, biotechnology, microbiology, drug discovery, alternative energy generation systems and computing needed for the professional practice in the field of Biosystems Technology.
2. Develop skills of students that are required to contribute to the design processes in Biosystems technology, including the ability to innovate, develop new systems and products while collaborating with the industry.
3. Inculcate the abilities of addressing issues of ethical considerations and safety in operations, environmental impact, and social and economic impact in professional practice.
4. Inculcate the ability to be a successful leader of multi-disciplinary teams that efficiently manage multiple activities in projects running concurrently that are applicable to Biosystems Technology.
5. Develop entrepreneurial abilities in order to promote venture creations in applied areas in Biosystems Technology.

3.2. Degree programs

Department of Biosystems Technology offers the following degree.

Bachelor of Biosystems Technology Honors degree: BBST (Hons)

Students can specialize in one of the following areas

Bioenergy

Biotechnology

Drug Discovery

After completion of their second year, students can choose to follow a major stream during their third and fourth years of study. As of now, department intends to offer majors in, bioenergy, biotechnology, and drug discovery. The selection criterion for these majors, in general, is based on merit and availability of resources. The department reserves the right for deciding number of available positions for each major in every academic year based on and not limited to factors such as availability of resources, job market, government regulations, etc.

3.3. Program Learning Outcomes (PLO)

On successful completion of this program student should be able to,

1. Discuss the potentials of energy generation approaches of solar, wind, biomass, hydropower and other types of renewable energy generation techniques.
2. Describe the techniques of biomass pre-processing operations and post processing value added operations in bioenergy generation process.
3. Describe the major energy conversion technologies for bio energy generation.
4. Use fundamental concepts and essential skills of basic sciences (chemistry, biology, energy) to understand and excel molecular sciences (BST) and technologies.
5. Integrate cross-disciplinary knowledge for designing novel (BST) solutions for sustainable development of the nation.
6. Effectively apply knowledge and skills on designing, researching, analyzing and interpreting data for investigating complex real-world problems related to bioenergy, biotechnology, and drug discovery fields and creating sustainable and innovative solutions individually and collaboratively.

7. Acquire proficiency in effective use of contemporary technologies related to biotechnology field and pursue lifelong personal and professional developments maintaining intellectual curiosity.
8. Demonstrate excellent interpersonal, communication, professional, ethical, entrepreneurial and finance management skills in both local and global contexts.

3.4. Minimum BBST Degree Requirements

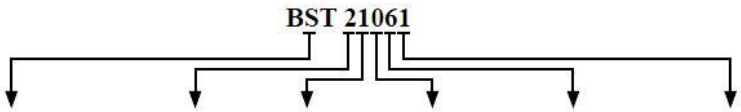
In order to receive a BBST Hons degree from the DBST of FT of SUSL, a student must meet the minimum requirements given below:

1. Complete a minimum of 120 credit hours.
2. Complete the Department Core Curriculum requirements outlined in this chapter.
3. Complete the major and support work requirements and the elective requirements for the BBST degree.
4. Meet all requirements for an honors degree as put forth by the SUSL Senate.
5. Achieve an overall 2.0 grade point average in all courses attempted at SUSL.
6. Be in good academic standing and free of any punishable misconduct at SUSL to obtain a class.
7. Apply formally for the conferment of degree in the Registrar's office.

3.5. BBST Curriculum

3.5.1. Course Numbering System

Courses offered by the DBST are designated by five-digit numbers following a three-letter abbreviation of the academic discipline.



BST	2	1	0	6	1
Academic Discipline	Year	Semester	Course Number		Number of Credits

3.5.2. Number of Credits

The number of credits assigned to any subject represents the total number of hours spent in class, in laboratory, spent on assignments, and estimated to be spent in exam preparation per semester

3.5.3. Curriculum

The BST curriculum has been prepared to satisfy the requirements of Sri Lanka Qualifications Framework (SLQF) Level 6 and to fulfil requirements of international accreditation boards. The program is of 8 semesters duration and the core program is of 120 credits.

3.5.4. Curriculum Component Area Requirements

All the courses offered in Year I and Year II are ***Compulsory***. During Year III and IV student must follow ***Compulsory*** courses in the relevant specialization (majoring) module, and select remainder from ***Optional*** category (if necessary) to satisfy their credit requirements. All students must complete the following component area requirements

Component Area	Credits
Mathematics, Basic Sciences and Computing	24
Technology Core	76
Communication, Economics, Management	20
Total	**120**

3.5.5. Annual Credit Schedule

Students are highly advised to follow the credit schedule indicated below for them to be able to complete the degree program in four academic years. However, student may take additional credits with prior approval of the faculty board of FT

Year	Semester I	Semester II	Total
Year I	17	17	34
Year II	17	15	32
Year III	19	19	38
Year IV	06	10	16
Total			**120**

3.6. Course Schedule

Students must complete a total of 120 credits and component area requirement following the course schedules given below. As of now Year I and Year II course schedule is unique for all BBST students. During Year III and IV student must follow the course schedule of the relevant majoring module. Moreover, student wishing follow additional courses may do so provided prior approval of the faculty board of FT

Year I and Year II

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year I Semester I - A student must earn a minimum of 17 credits			
Year I Semester I	BST 11013	Introduction to Biosystems Technology	3	Compulsory
	BST 11022	Mathematics	2	
	BST 11032	Chemistry I	2	
	BST 11042	Physics for Biological Systems	2	
	BST 11052	Principles of Biology	2	
	BST 11063	Personality Development	3	
	BST 11071	Scientific Communication	1	
	BST 11082	ICT for Technological Applications	2	
	BST 11910	Communicate in English I	0	
	Year I Semester II - A student must earn a minimum of 17 credits			
Year I Semester II	BST 12011	Fundamentals of Biometry	1	Compulsory
	BST 12022	Chemistry II	2	
	BST 12031	Renewable Energy Systems	1	
	BST 12042	Molecular Biology	2	
	BST 12052	Principles of Microbiology	2	
	BST 12063	Biological diversity and Bio-prospecting	3	
	BST 12073	Economics for Decision Making in BST	3	
	BST 12083	Process Control and Automation in Bio-industry	3	
	BST 12090	Historic Developments & Current Affairs of Sri Lanka	0	
	BST 12910	Communicate in English II	0	

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year II Semester I - A student must earn a minimum of 17 credits			
Year II Semester I	BST 21012	Experimental Designs	2	Compulsory
	BST 21022	Principles of Biochemistry	2	
	BST 21032	Instrumentation and Measurements	2	
	BST 21042	Biomass for Bioenergy	2	
	BST 21051	Introduction to Biotechnology	1	
	BST 21061	Introduction to Nanotechnology	1	
	BST 21071	Environmental and Health Impacts ofModern Technologies	1	
	BST 21082	Organizational Behavior	2	
	BST 21092	Computer Aided Designs for Technology	2	
	BST 21102	Data Acquisition Techniques and Signal Processing	2	
	BST 21110	Global Historical Landmarks and Current Affairs	0	
	BST 21910	Communicate in English III	0	

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year II Semester II - A student must earn a minimum of 15 credits			
Year II Semester II	BST 22012	Entrepreneurship and Technology Management	2	Compulsory
	BST 22021	Introduction to Drug Discovery	1	
	BST 22032	Applied Chemistry	2	
	BST 22042	Energy Conversion Technologies	2	
	BST 22051	Bioinformatics	1	
	BST 22062	Microbial Applications in Biosystems Technology	2	
	BST 22071	Human Resource and Quality Management	1	
	BST 22082	Introduction to Electronics and Electricity	2	
	BST 22092	Directed Study and Seminar	2	
	BST 22910	Communicate in English IV	0	

MAJOR MODULE: BIOENERGY

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year III Semester I - A student must earn a minimum of 20 credits			
Year III Semester I	BST 31212	Combustion Technologies for Bioenergy	2	Compulsory
	BST 31222	Biomass Gasification and Pyrolysis	2	
	BST 31232	Bioenergy Crop Cultivation and Harvesting Technologies	2	
	BST 31242	Liquid Biofuel Generation Technology	2	
	BST 31252	Anaerobic Digestion Technology	2	
	BST 31262	Supply Chains for Bioenergy and Biorefining	2	
	BST 31272	Biomass pretreatment and processing	2	
	BST 31282	Bio-based Power Generation	2	
	BST 31292	Pollution Control of Bioenergy Technologies	2	

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year III Semester II - A student must earn a minimum of 20 credits			
Year III Semester II	BST 32212	Waste management of bioenergy technologies	2	Compulsory
	BST 32222	Liquid Biofuel Purification Technologies	2	
	BST 32232	Biogas Purification, Storage and Combustion Technologies	2	
	BST 32242	Commercial Biofuel Technologies for Transportation	2	
	BST 32252	Project Management and Entrepreneurship for Bioenergy	2	
	BST 32262	Occupational Safety and Hazard Identification	2	
	BST 32272	Energy Recovery and Conservation	2	
	BST 32282	Bioenergy in Drying Technologies	2	
	BST 32292	Sustainable Bioenergy Industry	2	
	BST 32302	Quality Measurement & Analytical Methods	2	

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year IV Semester I - A student must earn a minimum of 6 credits			
Year IV Semester I	BST 41216	Industrial training (24 weeks of industrial training)	6	Compulsory
	Year IV Semester II - A student must earn a minimum of 10 credits			
Year IV Semester II	BST 42212	Bioenergy Plant Maintenance	2	Compulsory
	BST 42228	Industrial Research & Design Project (Group)	8	

MAJOR MODULE: DRUG DISCOVERY AND DEVELOPMENT

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year III Semester I - A student must earn a minimum of 20 credits			
Year III Semester I	BST 31413	Organic Chemistry-I	3	Compulsory
	BST 31423	Human Biology	3	
	BST 31433	Pharmaceutics-I	3	
	BST 31442	Medicinal Chemistry-I	2	
	BST 31452	Phytochemistry and Pharmacognosy-I	2	
	BST 31462	Drug Discovery and Development-I	2	
	BST 31473	Pharmaceutical Analytical Chemistry-I	3	
	BST 31481	Chemical Toxicology	1	

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year III Semester II - A student must earn a minimum of 20 credits			
Year III Semester II	BST 32413	Organic Chemistry-II	3	Compulsory
	BST 32433	Pharmaceutics-II	3	
	BST 32482	Synthetic Organic Chemistry	2	
	BST 32442	Medicinal Chemistry-II	2	
	BST 32462	Drug Discovery and Development-II	2	
	BST 32452	Phytochemistry and Pharmacognosy-II	2	
	BST 32472	Pharmaceutical Analytical Chemistry-II	2	
	BST 32012	Proposal Writing and Project Management I	2	
	BST 32491	Heterocycles in Drugs and Drug Discovery	1	
	BST 32501	Marketing and Regulation of Drugs	1	

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year IV Semester I - A student must earn a minimum of 9 credits			
Year IV Semester I	BST 41016	Industrial training	6	Compulsory
	BST 41413	Pharmaceutical Technology	3	
	Year IV Semester II - A student must earn a minimum of 10 credits			
Year IV Semester II	BST 42011	Career Development and Progression	1	Compulsory
	BST 42021	Proposal Writing and Project Management II	1	
	BST 42038	Research Project	8	

MAJOR MODULE: BIOTECHNOLOGY

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year III Semester I - A student must earn a minimum of 20 credits			
Year III Semester I	BST 31012	Ecological Concepts in Biosystems Technology	2	Elective
	BST 31022	Innovation Management and New Product Development	2	Compulsory
	BST 31033	Modern diagnostic techniques in disease control	3	
	BST 31042	Bioprocessing Technologies in Biorefinery	2	
	BST 31052	Dairy Biotechnology	2	
	BST 31063	Recombinant DNA technology and genetic transformation	3	
	BST 31073	Plant Cell and Tissue Engineering	3	
	BST 31082	Plant Growth Regulators and Signal Transduction	2	Elective
	BST 31092	Production of Plant Secondary Metabolites	2	

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year III Semester II - A student must earn a minimum of 20 credits			
Year III Semester II	BST 32012	Proposal writing and Project Management I	2	Compulsory
	BST 32023	Bioproducts for Organic Agriculture	3	
	BST 32032	Industrial Uses of Plant Fiber	2	
	BST 32043	Enzyme Technology	3	
	BST 32052	Principles of Molecular Virology	2	
	BST 32062	Molecular Plant Breeding	2	
	BST 32071	Molecular Biology Practicum	1	
	BST 32082	Biowaste Management	2	
	BST 32092	Unconventional Theories	2	Elective
	BST 32102	Cereal Technology	2	

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year IV Semester I - A student must earn a minimum of 6 credits			
Year IV Semester I	BST 41016	Industrial training (24 weeks of industrial training)	6	Compulsory
	Year IV Semester II - A student must earn a minimum of 10 credits			
Year IV Semester II	BST 42011	Career Development and Progression	1	Compulsory
	BST 42021	Proposal Writing and Project Management II	1	
	BST 42038	Research Project	8	

3.7. Course Contents

3.7.1. Year I Semester I

BST 11013[1] – Introduction to Biosystems Technology (C)[2]

3 credits (30-30-30-60)[3], Prerequisite: None

Theory

Meteorology: *Introduction to biological systems* – What is a biological system? various biological systems and their importance; *Weather and climate* – Define weather and climate, climatic parameters (rainfall, temperature, relative humidity, wind, atmospheric pressure, sunlight); *Meteorological station and its functions* – Site selection, instruments and installation, data collection, analysis and presentation, weather forecasting

Soil: *Soil* – Physical, chemical and biological properties of soil, characteristics of common soil types found in Sri Lanka

Water: *Water* – Surface and ground water, selection of water resource, rain water harvesting (construction of models), water quality parameters, water pollution sources and impact, waste water treatment; *Water lifting* – Conventional and non-conventional water lifting, operation and working principles of various types of water pumps (positive displacement and negative displacement), factors to be considered in selection of a water pump

Crop production: *Plantation and export agricultural crops* – Timber, plantations crops – tea, rubber, coconut, pepper, cinnamon, cloves, cardamom, nutmeg, cocoa, coffee, arecanuts, citronella, ginger and turmeric; *Controlled environmentsfor crop production* – Controlled conditions, protective structures, preparation of BoQ, preparation of models, hydroponic and aeroponic cultures, solid-media cultures

Aquaculture and Animal production: *Aquaculture* – Fresh water ornamental fish culture, fresh water table fish culture, aquatic plant industry, ornamental aquatic plant culture; *Livestock production* – Poultry management, dairy management, health management and sanitation, milk industry, broiler meat industry, egg related industries

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1. *In the course code: academic discipline (three-letter abbreviation), year/level (first digit), semester (second digit), course number (third and fourth digits), number of credits (fifth digit)*
2. *C – Compulsory, O – Optional*
3. *In the course capsules, figures in parentheses denote notional hours in class/theory (first figure), hours in laboratory (second figure), hours of assignment (third figure), and hours of exam preparation (forth figure) of the course.*

Food quality and post-harvest activities: *Food quality* – Factors affecting food spoilage, growth of microorganisms, traditional food preservation methods, food enrichment and fortification, regulations and standards, product development, packaging, sensory evaluation, shelf-life, food labeling, GMF and regulations, hazards and safety issues, allergies and poisoning, food additives, adulteration, quality certification, food act; *Post harvest* – Grain processing (rice), maturity index, post-harvest losses, fish harvest

Biowaste management: *Biowaste* – Sources of biowaste and classification, uses of biowaste, environmental friendly gardening

Practical

Meteorology: *Identification of various meteorological instruments and data recording* – Various types of rain gauges, maximum and minimum thermometers, wet and dry bulb thermometers, anemometers, barometers, sunshine recorder, pyrometer; *Represent rainfall data on various graphs* – Mass curve, hyetograph, moving average curve; *Field visit* – Visit to a standard meteorological station

Soil: *Determination of various soil properties* – Determination of soil texture, structure, color, bulk density, true density, water holding capacity, pH, cation exchange capacity and electrical conductivity; observation of soil organisms

Water: *Rainwater harvesting* – Construction of rainwater harvesting models, evaluating water quality; *Water pumps* – Identification of various types of water pumps and parts, installation of a centrifugal water pump

Crop production: *Product development with crops* – Product development from plantation and export agricultural crops; *Hydroponic and aeroponic cultures* – Hydroponic and aeroponic cultures

Aquaculture and Animal production: *Ornamental fish farming* – Identification of various fresh water fish species and ornamental plants, proper maintenance of a fish tank; *Meat and dairy products* – Various milk products (yoghurt, butter, cheese etc.), broiler meat preparation for the market, egg preparation for the market

Food quality and post-harvest activities: *Post-harvest technology* – Explore various grain processing machines, determine maturity indices of various crops, identification of a quality fish; *Field visit* – Two field trips to visit relevant industries

Biowaste management: *Bio-products from biowaste* – Preparation of compost and biological pesticides, study a biogas pit

BST 11022 – Mathematics (C)

2 credits (30-00-25-45), Prerequisite: None

Theory

Preliminaries: *Number Systems* – Real number line, Real numbers, Integers, Natural Numbers, Rational and Irrational Numbers, order of operations; *Equations and Inequalities* – Rules of inequalities, solving liner equations and inequalities; *Exponents, Logs, Roots and Radicals* – Laws of logarithms, Laws of exponents, Laws of indices, simplification of radical expressions, extraction of roots; *Permutations and Combinations* – Factorial of a number, working rule ${}_nP_x$, and ${}_nC_x$

Coordinate Geometry and Preliminaries of Trigonometry: *Cartesian Plane* – Rectangular coordinate system, ordered pairs and solutions to equations in two variables; *Equation of a straight line* – Liner distance between two points, Types of liner equations (Slope- point, point-point, point-line: y-intersect, x-intercept, x, y- intercept); *Working with linear equations* – Parallel equations, interceptions of two lines, perpendicular equations; *Other geometric shapes* – Circle on X-Y plane, Parabola, intersection of line and circle; *Preliminaries of trigonometry* – Concepts, Angles, Rules of Sine, Cosine, Tangent, Applications of Trigonometry Quadratic, Cubic and Higher Order Polynomials: *Quadratic Equations* – Properties (roots, intersections, turning points), Obtaining roots by factorization, completing square, using formula, Difference of squares and cubes; *Cubic and Higher order polynomials* – Properties, graphical presentation, estimation of approximate roots by graphical method

Limits and continuity of functions: *Limits* – Definition of the limit, Limits at infinity on the x- axis, Limits at infinity on the y- axis, infinity on both axes; *Techniques of Limits* – Cancelling a linear factor, nonexistence of limit, Difference of two squares, solve limits by conjugate numerator, multiplying by a unity factor, Factoring cubic polynomials, Substitution; *Continuity of functions* – Definition of Continuity, Types of Discontinuous Functions: The Step Function, the Jump Discontinuity

Differentiation: *Preliminaries* – The Concept and Definition of the Derivative (slope form and increment form), Differentiability, Calculation of the Derivative, Graphical Representation of the Derivative, Calculation of Derivatives from the Definition, Derivation of the First Principle of Derivatives; *Properties* – Linearity, Linear Combination Rule, Definition of Product Rule, Definition of the Quotient Rule, Definition of the Chain Rule (function of a function and composition version); *Logarithmic* – Derivative of log functions, Derivative of exponential functions; *Trigonometric* – Derivatives of Trigonometric functions; *Higher Order* – Higher order derivatives, Total and partial derivatives, Implicit differentiation; *Curve sketching* – Definition of Minimum, Maximum and inflection points, Calculation of minimum number of coordinates of curve sketching; *Real World Applications*

– Displacement, Velocity and Acceleration, Use in Basic Micro- economic models and theories Integration: *Introduction* – Relationship between integration and differentiation, derivation of general rule of integration; *Rules of integration* – Integral of a constant, power rule, standard table of integration, integration by parts, integration by substitution, partial fraction; *Area* – Evaluation of area under different functions, geometric shapes (circle, ellipse, sectoral area); *Differential equations* – Introduction to differential equations computing and modelling for bioengineering

Matrix Algebra and Liner Systems: *Matrix Algebra* – Types of matrices, matrix operations: additions, subtraction, multiplication, transpose of a matrix, determinant of a matrix, inverse; *Linear Systems* – Two variable to many variable systems, solutions through inverse approach, Cramer's rule

BST 11032 – Chemistry I (C)

2 credits (15-30-30-25), Prerequisite: None

Theory

The Importance of Chemical Principles: *Chemistry is a central science* – What is chemistry and its role in our day-to-day life (its impacts on health and medicine, energy and environment, materials and technology, food and agriculture) the study of chemistry, the scientific method

Modern Descriptions of the Atom: *Atomic Structure* – Discovery of the Electron and the Nucleus, the need for Quantum Mechanics; *Wave-Particle Duality of Light* – Light as a wave (characteristics of waves), Light as a particle (the Photoelectric effect); *Wave-Particle Duality of Matter*; *Schrödinger Equation* – Light as a particle (continued), Matter as a wave the Schrödinger equation; *Hydrogen Atom Wave functions (Orbitals)* – Wave functions (Orbitals) of the Hydrogen atom, shape and size of S and P orbitals, Electron Spin and the Pauli Exclusion principle; *Multi-electron Atoms* – Wave functions and Binding Energies of multi-electron Atoms, electron configurations

Periodicity: *The Periodic Table and Periodic Trends* – Ionization energy and Photoelectron spectroscopy, Electron affinity, Electro-negativity, Atomic and Ionic Radii, Isoelectronic Atoms

Chemical Bonding: *Introduction to Chemical Bond* – Ionic bonds, Covalent bonding, Polar covalent bonds

Lewis Structures: *Introduction to Lewis Structures* – Formal Charge, Resonance structures; *Lewis Structures: Breakdown of the Octet Rule* – Odd number of valence electrons, Octet deficient molecules, Valence shell expansion

The Shapes of Molecules: *VSEPR Theory* – Molecules without Lone Pairs, Molecules with Lone Pairs; *Molecular Orbital Theory* – Homonuclear molecules with MOs originating from S orbitals, Homonuclear molecules with MOs originating from S and P orbitals, Heteronuclear diatomic molecules; *Valence Bond Theory and Hybridization* – Sigma and pi Bonds; hybridization of atomic Orbitals (sp_3 Hybridization, sp_2 Hybridization, sp Hybridization)

Practical

The Importance of Chemical Principles: *Introduction to General Laboratory Practices*

Modern Descriptions of the Atom: *Scientific measurements; Mass and Volume relationships; recording experiments; making a graph; Laboratory techniques; Laboratory safety; simulation of Rutherford's Gold Foil experiment; simulation of the photoelectric effect*

Periodicity: *Periodic trends in the Periodic Table; "does coffee contain potassium"?*

The Shapes of Molecules: *Shapes and structures of molecules; Isomerism; bonding in pharmaceuticals (use Molecular Model Set)*

BST 11042 – Physics for Biological Systems (C)

2 credits (15-30-30-25), Prerequisite: None

Theory

Units of measurements: *Units of measurements* – Base units, derived units, decimal multiples and sub multiples, recommendation for writing SI unit names and symbols, non-SI units and other units

Principles of Newtonian mechanics: *Principles of Newtonian mechanics* – Newtonian mechanics (principles of motion, Newton's laws), momentum and momentum conservation law, work, energy and energy conservation law

Electricity and Magnetism: *Electricity and Magnetism* – Electricity and Magnetism, static charges and electric field, Resistor, Capacitor, Inductor, electromagnetic waves

Basic Electronics (Analogue and Digital): *Basic Electronics (Analogue and Digital)* – Introduction to Analogue electronics, metals and semiconductors, p-n junction, Diode, Photo diode, LED, Transistor; introduction to digital electronics: Boolean algebra, Basic types of logic gates and their truth table

Introduction to Thermodynamics: *Introduction to Thermodynamics* – Macroscopic and microscopic systems, state of a system, equilibrium of a system, Zeroth Law of thermodynamics, internal energy of a system, First law of thermodynamics, thermodynamic processes (Isothermal, Adiabatic), Specific heat, reversible process, Entropy**,** state changes, thermal properties of matter (convection, conduction and radiation)

Practical

Units of measurements: *Familiarization of measurement equipment* – verniercalipers, micrometers, dial gauges, triple beam balances, electronic balances, Spring scales, Calculation of the density of a metal ball

Principles of Newtonian mechanics: Newton's Laws; Motion under gravity; Calculation of the density of a metal ball; Simple pendulum

Electricity and Magnetism: Static charges and electric field, electricity and magnetism, Resistor, Capacitor, Inductor, electromagnetic waves; *Familiarization with electrical measuring instruments and components* – DC power supply, Signal generator, Oscilloscope, ammeter, voltmeter, multimeter, resistor, capacitors and inductor; *Electromagnetism*

Basic Electronics (Analogue and Digital): *Familiarization with basic electronic components*; I-V characteristics of diode*; Verification of truth tables of basic types of logic gates*

BST 11052 – Principles of Biology (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

Characteristics of living organisms: *Characteristics of living organisms and different levels of biological organization* – Introduction to living organisms, Cell theory, the five kingdoms (Prokaryotae, Protoctista, Fungi, Plantae, Animalia), create hypotheses and experiments using the scientific method

Chemical composition of living matter: *Chemical composition of living matter* – Organization of matter, bonding between atoms, water and its properties, acid, bases and salt, biological molecules in cells (large and small biomolecules)

Cell structure and function: *Structure and function of the cell* – Comparison of prokaryotic and eukaryotic cells, comparison of autotrophs and heterotrophs, composition and function of cell structures, cell membrane and organelles, comparison of plant and animal cells, cellular transportation, diffusion and osmosis, facilitated and active transport, pinocytosis and phagocytosis

Cellular energy balance: *Bioenergetics, cellular respiration and photosynthesis* – Cellular metabolism, enzymes, energy and ATP, hydrogen and electron carriers, glycolysis, Krebs cycle, electron transport chain, cellular respiration and fermentation, photosynthesis

Transcription and translation: *Nucleic acids and mechanisms of protein synthesis in the cell* – DNA structure and replication, RNA structure and the genetic code, protein synthesis

Genetics: *Principles of genetics and cellular reproduction* – Stages of mitosis and meiosis, eukaryotic and prokaryotic cell reproduction, Mendelian genetics, mutations and genetic changes, genetic inheritance, population genetics

Evolution: *Origin of life and evolution* – Formation of the earth, origin of heterotrophs and autotrophs, rise of eukaryotes, origin of multicellularity, natural selection, variation and speciation

Practical

Characteristics of living organisms: *Laboratory safety* – Laboratory familiarization and laboratory safety, handling of equipment and biological waste disposal

Chemical composition of living matter: *Microscope handling* – Parts of a microscope, care and handling of microscopes, slide preparation

Cell structure and function: *Slide preparation and Gram staining* – Slidepreparationfor observing bacteria, fungi, plant and animal cells, Gram staining

Cellular energy balance: *Laboratory equipment* – Use of measuring tools (photosynthetic meter, leaf area meter, refractometer, color charts)

Transcription and translation: *Preparation of solutions* – Identification and handling of hazardous chemicals and organisms, preparation of stock solutions, use of basic equipment (micro-pipettes, centrifuges, fridge, freezer; autoclave) and sterilization techniques

Genetics: *Mendelian and population genetics* – Tutorials on Mendelian and population genetics

BST 11063 – Personality Development (C)

3 credits (15-30-45-60), Prerequisite: None

Theory

Leadership: *Leadership* – Introduction to leadership, leadership power, leadership styles, leadership in day today life,

Interpersonal Relations: *Interpersonal relations* – Introduction to interpersonal relations, analysis of different ego states, analysis of transactions, analysis of life positions

Communication: *Communication* – Introduction to communication, flow of communication, listening, barriers to communication, how to overcome barriers to communication

Stress Management: *Stress Management* – Introduction to stress, causes of stress, managing stress

Group Dynamics and Team Building: *Group Dynamics and Team Building* – Importance of groups in an organization, interactions in group, group decision making, team building, interaction with the team, how to build a good team

Conflict Management: *Conflict management* – Introduction, causes of conflict, managing conflicts

Time Management: *Time management* – Time as a resource, identify important time wasters, individual time management styles, techniques for better time management

Motivation: *Motivation* – Introduction, relevance and types of motivations, motivating the subordinates, analysis of motivation

Personal grooming and social etiquette: *The science of personal grooming* – Mental grooming, business grooming, spiritual grooming and outward grooming; *Social etiquette*

Practical

Leadership: *Outward Bound Training (Group activity)*

Communication: *Practical communication skills*

Stress Management: Examining physical and mental wellbeing of a person, physical exercise and mental strength for a stress-free life at workplace and at home, developing mental strength to improve self-confidence, concentration ability and awareness for proper decision-making

BST 11071 – Scientific Communication (C)

1 credit (15-00-15-20), Prerequisite: None

Theory

Introduction to scientific communication and writing: *Introduction to Scientific Communication* – What is scientific communication? Background of the scientific process and dialog; *Scientific writing* – The role of written documentation in the scientific process with emphasis on the laboratory journal, report and the article

General understanding of scientific publications: *Scientific publications and practices* – Style of writing according to forum, form and content, search for scientific publications in relevant databases, critical source review and the correct use of references; *Thesis or dissertation writing* – Introduction to thesis and dissertation, contents of thesis/dissertation (abstract, introduction, literature review, materials and methods, results and discussion, references, annexures); Writing research papers – Components of scientific writing (introduction, materials and methods, results and discussion, references), IMRAD structure

Oral presentation: *Oral scientific presentation and popular scientific presentation* – Causes of anxiety, how to make an effective research presentation, responsibilityand ethics; *Planning the presentations* – Determining the purpose, assess the targetgroup/ audience, planning the space, day and time, organization etc.; Effective presentation techniques – Presentation style and creating effective visual aids

Ethical considerations: *Ethical considerations in scientific communication* – Ethical awareness around scientific communication culture, impact factor, publication bias, plagiarism and scientific fraud

BST 11082 – ICT for Technological Applications (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

ICT for Biosystems Technology: *An Introduction* – Introduction to Information and Communication Technology (ICT), The role of ICT in Biosystems Technology, Use of ICT in Biosystems Technology

Preparing documents: *Microsoft Word (latest version will be taught)* – Introductionto the importance of preparing electronic documents using MS Word, the importance of MS Word in Biosystems Technology; introduction to write a technical report

Data processing: *Microsoft Excel (latest version will be taught)* – Introduction to the importance of data processing using MS Excel, importance of MS Excel in Biosystems Technology, introduction to importance of statistical concepts in Biosystems Technology

Presentation skills and market promotional skills: *Microsoft PowerPoint (latest version will be taught)* – Introduction to prepare a good presentation, how to be a good presenter - techniques and practices

Knowledge acquisition and business communication: *Internet and Email* – Introduction to Internet and Email; ethics and rules; ethical and legal email marketing campaigns

Practical

ICT for Biosystems Technology: *Introduction to Microsoft Windows and Linux*

Preparing documents: *MS Word Basics* – Understanding MS Word, Basic editing, Character formatting, Paragraph formatting, Tables, Themes, Styles, Symbols and Equation; *MS Word advanced* – Table of contents, Insert Table of Figures and Caption, Insert Endnote and Footnote, Insert Citation, Citation Styles, Bibliography and References, Mail Merge and Track Changes

Data processing: *MS Excel Basics* – Understanding MS Excel basics, Charts, Conditional formatting, Sort and Filter; *MS Excel Advanced* – Pivot Table, What-If Analysis, Advanced Functions (Logical, Financial, Math and Trig, Statistical and Engineering) and Macro

Presentation skills and market promotional skills: *MS PowerPoint Basics* – Preparing a presentation using Themes, SmartArt, Pictures and Charts, Apply Transition effects with Timing, Use Animation and Advanced Animation techniques with Timing in the appropriate environments; *MS PowerPoint Advanced* – Advanced PowerPoint creations i.e. Posters, Banners, Brochures, Business cards, Invoices, Payrolls etc.

Knowledge acquisition and business communication: *Internet and Email* – Use of Internet and search engines for knowledge acquisition, Google Scholar for indexing full text or metadata of scholarly literature, Create an Email account andEmail group for marketing campaigns

BST 11910 – Communicate in English I (C)

0 credits (30-00-35-35), Prerequisite: None

Theory

Language Structure: Basic English sentence structures, uses, formation and types of nouns and pronouns with their singular and plural forms, use of “be” and “have”, prepositions, determiners (articles), forms and uses of tenses (the simple present, simple past, simple future, and their passive forms).

Speaking: Use social English confidently; introduce self and others; communicate information; produce meaningful statements on personal/ familiar topics; speak and discuss on general topics; engage in group discussions, conversations, and dialogues; formal and informal greeting, leave taking and responses; consonant and vowel sounds.

Listening: Listen to general conversations, dialogues, speeches, etc. and identify the topic/ subject matter; comprehend simple instructions, statements and questions; listen to and respond to songs appropriately.

Writing: Write short descriptions on personal/ familiar topics using simple sentences, write short compositions, improve spelling, and use basic capitalization and punctuation appropriately.

Reading: Identify and understand the general meaning of and simple short texts, read common/ general texts for comprehension, read and understand the impliedmeaning, read with humour. Integrated Skills: Listening, taking down notes, discussion and reading; reading, thinking and discussion.

3.7.2. Year I Semester II

BST 12011 – Fundamentals of Biometry (C)

3 credits (15-0-15-20), Prerequisite: None

Theory

Introduction: *Variability*-Variability in the environment; need for statistical methods; *Steps in Scientific method*- Definitions of scientific method, scientific method as a cycle of events; *Population and Sample*- Definitions of population and sample; *Theory of Probability*- Concept of probability, probability distributions and random variables.

Descriptive Statistical Methods: *Measure of Centre*- Arithmetic, Harmonic & Geometric mean, Median, Mode, Quartiles, Percentiles and letter values; *Measure of dispersion*- Range and inter quartile range; mean; absolute deviation, Standard deviation, Variance, Coefficient of variation; *Graphs and plots*- Frequency distribution and histogram, Stem, Leaf and box plot;

Statistical inference and hypothesis testing: *Testing point estimations*- One sample location problem, two sample location problem, Pooled t-test, Paired t-test, types of errors and power of the test; *Testing interval estimations*- Confidence interval for measures of centre, confidence interval for measures of dispersion.

BST 12022 – Chemistry II (C)

2 credits (15-30-30-25), Prerequisite: None

Theory

Thermodynamics: *Bond and Reaction Enthalpies* – Bond Energy / Bond Enthalpy (ΔHB); Enthalpies of Reaction (ΔHr); methods to calculate ΔHr; *Gibbs Free Energy and Entropy* – Spontaneous Change and Free Energy; Entropy; Free Energy of Formation; *Effect of Temperature* – Effect of temperature on spontaneity; thermodynamics in biological systems; Hydrogen-bonding; ATP- coupled reactions

Equilibrium: *Introduction to Chemical Equilibrium* – Nature of chemical equilibrium; meaning of the chemical equilibrium constant K; *Le Châtelier's Principle*- External effects on K (Le Châtlier's Principle); temperature dependence

of K; applications of Le Châtlier's Principle; Significant Figure Rules for Logs; *Solubility*- Solutions and Solubility; *Acid-Base Equilibrium*- Classification of Acids and Bases; definitions and relationships between pKw, pH, and pOH; strengths of acids and bases; equilibrium Acid-Base problems (Weak Acids and Weak Bases)

Titrations: *Acid-Base Titrations*- Acid-Base titrations; titration of strong acids and strong bases; titration of weak acids / strong bases &strong acids/weak bases

Oxidation-Reduction (Redox) Reactions: *Essentials of Redox Reactions*- Introduction to Oxidation-Reduction (Redox) reactions; balancing Redoxreactions; Electrochemical cells; *Chemical and Biological Oxidations*- Relationship between Cell Potential and Gibbs Free Energy; meaning of Standard Reduction Potentials; Nernst Equation

Practical

Thermodynamics: Heat effects and Calorimetry; determination of the Specific Heat of a meta;, Heats of solution and reaction; heat of combustion of candle wax

Equilibrium: Chemical equilibrium; solubility and solution; reversible reactions

Titrations: Acids, bases, and neutralization; pH and buffer solutions; determining the percent of Acetic Acid in Vinegar

Oxidation-Reduction (Redox) Reactions: Electron-losing tendencies of metals; determining Oxidation Numbers; electrolysis of water; Electroplating; determination of iron by reaction with permanganate

BST 12031 – Renewable Energy System (C)

1 credit (15-0-15-20), Prerequisite: None

Theory

Terminology in renewable energy systems: Introduction and terminology; approach to sustainability; energy demand in Sri Lanka and globally; Various type of non-renewable and renewable energy sources and techniques in Sri-Lanka and globally.

Discuss the energy demand in Sri Lanka and global situation: Understand the energy demand situation in Sri-Lanka and globally; consumption behaviour of different types of energy sources in difference areas, and understand future requirements.

Introduction to Biomass and Bioenergy: Introduction to biomass; uses and importance of biomass energy; biomass energy conversion technologies.

Introduction to Nuclear power generation and H_2 fuel cell applications: Nuclear fission, fusion; nuclear reactors; nuclear proliferation; advantages and disadvantages of nuclear energy; Electrolysis; basics of fuel cells, types of fuel cells; advantages and limitations of fuel cells.

Introduction to Wind energy, Solar Energy, Hydropower and GeothermalEnergy Generation: Understand the current potential of wind, solar and geothermal energy generation in Sri-Lanka and globally; availability of resourcesand future potential of wind, solar and geo thermal energy generation; Wind, solar and geothermal energy generation techniques; tools, equipment and machinery requirements for wind, solar and geothermal energy generation.

Introduction to Energy Storage Equipment: Energy storage techniques and equipment used to store the different types of generated renewable energy.

BST 12042 – Molecular Biology (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

Laboratory safety: *Introduction to a molecular laboratory*-Introduction to laboratory safety, preparation of chemical solutions, handling of laboratory equipment.

Structure, function and synthesis of DNA, RNA and protein: *DNA, RNA and Proteins*- Introduction to genomics and proteomics, PCR basics.

Basic structure of gene and its expression and regulation: *Components of a gene, expression and regulation of genes*- Basic structure of a gene, promoter, terminator, open reading frame; genetic code, gene expression and regulation, transcription factors.

DNA fingerprinting: *DNA fingerprinting techniques*- RAPD, SSR, RFLP and AFLP, uses of DNA fingerprinting techniques, Agerose gel electrophoresis, SDS-PAGE

Genetically modified organisms and biosafety: *Genetically modified organisms*- Genetically modified organisms; principles of *Agrobacterium* mediated genetic transformation, gene gun technique; *Biosafety and bioethics*- Biosafety regulationsin Sri Lanka, Biosafety regulatory framework and Biosafety education in Sri Lanka, bioethics.

Practical

Laboratory safety: *How to use molecular lab chemicals and equipment*- How to handle micro-pipettes, PCR machine, centrifuge, refrigerator, autoclave; solution preparation; waste disposal.

Structure, function and synthesis of DNA, RNA and protein: *Genetic material and protein isolation* - DNA, RNA and protein extraction and determination of their concentrations.

Basic structure of gene and its expression and regulation: *DNA digestion* - DNA digestion by restriction enzymes and gel electrophoresis; analysis.

DNA fingerprinting: *Gel electrophoresis*- Agrose gel electrophoresis, staining and detection.

Genetically modified organisms and biosafety: *Plasmid DNA isolation*- Bacterial plasmid isolation and digestion**.**

BST 12052 – Principles of Microbiology (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

Introduction and Historical Development of Microbiology: Introduction to microbiology; terms and history of microbiology; importance of different microbial groups; discovery of microorganisms; role of microorganisms; scientific development of microbiology; Golden era of bacteriology; Golden Age of microbiology.

Microscopy: Historical background; properties of light and glass in relation to concepts in microscopy; factors affecting image characteristics in microscopy; types and application of microscopy in biology; medicine and industry; common diagnostic applications of microscopy in the clinical laboratory.

Principles of Sterilization and Disinfection: Methods used for sterilization and disinfection; physical and chemical methods - their mechanisms and application.

Culture media: Classification; types and uses; preparation of culture media.

Morphology and physiology of microorganisms: Groups of microorganisms (with emphasis on bacteria, fungi, viruses);basic composition characteristics and the

principles of systematic; comparison of Prokaryotic cells–Eukaryotic cells; study of bacteria; arrangement of bacterial cells; anatomy ofthe bacterial cell; physiology of bacteria; principles of bacterial growth, bacterial nutrition, bacterial metabolism; introduction to virology; taxonomy of viruses; viral replication; bacteriophage versus animal virus replication and physiology; introduction to mycology: the major groups of fungi and their respective structure, function, lifecycle, physiology and classification; its economic importance in agriculture, food industry.

Control of Microorganisms: Terms related to destruction of microorganisms and suppression of microorganisms; methods of control of microorganisms; physical agents and chemical agents

Beneficial effects of microorganisms: Microorganisms in food, medicine, industry, agriculture, environment, air, in symbiotic associations, in biotechnology; role in evolution; microorganisms in waste treatment

Practical

Introduction and Historical Development of Microbiology: Laboratory practices and safety rules; equipment and apparatus.

Microscopy: Microscopes – types, parts; use and care of microscopes. +

Principles of Sterilization and Disinfection: Aseptic procedures – sterilization of apparatus by direct heat, use of ethanol and sodium hypochlorite; use of autoclave, hot air oven, laminar flow hood etc.

Culture media: Preparation of potato dextrose agar (PDA) and nutrient agar (NA) from natural ingredients.

Morphology and physiology of microorganisms: Bacterial smear; methods of staining bacteria and observation of bacteria under microscope;isolation and culture of microorganisms by streak plate method; isolation and culture of microorganisms by serial dilution technique and pour-plate method; differential staining technique-Gram stain; preparation of temporary wet mount for microscopic examination of fungi; microscopic study of morphology of different groups of fungi.

Control of Microorganisms: Examine clover plants for root nodules & Gram stain.

Beneficial effects of microorganisms: Measurement of population of microorganisms – use of haemocytometer; serial dilution.

BST 12063 – Biological diversity and Bio – prospecting (C)

3 credits (30-45-25-50), Prerequisite: None

Theory

Introduction to Biodiversity: *Introduction to biological diversity and"Biodiversity"*-Biological diversity to biodiversity; what is biodiversity; three levels of biodiversity; *Origin, evolution and the diversity of life*- Origin of life; chemical evolution, biological evolution; brief overview of evolution thoughthe geological timescale; *Genetic and Species Diversity*- Genes and genetic diversity; importance of genetic diversity; inbreeding & genetic drift; what is a species; different concepts to define a species; how many species on earth and in Sri Lanka?; *Ecosystem Diversity & Ecosystem Services*- What is an ecosystem; biotic and abiotic components of an ecosystem; Biomes of the world; ecosystem diversity of Sri Lanka; what are ecosystem services; ecosystem services in Sri Lanka and their contribution to human wellbeing.

Introduction to Bioprospecting: *Values and uses of Biodiversity*- Direct use value, indirect use value; existence value and option or bequest value; direct and indirect uses of biodiversity; uses of biodiversity in Sri Lanka; *Concept and process of bioprospecting*- Concept and examples of bioprospecting; why and where it is needed; four steps in bioprospecting; who does bioprospecting?; *Key issues and challenges of bioprospecting*- Potential environmental impacts of bioprospecting; protection vs. exploitation; lack of legal clarity; multi-sectoral involvement; Traditional/Indigenous knowledge & benefit sharing.

Bioprospecting and conservation of Biological Diversity: *Causes and consequences of extinction*- The sixth extinction; causes and consequences of extinction; *Introduction to biodiversity conservation*- Introduction to and elements of biodiversity conservation; *In-situ* conservation, *Ex-situ* conservation; biodiversity conservation outside protected areas; *Policy aspects on bioprospecting and biodiversity conservation*- International conventions and treaties; global and local policy directives.

Field: Field trip to Sinharaja World Heritage Site (2 days).

Practical

Introduction to Biodiversity: *Video on vertebrate evolution*- Quiz 1 based onthe documentary video narrated by Sir David Attenborough "Rise of Animals: Triumph of the Vertebrates" (BBC, 2013); *Video on the ecosystem diversity of the world*- Quiz 2 based on the documentary video narrated by Sir David Attenborough "Pole to pole" [Episode 1 of Planet Earth (BBC, 2006)].

Introduction to Bioprospecting: Student presentations on selected topics and examples in bioprospecting.

Bioprospecting and conservation of Biological Diversity: Student presentations on field trip to Sinharaja World Heritage Site

BST 12073 – Economics for Decision Making (C)

3 credits (45-30-45-30), Prerequisite: None

Theory

Apply the concepts of choice and opportunity cost to basic situations which involve scarcity, and clearly identify feasible choices: *Introduction to economics*-Scarcity and basic economic problems; scarcity and opportunitycost; definitions of concepts: scarcity, choice, opportunity costs, utility, economic systems; *Theory of consumer behavior*- Cardinal and ordinal utility, marginal utility; indifference curve analysis; budget constraints; consumer equilibrium; income effect and substitution effect

Understand how markets operate and be able to identify welfare outcomes for consumers and firms: *Theory of demand* - The law of demand; determinants of demand; exception to the law of demand; *Elasticity of demand*- Concept of elasticity; price elasticity, income elasticity, measuring elasticity; *Theory of supply*- Supply curve; determinants of supply, elasticity of supply; *Theory of production*- Factor-product relationship, factor-factor relationship, product- product relationship; *Theory of costs*-Economic and accounting cost, fixed and variable costs; cost in the short run, cost in the long run, marginal cost, marginalrevenue; profit maximization; demand and supply in markets; determination of price and quantity; market equilibrium; welfare of consumers and firms.

Understand how different market structures, firm technologies and economic and social policies affect market equilibrium and welfare outcomes: *Theory of market*-Perfect competition, imperfect competition; impact of policy and technological changes on supply, demand, prices and welfare; equilibrium analysis.

Strategy analysis: *Market structure and pricing*- Characteristics of markets; types of market structure; perfect competition; Monopoly, monopolistic competition, oligopoly; *Game theory*- Nature and scope of game theory; elements of a game, types of game; static games, dynamic games; games with uncertain outcomes; repeated games; limitations of game theory; *Pricing strategy*-Competitive advantage; market positioning, segmentation and targeting; price discrimination;

multiproduct pricing, transfer pricing; pricing and the marketing mix; dynamic aspects of pricing; other pricing strategies; *Investment analysis*-Cash flow analysis; risk analysis; nature of risk in capital budgeting; measurement of risk; cost of capital, nature and components; cost of debt, cost of equity; weighted average cost of capital; evaluation criteria; net present value; internal rate of return; comparison of net present value and internal rate of return; decision-making under risk and uncertainty

BST 12083 – Process Control and Automation in Bio – industry (C)

3 credits (30-30-30-60), Prerequisite: None

Theory

Process control methods in industries: Industrial perspective of typical process control problems; importance of process control, variables of a process, concept of a process control system; open loop and closed loop control.

Control system components: System variable measurements (temperature, pressure, flow, level etc.); transducers for measurements; transducer signal output and transmission; actuating devices (electrical and pneumatic); types of controllers (digital and pneumatic).

Operation of the controller: Function of the controller in a closed loop control system; operation of the controller in Proportional, Proportional + Integral and Proportional + Integral + Derivative modes and performance characteristics under each mode.

Tuning of controller: Tuning of controller using empirical methods for PID settings (Zeagler Nicholas 1 & 2 methods)

Practical

Process control methods in industries: Field practical.

Control system components: Field practical/ lab practical.

Operation of the controller: Field practical/ lab practical.

Tuning of controller: Field practical/ lab practical.

BST 12090 – Historic Development and Current Affairs of Sri Lanka (C)

0 credit (15-0-0-35), Prerequisite: None

Theory

Historically important events in Sri Lanka: *Historically important events*-Ancient Irrigation systems in Sri Lanka; traditional paddy cultivation, traditional paddy verities; free education system, free health service system in Sri Lanka; Sri Lankan traditional medicine services.

Traditional Sri Lankan sports: *Ancient games*- Traditional games in Sri Lanka such as *Angampora; n*ew-year games and their aims and objectives.

Sri Lankan Land Acts: *Important land acts*- Paddy land act; Land ordinance.

Current environmental issues in Sri Lanka: *Environment problems*- Environmental pollution in the country and control measures; disasters and disaster management in Sri Lanka.

Current development required in Sri Lanka: *Job interviews*- Control of brain drain; drug abuse among youth and how to control it; reduction in depletion of forest cover.

BST 12910 – Communicate in English II (C)

0 credits (30-00-35-35), Prerequisite: None

Theory

Language Structure: Forms and uses of tenses (the present continuous, past continuous, future continuous and their passive forms); conjunctions; complex sentences – with special reference to the relative clauses, relative pronounce and their uses; subject-verb agreement in simple and complex sentences; determiners – some, any, many, a lot.

Speaking: Use marks of courtesy in agreeing, disagreeing, getting permission, giving permission, thanking, apologizing, appreciating; ways of saying ‘yes’ or ‘No’; use questions appropriately to ask for information; provide appropriate responses to fairly complex questions with a seasonable degree of accuracy; express facts and opinion on familiar topics; make and respond to suggestions; role plays; talking about one’s family.

Listening: Listen to variety of texts (dialogues, conversations, etc.); comprehend fairly complex questions; understand internal cohesion; understand simple explanations and descriptions in short texts; identify and understand key ideas in a longer text; listen and take down notes; listen for comprehension.

Writing: Write down dictated notes, write short compositions on general topics with a fair degree of accuracy, write conversations and dialogues, take and convey messages, write informal letters, do Paragraph writing. Vocabulary: Use contextual, structural, and morphological clues to deduce meanings of unfamiliar words of phrases.

Reading: Read variety of texts and respond appropriately, use Skimming andscanning techniques identify and understand main ideas in more complex texts, infer implicit information in simple texts, read and take down notes. Integrated Skills: Text reconstruction (Listening, Writing, Speaking, and Reading).

3.7.3. Year II Semester I

BST 21012 – Experimental Designs (C)

2 credits (15-30-25-30), Prerequisite: None

Theory

Meteorology: *Introduction to experimentation* – What is an experiment? Principles involved in treatment, subject, control, block, plot: replication, randomization, local control of error; nature of a good experiment; types of reasoning: inductive, deductive; planning an experiment; *Analysis of Variance (ANOVA)* – Basis of ANOVA; assumptions, limitations; specification of linear statistical model; criteria for best model

Experimental Designs: *Single factor Analysis of Variance* – Completely Randomized Block Design, Randomized Complete Block Design, Latin Square Design; *Mean Comparisons* - Least Significant method, Duncan's method, Dunnette's method: group comparisons; *Multiple factor Analysis of Variance* - What is a factorial experiment? Interaction among factors; advantages, limitations; Two factor factorial models, Three factor factorial models; Factorial models in block designs: Split plot and Split –Split Plot, strip block; confounding in factorial designs; fractional replication; *Non-orthogonal designs* - Incomplete block designs; sequential and partial sums of squares; Generalized Liner Models; computer aided analysis of GLM

Applications of Experimental Designs: *Introduction* – Identification of treatments, subjects and field for experimentation; *Field Layouts* – Preparation of field layouts for basic block designs; *Data Recording and Analyses* - Preparation of database tables; data recording and computer aided data analyses (Computer software for statistical analysis; SAS, R, Minitab, etc.)

BST 21022 – Principles of Biochemistry (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

Describe structure and biological functions of carbohydrates, proteins, lipids, vitamins and minerals: *Structure and properties of carbohydrates*

– Classification; structures, functions, and reactions of monosaccharides, disaccharides and polysaccharides and digestion of carbohydrates; *Structure and properties of Proteins* – Structures and properties of amino acids and organizational levels of protein structure; *Structure and properties of dietary lipids* - Structure and properties of fatty acids, triacylgylcerols, phospholipids glycolpids and cholesterol; *Structure and properties of vitamins and minerals* - Overview; biological functions of water soluble and fat soluble vitamins and minerals.

Enzymes and their properties: *Reactions and properties of enzyme* – Nomenclature, properties, activities and kinetics of enzymes

Metabolism: *Carbohydrates* – Introduction; monosaccharide and disaccharide metabolism, glycogen metabolism; Krebs cycle and its regulations; *Proteins* - Amino acid metabolism; conversion of amino acids to specialized products; *Fat and oils* - Digestion and absorption of dietary lipids, fatty acids and triacyglycerolsynthesis and degradation; cholesterol metabolism; interactions of different metabolic pathways and energy sources; *Storage and expression of genetic information* - DNA structure and replication; RNA structure and synthesis; Protein synthesis

Practical

Describe structure and biological functions of carbohydrates, proteins, lipids, vitamins and minerals: Qualitative and quantitative tests for carbohydrates, proteins, fats and oils

Enzymes and their properties: Basic enzyme assay

BST 21032 – Instrumentation and Measurements (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

Basic units of measurements: *Basic units of measurements* – Historical background; Base units, Derived units; Decimal multiples and sub multiples; recommendationfor writing SI unit names and symbols; Non SI units; other units

Fundamental concepts: *Fundamental concepts* – Measure and influence quantities;True value of a quantity; Nominal value, conventional true value; Error and relative error, random errors, systematic errors; accuracy and precision; calibration; correction and

deviation; Tolerance; hierarchy of measurement standards; Traceability, Resolution, Discrimination and Sensitivity; repeatability of measurements; reproducibility of measurements.

Measurements and measurement tools inindustry:*Measurements and measurement tools in Industry* – Description; principles of operation, maintenance; proper usage for measurements and adjustment/calibration of length measurement tools; temperature measurement tools; mass measurement tools; electrical measurement tools; Force and Pressure measurements tools.

Quality control and quality assurance: *Quality control and quality assurance* – Principles of QC (matrix interference and spike analysis; Precision & accuracy; Blind samples; Sensitivity, Selectivity; detection limits; Standard reference samples; Control charts; QC plan, Principles of QA (method of validation, inter laboratory checks, laboratory plans, QA plans, data auditing and accreditation), Overview of quality management systems.

Practical

Fundamental concepts: *Fundamental concepts* – Familiarization of measurement equipments-vernier caliper, micrometer, Dial gauge, Familiarization of measurement equipments-2-Triple beam balance, electronic Balance, Spring scale, Calculation of the density of a metal ball.

Measurements and measurement tools in industry: *Measurements and measurement tools in Industry* – Length measurements and tools; temperature measurement and tools; electrical measurement and tools; Mass measurement and tools

BST 21042 – Biomass for Bioenergy (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

Introduction to biomass, bioenergy, and their importance: *Introduction to biomass, bioenergy, and their importance* – Energy types; Renewable, Non-renewable, Conventional, Non-conventional; what is biomass; formation of biomass; what is bioenergy; importance and uses of biomass.

Classification of biomass: *Classification of biomass* – Energy plantations; Aquatic plants, Animal waste, Forest residue, Agricultural crop residue, Municipal waste, Industrial waste; classification of biomass fuels (Atomic ratios, Ratio of biomass components, Ternary diagram).

Characteristics and composition of biomass: *Characteristics and composition of biomass* – Proximate analysis, Ultimate analysis; Calorific value, Bulk density; major components of biomass (organic, inorganic, moisture); Cellulose, Hemicellulose, Lignin, Pectine, Extractives, Starch, Sugar, Proteins, Inorganic substances; physical properties; thermodynamic properties of biomass; energy content, moisture content and heating value; biomass species and available energy.

Biomass production techniques and harvesting methods: *Biomass production techniques and harvesting methods* – Major steps in biomass production - from site survey to harvesting of biomass; Biomass harvesting methods

Biomass pre-processing techniques: *Biomass pre-processing techniques* - Biomass pre-processing operations; size reduction and densification to provide optimum operation condition in bioenergy production process, and drying operation to maintain optimum moisture content of the biomass, especially in thermochemical bioenergy preparation process.

Biomass energy transformation techniques: *Biomass energy transformation techniques* - Major energy transformation techniques; Thermochemical conversions; Gasification, Pyrolysis, combustion; Biochemical conversions; Anaerobic digestion, Fermentation, Physicochemical conversions; Oil extraction.

Physicochemical conversions; Extraction technology for biofuel production: *Physicochemical conversions; Extraction technology for biofuel production* - Introduction to the extraction technology: liquid-solid extraction and liquid-liquid extraction; types of agricultural products which can be used to produce biofuel by extraction technique; Calculation and design different types of extraction operations for difference applications including industrial application

Introduction to value adding operations and purification technologies of bio fuel: *Introduction to value adding operations and purification technologies of bio fuel* - Introduction to value added operation and purification techniques of biofuel; distillation technique, evaporation, filtration, and other unit operations.

Practical

Introduction to biomass, bioenergy, and their importance: – Assignment on "advantages and limitations of bioenergy"

Classification of biomass: Calculations and group work on biomass energy sources (Chart).

Characteristics and composition of biomass: Microscopic identification of biomass components and calculations on physical properties of biomass

Biomass production techniques and harvesting methods: Tutorial on biomass harvesting

Biomass pre-processing techniques: Lab session on biomass drying and tutorial session on biomass pre-processing Physicochemical conversions; Extraction technology for biofuel production: Lab session on Bio-oil extraction process Introduction to value adding operations and purification technologies of bio fuel: Lab session on Distillation and Filtration techniques

BST 21051 – Introduction to Biotechnology (C)

1 credits (15-0-15-20), Prerequisite: None

Theory

Introduction to biotechnology: *What is Biotechnology* – What is Biotechnology; history and list of fields in biotechnology; "traditional" vs "modern" biotechnology

Multidisciplinary nature of biotechnology: *Plant biotechnology* - Microbial biotechnology; eukaryotic and prokaryotic cells and their genomes; recombinant DNA technology; plant transformation, protoplast fusion, chloroplast engineering, biolistic mediated transformation and *Agrobacterium*-mediated transformation; biotechnology in aquaculture; enhancement of seafood quality; safety issues in its application in various disciplines; *Industrial biotechnology* - Introduction to fermentation process; type of fermentation, industrial, medical and environmental application of fermentation technology; scaling up and downstream processing in industry; bioreactors; recovery of the products by centrifugation, affinity column purification, membrane filtration, chromatographic methods; removalof bacterial and viral contaminants from the final products; Bioethanol from biomass; *Animal biotechnology* - Animals as models in biotechnology research; stem cells and tissue engineering; benefits; regulation and ethical issues in animal biotechnology; *Medical and Forensic biotechnology* - Diagnosis and treatment of disease; antibiotics, vaccines, monoclonal antibodies and biopharmaceuticals;Gene therapy; DNA as fingerprinting; use in criminal investigations and other forensic needs; *Environmental biotechnology* - Bioremediation, biodegradation and environmental sustainability; microbes involved in bioremediation.

Ethical and safety issues related to biotechnology: *Bioethics, biosafety and regulations in biotechnology* - Genetically modified organisms, food, feed and processed products (GMO/FFPs); basic concepts of RNA antisense technology and its application in production of GMOs; benefits, risks and concerns of GMO/FFPs; bioethics, legality, social issues and dilemmas involved in modern biotechnology; Biosafety Act

BST 21061 – Introduction to Nanotechnology (C)

1 credits (15-0-15-20), Prerequisite: None

Theory

Introduction to the basic concepts of nanotechnology: *Introduction to nanotechnology* – Definition of nanotechnology; challenges of nanotechnology; understanding nano size; importance of one billionth of a meter; introduce nanoscale; influence of nano over relatively bulk material

Basic bulk material properties and the effects of decreased dimensions*: Basic bulk material properties and the effects of decreased dimensions* - Size effects of materials; large surface to volume ratio and other properties; surface effects on the properties.

Types of nanostructure and properties of nanomaterials: *Types of nanostructure* - One dimensional, Two dimensional and Three dimensional nanostructured materials; types of nanomaterials such as Carbon-based material, Metal-based material, Dendrimers and Composites; properties such as optical, physical, chemical, electrical and magnetic change of nanomaterials

Synthesis and preparation of nanomaterials: *Synthesis of nanomaterials* - Top-down and bottoms-up methods; synthesis and fabrication methods of nanomaterials; Nano-device fabrication methods; Thin film fabrication methods; *Characterization techniques and tools for nanomaterials* - The measurement of physical properties, such as size, surface area; morphology, optical properties, etc., and chemical properties, such as composition, surface composition, electrochemistry, oxidation state, etc.; discuss details of the various characterization techniques such as optical microscope, transmission electron microscopy (TEM), atomic force microscopy (AFM), scanning electron microscopy (SEM), X-ray diffraction, Fourier transform infrared spectroscopy (FTIR), Raman spectra, X-ray photoelectron spectroscopy (XPS), and particle size analysis; introduce synchrotron radiation.

Application of Nanotechnology: *Nanotechnology in everyday life* - Nanotechnology in everyday life; nanotechnology-enabled devices such as biosensors etc.; applications of nanotechnology and nanomaterials in biotechnology; medical applications, bioenergy and biofuel production.

BST 21071 – Environmental and Health Impacts of Modern Technologies(C)

1 credits (15-0-15-20), Prerequisite: None

Theory

Modern Technologies: *Modern Technologies* – Definition of Modern Technology; types of modern technologies and its evolution; advantages and disadvantages of modern technologies

Environmental Technologies and Clean Technologies: *Environment Technology and Clean Tech* – Definition; environmentally friendly energy and energy storage; Circular economy; sustainable water management; sustainable mobility, resources and material efficiency; energy efficiency

Advantages and Disadvantages of Environmental Technologies: *Advantages and Disadvantages* – Renewable energy; water purification, air purification; sewage treatment; environmental remediation; solid waste management; energy conservation alternatives and clean power; Desalination; Composting; Pyrolysis; ocean treatment and energy conservation (OTEC); risks and concerns of modern technology on the environment – Pollution

Pollution and Biofilters: *Pollution and Biofilters* – Definition; types of pollutions; Bioswale, Biotrips, Bioscrubbers, Vermifilters, Tricking Filters; Constructed Wetlands and Natural Wetlands; Slow Sand Filters; Treatment Ponds; Green Belts, Green Walls, Riparian Zones and Forests

Health Impacts of Modern Technologies and Energy Conservations: *Energy Conservations* – Definition; types of health impacts; Chronic Kidney Disease (CKDU); air pollution; nano material; chemical waste relevant to modern technologies; Energy Tax, Building Design, Transportation, Consumer Products, Energy Conservation in different countries – Asia, European Union, USA, India, Japan, Lebanon, Nepal, New Zealand, Nigeria, Turkey and Sri Lanka

BST 21082 – Organizational Behavior (C)

2 credits (30-0-30-40), Prerequisite: None

Theory

Organizational culture: *Organizational culture* – Introduction; definitions, characteristics; creating and maintaining a culture; changing organizational culture

Diversity and globalization: *Diversity and globalization* – Diversity and its nature; managing diversity in organizations; globalization and its impacts; globalization and e-business

Organizational design: *Organizational design* – Classical and modern organization theory; organization designs, organizational development and approaches

Cognitive processes of organizational behavior: *Cognitive processes of organizational behavior* – Perception, personality and attitudes; work motivation, learning, leadership

Organizational dynamics: *Organizational dynamics* – Managing issues; group dynamics; crisis management, management of strikes; organizational conflicts; coping with problem behavior; security at workplace, occupational safety and health

BST 21092 – Computer Aided Designs for Technology (C)

2 credits (15-30-30-25), Prerequisite: None

Theory

Understand the basics of AutoCAD: *Understand the basics of AutoCAD* – Introduction to Computer Aided Design; its application in Biosystems technology; background of CAD software.

Coordinates Systems, Status Toggles and Drafting Settings: *Coordinates Systems, Status Toggles and Drafting Settings* – Coordinate systems in AutoCAD; introduce Status Toggles and Shortcut keys; drafting settings

Important Toolbars in AutoCAD: *Important Toolbars in AutoCAD* – Standard Toolbar; Draw Toolbar; Modify Toolbar; Dimension tools; Toolbar: Inquiry and Measurements; Layers, Style, Properties, Zoom; introduction of other important tools; commands and options in AutoCAD

Page Setup, Plot and Publish: *Page Setup, Plot and Publish* – Model, Layout, Plot, Publish

3D Modelling and Isometric Drawings: *3D Modelling and Isometric Drawings* – Overview of 3D modeling; Isometric drawings; introduction to Wireframe Models and 3d Visualizations

Practical

Understand the basics of AutoCAD: Starting AutoCAD and Familiarizing with the interface; use/customize basic options in AutoCAD; Drawing Units in AutoCAD; Command Line, Commands and Command Alias; Drawing Limits; using AutoCAD Drawing templates; working in different Workspaces; using AutoCAD Help

Coordinates Systems, Status Toggles and Drafting Settings: Coordinate systems in AutoCAD; introduce Status Toggles and Shortcut keys; drafting settings

Important Toolbars in AutoCAD: Standard Toolbar; Draw Toolbar; Modify Toolbar; Dimension tools; Toolbar: Inquiry and Measurements; Layers, Style, Properties, Zoom; introduction of other important tools; commands and options in AutoCAD

Page Setup, Plot and Publish: Model, Layout, Plot, Publish

3D Modelling and Isometric Drawings: Overview of 3D modeling; Isometric drawings; introduction to Wireframe Models and 3d Visualizations

BST 21102 – Data Acquisition Techniques and Signal Processing (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

Introduction to Data Acquisition Systems: *The general structure of the computerized data acquisition systems* – An overview of the DAS, Sampling theorem; signal conditioning; *Sensors, transducers & applications* - Introduction to sensors & transducers; applications of sensors (i.e. temperature, light, displacement, acceleration, pressure, flow, mechanical strain); signal conditioning for different types of transducers; *Data acquisition boards* - Main types; analog input and

output functions; digital input and output functions; counter / timer functions; characteristics;

General programming for data acquisition: *General programming for data acquisition* – Data acquisition programming using graphical programming environments

Data Analysis techniques: *Data Analysis techniques* – Data processing and analysis techniques

Practical

Introduction to Data Acquisition Systems: *Sensors, transducers & applications* - An overview of the DAS, Sampling theorem; signal conditioning; *Sensors, transducers & applications* - Introduction to sensors & transducers; applications of sensors (i.e. temperature, light, displacement, acceleration, pressure, flow, mechanical strain); signal conditioning for different types of transducers

General programming for data acquisition: Data acquisition programming

Applications in data acquisition and signal processing: Practical aspects of measuring different mechanical and electrical values i.e. force, displacement, speed, acceleration, temperature, pressure, torque, strain, rotational values, electrical power, light intensity, humidity, sound intensity

Data Analysis techniques: Controlling stepper and DC motors; Image acquisition and processing; data communication protocols: serial, TCP/IP, wireless etc…

BST 21110 – Global Historical Landmarks and Current Affairs (C)

0 credits (15-0-0-35), Prerequisite: None

Theory

Historically important landmarks: *Historically important incidences in the world* – The impacts of Industrial revolution and the Green revolution

Sport world: *World famous sports* – Olympics, FIFA games, Cricket etc. in the past and at present

World environmental issues: *Present environmental issues and challenges* – Biodiversity in the world and present; threats to it; environment pollution and mitigating factors; global warming and factors affecting for it; climate change, causes and impacts on the world; Climate change related agreements; use of agrochemicals; waste and waste management

Newly introducing arenas: *Important new arenas* – Carbon footprint, carbon sequestration and carbon trading; Energy crisis in the world and alternative energy sources; Genetically modified organisms, food, feed and processed products

Future global expectations: *Sustainable development* – Sustainable development and sustainable development goals (SDGs)

BST 21910 – Communicate in English III (C)

0 credits (30-00-35-35), Prerequisite: None

Theory

Language Structure: Uses, formation and classification of adjectives and adverbs; phrasal verbs; functions of basic modals; determiners – a few, few, a little, little, no, none; forms and uses of tenses (present perfect, past perfect, future perfect and their passive forms). Vocabulary: High frequency vocabulary items requiredfor academic purpose; use dictionaries and glossaries; use clues provided by etymology, suffixes, pre-fixes, pre-modifiers and post modifiers.

Speaking: Express likes and dislikes, describe routine; interact in discussions on academic topics; take turn in various speech situations, communicate with confidence to an acceptable degree of fluency. Listening: Listen and take down notes, understand the gist of spoken/ academic texts and respond appropriately, identify the main idea and the supporting details, listen and comprehend instructions and/ or information related to the field of study presented orally.

Writing: Spelling/ Spelling rules, describe a process using sequence markers with a reasonable degree of accuracy, write short reports, be familiar with official correspondence, compile a resume (Bio-data), write appropriate covering letters, write essays, paraphrase texts; use coherence and cohesive devises.

Reading: Differentiate the main idea from the supporting details, identify and unstained functions of discourse markers/ coherence and cohesive devises, read intensively for comprehension, read between lines/ understand the implied meaning; use encyclopedias, read with humour Vocabulary: Everyday expressions – conversation

building expressions with “this” and “that”. Integrated Skills: Static Description – description of organisms, substance, objects, people and places in relation to definition, classification, physical appearance, chemical composition, structure etc.; express cause and effect relationship; comparison and contrast; definition and exemplification.

3.7.4. Year II Semester II

BST 22012 – Entrepreneurship Development & Technology Management (C)

2 credits (30-10-30-30), Prerequisite: None

Theory

Nature of entrepreneurship: *Introduction* - Entrepreneurship and its importance*; Schools of thought* - Different approaches to describing an entrepreneur; *Entrepreneurial personality and skills* - Entrepreneurial characteristics/traits*; Role of entrepreneurship in the economy* - Contribution of entrepreneurship to the economic development of a nation.

Entrepreneurship and innovation: *Entrepreneurship and creativity* - Creativity and the creativity process; *Entrepreneurship and innovation* - Innovation and the innovation process.

Entrepreneurial process: *Idea generation* - Sources of ideas and opportunities, and how an idea becomes an opportunity; *Opportunity analysis* - Opportunity recognition and opportunity analysis; *Fundamentals of a business plan* - Essentialsof a business plan; *Preparation of a business plan* - Business plan preparation.

Financing a new venture: *New venture finance* -Sources and strategies for financing new ventures.

BST 22021 – Introduction to Drug Discovery (C)

1 credits (15-00-20-15), Prerequisite: None

Theory

Introduction: *An Overview of Modern Drug Discovery and Development Processes*- Target selection; Hit identification; identify a clinical candidate*; History and Development of the Pharmaceutical Industry* - Preindustrial drug discovery; milestones in drug discovery.

Drug Targets and in vitro Screening: *Drug Targets* - Proteins, Inhibition of Enzymes, G-Protein-Coupled Receptors (GPCRs); *In vitro Screening* - Essentialterminology; biochemical assays, cellular assays; Assay systems and methods of detection; Streptavidin and Biotin.

Medicinal Chemistry and Pharmacokinetics: *Medicinal Chemistry* - Structure–Activity relationships and Structure–Property relationships; the Pharmacophore; *Pharmacokinetics* - Absorption, distribution, elimination pathways; In vitro ADME screening methods; In Vivo Pharmacokinetics.

***In vivo* Screening:** *Animal Models of Disease States* - Sources of animal models; validity of animal models; species selection; number of animals; Exemplary animal models by disease category; *Pharmacokinetics* - Absorption, distribution, elimination pathways; In vitro ADME screening methods; In vivo Pharmacokinetics.

Drug Safety: *Safety and Toxicology* - Sources of toxicity; acute versus chronic toxicity*; Basics of Clinical Trials* - Basics of Clinical Trials; Investigational New Drug Application, Phase I, II, III, and IV; Clinical Trials.

Biomarkers: *Biomarkers and Translational Medicine* - Definition of a Biomarker; classification; characteristics and impact of Biomarkers; Translational medicine.

Organizational Considerations: *Pharmaceutical Companies vs Academia* - Organizational structures of Pharmaceutical companies; Business division interactions; The Discovery Project Team; Evolutionary cycle; Academic drug discovery; Funding issues.

Intellectual Property and Patents: *Intellectual Property and Patents* - Inherent properties and Patentability; Novelty, Obviousness; Inventorship; Assignment and Ownership; classification of patents and patent applications; patent applications and their contents.

Case Studies: *Selected Case Studies* - Case study of a historically important drug; case study of a recently developed drug: HIV Protease Inhibitors.

BST 22032 – Applied Chemistry (C)

2 credits (15-30-30-25), Prerequisite: None

Theory

Chemical Kinetics: *Rate Laws* - Introduction to Kinetics; rates of chemical reactions; rate expressions and rate laws*; Nuclear Chemistry and Chemical Kinetics* - Nuclear

chemistry: Radioactive decay; chemical kinetics; second order integrated rate laws; relationship between k and K; elementary steps and molecularity; *Reaction Mechanisms* - Investigating reaction mechanisms; *Kinetics and Temperature* - Effect of temperature on reaction rates; the reaction coordinate and the activation complex; *Catalysts* - Introduction to catalysis; types of catalysts; catalysts of life and enzyme catalysis.

Functional Groups: *Common Functional Groups* - Structural and reactivity characteristics of biologically relevant functional groups: Haloalkanes, Alcohols, Ethers, Phenols, Aldehydes and Ketones, Carboxylic Acids, Esters, Amines, Amino Acids, and Amides; *Impact on Technology* - Addition polymerization, condensation polymerization; Copolymers; physical properties of polymers*;* *Impact on Biology* - Proteins, Carbohydrates, Nucleic Acids.

Applying Chemical Principles: *Acid-Base Titrations* - Explain a biological process (e.g. fixation of the greenhouse gas carbon dioxide by a micro-organism) using the basic chemical principles; biological effects of radiation; use of radioisotopes in nuclear medicine; industrial catalysis; enzymatic catalysis.

Practical

Chemical Kinetics: Iodination of Acetone; reaction between iodide ion and bromateion under acidic conditions; half-life of Barium-137m; rate studies on the decomposition of Aspirin; Tyrosinase enzyme kinetics.

Functional Groups: Preparation of a hand cream; extraction and identification of fatty acids from corn oil; preparation and properties of soap; polymerization reactions; isolation and identification of casein; properties of enzymes;denaturation; saturated and unsaturated fats; preparation of aspirin; isolation of caffeine from tea leaves; separation of plant pigments.

BST 22042 – Energy Conversions Technologies (C)

1 credits (15-30-15-40), Prerequisite: None

Theory

Combustion technique for bioenergy generation: The thermochemical theory of combustion operation; bioenergy generation; equipment types, operating parameters

and controls in combustion operation and industrial application.

Gasification technique for Bioenergy generation: The thermochemical theory of gasification; bioenergy generation; equipment types, operating parameters and controls in gasification operation and industrial application.

Pyrolysis technique for bioenergy generation: The thermochemical theory of pyrolysis operation; bioenergy generation; equipment types, operating parameters and controls in pyrolysis operation and industrial application.

Hydrothermal and other techniques for bioenergy generation: Thethermochemical theory of hydrothermal and other bioenergy generation techniques, and industrial application.

Introduction to biochemical conversions: Biochemical conversion steps; improving conversion efficiency techniques.

Anaerobic digestion: Anaerobic digestion process; introduction to Biogas; microbial process of biogas production; composition of bio gas; uses of biogas.

Alcohol fermentation: Fermentation process; bioethanol production process; bioethanol and its uses.

Biodiesel production: Process of trans-esterification; biodiesel production process; biodiesel and its uses.

Practical

Combustion technique for bioenergy generation: Field practical on thermochemical approach.

Gasification technique for Bioenergy generation: Practical session on gasification & pyrolysis techniques.

Pyrolysis technique for bioenergy generation: Group work on thermochemical approach.

Hydrothermal and other techniques for bioenergy generation: Tutorial on video presentation.

Introduction to biochemical conversions: Group work on biochemical approach; practical session on biogas technique.

Anaerobic digestion: Practical session on biogas technique (Field visit)

Alcohol fermentation: Lab session on fermentation process.

Biodiesel production: Biodiesel production from coconut oil.

BST 22051 – Bioinformatics (C)

1 credits (00-30-10-10), Prerequisite: None

Practical

Introduction to bioinformatics and online resources: *Introduction to bioinformatics*

- Define bioinformatics; historical and scientific context; familiarizing with online bioinformatics tools and websites.

Nucleotide and protein sequences: *Working with sequences* **-** Gene bank entry; genome, open reading frames, exons and introns; protein structure databases, protein domain, sequence comparison and similarity searching; BLAST, BLASTP,tBLASTn, Clustal W, online tools to perform local and global alignment of protein sequences; pare wise and multiple sequence alignment; interpret sequencealignments; molecular phylogeny; restriction site analysis; protein signal sequence prediction.

Bioinformatics Database and Software Resources: *Online databases and software*

- National Center for Biotechnology Information (https://www.ncbi.nlm.nih. gov/), Swiss Institute of Bioinformatics (https://www.sib.swiss/), The European Bioinformatics Institute (https://www.ebi.ac.uk/), DNA data bank of Japan (https:// www.ddbj.nig.ac.jp/index-e.html), Integrated DNA technology (https:// sg.idtdna. com/pages/home), Protein data bank (https://www.rcsb.org/), ChloroP (http://www. cbs.dtu.dk/services/ChloroP/), Phytozome (https://phytozome.jgi. doe.gov/pz/ portal.html),NEBcutter (http://nc2.neb.com/NEBcutter2/)

BST 22062 – Microbial Applications in Biosystems Technology (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

Characters of microorganisms in relation to industrial applications: Charactersof bacteria and fungi, which make them suitable for industrial application.

Bioreactors and Bioreactor operation: Different types of bioreactors; bioreactor kinetics and different methods used to extract products from bioreactors.

Application of microorganisms in alcoholic beverage production: *Application of microorganisms in different types of alcoholic beverages (such as beer, wine etc.)*

Application of microorganisms in food industry: Use of microorganisms to produce different types of foods such as meat products, dairy products, fermented vegetables and grain products, yeast, single cell protein etc.

Application of microorganisms in Agriculture: Different applications of microorganisms in agriculture such as, production of microbial insecticides, fertilizers etc.

Application of microorganisms in the production of industrial chemicals: Applications of microorganisms in the production of industrial chemicals such as organic acids, industrial alcohols, amino acids etc.

Applications of microorganism in producing medically important products: Application of microorganisms in the production of medically important products such as antibiotics, alkaloids, steroids and sterols, vaccines etc.

Application of microorganism in waste management: Different applications of microorganisms in waste management such as microbial waste treatment plants, wetlands etc.

Application of biotechnological tools in industrial microbiology: Application of biotechnological tools such as polymerase chain reaction (PCR), microarrays, DNA sequencing, metagenomics, bio informatics etc.

Screening of microorganisms with industrial potential: Different methods used to screen microorganisms with potential for industrial applications.

Practical

Characters of microorganisms in relation to industrial applications: Direct and indirect methods used to measure microbial growth.

Bioreactors and Bioreactor operation: Measuring and analyzing of bioreactor kinetics Application of microorganisms in alcoholic beverage production: A filed visit to an alcoholic beverage production factory to study its operation.

Application of microorganisms in food industry: Production of different types of food products using microorganisms in the laboratory - Visit to food producing factory and study its operation

Applications of microorganism in producing medically important products: Screening and extracting antimicrobial compounds.

BST 22071 – Human Resource and Quality Management (C)

1 credits (15-00-15-20), Prerequisite: None

Theory

Introduction to ISO Standards: *ISO Standard and the requirement of ISO Standard for a Company or an Organization, and discuss the difference types of ISO standards for assorted applications.*

Introduction to ISO 14001 standards: *Introduction to Environment Management System (EMS), ISO 14001 registration requirements, ISO 14001 concept; explain the 'Deming Cycle', elements of ISO 14001 according to 'Deming Cycle'.*

Overview of ISO 14001 requirements: *ISO 14001 contents; key concept of ISO 14001; explain the ISO 14001 requirements and its application to an organization.*

Introduction to ISO 50001 Standards: ISO 50001 Standard and Energy management System of an organization; the preparation methods and techniques of ISO 50001 documents, and understanding the ISO 50001 requirement to align with difference types of organization applications.

Different ISO Standards requirement for the Industry: ISO 9001 Standard, ISO 18001 Standard, ISO 14064 standard, ISO 45001 and other commonly use ISO standards on an industry scale with the applications.

Introduction to management and business environment: Understand the management process; main management functions; managerial skills and roles; basic concept of organizational structure; components of an organizational environment; concepts of motivation; leadership in organizations; communication; interpersonal relationships.

Main human resource functions and their applications: Introduction to HRM; elements of manpower planning; recruitment, selection &induction; handling grievances; training and development; performance management; elements of industrial relations; disciplinary procedures; record management; employee health &safety; welfare and benefit services; Case study.

Operational management with problem solving: Introduction to Operation Management: capacity planning, material requirement planning; selection process; layout planning; forecasting and inventory management in industrial operations and processes.

Problem identification and Solving: Introduction to '5S' and 'Seven waste types' and other newly emerging techniques for operation control, and apply problem solving techniques with Lean and Kaizan approach to solve operational problems.

BST 22082 – Introduction to Electricity and Electronics (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

Introduction to Electricity: Introduction to electricity; First law of static electricity; electrostatic induction; Coulomb's law.

Electric intensity and Electric fields: Electric intensity; concept of electric field &line of forces; various types of electric fields (one and two point charges); electricfield of continuous charge distributions; Gauss' law; application of Gauss' law (sphere of charge, spherical shell of charge, infinite line charge and a uniform sheet of charge).

Electric Potential: Electric potential due to point charge and continuous charge distribution; Capacitors and dielectrics; Energy stored in electric field; electric dipole moment; method of images.

Current and Current Density: Current and current density; drift velocity; resistance, resistivity and conductivity, resistor color coding, Ohm's law.

Bioelectricity: Introduction to bioelectricity and its applications; Diodes (biasing, DC and AC resistance, equivalent circuit, load line analysis, half & full wave rectification and diode testing); Zener diode.

Electronics: Bipolar transistors (operation, configuration, characteristics, testing, biasing methods, load line analysis, switching network); Operational amplifiers (inverting, non-inverting); basic OP-Amp circuits; applications of OP-Amp

Logic gates: Binary, decimal, octal and hex number systems; Logic gates; Logic expressions and its simplifications using Boolean algebra and k-Maps and De Morgan's theorem; Combinational logic circuits; half and full adder; Introduction to Bioelectronics, Biosensors; applications of bioelectronics.

Practical

Introduction to Electricity: Experiments from Gold Leaf Electroscope (Identification of charge, Ice Cage experiment) Coulomb's law experiments

Electric intensity and Electric fields: Experiments on electric fields (electric field mapping experiments, electric field strength measurements); Continuing experiments on various shaped electric fields (electric field strength measurements on various charge distributing systems)

Electric Potential: Mapping equipotentials (Point charge, Concentric conductors, Parallel plate capacitors); Experiments on electric dipoles.

Current and Current Density: Experiments on Ohm's law (verification of law; determination of electrical parameters)

Bioelectricity: Experiments on bioelectricity**;** Diodes related experiments (half and full wave rectification, voltage regulator).

Electronics: Transistor amplifier and switch; transistor characteristics; Experimentson Inverting and Non-inverting Operational amplifiers.

Logic gates: Experiments on logic gates (identification of gates, verification of arithmetic operation of gate systems); Experiments on logic gate systems.

BST 22092 – Directed Study and Seminar (C)

2 credits (00-60-20-20), Prerequisite: None

Practical

Directed Study and Seminar: Proposal formulation for the potential applications of BST and presentation - *Formulating a proposal for the potential applications of BST using the following, on an industrial scale: biopesticides and biofertilizer, industrial applications of enzymes, cereals, fiber, fats and oils, plantation crops, timber, spices, aquaculture, leather, cosmetics, confectionary, clothes etc;* Conducting a small scale research - Carrying out a small scale research based on a selected topic.

BST 22910 – Communicate in English IV (C)

0 credits (30-00-35-35), Prerequisite: None

Theory

Language Structure: Forms and uses of tenses (present perfect continuous, past perfect continuous and future perfect continuous and their passive forms); conditions; complex modality – modals with perfective/ progressive aspects, semi-auxiliaries and catenative; nominalization; focalization.

Speaking: Present and discuss matters pertaining to their field of study (present information clearly, ask for information/ clarification, express a point of view: agree/ disagree politely, answer questions appropriately); discussions on academic/ social/ ethical issues; use appropriate interactive strategies; public speaking.

Listening: Understand opinions and inferences, take down notes appropriately on academic texts, identify various registers, identify and comprehend points made by multiple speakers; listen and take down notes; listen for comprehension.

Writing: Summary/ Précis writing; write articles, assignments, tutorials to a considerable degree of accuracy; write academic/ formal essays.

Reading: Understand implicit information in texts by making inference; distinguish between facts, suppositions, opinions, attitudes and arguments. Integrated Skills: Description of a process; describing position, movement, and direction; narration: field/ laboratory report; description of graphs, charts and tables. Vocabulary: Common expressions for modifying statements.

3.8. Major Module: BioEnergy

3.8.1. Year III Semester I

BST 31212[1] - Combustion Technologies for Bioenergy (C)[2]

2 credits (30-30-40)[3], Prerequisite: None

Theory

Characterization of fuel: *Characterization of fuel*- Estimation of Calcific value of fuel, proximate and ultimate analysis. Combustion efficiency, Ignition point, flash point of liquid biofuels. Combustion properties and emission of liquid fuels such as biodiesel, bio ethanol and bio-oil, emulsified bio-oil, and diesel and biodiesel blends.

Combustion fundamentals: *Combustion fundamentals*- Introduction to solid, liquid and gas phase combustion. Solid biomass combustion: Ultimate and proximate analysis of solid fuels. Initial fuel drying, Ignition and combustion of volatile constituents, burning out of the char, Type of Grate Stokers, Fixed and moving bed Combustion technologies, Fluidized bed, and suspension type combustion technologies for particulate biomass. Bubbling fluidized bed (BFB) combustors and Circulating fluidized bed (CFB) combustors for biomass boilers. Effect of excess air, primary and secondary air requirement for solid biomass combustion, Economizers, Incinerator types, Waste-to-energy plants

Boiler technology for bioenergy: *Boiler technology for bioenergy*- Boiler technology, boiler types and selection, Biofuel feeding mechanisms, Configurations of combustion systems, Co-firing, Low pressure steam distribution, Biomass boiler operation and maintenance: Boiler feedwater treatment, Start-up and shut-down, Boiler inspection & testing

Practical

Energy audit for a biomass boiler plant: Field practical

Bomb Calorimeter: Lab practical

Proximate Analyzer: Lab practical

BST 31222 - Biomass Gasification and Pyrolysis (C)

2 credits (30-30-40), Prerequisite: None

Theory

Biomass pyrolysis: *Biomass pyrolysis*- Pyrolysis of biomass yields solid char (biochar), tar (bio-oil), and pyrolysis vapor which are subsequently condensed to obtain tar and producer gas. Biomass drying process, Slow pyrolysis (Biochar production), Fast pyrolysis and flash pyrolysis, Biomass Torrefaction, Hydrothermal conversion technologies, Activated carbon production technology (surface area enhancement process)

Biomass gasification technologies: *Biomass gasification technologies*- Gasification Process, the overall performance of the gasification process with effect of temperature, gasification agent, equivalence ratio (ER), gasifying agent to biomass ratio, biomass moisture content, feedstock characteristics, reactor design and configuration, incorporation of catalysts, etc. Type of gasifiers and their technology; fixed-bed reactors with the cross draft, downdraft and updraft modes, entrained flow reactors, moving bed reactor, and fluidized bed reactors, including circulating fluidized bed and bubbling fluidized bed reactors

Biomass producer gas (syngas) utilization in the industry: *Biomass producer gas (syngas) utilization in the industry*- Characterization of producer gas, Producer gas combustion, Producer gas for high temperature applications, Utilization for internal combustion engine, Syngas use for producing chemicals, Produce liquid fuel and H_2

Practical

Activated carbon production plant: Field visit

BST 31232 - Bioenergy Crop Cultivation and Harvesting Technologies (C)

2 credits (30-12-58), Prerequisite: None

Theory

Bioenergy Crops and Feedstocks: *Bioenergy Crops and Feedstocks*- First generation/ Second Generation/Third generation liquid biofuel feedstocks cultivation and harvesting Technologies, Cultivation and harvesting technologies of direct energy

crops (also referred as short-rotation woody crops that is, higher than long-rotation forest systems grown on forest land), Short-rotation tree plantations for bioenergy, Biomass harvesting methods and equipment, Precision agriculture and harvesting

Sustainable Energy Farming *Sustainable Energy Farming*- Environmental impact and challenges for sustainable energy farming development, Land use estimation, impact on biodiversity, sustainable fertilizers and agrochemicals use

Biomass Resources and their Bioenergy Potential Estimation *Biomass Resources and their Bioenergy Potential Estimation*-Estimation based on statistical data, Estimation integrating RS and GIS techniques, Biomass yield estimation models

Post-harvesting Bioenergy Feedstocks: *Post-harvesting Bioenergy Feedstocks*- Agricultural residues from crops such as corn (corn stover, etc.), sugarcane (bagasse, cane trash, etc.), paddy rice (rice straw, paddy husk, etc.), wheat (wheat straw, etc.), and beets oilseeds such as several plants of brassica family (e.g., rapeseed), sunflower seed and soybeans, Biomass processing technologies (palletization, chipping)

Practical

Sugarcane cultivation: Field visit

BST 31242 - Liquid Biofuel Generation Technology (C)

2 credits (30-20-50), Prerequisite: None

Theory

Fermentation Technologies for Bioethanol Conversion: *Fermentation Technologies for Bioethanol Conversion*- First generation feedstocks: Conventional route of Liquefaction, Saccharification, and Fermentation, Developed routes of Simultaneous Saccharification and Fermentation (SSF) and Simultaneous Liquefaction, Saccharification and Fermentation (SLSF) Second/Third generation feedstocks: Cellulose conversion and Fermentation of complex (C6/C5) Sugars

Biodiesel Production Technologies: *Biodiesel Production Technologies*- Acid catalyst esterification, Transesterification technology, Thermal/catalytic cracking, Bio-oil generation from pyrolysis, Catalytic deoxygenation for biodiesel/bio-oil

Synthesis of Intermediate Liquid Biofuels from Biorefineries: *Synthesis of Intermediate Liquid Biofuels from Biorefineries*- Bio-based production processes of Methanol, Refined Fischer-Tropsch liquids (FTL), dimethyl ether (DME), Oxymethylene ether (OMEx), Hydroxy-methyl Furfural (HMF)

Biofuel Distillation for Initial Separation/Purification: *Biofuel Distillation for Initial Separation/Purification*- Use of distillation columns for liquid-liquid separation, Azeotropic nature of ethanol/water mixture, Basic principles of distillation technology

Liquid Biofuel Plant Operation and Maintenance: *Liquid Biofuel Plant Operation and Maintenance*- Safe start-up, operation, and shut down of fermenters, catalytic bioreactors, and distillation columns, Utility equipment attached to fermenters, Catalytic bioreactors and distillation columns: Operation and maintenance

Economics of Liquid Biofuel Generation Processes: *Economics of Liquid Biofuel Generation Processes*- Qualitative comparison of capital cost of biorefinery plants, Economics of biorefinery equipment technologies/catalysts/energy, feedstock-based cost for liquid biofuels

Practical

Bioethanol distillery plant in a Cane sugar processing plant: Field visit

Fermentation: Lab Practical

Measuring the oxidative stability/anti oxidation capacity of Biodiesel : Lab Practical

BST 31252 - Anaerobic Digestion Technology (C)

2 credits (30-30-40), Prerequisite: None

Theory

Feedstock identification and characteristics in anaerobic digestion: *Feedstock identification and characteristics in anaerobic digestion*- Biowaste generation, supply, and availability. Applicability of different feed stocks (Solid/Liquid). Different pretreatment techniques. Anaerobic co digestion. Determination of Biomethane potential of substrate. Energy generation potential

Anaerobic conversion process: *Anaerobic conversion process*- Anaerobic Digestion (AD) as sustainable waste management technology. Biological process fundamentals of anaerobic conversion.

Classification of anaerobic reactors: *Classification of anaerobic reactors*- Features of Low rate and high-rate anaerobic reactors. Classification according to total solid content, feeding strategy etc. Selection of anaerobic reactor for given substrate.

Operating and monitoring parameters: *Operating and monitoring parameters*- Start up, operation and monitoring of anaerobic reactor, Parameters controlling the conversion of organic waste to biogas. Online and offline monitoring parameters, COD removal efficiency, HRT, SRT, Temperature, C/N ratio, alkalinity, pH, TS, TVS. Biogas production rate, biogas composition etc. Effect of Inhibition and toxicity. Identify reasons for failure of anaerobic reactors.

Design of anaerobic reactor: *Design of anaerobic reactor*- Introduction for strategies to design anaerobic reactors for both high rate and low-rate reactors. Design of continuous stirred tank reactor to treat organic fraction of municipal solid wastes. Calculation of reactor dimensions.

AD technology developments: *AD technology developments*- Historical developments of AD technology in Global and local context. Different stages of developing AD technology. Introduction to small scale, medium scale and large-scale AD systems and associated equipment. Centralized co digestion plants. Biogas upgrading techniques such as scrubbing, membrane separation etc.

Economic analysis of anaerobic reactors/plants: *Economic analysis of anaerobic reactors/plants*- Analyses of the economic performance of given anaerobic digestion s plant based on net present value (NPV) and internal rate of return (IRR) concepts

Practical

Anaerobic wastewater treatment plant: Field visit

Lab scale anaerobic digester/Lab scale bioreactor: Lab Practical

Biomethane potential test: Lab Practical

BST 31262 - Supply Chains for Bioenergy and Biorefining (C)

2 credits (30-00-70), Prerequisite: None

Theory

Biomass Resource Assessment: *Biomass Resource Assessment*- Classification of biomass resources, Qualities desired in biomass resources, Biomass resource assessment methods for Agricultural residues, Forestry residues, Residues from agri-food industry, Residues from timber industry, Livestock by-products, Municipal solid waste, Energy crops, Biomass resource potential of short rotation woody crops, Crop termination, Biomass resource potential of sugar and starch crops, Microalgae and macroalgae productivities and yields

Biomass Collection and Storage: *Biomass Collection and Storage*- Biomass collection methods and technologies, Biomass transportation methods, Biomass storage methods: Open-air storage, Covering without climate control, Ensilage, Covering with climate control, Steel or concrete bins and silos, etc., Storage of woody material, Trade-off between cost and dry matter loss, Biomass storage within the supply chain, Biomass properties impacting storage: Biomass moisture, Biomass density, Self-heating/fire/explosion/health and safety during biomass storage, Dust management during storage, Degradation management during storage, Monitoring of storage facilities

Biomass and biofuel Supply, Demand, and Markets: *Biomass and biofuel Supply, Demand, and Markets*- Background in biomass supply chains, Economic forces determining biomass supply and demand, Key drivers in biomass markets, Future trends, Liquid biofuel distribution and end use

BST 31272 - Biomass pretreatment and processing (C)

2 credits (30-12-58), Prerequisite: None

Theory

Mechanical Processing: *Mechanical Processing*- Technologies of Peeling, Chipping, Crushing, Shredding, Grinding, Pulverizing, Milling, Magnetic separation, Screening, Sorting (manual & automated), Waste Fuel–Coal Blending

Fractionation Technologies: *Fractionation Technologies*- Hydrothermal pretreatment, Enzymatic hydrolysis, Alkaline hydrolysis, Acid dilution, catalytic conversion, saccharification.

Energy Densification Technologies: *Energy Densification Technologies*- Pellets and

briquettes, Wood pellets produced from sawdust, Briquettes from energy plants, Solidified Charcoal, and carbonized fuels, Hydraulic or mechanical presses, Mechanism of solidifying biomass, The screw-type Formatore

Biomass Drying: *Biomass Drying*- Effect of moisture in biomass as a fuel. Biomass drying technologies (packed bed, fluidized bed suspension drying by waste heat or flue gas heat). Solar drying technologies for biomass. Agricultural waste preparation: baling techniques

Economics of Solid Biofuels Generation Processes: *Economics of Solid Biofuels Generation Processes*- Heat of combustion and Calorific value of solid biofuels, the cost of production of solid biofuel (Cost of briquettes and pellets production), Estimated profit from solid biofuel sales.

Practical

Hydrothermal liquefaction: Lab Practical

Determine carbon, hydrogen, nitrogen content in solid and liquid material: Lab Practical

Determination of the ash fusion of solid fuel ashes like biomass: Lab Practical

Separation of biomass extracts: Lab Practical

BST 31282 - Bio-based Power Generation (C)

2 credits (30-12-58), Prerequisite: None

Theory

Biomass based power generation: *Biomass based power generation*- High pressure boilers for power generation, CHP, Power generation technologies, Steam Turbines, Gas Turbines, High pressure steam distribution, superheated and saturated steam distribution systems, Biomass-based Cogeneration, Biomass Gasification for Electrical Applications, Producer gas for generators; Producer gas operated Internal combustion engines (full gas mode and dual fuel mode with diesel)

Grid integration and control: *Grid integration and control*- Grid-inter-phasing system, step-up transformers, multilevel inverter for biomass-based power generation, power quality control, microgrid applications, Power distribution.

Economics of bio-based power generation: *Economics of bio-based power generation*- Levelized energy cost calculations, Sustainable Use of Agricultural Resources for power generation, The role of bio-based power generation in a future bioeconomy: Policies and facts (infeed tariff rates)

Practical

Biomass cogeneration plant in a Cane sugar processing plant: Field visit

BST 31292 - Pollution Control of Bioenergy Technologies (C)

2 credits (30-00-70), Prerequisite: None

Theory

Air, Water and Land pollution: *Air, Water and Land pollution*- Introduction to air, water, and land pollution. Effect of industrial development to the environment.

Nature of pollutants/Contaminants/Toxicology: *Nature of pollutants/Contaminants/ Toxicology*- Air pollutants: CO, NO_2, SO_2, Particulate matter, Ground level ozone,

Water pollutants: Microbial Pathogens (bacteria, protozoa, or viruses), Organic materials (petroleum, insecticides and herbicides, detergents, disinfecting cleaners), Inorganic materials (ammonia, chemical waste, fertilizers, and heavy metals) Heavy metals (arsenic, mercury, copper, chromium, zinc, and barium), Macroscopic pollutants, Thermal pollution Soil pollutants: agriculture and animal husbandry, animal wastes, use of long-lived pesticides, herbicides, fungicides, fertilizers

Noise pollution: Noise levels, Types of machineries that generate noise

Environmental Measurements: *Environmental Measurements*- Assessment of chemical, physical, or biological factors in the environment

Water Quality Measurements: Dissolved Organic Matter, Conductivity, Salinity and TDS, Dissolved Oxygen, Phosphorus and Nitrogen as Nitrate and Ammonia, pH, Turbidity, TSS and Clarity, Water Temperature

Air quality measurements: Ground level ozone Carbon monoxide, Sulfur dioxide (SO_x), Nitrogen dioxide (NO_x), aerosols, Particulate matter (PM), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and mercury (Hg),

Soil quality measurements: Physical (soil texture, bulk density, etc.), chemical (pH, salinity, organic carbon, etc.), and biological (microbes and enzymes) parameters

Global and national environmental standards: *Global and national environmental standards*- Industrial Emissions Directive 2010/75/EU, USA-EPA, National Environmental Act No. 47 of 1980, Central Environmental Authority, National Environmental (Stationary Sources Emission Control)

Regulations, No. 01 of 2019. National Environmental (Noise Control) Regulations No.1 1996, National Environmental (Ambient Water Quality) Regulations, No. 01 of 2019. National Environmental (Protection and Quality) Regulations, No. 1 of 2008. Waste disposal. Ambient air quality, Pollutant Emissions from bioenergy processes (airborne, waterborne, and solid emissions), Emission control and monitoring technologies, End-of-pipe treatment technologies,

Environmental impact assessment of bioenergy processes: *Environmental impact assessment of bioenergy processes*- General EIA approach, Impacts on Physical environment: air, water, soil, geology, hydrology, Biological environment impacts: Flora and fauna, Socio-economic impacts

Environmental emissions and control in various biomass conversion processes: *Environmental emissions and control in various biomass conversion processes*- Flue gas emissions from biomass combustion and plant emissions factors (PM_{10}, CO, NO_x, SO_x), Air pollution control techniques: Cyclone separators, Electrostatic precipitators, Bag filters,

Methods of solid waste generation: Bottom ash and fly ash generation, Dust due to particle size reduction, Odor control due to storage and processing, Amount of ash produced by biomass energy plants and disposal methods.

Carbon emissions and capture: Adsorption removal of CO_2 by activated carbon, Fixing CO_2 by microalgae

Gas emissions from compost including methane (CH_4), ammonia (NH_3), hydrogen sulfide (H_2S), methyl sulfur [$(CH_3)_3S$], methanethiol (CH_3SH), sulfur dioxide (SO_2), and other alkane gases,

Liquid emissions and control in biomass conversion (dendro-power), Tar generation in biomass gasification processes, Spent wash treatment using anaerobic digestion, Disposal of biogas slurry and residues,

NO_x removal techniques: selective catalytic reduction (SCR) and selective non catalytic reduction (SNCR) of NO_x using ammonia,

Pollutant gas removal techniques: Absorption, adsorption, thermal destruction, condensation, biological purification, membrane separation, and photooxidation decomposition

3.8.2. Year III Semester II

BST 32212 - Waste management of bioenergy technologies (C)

2 credits (30-30-40), Prerequisite: None

Theory

Introduction to Waste Management: *Introduction to Waste Management*- Definition of Waste, Waste classification, Waste as a feedstock for bioenergy generation, Types of waste generation in bioenergy plants and factory premises (including administrative buildings, vehicle cleaning, kitchens, canteens, rest rooms, toilets, etc.), National waste management policies, International conventions for waste management, Authorities and institutions for waste management

Waste Management Techniques: *Waste Management Techniques*- Waste management hierarchy, 3R principle (Reduce, Reuse, Recycle), 5R Principle (Refuse, Reduce, Reuse, Repurpose, Recycle), Source Reduction and Waste Minimization, Resources recovery from waste (energy, nutrients, materials, chemicals), Waste pre-processing technologies: Screening, Shredding, Sieving, Volume/Size reduction, Air/Magnetic separation, Crushing, Milling, etc., Waste composting, Waste pyrolysis, Waste incineration, Engineered landfilling for hazardous waste, Aerobic/Anaerobic digestion of waste, Zero waste/discharge concept, CO_2 emission reduction and removal techniques from bioenergy plants

Waste quantification methods and tools: *Waste quantification methods and tools*- Waste material flow diagrams, Mass balance calculations for waste using Microsoft Excel modeling

Case Examples for Waste Management in Bioenergy Plants: *Case Examples for Waste Management in Bioenergy Plants*- Waste management in Biomass Boilers/ Biomass power generation (fly ash, bottom ash, dust generation, etc.), incineration/ Cogeneration plants, bioethanol/biodiesel refineries (spent wash, wastewater, lignin, solid residues, etc.), biogas generation plants

Entrepreneurship from Waste Management: *Entrepreneurship from Waste Management*- Value-added business start-ups from bio-waste

Practical

Solid waste processing plant for heat/power generation: Field visit

BST 32222 - Liquid Biofuel Purification Technologies (C)

2 credits (30-15-55), Prerequisite: None

Theory

Bioethanol Purification and Dehydration Technologies: *Bioethanol Purification and Dehydration Technologies*- Azeotropic distillation, Extractive distillation, Molecular-sieve absorption, Pressure swing distillation, Industrial scale case-based examples of bioethanol dehydration

Biodiesel Purification Technologies: *Biodiesel Purification Technologies*- Equilibrium-based separation: Distillation & L-L Extraction, Affinity-based purification: Adsorption & Ion exchange, Membrane-based: Membrane separation, Reaction-based: Membrane bioreactors, Industrial scale case-based examples of biodiesel purification

Economics of liquid biofuel purification technologies: *Economics of liquid biofuel purification technologies* - Economic parameters for liquid biofuel purification technologies, Evaluation, and comparison of economic parameters for different liquid biofuel purification technologies, Selection of liquid biofuel purification technologies for industrial scale applications

Practical

Azeotropic separation of bioethanol: Lab Practical

Purification of biodiesel: Lab Practical

Measuring the water content of Biofuel: Lab Practical

BST 32232 - Biogas Purification, Storage and Combustion Technologies (C)

2 credits (30-00-70), Prerequisite: None

Theory

Biogas purification technologies: *Biogas purification technologies*- Constituents of biogas and their impacts, Moisture removal using cooling and condensation,

adsorption with silica gel. Sulfur removal technologies: H_2S removal using activated carbon, Iron Hydroxide or Oxide, Biofiltration. CO_2 removal using water scrubbing, alkali absorption, Amine scrubbing: adsorption and stripping. Pressure swing adsorption (PSA) i.e., Pressure driven media adsorption. Membrane separation: Selectivity and permeate, Polymeric membranes as PDMS, polyamide. Membrane modules: Hollow fiber membrane module. Calcium looping, NH3 scrubbing

Biogas collection and storage systems: *Biogas collection and storage systems*- Water displacement method. Classification of biogas storage systems: Low pressure biogas storage: Floating biogas holders: Flexible membrane as HDPE, LDPE. Medium pressure biogas storage. High pressure biogas storage: Compressed bio methane (CBM) and Liquefied Bio Methane (LBM). Distribution of bio methane. Dedicated Biomethane Pipelines, Natural Gas Pipeline Network. Adsorption technology for biomethane storage, Adsorbed Natural Gas (ANG).

Biogas combustion: *Biogas combustion*- Required gas quality for different applications as Boiler, Electricity generation, vehicle fuel, gas grid, Combustion characteristics and products. Biogas as a dual fuel. Biogas engine emissions due to internal combustion, Combined heat, and Power (CHP) from biogas. Biogas fired boilers.

Economics of biogas purification systems: *Economics of biogas purification systems*-Economic Evaluation of alternative biogas purification methods E.g., removal of H2S from biogas. Biofilter technology vs adsorption technology. Removal Efficiency of alternative system, Associated capital and operating costs. Payback period.

Troubleshooting (Technical challenges) in biogas plants: *Troubleshooting (Technical challenges) in biogas plants*- Effect of different feeding patterns and composition of feed stocks, Potential Inhibition of anaerobic process: Lipid inhibition, NH3 inhibition, SO4 inhibition. Strategies to overcome inhibition, Mixing and heating system associated issues. Culture condition and active methanogens presence. Temperature fluctuations. Lack of Buffer capacity (alkalinity level).

BST 32242 - Commercial Biofuel Technologies for Transportation (C)

2 credits (30-10-60), Prerequisite: None

Theory

Vehicle engine operation and emissions: *Vehicle engine operation and emissions*- Vehicle engine types, Internal combustion engines, sterling engines, Pollution

control for vehicle engine exhaust emissions (light duty/heavy duty vehicles), Sri Lankan standards for vehicle emissions

Biofuels for transportation: *Biofuels for transportation*- Biofuel selection for transportation modes, Biogas for transportation, Fuel cell technologies, Biohydrogen technologies, Bio-based ammonia as energy carrier, Conversion technologies of syn-gas to high calorific value fuel (Biofuel for aircraft), Economics of commercial biofuel for transportation

Fuel blending technologies: *Fuel blending technologies*- Bioethanol blending with gasoline (Gasohol as commercial fuel: E5, E10, E20, E80, E100), Biodiesel blending with diesel, Biofuel properties improvement methods (Octane number enhancement, catalysts/enzymes for fuel properties improvement, etc.)

Practical

Measuring the flash point of biofuel: Lab Practical

Measuring the viscosity of biofuel: Lab Practical

Measuring and finding the octane number of liquid biofuels: Lab Practical

Measuring pH of biofuels: Lab Practical

BST 32252 - Project Management and Entrepreneurship for Bioenergy (C)

2 credits (30-00-70), Prerequisite: None

Theory

Project Proposal and Technical Writing: *Project Proposal and Technical Writing*- Contents of a project proposal, Project proposal writing procedure, Technical writing style, Project proposal, Information search and literature review, Citing and referencing, Use of word processors for report writing (MS Word practice)

Project Management for Implementation of Bioenergy Systems: *Project Management for Implementation of Bioenergy Systems*- Projects in bioenergy sector, Introduction to project management, Setting-up projects for success, Designing and planning a project, Project scheduling and budgeting, Managing stakeholders, teams

and project communication, Uncertainty and risks of projects, Project evaluation & management tools

Entrepreneurship in Bioenergy Sector: *Entrepreneurship in Bioenergy Sector*- Principles of entrepreneurial management, Small business enterprises, Challenges for entrepreneurs in bioenergy sector, Innovations in bioenergy, Business ideas in bioenergy sector, Cost effective business initiatives/start-ups in bioenergy sector, Economically viable business implementations in bioenergy sector

BST 32262 - Occupational Safety and Hazard Identification (C)

2 credits (30-00-70), Prerequisite: None

Theory

Introduction to Occupational Safety and Health: *Introduction to Occupational Safety and Health*- Occupational Safety & Health Laws, Occupational Hygiene, Occupational Diseases, Occupational Stress, Health impacts at industrial workplaces, Possible accidents at industrial plants, First aid in industrial environment

Areas of Occupational Safety: *Areas of Occupational Safety*- Chemical Safety, Food Safety, Electrical Safety, Fire Safety, Biological Hazards, Construction Safety, Ensuring Labor Safety through Ergonomics, Avoidance of Workplace Hazards, Personal Protective Equipment (PPE), Fire Extinguishers/Fire Hydrant systems, Safety Equipment Demonstration

Hazard identification and Risk Assessment in Bioenergy Plants: *Hazard identification and Risk Assessment in Bioenergy Plants*- Accident Investigation, Principles of Risk Assessment, Machinery/Plant Risk identification, Health and Safety inspection, Root cause analysis for accidents, Job Hazard Analysis (JHA), Qualitative risk analysis methods, Prioritization of risks, Hazard controlling and prevention, Writing safety recommendations and reporting accidents, Standard Operating Procedures (SOPs) for plant equipment

BST 32272 - Energy Recovery and Conservation (C)

2 credits (30-30-40), Prerequisite: None

Theory

Principles of heat exchangers and their technologies: *Principles of heat exchangers and their technologies*- Concepts of Heat transfer (conduction, convection, radiation, heat resistance: fouling, scaling, film resistance), Heat & mass transfer fundamentals (Heat transfer rate, Heat transfer coefficients, Heat capacities, Mass flow rates-Flow arrangements, Logarithmic temperature difference, Heat exchangers selection, Double Pipe Heat Exchangers, Shell and Tube Heat Exchangers (TEMA nomenclature, Tube arrangement, Multiple passes, Tube sheets), Tube and Fin Heat Exchangers, Plate Heat Exchangers, Fabrication and maintenance techniques of heat exchangers

Heat Recovery Technologies: *Heat Recovery Technologies*- Gas to gas, gas to liquid heat exchanger technologies to heat recovery from flue gas (thermic oil/fluid or water as heat transfer medium) heating/cooling jackets & coils, condensers, preheaters, calandria, Process heat recovery Technologies (from hot streams to cold streams)

Heat recovery from boiler waste heat: *Heat recovery from boiler waste heat*- Condensate and flash steam recovery from steam distribution

Heat pumps and heat pipes: *Heat pumps and heat pipes*- Applications of heat pumps and their technologies (drying or space heating applications), The thermodynamic cycle, refrigeration cycle, and absorption heat pump (AHP). Principle of Heat pipes and application for heat recovery

Practical

Exploring energy recovery applications in a bioenergy-related industry: Field visit

Lab scale Refrigeration cycle unit: Lab Practical

BST 32282 – Bioenergy in Drying Technologies (C)

2 credits (30-30-40), Prerequisite: None

Theory

Drying Techniques in Bioenergy Systems: *Drying Techniques in Bioenergy Systems*-Principles of drying, Tower dryers, Belt dryers, Feed and turn dryers, Drum/rotary dryers, Flat grate dryers, Fluidized bed dryers, Drying chambers, Paddle Dryer, Flash Dryer, Flat & Wave Bed Paddle Dryer

Heat sources for Drying from Biomass Combustion Systems: *Heat sources for Drying from Biomass Combustion Systems*- Biomass gasifier furnace for drying, Moving Grate Combustion for drying, Great combustion for drying, Underfed Hearth Combustion for drying, Moving Grate Combustion for drying, Fluidized Bed Hot Air Generators for drying

Indirect hot air generators: *Indirect hot air generators*- Exhaust gas/air heat exchanger, Heat recovery, Flue Gas-Water (liquid) Heat Exchangers, Thermic fluid heaters (liquid-air heat exchangers), Hot water to air heat exchangers (hot air generators), Steam to air heat exchangers, Superheated steam as drying medium

High-temperature drying - direct hot air generators: *High-temperature drying - direct hot air generators*-Hot air cyclone cleaning, Dust (bag) filters

Biomass Dryer Application: *Biomass Dryer Application*- Bio-based drying applications in Maize, Corn, Sorghum, Wheat, Rice, Cotton straw; Coconut fiber, Coco peat, Coco coir, Palm fiber, Tea/Crepe rubber/Sheet rubber/Copra/Desiccated Coconut/Food processing industries, Drying for clay tile industry, Biofertilizer drying, Hybrid drying techniques: Fossil fuels, Solar, Microwave, Infrared, etc.

Practical

Exploring bioenergy-based drying: Field Visit

Biomass drying: Lab Practical

Moisture content measurement of biomass: Lab Practical

Weight measurements of biomass and dried biomass: Lab Practical

Particle size distribution of different biomass materials: Lab Practical

BST 32292 - Sustainable Bioenergy Industry (C)

2 credits (30-00-70), Prerequisite: None

Theory

Sustainable Development Concepts for Bioenergy Systems: *Sustainable Development Concepts for Bioenergy Systems*- Definition of sustainability, Triple bottom-line of sustainability: People/Profit/Planet and Environmental/Social/ Economic Sustainability, UN sustainability goals, Concepts of clean energy, clean technology, and cleaner production, improvement of sustainability through resources recovery, introduction to circular economy

Impacts of Feedstock Cultivation for Bioenergy Systems: *Impacts of Feedstock Cultivation for Bioenergy Systems*- Impacts due to Land use, impacts on biodiversity, ecology, and environment, Socio-economic impacts of feedstock cultivation for bioenergy and biofuel generation

Introduction to Life Cycle Assessment of Bioenergy Systems: *Introduction to Life Cycle Assessment of Bioenergy Systems*- Life cycle thinking of bioenergy systems (Determination of life cycle system boundary of a bioenergy system), Standard LCA methodology (ISO 14040-44 Framework), Identification of life cycle energy inputs/ outputs and emissions (airborne, waterborne, solid phase), Introduction to carbon footprint and water footprint, Introduction to life cycle environmental impacts

Introduction to Sustainability Assessment of Bioenergy Systems: *Introduction to Sustainability Assessment of Bioenergy Systems*- Requirements for energy sustainability of a bioenergy system, Energy payback period/Renewability factor, Ways of greenhouse gas (GHG) accounting of biogenic emissions for climate change impact, Social sustainability indicators related to bioenergy systems, Economic sustainability of combustion technologies, biofuel refinery technologies, Cost of energy, Opportunity cost of bioenergy generation

Sustainable Bioenergy-related Industries: *Sustainable Bioenergy-related Industries*-Case-based discussion of: Cane sugar production process, Palm oil refinery process, Rice processing industry, etc.

BST 32302 - Quality Measurement & Analytical Methods (C)

2 credits (30-12-58), Prerequisite: None

Theory

Quality parameters monitoring relevant for bioenergy processes: *Quality parameters monitoring relevant for bioenergy processes*-Parameters for biogas production process: OLR, Input SO_4, VFA, HRT, Temperature, NH_3/NH_4, Biogas composition.

Parameters for gasification and direct combustion: Output Gas quality composition, calorific value, fuel quality (moisture content, particle size), Rapid spectroscopic techniques and chemometrics to predict the key biomass and biofuel parameter calorific value.

Liquid Biofuel quality parameters: Free and total glycerin, flash point, cloud point, oxidation stability, cold soak filterability, and metals, Failure rates for cold soak filterability and oxidation stability, Flash point failure, Starch and sugar content, moisture content, purity of bioethanol/biodiesel, 2_{nd} Generation Cellulose percentage

Quality Assurance of Analytical Measurement in bioenergy processes: *Quality Assurance of Analytical Measurement in bioenergy processes*- Sampling, Analytical methods, Reference Materials and Chemical Standards, Analysis of quality, Statistical Terms and Data Handling, Acronyms in quality assurance

Analytical methods for bioenergy processes: *Analytical methods for bioenergy processes*

Liquid phase analysis (offline/online parameters), Gas phase analysis (offline/ online parameters)

Structure Analysis by Diffraction: X-ray Diffraction Analysis (XRD)

Spectroscopy Techniques: Ultraviolet and Visible Spectroscopy, Infrared and Raman Spectroscopy, Atomic Spectroscopy, Inductively Coupled Plasma (ICP) Spectroscopy

Spectrometry Techniques: Mass Spectrometry (MS), X-Ray Fluorescence Spectrometry (XRF), Fourier Transform Infrared Spectrometry (FTIR)

Basic Principles of Chromatography: Gas Chromatography (GC), Gas Chromatography Mass Spectrometry (GC/MS), Liquid Chromatography, Thin Layer Chromatography

Thermal Analysis and Calorimetry: Thermo-Gravimetric Analysis (TGA), Differential Scanning Calorimeter (DSC)

Microscopy: Optical Microscopy, Scanning Electron Microscopy (SEM)

Practical

Analysis of biogas using Gas Chromatography: Lab Practical

Identification and quantification of components of biogas, liquid biofuels, and biomass: Lab Practical

Fume-hood - Conduct laboratory sessions with hazardous and toxic fume chemicals: Lab Practical

Composition analysis: Lab Practical

3.8.3. Year IV Semester I

BST 41216 - Industrial Training (C)

6 ***credits (00-00-24*), Prerequisite: None***

Independent Learning

Knowledge and exposure to industrial applications of Bioenergy systems: *Knowledge and exposure to industrial applications of Bioenergy systems*- Bioenergy plant equipment: Biomass and Biogas Boilers & Pressure vessels, Reactors/ bioreactors, Fermenters, Distillation columns, Bio-based Power generation units, Other related-process equipment, Utilities, Plant instrumentation, Plant accessories, etc., Bioenergy-related plant operation, maintenance, and troubleshooting, Energy efficiency and conservation, Health-Safety-Environmental (HSE) aspects of a bioenergy-related plant, Software platforms, control & automation systems, Quality control and assurance of bioenergy plants, Commercial-scale bioenergy distribution and storage, Waste management and pollution control in bioenergy plants

Industrial Bioenergy systems, their procedures, and practices: *Industrial Bioenergy systems, their procedures, and practices*- Feedstock cultivation and storage, Organizational hierarchy and management team in a bioenergy plant, Administration/financial/general management/logistics/HSE/legal practices in a bioenergy plant, Practices of professional ethics/personal relations, Organizational practices for efficiency improvement and business sustainability

Practical skills and soft skills development: *Practical skills and soft skills development*- Practical Skills Development: Electrical/Mechanical workshop tools and practices, Cutting, Welding, Lathe operations, Fitting, Drilling, Basic electrical repairs, Safety at electrical/mechanical workshop

Soft Skills Development: Teamwork, Communication skills, Time management, CV writing and interview facing

3.8.4. Year IV Semester II

BST 42212 - Bioenergy Plant Maintenance (C)

2 credits (30-00-70), Prerequisite: None

Theory

Introduction to Bioenergy Plant Maintenance: *Introduction to Bioenergy Plant Maintenance*-Purpose of Plant Maintenance, Sequences of Breakdowns, Reliability of Equipment, Failure modes, Root causes for maintenance, Breakdown maintenance, Defining and measuring downtime of maintenance, Cost and Risk in Maintenance

Maintenance of Bioenergy Plant equipment, accessories, and Instrumentation: *Maintenance of Bioenergy Plant equipment, accessories, and Instrumentation*-Plant Equipment Maintenance: Piping and Valves, Pumps, Electrical Motors, Turbines, Heat Exchangers, Compressors, Cooling Tower, Chillers, Boilers, Chimneys, Generators, Reactors/Bioreactors, Distillation columns/Evaporators, Belt Conveyors, Screw Conveyors, Bucket Elevators, etc. Instrumentation for Maintenance: Temperature/Pressure/Flow Rate/Level/Torque/Force/RPM measurement and instrumentation, Non-Destructive Testing (NDT), Boilers and pressure vessels inspection, Maintenance of Equipment Accessories: Bearings, Shafts, Joints, Keys, Pulleys, Gears, Belts, Screws, Agitators, Steam distribution system accessories, etc.

Maintenance Management of Bioenergy Plants: *Maintenance Management of Bioenergy Plants*- Overview of Performance Measurement and Plant maintenance, Key Performance Indicators in Bioenergy Systems, Strategies of maintenance planning: Shut-down maintenance, Corrective maintenance, Preventive maintenance, and Planned maintenance, Plant performance improvement strategies: 5S, Kaizen, Total Productive Maintenance (TPM) concepts, Lean concepts in bioenergy plant maintenance, World Class Manufacturing (WCM) principles for bioenergy industry

Economics in Maintenance of Bioenergy Plants: *Economics in Maintenance of Bioenergy Plants*- Cost of plant maintenance, Maintenance of spare parts inventories, Effective parts Inventory control: Lifetime of spares, Lead time of spares, Reorder level, Reduction of carrying costs for possible spares, Efficient storage techniques of spare parts, Cost-effective labor management in plant maintenance activities

BST 42228 - Industrial Research & Design Project (Group) (C)

2 credits (30-00-770), Prerequisite: None

Theory (Research and Design Project)

Research

Introduction to Research Methodologies: *Introduction to Research Methodologies*- Data collection techniques (Sampling techniques, Data survey methods), Data analysis techniques (Regression analysis using software tools such as Excel/ MATLAB, etc.)

Literature Review: *Literature Review*- How to understand components of a research publication, Research problem identification and statement of problem with research objectives, Citing and referencing, Referencing software tools (Mendeley, Endnote, etc.)

Methodology Development: *Methodology Development*-Features of reporting research methodologies/Analytical Techniques/Experimental rigs/Mathematical models

Results analysis and discussion: *Results analysis and discussion*-Art of Results Discussion, Results Interpretation Methods (Generation of Effective Results Tables/ Figures/Graphs, etc.)

Research Proposal: *Research Proposal*-Components of a Research Proposal, Research Proposal and Progress Presentation

Thesis and Research Presentation: *Thesis and Research Presentation*-Components of a Research Thesis, Abstract/Extend Abstract writing, Oral Presentation of Research Findings

Research Project Work

Design Project

Identification of Design Problem: *Identification of Design Problem*- Selection of a design problem that require an innovative solution in the bioenergy industry

Design Concept Development and Planning: *Design Concept Development and Planning*-Identify design objectives, parameters, and constraints, customer needs, and anticipated industrial application, Work and Time planning of project development

Concept Review and approval of design concept: *Concept Review and approval of design concept*-Review and readjust the developed design concept and plan

Material Selection: *Material Selection*-Properties of materials, Metallurgy for industrial equipment, Design codes and standards, Design nomenclatures, Standard sizing of equipment and accessories

Testing a prototype: *Testing a prototype*-Fabrication of a prototype of initial design concept and initial testing, Workshop practices and fabrication skills

Detailed Design: *Detailed Design*- Design and drawing of detailed 3-D model development using computer-aided tools

Design Project Work

3.9. Major Module: Biotechnology

3.9.1. Year III Semester I

BST 31012 – Ecological Concepts in Biosystems Technology (O)

2 credits (15-30-15-40), Prerequisite: None

Theory

Basics of Ecology: *Basics of Ecology* – Definition; living and nonliving components; species, population, community, ecosystem, biosphere, biome; food chain, food web; trophic levels and ecological pyramids; population density and dynamics; habitats, niche, niche overlap and resource partitioning of biological diversity.

Ecosystem Services: *Ecosystem Services* – Provisioning services, cultural services, regulating services, supporting services; sustainable development of biological system.

Various Applications of Ecological Concepts in Biosystem Technology: *Insect Pest Management* – Definition; ecological concepts of emerging pests; cultural control, mechanical control, chemical control/pesticides, biological control, integrated pest management.

Aquatic Biology and Aquaculture: *Aquatic Biology and Aquaculture* – Definition; ornamental fish culture; basic principles of aquarium life; choosing an aquarium; fish identification; ornamental fish families; diseases of fish; artificial breeding; selecting a site for the construction of fish pond; culturing techniques-monoculture, polyculture, integrated aquaculture; feeding, harvesting, packing for the market; ecological benefits of aquaculture; issues of aquaculture – impacts on wild fish, coastal ecosystems, genetic modification.

Water Resources and Rainwater Harvesting: *Water Resources and Rainwater Harvesting* – Classification of water table; water quality parameters – physical (TSS, color, odor, turbidity, temperature), chemical (pH, DO, BOD, COD, salinity, hardness), biological (total coliforms, faecal coliforms); waste water management (industrial, agricultural and domestic); rain water harvesting (non-traditional, fresh water, flooded forest, solar power panels); applications of rainwater harvesting (aquaculture, domestic use, industry).

Organic Farming: *Organic Farming* – Definition; crop diversity; soil management; controlling other organisms; livestock; genetic modification; composting; economics of organic farming; disadvantages of organic farming.

Environmental Toxicology and CKDu: *Environmental Toxicology and CKDu* – Definitions; sources of environmental toxicology (PCBs, Heavy Metals, Pesticides)

Cyanobacteria and Cyanotoxins; CKDu - global and local situation; CKDu and CKD.

Agroecology and Sustainable Timber Production: *Agroecology and Sustainable Timber Production* – Definition of agroecology; agro-population ecology; indigenous agroecology; inclusive agroecology; views on organic and non-organic milk production; views on no – till farming; ten elements in agroecology and how they will be used; plant breeding technology; pre- and post-harvest technology; sustainable timber; green star rating system; chain of custody (PEFC, responsible wood, FSC); specifying certified timber; sustainable wood (bamboo, oak, teak, mahogany, Douglas fir); methods of timber seasoning and preservation; timber grading; non-timber forest products.

Biological Diversity Conservation and Biosystem Technology in a Natural History Museum: *Biological Diversity Conservation and Biosystem Technology in a Natural History Museum* – Definition; levels of BD; necessity to conserve BD; conservation practices in the world and in Sri Lanka; concept of a Museum; techniques that can be applied to Biosystems in a Natural History Museum.

Practicals

Basics of Ecology: Measuring abundances and random sampling of population – Quadrate method, Capture, Mark, Release and Recapture method; Determination of population size – Line Transect.

Ecosystem Services: Calculating GPP and NPP in an ecosystem.

Various Applications of Ecological Concepts in Biosystem Technology: Identification and preserving insect pest of different crops.

Aquatic Biology and Aquaculture: Fish morphology and taxonomy; Identification of fresh water fish of Sri Lanka.

Organic Farming: Continuous assessment of crop organic farming.

Water Resources and Rainwater Harvesting: Water quality analysis of several water bodies.

Environmental Toxicology and CKDu: Questionnaire / Survey.

Agroecology and Sustainable Timber Production: Artificial propagation of plants.

Biological Diversity Conservation and Biosystem Technology in a Natural History Museum: Preparation of a bird skeleton; Alizarin Red S and Alcian Blue for colouring vertebrate embryos and skeletons; Bioplastic preservation techniques for both flora and fauna.

BST 31022 – Innovation Management and New Product Development (C)

2 credits (15-30-30-25), Prerequisite: None

Theory

Assess and interpret innovation processes: *What is the Management of Technological Innovation?* – Introduction of the concept; types of innovation; innovation management; *Organizing for Innovation* – Innovation management process; resources required; innovation management approaches; *Technological Innovation* – Concept of technological innovation; the process; role of technological innovation.

Develop and formulate managerial strategies to shape innovative performance: *Innovation Strategy* – Needs of innovation strategy; importance, resources required, innovation strategy formulation; *Networks and Communities of Innovators* – Concept check, formation, function and role of network of innovators; innovator communities; stakeholders of innovator communities, roles and functions; *The Management of Research and Development* – Research and development process; resources involved; management process.

Utilize tools of innovation management to map and measure innovative activities: *Managing Product Innovation* – Product and process innovation; management process, resources involved; *The other Side of R&D: Learning from Others* – Research and development in an open environment; open innovation; role of open innovation; importance of open innovation for developing nations; technology spin offs.

Diagnose different innovation challenges and make recommendations for resolving them: *Capturing Value from Innovation* – Role of innovation; value creation, competitive advantage, market competitiveness; *Conclusions and Future Challenges* – Innovations; future markets, market places.

New product development: *New product development (NPD) process* – New product idea screening; case examples of new product screening; evaluation of idea screening and how to screen them; critical internal and external success factors. *New product development teams* – Case examples of new product development teams; managing conflicts and reaching a consensus.

Practicals

New product development: New product idea generation; product development planning, execution and record keeping; techniques of new product development.

BST 31033 – Modern diagnostic techniques in disease control (C)

3 credits (30-30-40-50), Prerequisite: None

Theory

Common diseases among livestock species (bovine, ovine, caprine, swine and poultry) and they economic significance of diseases to the livestock industry: *Introduction* – What is a disease; epidemiological triad; significance of diseases to the livestock industry; *Common diseases of livestock species* – Common diseases among cattle, goat, swine, poultry and rabbit; *Public health significance of animal diseases* – Zoonoses; occupational health hazards.

Animal disease diagnosis, prevention and control in sustainable livestock industry: *Diagnosis of diseases* – Methods of diagnosing a disease; tentative and differential diagnosis of animal diseases; *Control and prevention of animal diseases* – Methods of controlling diseases, preventive measures; *Vaccination as a disease control method* – Types of vaccines; production of vaccines using novel technologies.

Laboratory diagnosis of animal diseases using advanced techniques: *Sample collection* – Types of samples to collect for laboratory diagnosis; storage of samples and dispatch of samples for proper diagnosis; *Quality management in livestock diagnostic laboratories* – General maintenance of the laboratory for proper functioning; biosafety and biosecurity; scientific services; *Validation of diagnostics assays for infectious diseases* – Assay development pathway and validation pathway; reproducibility and repeatability; monitoring of performances; *Introduction to diagnostic tools in animal disease diagnosis* – Immunoassays; use of biosensors; nucleic acid detection; nanotechnology, proteomics et; *Comparison of advanced diagnostic techniques over conventional methods* – Advantages and disadvantages of advanced diagnostic methods.

Isolation and identification of plant disease causal organisms: *Techniques used for the isolation and detection of plant pathogens* – Different isolation methods from plant materials and soil including Baermann funnel technique and whitehead tray method; plant virus isolation and purification techniques; Koch's postulation method; bacterial and fungal pure culturing techniques; identification of pathogenic bacteria and fungi using macroscopic and microscopic methods; serial dilution and sub culturing techniques; microscope slide preparation and Gram staining of bacteria.

Practicals

Common diseases among livestock species (bovine, ovine, caprine, swine and poultry) and they economic significance of diseases to the livestock industry:

Survey on identifying the common diseases among livestock species; Awareness programme on zoonoses and occupational health hazards.

Animal disease diagnosis, prevention and control in sustainable livestock industry: Diagnosis of diseases; Awareness programme on disease control and prevention.

Laboratory diagnosis of animal diseases using advanced techniques: *Hematological tests for disease diagnosis* – Different hematological testing and advances in the technology; *Clinical chemistry* – Clinical biochemical test for diagnosis of diseases (liver function, kidney function etc.); *Histopathological investigation* – Sampling; tissue processing; staining and investigation of tissues; use of immunohistochemistry, immunofluorescence techniques and other advanced techniques; *Clinical microbiology* – Isolation and identification of causative organisms; antibiotic sensitivity testing for selecting an effective treatment plan; *Molecular detection and identification of animal pathogens in laboratorial settings*
– Polymerase chain reaction; allied PCR techniques such as, typing methods; use of specific probes; hybridization techniques; phylogenetics and metagenomics; DNA sequencing; recombinant DNA technology; LAMP assay, Microarray etc; Different types of sample collection from diseased animals; Introduction to the pathology laboratory; Hematological techniques; Clinical chemistry in laboratory testing of clinical samples; Histopathological investigation; Microbiological investigation of samples; Use of advanced techniques in disease diagnosis (e.g. PCR).

Isolation and identification of plant disease causal organisms: *Molecular detection of plant pathogens* – Fungal, bacterial and viral DNA and RNA extraction; PCR methods; enzyme-linked immunosorbent assay (ELISA); phylogenetics and metagenomics; DNA sequencing methods for identification**.**

BST 31042 – Bioprocessing Technologies in Biorefinery (C)

2 credits (15-30-15-40)2, Prerequisite: None

Theory

Biorefinery concept: *Bio refinery concept* – Introduction to biorefinery; classification of biorefinery; Biorefinery Vs. Petro chemical refinery; SWOT analysis for bio refinery.

Integrated biorefinery for sustainable production of fuels, chemicals: *Integrated biorefinery* – Biorefineries using Corn, Soybeans, and Sugarcane; Lignocellulosic biorefinery, Pre-treatment methods for lignocellulosic biomass; Thermochemical platform for lignocellulosic biorefinery.

Chemical and Biological Conversions for Fuel and Chemical Production: *Energy crops for biorefinery* – Fermentation; Transesterification; biodiesel production; anaerobic digestion; Biogas production process; biohydrogen production and fuel cell technology.

Novel and traditional energy crops and their biorefinery potential: *Energy crops for biorefinery* – Sugar, starch and oil crops in biorefinery; new local energy crops for biorefinery; Microalgae as feedstock for biofuels and biochemicals.

Pre-treatment of biomass for biorefinery: *Biomass pre-treatment* – Cellulose, hemicellulose, lignin, extractives, amylases, cellulases, xylanases, lignin degrading enzymes; pre-treatment technologies; pulp and paper manufacturing.

Bioproducts from biorefinery: *Production of value added bio-materials by biorefinery* – Production of succinic, acetic, butyric, propionic, lactic and polylactic acids using microbes for industrial applications; production of polyhydroxyalkanoates in biomass refining; bioplastic production.

Practicals

Integrated biorefinery for sustainable production of fuels, chemicals: Field visit

Chemical and Biological Conversions for Fuel and Chemical Production: Biodiesel production from coconut oil.

Novel and traditional energy crops and their biorefinery potential: *Biofuel preparation* – Biofuel production from microalgae.

Pre-treatment of biomass for biorefinery: *Analyzing fungal laccases activity* – Fungal laccases activity analysis on plant materials; paper manufacturing.

Bioproducts from biorefinery: *Polyhydroxyalkanoates and bioplastics* – Bioplastic production; screening of polyhydroxyalkanoates producing bacteria**.**

BST 31052 – Dairy Biotechnology (C)

2 credits (15-30-15-40)2, Prerequisite: None

Theory

Present situation, potentials, constraints and future trends in local and global dairy industry: *Introduction* – Dairy industry in Sri Lanka and globally; *Present situation and future trends in local and global dairy industry* – Significance of dairy industry;

present situation and future trends; identify the short-comings in the industry; *Strategies for the development of the industry* – Strategies for the development of the dairy industry; recent advances in dairy industry and comparative study on the dairy industry with the countries that are self-sufficient in dairy production.

Designing and establishing a new dairy farm and general management practices to improve the milk yield through technology development: *Methods of dairy farming* – Different farming methods; identifying the weakness in the existing dairy farming systems; *Benefits of new technology* – Functional and benefits of technology in dairy farming and available technologies to improve the dairy farming; *Establishment of new dairy farm equipped with new technology* – Identifying the thrust areas for improvement of the dairy industry (to have high animal productivity) and designing a profit oriented dairy farm.

Developing genomics technologies for increased genetic gain and improved milk production in dairy cattle: *Factors affecting the milk production* – Factors affecting milk production such as genetic make-up in terms of the use of improved breeds selected for milk production; a favorable nutritional environment and improved managerial practices; *Issues pertaining to genetic improvement of livestock for production* – Milk production as a factor of genotype-environment interactions; Basic populations, quantitative genetics, molecular genetics, and their application in animal breeding; *Techniques applied in molecular genetics to improve the yield* – Molecular techniques in conjunction with conventional animal breeding techniques to optimize animal breeding programmes, which would result in higher yields; use of genetic markers in animal breeding programmes; *Genetics markers for selection of animals for better traits* – Commonly used genetic markers such as DNA-based markers; RFLPs; minisatellites, and PCR-based markers such as minisatellites, microsatellites and SNPs; *Recombinant technology to influence the milk production trait* – Recombinant DNA technology to introduce milk production traits artificially into a dairy animal, and transmission through the germ line to have the same modified genetic material in all cells.

Different methods of reproductive manipulation to maximize the production: *Basics of reproduction* – Anatomy of reproduction system; reproductive physiology (neuro endocrine mechanism in reproduction); *Assisted reproductive technologies* – Manipulation of female reproductive tract physiology; artificial insemination; multiple ovulation and embryo transfer; in vitro production of embryos; in vitro assisted fertilization; cloning, transgenesis, xenografting-germ cell transplantation, preimplantation; genetic diagnosis and sperm sexing.

Milk let down process, factors affecting milk yield and improvement of milk yield and maintaining of the quality of milk: *Basics of mammary system and its function* – Anatomy of mammary system and neuro endocrine mechanism on milk synthesis; *Factors affecting milk yield* – Environmental factors, nutrition, genetic makeup of animals, health etc; *Improvement of milk yield* – Role of dry period in

milk yield; preventing diseases affecting milk yield; nutritional management for improving milk yield; *Milk quality* – Factors to be considered in the production of hygienic milk.

Production of different kind of dairy products and role of biotechnology in dairy processing: *Milk processing techniques* – Milk collection, clarification, separation, membrane processing, standardization etc; *Different dairy products* – Production of curd, yoghurt, cheese, butter etc.; involvement of microorganisms in dairy product development; *Organisms involved in dairy products* – Organisms that are needed for dairy product development and the use of biotechnological methods to improve the yield and the quality of the products; *Production of dairy products enriched with healthy bacteria* – Use of probiotic organisms to improve the quality of dairy products and health benefits.

Practicals

Present situation, potentials, constraints and future trends in local and global dairy industry: Survey on identification of present situation and future trends in local and global dairy industries; Self-study on identifying the strategies for the development of the dairy industry; Recent advances in dairy industry.

Designing and establishing a new dairy farm and general management practices to improve the milk yield through technology development: Visit to dairy farms in order to identify the existing farming conditions.

Developing genomics technologies for increased genetic gain and improved milk production in dairy cattle: Survey on determining the milk production factors and identifying the existing problems in milk production; Practical on basic molecular techniques used to identify genetic markers; Practical on recombinant DNA technology.

Different methods of reproductive manipulation to maximize the production: Identifying the parts of bovine reproductive system; Synchronization and artificial insemination of dairy cows; Field visit to AI centre to have understating on semen processing.

Milk let down process, factors affecting milk yield and improvement of milk yield and maintaining of the quality of milk: Survey to determine the factors associated with milk yield and quality; Milk quality testing; Production of hygienic milk.

Production of different kind of dairy products and role of biotechnology in dairy processing: Production of value-added dairy products; Use of probiotics to improve the quality of dairy products.

BST 31063 – Recombinant DNA technology and genetic transformation (C)

3 credits (30-30-25-65)3, Prerequisite: None

Theory

Molecular structure of DNA and restriction digestion: *Molecular structure of DNA* – Basic building blocks of DNA; nucleotides, nucleobases, deoxyribose sugar, phosphate group and double helix structure of DNA; plasmid DNA; *Basic units of DNA* – Types of restriction enzymes; palindromic sequences identified by different restriction enzymes; DNA blunt and sticky ends restriction methods.

Cloning and expression vectors: *Gene amplification, cloning and transformation* – Open reading frame; amplification by cDNA and purification of amplified gene; ligation of gene to plasmid; blunt and sticky end cloning, T/A cloning, gene cloning to have poly His tag; bacterial competent cells and different E. coli strains; bacterial transformation by heat shock and electroporation; blue-white colony selection; gene sequencing; recombinant plasmid isolation for downstream processes (recombinant protein production or plant transformations).

Genetically modified plants: *Plant transformation methods* – Agrobacterium tumefaciens; features of Ti/Ri plasmid; how Agrobacterium transfers its tumor inducing genes to plant genomes and exploiting this phenomenon for transgenic plant production; Arabidopsis floral dip transformation; gene gun and biolistic transformation.

Practicals

Molecular structure of DNA and restriction digestion: *DNA amplification with primers containing restriction sites and DNA digestion* – Designing primer with restriction sites; PCR amplification of relevant genes by primers with restriction sites; plant and plasmid DNA digestion by different restriction enzymes.

Cloning and expression vectors: *Gene cloning to plasmid vectors* – Sticky and blunt end digestion of plasmids**;** recombinant plasmid production by ligating genes and bacterial transformation (heat shock method).

Genetically modified plants: *Agrobacterium mediated plant transformation* – Gene cloning to Ti plasmid and heat shock transformation to Agrobacterium competent cells; co-cultivation with callus; selection of transformed calli on antibiotic selection media and regeneration; present scenario of genetically modified crops.

BST 31073 – Plant Cell and Tissue Engineering (C)

3 credits (30-30-40-50)3, Prerequisite: None

Theory

Introduction to plant tissue culture: *Introduction to plant cell and tissue culture* – History of plant tissue culture and its development with time; concepts and principles of plant tissue culture; totipotency; plant culture vs plant tissue culture; *Tissue culture laboratory and equipment* – Designing a low cost, commercial level and research level plant tissue culture laboratory and purchasing necessary equipment, tools and chemicals; *Clonal propagation system* – Micropropagation, somatic embryogenesis, organogenesis, disease indexing.

Plant tissue culture techniques: *Plant tissue culture techniques and their application in plant biotechnology* – Basic facilities, sterilization methods, media composition and preparation; importance and application of tissue culture in plant biotechnology.

Crop improvement techniques: *Production of new cultivars* – Somatic hybridization, protoplast fusion, somaclonal variation; *Stages of micropropagation* – Care of plant material; selection of starting plant materials; preparation of medium; sterilization; preparation of explants; inoculation culture, subculture; culture room management; acclimatization and transfer out to soil.

Cryopreservation: *Cryopreservation in germplasm conservation* – Introduction to in-situ and ex-situ plant preservation techniques; theoretical basis of plant cryopreservation; advantages and disadvantages of plant cryopreservation; *Plant cryopreservation protocols* – Air drying (flash drying, normal drying); classical slow-cooling (or slow-freezing); encapsulation/dehydration; vitrification and other protocols.

Practicals

Introduction to plant tissue culture: Demonstration of equipment in the tissue culture laboratory.

Plant tissue culture techniques: *Types and purpose of culture* – Orchid seed culture, organ culture, embryo culture, single node culture, explant without pre-existing bud-culture, callus culture, haploid culture.

Crop improvement techniques: Orchid seed culture; callus culture, regeneration techniques; anther culture with monocots and dicots; Isolation.

BST 31082 – Plant Growth Regulators and Signal Transduction (O)

2 credits (15-30-25-30)2, Prerequisite: None

Theory

Introduction to plant growth regulator: *Introduction to plant growth regulators* – History and nature of endogenous growth hormones vs plant growth regulators; *How do Plant Hormones Work?* – Steroid hormones and peptide hormones; *Phytohormones and plants' responses* – Importance of plant hormones; hormonal interplay; applications of plant hormone research.

Types of plant growth regulators and their impact: *Auxins* – Biosynthesis and metabolism; properties, preparation and mode of action; *Cytokinins* – Biosynthesis and metabolism, properties, preparation and mode of action; *Gibberellins* – Biosynthesis and metabolism, properties, preparation and mode of action; *Abscisic Acid* – Biosynthesis and metabolism, properties, preparation and mode of action; *Ethylene* – Biosynthesis and metabolism, properties, preparation and mode of action; *Other plant growth regulators* – Brassinosteroids, salicylates, jasmonates, polyamines; *Functions of plant growth regulators* – Physiological effects and functions of plant growth regulators in agriculture; rooting hormones; *Application of plant growth regulators* – Targets of manipulation of crop growth and application of plant growth regulators; commercial application of plant growth regulators.

Commercial use of plant growth regulators, physiological effects and their functions in plants and plant products: *Functions of plant growth regulators* – Physiological effects and functions of plant growth regulators in agriculture; rooting hormones; *Application of plant growth regulators* – Targets of manipulation of crop growth and application of plant growth regulators; commercial application of plant growth regulators.

Plant growth retardants: *Introduction to plant growth retardants* – Reasons for growth control of plants; growth control techniques; how plant growth retardants work; benefits of using plant growth retardants; *Plant growth retardants used in Greenhouses* – B-nine, cycocel, bonzi, sumagic, florel and a-rest; *PGR efficacy* – Application, dosage, target tissue.

Practicals

Introduction to plant tissue culture: Responses of plants to unilateral light, gravity etc.

Types of plant growth regulators and their impact: Responses of different ratios of auxins and cytokinins; Organogenesis and embryogenesis; Application of plant growth hormones in fruit ripening; Application of plant growth hormones in post-harvest technology.

Plant growth retardants: Use of B-nine and Cycocel in floricultural plants.

BST 31092 – Production of Plant Secondary Metabolites (O)

2 credits (15-30-25-30), Prerequisite: None

Theory

Introduction to plant metabolites: *Introduction to plant metabolism* – Plant metabolism; primary and secondary metabolism, enzymes and cofactors; *Functions of plant secondary metabolites* – Introduction & ecological perspectives; principle of phytotherapy; industrial uses of plant secondary metabolites; *Classification of Secondary metabolites* – Nitrogen containing secondary products; Phenolic compounds and Terpenes.

Biosynthesis of secondary metabolites: *Phytochemistry* – Alkylation reaction; transamination, decarboxylation, carboxilation, oxidation and reduction reactions; phenolic oxidative coupling; glycosylation reactions etc; *Introduction to biosynthesis of secondary metabolites* – Basic organic chemistry of biosynthetic reactions; pathway organization and major pathways of secondary-metabolite biosynthesis.

Secondary metabolites: *Alkoloids* – Introduction to alkoloids and classification; physicochemical properties, biosynthesis, physiology, ecology, biological activity; *Terpenoids* – Introduction to terpenoids; biosynthesis, physiology, ecology, biological activity; *Phenolics* – Introduction to phenolics; biosynthesis, physiology, ecology, biological activity; *Minor Secondary Metabolites* – Mustard oil, Cyanogenic Glycosides, Cardiac Glycosides, Polyacetylenes.

Production of plant secondary metabolites: *Production of secondary metabolites through biotechnology* – Bioreactors; suspension cultures and immobilized plant cells; hairy root culture.

Drug extraction techniques: *Drug extraction techniques* – Maceration, digestion, infusion, decoction, percolation, leaching; Soxhlet apparatus; steam distillation; solid-phase extraction; basic knowledge of industrial extraction techniques; extraction solvents; extraction concentration, solvent recovery, distillation, rotary evaporator.

Practicals

Production of plant secondary metabolites: *Production of plant secondary metabolites* – Establishment of callus cultures, suspension cultures; transformation with Agrobacterium rhizogenes; hairy root culture.

Drug extraction techniques: *Extraction of secondary metabolites important in drugs* – Maceration techniques; use of Soxhlet apparatus; steam distillation, solid-phase extraction.

3.9.2. Year III Semester I

BST 32012 – Proposal writing and Project Management I (C)

2 credits (30-00-30-40), Prerequisite: None

Theory

Introduction: *Introduction* – What is research; specific characteristics of research?; *Objectives of research* – The three objectives of a research: 1. Theoretical objective 2. Factual objective and 3. Application objective; *Classification of research* – Basic level and applied level; *Kinds of research* – On the basis of objectives of research, on the basis of approach of research, on the basis of precision in research findings, on the basis of nature of findings; *Research methods and research methodology*

Scientific writing: *Scientific writing* – Introduction to scientific writing; *Structure of thesis* – Introduction to thesis; contents of thesis: abstract, introduction, literature review, materials and methods, results and discussion, conclusion, future suggestions, references, appendices; *Standard scientific research paper components* – Components of scientific writing: introduction, objective, materials and methods, results and discussion, conclusion, acknowledgement, references.

Proposal formulation: *Proposal formulation for final year research and funding agencies* – Introduction to what a proposal is; uses of a proposal; *How to make research proposal* – Preparation needed for making a research proposal; *Content of a research proposal* – Background information, budget, references.

How to conduct research: *How to conduct research effectively* – Define question; gathering information; forming hypothesis/hypotheses; planning research; collecting data, organizing and analyzing data, interpreting data, and drawing conclusions; *Problems faced during research* – Communicating results; time limitation, budget allocation, unknown factors; *How to make an effective research presentation at a seminar* – Factors to be considered while making a presentation.

BST 32023 – Bioproducts for Organic Agriculture (C)

3 credits (30-30-40-50), Prerequisite: None

Theory

Introduction to organic agriculture: Terms defined; rules, certification; Inputs for organic agriculture: Introduction to plant nutrition, natural soil conditioners; introduction to soil conditioners; soil conditioners for organic farming and how they work; biological control of pests and diseases; organic weed control.

Organic fertilizers: Terms defined; healthy soil/ healthy crops/ healthy yield; nutritious "Food" for plants; raw materials for the production of organic–fertilizers; value addition; packaging, storage, quality control.

Biofertilizers: Terms defined; introduction to soil microbiology, effective soil microbes; raw materials for the production of organic fertilizers; value addition, packaging, storage; quality control.

Introduction to Bio pesticides for organic Agriculture: *Introduction Biopesticides* – Introduction to crop pests; historical development of biopesticides and current status of utilization of biopesticides in organic farming; overview of biopesticides; biopesticide definitions; classes of biopesticides; benefits and barriers to biopesticide use; raw materials for the production of biopesticides; value addition, packaging, storage; quality control.

Microbial pesticide: *Microbial pesticide overview and Development* – Introduction to microbial biopesticides; isolation and identification of microbial control agents; mass production of microbial pesticide products; quality assessment (batch variation); a potential bio-control agent against plant diseases and insect pest management in organic farming; Entomopathogenic microbes: Introduction, history, classification; infection mechanism; enzymes and toxins.

Biochemical pesticide: Biochemical pesticides: plant extracts, semiochemical, natural plant growth regulators, and natural insect growth regulators; role of phytochemicals in crop protection; applications of biochemical biopesticides in organic farming

Practicals

Introduction to organic agriculture: Application of rules and laws in organic agriculture; certification process; laboratory methods in analyzing major plant nutrients; production of soil conditioners for organic farming.

Organic fertilizers: Production of organic fertilizers for short-term and perennial crops.

Biofertilizers: Production of biofertilizers for short-term and perennial crops.

Introduction to Bio pesticides for organic Agriculture: Types of biopesticides**.**

Microbial pesticide: Isolation and identification of microbial control agents; entomopathogenic microbes.

Biochemical pesticide: Screening of antimicrobial properties of plant extracts.

BST 32032 – Industrial Uses of Plant Fiber (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

Historic background of plant fiber industry: *Traditional plant fiber industry* – Traditional use of natural fiber, including types of plants and extraction methods; traditional textile industry.

Chemical and structural properties of plant fibers: *Chemical structure of plant fibers* – Chemical structures of different plant fibers; structural properties of plant fiber; cellulose, hemicellulose, pectin, lignin and aromatic compounds; plant fibers used in textile industry.

Types of plants for fiber: *Commonly used plant for fiber extraction* – Cultivation, extraction and processing of fiber from cotton, sisal, coconut, bamboo, kenaf, banana, pineapple, agave, flax, hemp, jute, poplar and spruce; preservation and treatment; potential crop residues for fiber extraction.

Natural fiber composite: *Plant fiber-reinforced materials* – Introduction to composites; fiber reinforced composites; plant fiber reinforced polymers in automotive interior application; natural fibers in geotextiles for soil protection and erosion control.

Practical

Historic background of plant fiber industry: *Traditional methods used for plant fiber extraction* – Plant fiber extraction using traditional methods; identification of potential plant species for fiber extraction.

Chemical and structural properties of plant fibers: *Identification of different plant fibers* – Identification of different plant fibers; analyzing the size and shape of different plant fibers; collection of traditional plant fiber materials; microscopic

analysis of plant fibers and grading; fiber extraction from different plants; retting and processing of plant fibers.

Types of plants for fiber: *Identification of potential sources for plant fiber* – Searching for local plant species for fiber industry; searching for traditional knowledge that can be used in plant fiber industry; familiarizing with SEM catalogue; ASTM standardization.

Natural fiber composite: *Planning startup industry* – Project proposal presentation for a startup fiber industry; developing a plant fiber composite.

BST 32043 – Enzyme Technology (C)

3 credits (30-30-40-50), Prerequisite: None

Theory

Introduction to enzymes: *Biosynthesis, structure, function of enzymes* – Protein biosynthesis and structure; enzyme nomenclature and classification; *Enzyme kinetics* –Active site features; lock and key model; induced fit model; Km and Kcat, effect on temperature, pH, substrate level, enzyme level on enzymatic activity and reaction; inhibitors.

Extraction and purification of enzymes: *Enzyme extraction and isolation* – Choice of enzyme sources; chemical and physical methods used for enzyme extraction; isolation of enzymes; *Purification of enzymes* – Dialysis; ultrafiltration, gel filtration; ion exchange chromatography; organic solvent fractionation; ammonium sulphate fractionation; affinity chromatography; HPLC; fast protein liquid chromatography.

Recombinant enzyme synthesis and purification: *Recombinant protein synthesis in bacteria* – Genes; open reading frame; cloning to expression vectors; bacterial transformation; culture, incubation, recombinant protein extraction.

Industrial applications of enzymes: *Industries that use enzymes in large scale* – Detergent industry, starch industry; production of glucose and maltose syrup; food industries; use of proteases and lipases in leather and wool industries; paper and pulp industries and biopharmaceutical industries.

Practicals

Introduction to enzymes: *Protein database* – Familiarizing with protein

databases; *Determination of Km and Kcat* – Tutorial for determining Km and Kcat.

Extraction and purification of enzymes: *Protein databases* – Familiarizing with protein databases and protein bioinformatics; *Purified protein analysis* – Protein fractionation and SDS PAGE analysis.

Recombinant enzyme synthesis and purification: *Recombinant protein synthesis, extraction and purification* – Open reading frame; cloning to cloning vectors; bacterial plasmid isolation and enzymatic digestion; bacterial transformation; blue white colony selection and culturing of bacteria with recombinant plasmids; bacterial competent cell preparation; recombinant plasmid digestion and cloning to expression vectors and bacterial transformation; recombinant protein induction and synthesis; Ni-column purification, dialysis, SDS PAGE analysis.

BST 32052 – Principles of Molecular Virology (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

Introduction to viruses: *Virus taxonomy* – Introduction to different types of viruses; history of virology; classification and nomenclature of viruses; genetic material of viruses; different shapes, sizes and structures of viruses.

Viral gene expression and regulation: *Virus gene expression in host cells* – RNA and DNA as genetic material of viruses; regulation of host gene expression by viruses; molecular basis of virus-host cell interactions.

Virus replication: *Overview of virus replication cycle* – Stages of replication; attachment, penetration, uncoating, biosynthetic phase, assembly, release and maturation; pathogenesis in multicellular hosts; polyclonal and monoclonal antibody preparation.

Virus as bio pesticides: *Insect pathogenic viruses* – Baculoviruses as pathogens of arthropods; naturally occurring as well as genetically manipulated baculoviruses as biological control agents for insect pests; baculovirus production technology.

Uses of virus in biotechnology field: *Virus for vaccines and recombinant protein synthesis* – Immune response against viruses; virus vaccines; virus vectors for recombinant protein synthesis.

Practicals

Introduction to viruses: *Presentation on viruses* – What are viruses.

Viral gene expression and regulation: *Self study on viral genetics* – Presentation on viral genetic materials; viral genetic material extraction.

Virus replication: *Virus identification* – ELISA test for virus identification.

Virus as bio pesticides: *Virus biopesticides* – Searching information for virus biopesticides.

Uses of virus in biotechnology field: *Recombinant protein production in viruses* – Tutorial on virus recombinant protein synthesis.

BST 32062 – Molecular Plant Breeding (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

Introduction to conventional and molecular plant breeding: *Mendelian genetics and conventional plant breeding* – History of plant breeding; Mendelian laws; conventional plant breeding methods; linkage and genetic mapping; homologous recombination; recombination frequency and crossovers; *Introduction to molecular plant breeding* – Genetic basis of major genes and QTLs; heritability, hybrid vigour.

QTL analysis: *QTL mapping* – DNA fingerprinting techniques (RAPD, SSR, RFLP); recombinant inbred lines; mapping populations; genetic markers; linkage maps, mapping programs, QTL analysis.

Marker assisted selection: *Marker-assisted selection* – Use of genetic markers in breeding programs; selection of QTLs for marker assisted selection; marker assisted backcrossing.

Practicals

Introduction to conventional and molecular plant breeding: *Artificial pollination, tutorial* – Emasculation and hand pollination methods; *Tutorial* – Heritability and heterosis.

QTL analysis: *Tutorial* – QTL analysis, mapping programs.

Marker assisted selection: *Marker-assisted selection* – PCR amplification of plant DNA with markers (screening plant with genetic markers).

BST 32071 – Molecular Biology Practicum (C)

1 credit (00-30-10-10), Prerequisite: None

Practicals

Chemical and media preparation: *Bacterial growth media and chemical solution preparation* – Bacterial growth media and selection media preparation with antibiotics and x-gal; buffer solution preparation; primer dilution; gel electrophoresis solution preparation; laboratory equipment handling.

Gene manipulation: *Components of a gene, expression and regulation of genes* – cDNA synthesis; primer designing; gene amplification; restriction digestion; cloning; sequencing; transformation; competent cell preparation and maintaining.

Genetically modified organisms: *Agrobacterium mediated transformation* – Agrobacterium mediated transformation; co-cultivation; transformant screening; regeneration; Arabidopsis floral dip transformation; yeast two hybrid assay.

BST 32082 – Biowaste Management (C)

2 credits (15-30-15-40), Prerequisite: None

Theory

Introduction to biowaste management: Introduction of the integrated sustainable biowaste management framework; physical components of a biowaste management system; different steps in the biowaste management chain; The key requirements for an appropriate management as well as the main challenges; the governance aspects of a biowaste management system; different stakeholders and their roles and responsibilities.

Biowaste management technologies: The treatment of biowaste; basics of two very common organic waste treatment technologies: composting and anaerobic digestion; vermin-composting, Black Soldier Fly larvae or options of thermochemical

conversion; Treatment principles and processes; Key issues in operation and maintenance of treatment facilities.

Assessment and planning methods for biowaste management: Strategic aspects of biowaste management; Integration biowaste management into the municipal solid waste system.

Practicals

Introduction to biowaste management: Identification of different biowaste materials; Studying the governance aspects of a biowaste management system.

Biowaste management technologies: Case studies and practical exercises.

Assessment and planning methods for biowaste management: Biodegradation of municipal waste.

BST 32092 – Unconventional Theories (O)

2 credits (30-00-30-40), Prerequisite: None

Theory

History and contributors: *Concept of over unity* – History and contributors: Concept of over unity; energy saving applications; Why do people tend to think over unity exists? Perpetual motion, law of conservation of energy; *Contributors* – Nikola Tesla, Wilhelm Reich.

Roto-Verter: *Theory of Roto-Verter* – Basics of Roto-Vertor; Roto-Verter theory and application; technical explanation of operation in RV mode.

Exploration of unspoken history and work: *Nikola Tesla* – Tesla Coil, Tesla Tower, Wireless power transmission; *Wilhelm Reich* – Wilhelm Reich and Orgone Energy, Cloud bluster, Gravity machines.

BST 32102 – Cereal Technology (O)

2 credits (15-30-15-40), Prerequisite: None

Theory

Describe the local and world cereal production, processing and utilization: *Wheat, rice, corn, sorghum and other cereal production, processing and utilization* – Origin and production; trade and consumption; classification and grading; processing; utilization as food and feed.

Explain the evaluation of chemical composition of cereal grains: *Cereal carbohydrate* – Properties of starch and non-starch polysaccharides; *Cereal proteins* – Composition and properties of proteins; *Cereal lipids* – Free and bound lipids; non starch lipids; free fatty acid composition; non-saponifiable lipids; lipids in structural parts; *Minor constituents* – Vitamins, minerals, enzymes, pigments, nutritional related components.

Explain the processing technologies involved in major cereal products: *Breads and yeast-leavened bakery products* – Bread-baking industry trends; dough processing; production steps of bread; bread quality parameters; processing of other yeast-leavned products (bun rolls, noodles) and their quality parameters; *Noodles production technology* – Processing and quality parameters of commonly consumed noodles and noodle product development strategies; *Malted cereals their production and uses* – Malting process; the brewing process; baking applications; malts in distilled sprits.

Demonstrate cereal as potential functional foods: Health beneficial compounds in cereals – Health beneficial phytochemicals in cereals; cereal resistant starch.

Practicals

Describe the local and world cereal production, processing and utilization: Determination of rice grain quality.

Explain the evaluation of chemical composition of cereal grains: Determination of rice carbohydrates, proteins and lipids from diverse varieties grown in Sri Lanka.

Explain the processing technologies involved in major cereal products: Processing and quality evaluation of bread, bun and noodles; cooking properties of rice.

Demonstrate cereal as potential functional foods: Determination of antioxidant capacity of rice and rice products; estimation of resistant starch content of raw and processed rice.

3.9.3. Year IV Semester I

BST 41016 – Industrial Training (C)

6 credits (00-24 weeks-00-00), Prerequisite: None

Practical

Industrial training

3.9.4. Year IV Semester II

BST 42011 – Career Development and Progression (C)

1 credit (15-15-10-10), Prerequisite: None

Theory

Career-decision process: *General overview of career-decision process* – Identify the decision to be made; know yourself (raise consciousness); Identify options and gathering information (explore options); evaluate options that will solve the problem; select one of the options; *Managing your career: Prepare for career transitions and effectively manage your career* – Determine your interest and passion; identify your strengths and weaknesses; communication skills, personal confidence, motivation, emotional intelligence; job seeking skills.

Relational Approach to Self-Assessment and Career Development: *Career theory* – System theory framework of career development.

Job search approaches: *Approaches to job search* – Job hunting preliminaries; informational interviews; internet resources; job search; interviewing; evaluating the offer.

Approaching job interviews: *Job interviews* – The selection process; employer perspective; the 3 Ps of successful interviews; tricky questions; other section methods; interview types, interview skills, interview tips; ways to find employment; *Putting it all together: be the master of your career*

BST 42021 – Proposal Writing and Project Management II (C)

1 credit (00-30-10-10), Prerequisite: None

Practicals

Proposal writing and project management:

BST 42038 – Research Project (C)

8 credits (00-600-00-00), Prerequisite: None

Practicals

Research project:

3.10. Major Module: Drug Discovery and Development

3.10.1. Year III Semester I

BST 31413 - Organic Chemistry –I (C)

3 credits (30-30-30-60), Prerequisite:

None Theory

Organic reactions: *Organic reactions* - Chemical reactions; Nucleophiles and electrophiles; Curly arrows represent reaction mechanisms; Drawing reaction mechanisms with curly arrows

Nucleophilic addition to the carbonyl group: *Nucleophilic addition to the carbonyl group* - Molecular orbitals explain the reactivity of the carbonyl group, Attack of cyanide on aldehydes and ketones, The angle of nucleophilic attack on aldehydes and ketones, Nucleophilic attack by 'hydride' on aldehydes and ketones, Addition of organometallic reagents to aldehydesand ketones, Addition of water to aldehydes and ketones, Hemiacetals, Acid and base catalysis of hemiacetal and hydrate formation, Bisulfite addition compounds

Delocalization and conjugation: *Delocalization and conjugation* - Introduction, The conjugation of two π bonds, UV and visible spectra, allyl system, Delocalization over three atoms is a common structural feature, Aromaticity

Acidity, basicity, and pKa of organic compounds: *Acidity, basicity, and pKa of organic compounds* - Acids, bases, and pKa, Acidity, Constructing a pKa scale, Nitrogen compounds as acids and bases, Substituents affect the pKa, Carbon acids, Implications of pKa in the development of thedrug cimetidine, Lewis acids and bases

Organometallic compounds: *Optimization of Drug Metabolic and Pharmacokinetic Properties* - Introduction, Organometallic compounds contain a carbon–metal bond, Making organometallics, Using organometallics to make organic molecules, Oxidation of alcohols

Nucleophilic substitution at the carbonyl group: *Nucleophilic substitution at the carbonyl group* - The product of nucleophilic addition to a carbonyl group, Carboxylic acid derivatives, Reactivity differences of carboxylic acid derivatives, Acid catalysts increase the reactivity of a carbonyl group, Making Acid chlorides, Making other compounds by substitution reactions of acid derivatives, Making ketones from esters

Nucleophilic substitution at C=O with loss of carbonyl oxygen: *Nucleophilic substitution at C=O with loss of carbonyl oxygen* - The product of nucleophilic addition to a carbonyl group, Carboxylic acid derivatives, Reactivity differences of carboxylic acid derivatives, Acid catalysts increase the reactivity of a carbonyl group, Making Acid chlorides, Making other compounds by substitution reactions of acid derivatives, Making ketones from esters

Stereochemistry: *Stereochemistry* - Stereochemistry, enantiomers, diastereoisomers, Chiral compounds with no stereogenic centres Axes and centres of symmetry, Separating enantiomers is called resolution

Nucleophilic substitution at saturated carbon: *Stereochemistry* - Stereochemistry, enantiomers, diastereoisomers, Chiral compounds with no stereogenic centres Axes and centres of symmetry, Separating enantiomers is called resolution

Elimination reactions: *Stereochemistry* - Substitution and elimination, How the nucleophile affects elimination versus substitution, E1 and E2 mechanisms, Effects of substrate structure allowing E1, The role of the leaving group, stereoselective E1 reactions, E2 eliminations transition state features, The regioselectivity of E2 eliminations, E1Cb mechanisms

Retrosynthetic analysis: *Stereochemistry* - Creative chemistry, Retrosynthetic analysis: synthesis backwards, Disconnections must correspond to known, reliable reactions, Synthons are idealized reagents, Multiple step syntheses: avoid chemoselectivity problems, Functional group interconversion, Two-group disconnections are better than one-group disconnections, C–C disconnections, Available starting materials, Donor and acceptor synthons, Two-group C–C disconnections, 1,5-Related functional groups, ‘Natural reactivity’ and ‘umpolung’

Practical

Organic reactions: *Conduct simple chemical reactions*

Nucleophilic addition to the carbonyl group: *Nucleophilic addition reactions to carbonyl group*

Delocalization and conjugation: *UV visible spectra of compounds with conjugation*

Organometallic compounds: *Use organometallic compounds to make carbon-carbon bonds*

Nucleophilic substitution at the carbonyl group: *Conduct Nucleophilic substitution reactions at carbonyl group*

Nucleophilic substitution at C=O with loss of carbonyl oxygen: *Conduct Necleophilic substitution reactions at carbonyl group*

Stereochemistry: *Separating stereoisomers using analytical HPLC*

Nucleophilic substitution at saturated carbon: Conduct nucleophilic substitution reactions at saturated carbon

Elimination reactions: Conduct E1 and E2 reactions at saturated carbon

BST 31423 - Human Biology (C)

3 credits (45-00-45-60), Prerequisite:

None Theory

Cell: *Typical human cell* - structures and basic functions of organelles, Modes of transport across a cell membrane; diffusion, osmosis, solvent drag vesicular transport, active transport, movement of ions across ion channels, Concept of drug receptors

Tissues: Structure and function of epithelial tissue, glands, connective tissue including bone and cartilage, muscle tissue and nerve tissue

Cardiovascular system: *Heart* - anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heartbeat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart

Respiratory System: Human respiratory system, Mechanism of breathing and its regulation, Exchange of gases, transport of gases and regulation of respiration, Respiratory volumes

Gastrointestinal System: Human alimentary canal and digestive glands, Role of digestive enzymes, Digestion, absorption and assimilation of digested food

Excretory System: Modes of excretion, Human excretory system- structure and function, Urine formation, Rennin angiotensin system

Nervous system: Definition and classification of nervous system, Structure of a neuron, Generation and conduction of nerve impulse, Structure of brain and spinal cord, Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata

Endocrine System: Introduction to endocrine glands and the hormonal regulation, Basic structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal glands, pancreas, placenta, thymus, pineal body, stomach, intestinal lining associated endocrine cells

Reproductive System: *Male genital system* - basic structure and function of testes, ducts deferens, seminal vesicles, prostate gland, penis, morphology of spermatozoa. *Female genital system* - basic structure and function of ovary, fallopian tube, uterus, vagina and associated glands, Menstrual cycle

Sensory Organs: Basic structure of eye, ear, tongue and nasal cavity, Sensory receptors of the skin: touch, pressure, pain, temperature

BST 31433 - Pharmaceutics-I (C)

3 credits (30-30-30-60), Prerequisite:

None Theory

Introduction to Dosage Forms: *Introduction to Dosage Forms* - Introduction to dosage forms, administration techniques, routes of administration and primary packaging material

Fundamentals of Monophasic Liquid Dosage Forms: *Fundamentals of Monophasic Liquid Dosage Forms* - Definition of monophasic liquid dosage forms. Understanding classification, formulation consideration and manufacturing process

Fundamentals of Biphasic Dosage Forms: *Fundamentals of Biphasic Dosage Forms* - Definition of Coarse dispersion, Introduction to emulsions, formulation of emulsions, emulsifying agents, types of emulsions, stability of emulsions, introduction to suspensions, formulation of suspensions, suspending agents, Understanding advantages and disadvantages of biphasic dosage forms over monophasic dosage forms

Powders and Granules: *Powders and Granules* - Introduction to pharmaceutical powders, Bulk properties of powders, Particle size reduction, Manufacturing Methods, powders as a dosage form. Powders as a dosage form

Solid Oral Dosage Forms I (Tablets): *Solid Oral Dosage Forms I (Tablets)* - Introduction and definition of tablets, classification of tablets, identification of common excipients and their functions, granulation, compression and coating of

tablets, advantages and disadvantages of tablets as a dosage form, Tablet defects, Packaging of tablets

Solid Oral Dosage Forms II (Capsules): *Solid Oral Dosage Forms II (Capsules)* - Introduction of capsules, classification of capsules, Hard Gelatin Capsules, Soft Gelatin Capsules, Extemporaneous and automated filling methods, Advantages and disadvantages of capsules as a dosage form

Modified Release Solid Oral Dosage Forms: *Modified Release Solid Oral Dosage Forms* - Introduction of modified release dosage forms and delayed release dosage forms, Extended and delayed release mechanisms, Types of extended release delivery systems

Practical

Introduction to Dosage Forms: Identification and classification of dosage forms, understanding the elements in labels, administration techniques and specialties of the dosage forms

Fundamentals of Monophasic Liquid Dosage Forms: Compounding of hypertonic saline solution and Lugol's iodine solution

Fundamentals of Biphasic Dosage Forms: Laboratory scale development of cream base, and Calamine Lotion BP

Powders and Granules: Evaluation of flow for pharmaceutical powders and granules by angle of repose, bulk density, tapped density, Carr's compressibility index and Hausner ratios

Solid Oral Dosage Forms I (Tablets): Video demonstration of tableting procedure, instrumentation of single stationary tableting machine and multi stationary rotary press

Solid Oral Dosage Forms II (Capsules): Video demonstration of capsule filling methods (extemporaneous and automated), evaluation of market samples of various capsules and relevant primary packaging material

Modified Release Solid Oral Dosage Forms: Video demonstration of different tablet coating procedures

BST 31442 - Medicinal Chemistry-I (C)

2 credits (15-30-25-30), Prerequisite:

None Theory

Introduction: *Introduction* - Brief overview of modern rational drug design process

Lead Discovery: *Lead Discovery* - Sources of Lead Compounds: Endogenous Ligands, Other Known Ligands, Screening of Compounds. Sources of Compounds for Screening, Drug-Like, Lead-Like, and Other Desirable Properties of Compounds for Screening, Random Screening, Targeted (or Focused) Screening, Virtual Screening, and Computational Methods in Lead Discovery, Hit-To-Lead Process, Fragment-based Lead Discovery

Lead Modification: *Lead Modification* - Identification of the Pharmacophore, Functional Group Modification, Structure–Activity Relationships, Structure Modifications (to Increase Potency, Therapeutic Index, and ADME Properties), Structure Modifications to Increase Oral Bioavailability and Membrane Permeability

Receptors: *Receptors*-GeneralConsiderations,ImportantInteractions(Forces)Involved in the Drug–Receptor Complex,Determination of Drug–Receptor Interaction, Theories for Drug–Receptor Interactions, Topographical and Stereochemical Considerations, Case History of the Pharmacodynamically Driven Design of a Receptor Antagonist: Cimetidine, Case History of the Pharmacokinetically Driven Design of Suvorexant

Enzymes: *Enzymes* - Enzymes as Catalysts, Mechanisms of Enzyme Catalysis, Coenzyme Catalysis, Enzyme Catalysis in Drug Discovery

Enzyme Inhibition and Inactivation: *Enzyme Inhibition and Inactivation* - Enzyme inhibition/inactivation and its therapeutic effects, Reversible Enzyme Inhibitors:Mechanism, Selected Examples of Competitive ReversibleInhibitor Drugs, Aspects of Lead Discovery, Lead Modification, Mechanism of Action, Case History of Rational Drug Design of an Enzyme Inhibitor: Ritonavir, Irreversible Enzyme:Mechanism, Selected Examples, Aspects of Lead Discovery, Lead Modification, Mechanism of Action

Practical

Lead Discovery: Related to above topics

Lead Modification: Related practical to above topics

Receptors: *Construct Dose-response curve for an antagonist*: effect of a competitive antagonist, effect of varying concentration of a competitive antagonist in the presence of a fixed, maximally effective concentration of agonist, and effect of various concentrations of a noncompetitive antagonist on the response

Enzymes: Applications of enzyme catalysis in drug discovery

Enzyme Inhibition and Inactivation: Selected example of enzyme inhibition/ inactivation and its therapeutic effects

31452 - Phytochemistry and Pharmacognosy- I (C)

2 credits (15-30-25-30), Prerequisite:

None Theory

Introduction: *Pharmacognosy* - Introduction to Pharmacognosy and contribution to pharmacy industry. Plant nomenclature and taxonomy; Herbal Monographs and official references for natural products; *Phytochemistry* - Overview of major pharmaceutically important secondary metabolites from natural sources (phenolic, steroids, terpenoids glycosides and alkaloids) of pharmaceutical interest

Crude Drugs: *Crude drugs* - Classification: alphabetical, biological, chemical, pharmacological, taxonomical, chemotaxonomical, serotaxonomical, etc. General principles of cultivation, collection of plant derived drugs of commercial importance. Processing, storage, and preservation of crude drugs; *Types of crude drugs* - Detailed study of ***a very limited number*** of the following classes of crude drugs by studying source, cultivation, collection, preparation, storage, their characteristics, constituents, chemical test, substituents, etc. Classes: Carbohydrates and their derived products, Tannins, Lipids, Proteins, Volatile Oils, Saponins, Cardio active sterols

Quality control of crude drugs: *Quality control of crude drugs* - Morphological, microscopical, physical, chemical, biological analysis of herbal preparations/drugs

Secondary metabolites: *Secondary metabolites* - Introduction, Classification of secondary metabolites, Terpenoids and steroids, Alkaloids, Fatty acid-derived substances and polyketides, Nonribosomal polypeptides, Enzyme cofactors, Functions of secondary metabolites, Sources of secondary metabolites, Uses/ applications of secondary metabolites

Practical

Crude Drugs: Identification of some crude drugs by morphological characters; Microscopical study of some selected authentic drugs and some selected powdered drugs

Quality control of crude drugs: *Quality control of crude drugs* - Extract/isolate drugs from natural sources using different techniques, set up quality control procedures necessary for quantitative and qualitative evaluation and detection of adulterants in drugs from natural sources, Perform various chromatographic techniques as a major part of quality control of herbal drugs

Secondary metabolites: Isolation and detection of selected limited number of secondary metabolites from selected limited number of sources: e.g.active principles of caffeine from tea dust, extraction, and detection of compounds from cinchona, Screening tests for selected alkaloid containing compounds

BST 31462 - Drug Discovery and Development-I (C)

2 credits (15-30-25-30), Prerequisite:

None Theory

Therapeutic Modalities: *Main Types of Therapeutic Agents* - Brief Introduction of Conventional Therapeutic Drugs, Biopharmaceuticals, Cell-Based Therapies, Tissue and Organ Transplantation etc

Drug Targets: *Drug Targets* - Existing drug targets, and new drug targets; *Strategies for Finding New Drug Targets* - Conventional Strategies for Finding New Drug Targets: Analysis of pathophysiology, Analysis of mechanism of action of known drugs; New strategies for identifying drug targets: Disease genes, Disease-modifying genes (gene expression profiling and comprehensive gene knockoutStudies), 'Druggable' genes; *Target Validation* - Pharmacological approaches, Genetic approaches: Antisense oligonucleotides, RNA interference (RNAi), Transgenic animals

Lead Discovery: *High-Throughput Screening* - Assay development and validation: Biochemical Assays: Assay readout and detection, Ligand binding assays, Fluorescence technologies; Cell-based assays: Readouts for cell-based assays, fluorometric methods, reporter gene assays, yeast complementation assays, high-throughput electrophysiology assays; Biophysical methods in high-throughput screening; Data analysis and management; Screening Libraries and Compound Logistics; Profiling

Medicinal Chemistry: *Role of Medicinal Chemistry in Drug Discovery Process* - Target Selection and Validation; Lead Identification/Generation; Lead Optimization; Addressing Attrition

Optimization Strategies in Drug Discovery: *Optimization of Drug Metabolic and Pharmacokinetic Properties* - Optimization of DMPK Properties: Absorption and bioavailability, Avoiding PK-based drug–drug interactions, Achieving/avoiding CNS exposure, Clearance, Role of metabolite identification (Active metabolites, Minimizing risk for reactive metabolites); Human PK And Dose Prediction: Prediction of absorption rate and oral bioavailability, clearance, volume of distribution, plasma concentration time profile, and human efficacious dose

Practical

Drug Targets: Conduct experiments related to new drug target discovery and validation.

Lead Discovery: Conduct experiments related to for lead discovery

Optimization Strategies in Drug Discovery: Conduct experiments related to several optimization strategies in drug discovery

BST 31473 - Pharmaceutical Analytical Chemistry-I (C)

3 credits (30-30-30-60), Prerequisite:

None Theory

Control of the Quality of Analytical Methods: *Control of the quality of analytical methods* - Introduction; Control of errors in analysis; Accuracy and precision; Validation of analytical Procedures, Important terms used in the control of analytical procedures, Basic calculations in pharmaceutical analysis

Classical Methods of Analysis: *Classical Methods of Analysis* - Gravimetric Analysis, Titrimetric analysis (Acid Base Titrations, Redox Titrations, Precipitation Titrations, Complexometric Titrations and Potentiometric Titrations)

Introduction to Analytical Separations*: Introduction to Analytical Separations* - Mechanical Phase separations (Precipitation, Filtration, Distillation, Extraction and Ion Exchange Based Separation),Chromatographic theory, General Description of

Chromatography, Classification of Chromatographic Methods, Elution in Column Chromatography, Chromatograms, Migration Rates of Solutes, Band Broadening and Column Efficiency, Variables Affecting column Efficiency, Applications of Chromatography

Ultraviolet and visible spectroscopy: *Ultraviolet and visible spectroscopy* - Introduction; Factors governing absorption of radiation in the UV/visible region; Beer–Lambert Law; Instrumentation; Diode array instruments; Instrument calibration; UV spectra of some representative drug molecules; Use of UV/ visible spectrophotometry to determine pKa values; Applications of UV/ visible spectroscopy to pharmaceutical quantitative analysis

Infrared spectrophotometry: *Infrared spectrophotometry* - Introduction; Factors determining intensity and energy level of absorption in IR spectra; Instrumentation; Sample preparation; Application of IR spectrophotometry in structure elucidation; Examples of IR spectra of drug molecules; IR spectrophotometry as a fingerprint technique, as a method for identifying polymorphs; Near-infrared analysis (NIRA); Examples of NIRA applications

Mass spectrometry: *Mass spectrometry* - Introduction; ionization methods; Ion separation techniques; Molecular fragmentation Patterns; Gas chromatography–mass spectrometry (GC–MS); Mass spectrometry in drug discovery

Nuclear magnetic resonance spectroscopy *(Note: omit all sections which have been discussed in other courses)*: *Nuclear magnetic resonance spectroscopy* - Introduction and theory of NMR spectroscopy, Instrumentation, Proton (1H) NMR, Application of (1H) NMR to structure confirmation in some drug molecules, Carbon NMR, Two-dimensional NMR spectra

Atomic spectrophotometry: *Atomic spectrophotometry* - Atomic emission spectrophotometry (AES): Introduction, Instrumentation, quantitation by AES, Interferences in AES analysis, Assays based on the method of standard additions, Atomic Atomic absorption spectrophotometry (AAS): Introduction, Instrumentation, Examples of assays using AAS, Some examples of limit tests employing AAS, Inductively coupled plasma emission spectroscopy: Brief overview

Practical

Control of the Quality of Analytical Methods: *Control of the quality of analytical methods* - Perform basic calculations in pharmaceutical analysis, use appropriate software for error analysis. Follow an appropriate procedure for the use of a calibrated balance

Classical Methods of Analysis: *Classical Methods of Analysis* - Selected experiments on classical analytical methods

Introduction to Analytical Separations: *Introduction to Analytical Separations* - Conduct selected analytical separations

Ultraviolet and visible spectroscopy: *Ultraviolet and visible spectroscopy*- Conduct UV/visible spectroscopy for pharmaceutical analysis

Infrared spectrophotometry: *Infrared spectrophotometry* - Application of IR spectrophotometry in structure elucidation (of drug molecules), foridentifying polymorphs; NIRA applications in drug discovery and development

Mass spectrometry: *Mass spectrometry* - Solve problems/case studies of mass spectrometry applications in drug discovery and development

Nuclear magnetic resonance spectroscopy *(Note: omit all sections which have been discussed in other courses)*: *Nuclear magnetic resonance spectroscopy* - Determine structures using given NMR data

Atomic spectrophotometry: *Atomic spectrophotometry* - Solve sample problems related to quantitation by AES, and AAS in pharmaceutical analysis

BST 31481 - Chemical Toxicology (C)

1 credit (15-00-15-20), Prerequisite:

None Theory

General Principles of Toxicology: General Principles of Toxicology - Core definitions and terminologies applied in toxicology, different areas of toxicology, Hazard identification function, Risk assessment function

Toxicokinetics: *Toxicokinetics* - Interactions of xenobiotic with biological membranes, Absorption, Distribution, Metabolism, Excretion, Adaptive toxicokinetic response

Toxicodynamics: *Toxicodynamics* - Introduction to toxicodynamics, Direct-acting toxicants, Metabolism dependent toxicants, Adaptive toxicodynamic response

Target Organ Toxicity 1 (Hepatotoxicity): *Target Organ Toxicity 1 (Hepatotoxicity)* - Gross anatomy and physiological roles of human liver, Major toxic responses of the liver, Major hepatotoxicant classes. Evaluation of hepatotoxicity

Target Organ Toxicity 2 (Nephrotoxicity): *Target Organ Toxicity 2 (Nephrotoxicity)* - Gross anatomy and physiological roles of kidneys, nephrons and associated ducts. Acute and chronic renal injury. Major human nephrotoxicants, Evaluation of renal function

Chemical Carcinogenesis: *Chemical Carcinogenesis* - Terminologies and definitions associated with carcinogenesis, Classification of carcinogens, Multistep process in carcinogenesis. Overview of chemical carcinogens and IARC classification of carcinogens

Toxicology of Heavy Metals: *Toxicology of Heavy Metals* - Background of poisoning, Initial assessment, Resuccination, Supportive therapy, Prevention of further absorption of poison, Accelerating the elimination of poison, Specific antidotes

Poisoning, Overdose and Antidotes: *Poisoning, Overdose and Antidotes* - General Characteristics of metallic poisoning, Methods of exposure, an overview of pathophysiology, specific antidotes

3.10.2. Year III Semester II

BST 32413 - Organic Chemistry-II (C)

3 credits (30-30-30-60), Prerequisite:

None Theory

Electrophilic addition to alkenes: *Electrophilic addition to alkenes* - Electrophilic addition to alkenes, Alkenes react with bromine, Oxidation of alkenes to form epoxides, Electrophilic addition to unsymmetrical alkenes is regioselective, Electrophilic addition to dienes, Unsymmetrical bromonium ions open regioselectively, Electrophilic additions to alkenes can be stereospecific, Adding two hydroxyl groups: dihydroxylation, Breaking a double bond completely: periodate cleavage and ozonolysis, Adding one hydroxyl group: how to add water across a double bond

Nucleophilic addition to the carbonyl group: *Nucleophilic addition to the carbonyl group* - Formation and reactions of enols and enolates, Tautomerism: formation of enols by proton transfer, Simple aldehydes and ketones and their enols, Acid and base catalysis of Enolization,enolate ion as the intermediate in the base-catalysed reactions, Summary of types of enol and enolate, Stable enols, Reaction with enols or enolates as intermediates, Stable equivalents of enolate ions

Electrophilic aromatic substitution: *Electrophilic aromatic substitution* - Introduction: enols and phenols, Benzene and its reactions with electrophiles, Electrophilic substitution on phenols, Activation of benzene by nitrogen lone pair, Alkyl benzenes substitute at the ortho and para positions, Electron-withdrawing substituents, meta products, Halogens show evidence of both electron withdrawal and donation, Two or more substituents may cooperate or compete, Some problems and some opportunities, A closer look at Friedel–Crafts chemistry, Exploiting the chemistry of the nitro group

Conjugate addition and nucleophilic aromatic substitution: *Conjugate addition and nucleophilic aromatic substitution* - Conjugated alkenes as electrophiles, Summary: factors controlling conjugate addition, Reaction of other electron deficient alkenes, Conjugate substitution reactions, Nucleophilic epoxidation, Nucleophilic aromatic substitution, The addition–elimination mechanism, The SN1 mechanism for nucleophilic aromatic substitution: diazonium compounds, The benzyne mechanism

Chemoselectivity and protecting groups: *Chemoselectivity and protecting groups* - Selectivity, Reducing agents, Reduction of carbonyl groups, Hydrogen as a reducing

agent: catalytic hydrogenation, Getting rid of functional groups, Dissolving metal reductions, Selectivity in oxidation reactions, Competing reactivity: choosing which group reacts 546; A brief survey of protecting groups

Regioselectivity: *Nucleophilic substitution at the carbonyl group* - Introduction, Regioselectivity in electrophilic aromatic substitution, Electrophilic attack on alkenes, Regioselectivity in radical reactions, Nucleophilic attack on allylic compounds, Electrophilic attack on conjugated dienes, Conjugate addition

Alkylation of enolates: *Alkylation of enolates* - Diverse reactivity of carbonyl groups, Some important considerations that affect all alkylations, Alkylation of Nitriles and nitroalkanes, Choice of electrophile for alkylation, Lithium enolates of carbonyl compounds, Alkylations of lithium enolates, Using specific enol equivalents to alkylate aldehydes and ketones, Alkylation of β-dicarbonyl compounds, Ketone alkylation poses a problem in regioselectivity, Enones provide a solution to regioselectivity problems, Using Michael acceptors as electrophiles

Reactions of enolates with carbonyl compounds: the aldol and Claisen reactions: *Reactions of enolates with carbonyl compounds: the aldol and Claisen reactions* - The aldol reaction, Cross-condensations, Specific enol equivalents can be used to control aldol reactions, How to control aldol reactions of esters, How to control aldol reactions of aldehydes, How to control aldol reactions of ketones, Intramolecular aldol reactions, Acylation at carbon, Crossed ester condensations, Summary of the preparation of keto-esters by the Claisen reaction, Controlling acylation with specific enol equivalents, Intramolecular crossed Claisen ester condensations

Aromatic heterocycles: *Reactions of aromatic heterocycles* - Pyridine as an unreactive aromatic imine, Six-membered aromatic heterocycles with oxygen in the ring, Five-membered aromatic heterocycles are good at electrophilic substitution, Furan and thiophene are oxygen and sulfur analogues of pyrrole, More reactions of five-membered heterocycles, Five-membered rings with two or more nitrogen atoms, Benzo-fused heterocycles, Fusing rings to pyridines: quinolines and isoquinolines; *Synthesis of aromatic heterocycles* - Thermodynamics, Disconnect the carbon– heteroatom bonds first, Pyrroles, thiophenes, and furans from 1,4-dicarbonyl compounds, The Hantzsch pyridine synthesis, Pyrazoles and pyridazines from hydrazine and dicarbonyl compounds, Pyrimidines can be made from 1,3-dicarbonyl compounds and amidines

Diastereoselectivity: *Diastereoselectivity* - Prochirality, Diastereoselective Additions to carbonyl groups, Stereoselective reactions of acyclic alkenes, Stereoselective Aldol reaction, Single enantiomers from diastereoselective reactions

Asymmetric synthesis: *Stereochemistry* - Introduction, The chiral pool, Separation of enantiomers, Chiral auxiliaries, Chiral reagents, Asymmetric catalysis, Asymmetric formation of carbon–carbon bonds, Asymmetric aldol reactions

Practical

Electrophilic addition to alkenes: *Electrophilic addition to alkenes* - Conduct 2–3 step organic syntheses (use reactions relevant to drug discovery and development), purifications, analysis, and the required method developments

Nucleophilic addition to the carbonyl group: *Nucleophilic addition to the carbonyl group* - Conduct 2–3 step organic syntheses (use reactions relevant to drug discovery and development), purifications, analysis, and the required method developments

Electrophilic aromatic substitution: *Electrophilic aromatic substitution* - Conduct 2–3 step organic syntheses (use reactions relevant to drug discovery and development), purifications, analysis, and the required method developments

Conjugate addition and nucleophilic aromatic substitution: *Conjugate addition and nucleophilic aromatic substitution* - Conduct 2–3 step organic syntheses (use reactions relevant to drug discovery and development), purifications, analysis, and the required method developments

Chemoselectivity and protecting groups: *Chemoselectivity and protecting groups* - Conduct 2–3 step organic syntheses (use reactions relevant to drug discovery and development), purifications, analysis, and the required method developments

Regioselectivity: *Nucleophilic substitution at the carbonyl group* - Conduct 2–3 step organic syntheses (use reactions relevant to drug discovery and development), purifications, analysis, and the required method developments

Alkylation of enolates: *Alkylation of enolates* - Conduct 2–3 step organic syntheses (use reactions relevant to drug discovery and development), purifications, analysis, and the required method developments

Reactions of enolates with carbonyl compounds: the aldol and Claisen reactions: *Reactions of enolates with carbonyl compounds: the aldol and Claisen reactions* - Conduct 2–3 step organic syntheses (use reactions relevant to drug discovery and development), purifications, analysis, and the required method developments

Diastereoselectivity: *Diastereoselectivity* - Conduct one step asymmetric syntheses (use reactions relevant to drug discovery and development), purifications, analysis, and the required method developments

Asymmetric synthesis: *Stereochemistry* - Conduct one step asymmetric syntheses (use reactions relevant to drug discovery and development), purifications, analysis, and the required method developments

BST 32433 - Pharmaceutics-II (C)

3 credits (30-30-30-60), Prerequisite:

None Theory

Parenteral Preparations: *Parenteral Preparations* - Overview of unique characteristics of parenteral dosage forms, Formulation Principles, General manufacturing process, Container and Closure, Overview of a production facility, Overview of preliminary quality control tests

Ophthalmic Preparations: *Ophthalmic Preparations* - Introduction to types of ophthalmic dosage forms (solutions, gel-forming solutions, powders for solution, suspensions, emulsions, ointments, ocular inserts), Overview of the manufacturing process, specific characteristics, Primary packaging

Pulmonary Drug Delivery: *Pulmonary Drug Delivery* - Introduction to pulmonary drug delivery, Nebulizers, Metered dose inhalers (Device Design and Formulation Consideration), Dry powder inhalers (Formulation consideration, Device design)

Transdermal Drug Delivery System: *Transdermal Drug Delivery System* - Overview of transdermal drug delivery, Mechanisms of enhancing drug penetration through skin, Topical semisolid dosage forms, ointments, Gels, Transdermal patches

Suppositories and Pessaries: *Suppositories and Pessaries* - Introduction and definition of suppositories, types of suppositories, suppository bases, overview of manufacturing

Stability of Pharmaceutical Products: *Stability of Pharmaceutical Products* - Introduction and definition of stability, stability of pharmaceutical dosage forms (Tablets, Capsules, Emulsions, Suspensions and solutions), Pharmaceutical incompatibility, Primary and secondary packaging material

Practical

Parenteral Preparations: *Parenteral Preparations* - Identification and classification of parenteral preparations, reconstitution of parenteral dosage forms and video demonstration of the manufacturing process

Ophthalmic Preparations: *Ophthalmic Preparations* - Identification and classification of ophthalmic preparations, video demonstrations of the manufacturing process

Pulmonary Drug Delivery: *Pulmonary Drug Delivery* - Identification and classification of MDIs and DPIs, Demonstration of correct administration techniques, Video

demonstration of the manufacturing process of MDIs DPIs. Compounding of Menthol and eucalyptus oil inhalation BP

Transdermal Drug Delivery System: *Transdermal Drug Delivery System* - Compounding of Whitfield ointment BP 2000, Laboratory scale development of hydro alcoholic gel base

Suppositories and Pessaries: *Suppositories and Pessaries* - Video demonstration of the manufacturing process of suppositories, evaluation of market samples, administration techniques of suppositories. Extemporaneous preparation of suppositories

BST 32482 - Synthetic Organic Chemistry (C)

2 credits (30-30-20-20), Prerequisite:

None Theory

Introduction: *Designing an organic synthesis* - Introduction of "the disconnection approach", Designing a synthesis: analysis, synthesis

Basic principles: *Basic principles* - Synthons and reagents, disconnections and functional group interconversions, functional group addition, changing polarity, use of mechanistic information

Strategies: Order of events, Chemoselectivity, Reversal of polarity, Regioselectivity, Stereoselectivity

Disconnections: One group disconnections: C-X, C-C, Two group disconnections: C-X, C-C

Case studies: Investigate synthesis of selected marketed drugs to exemplify how organic synthesis used in drug synthesis

Practical

Introduction: *Designing an organic synthesis* - Conduct 2–3 step organic syntheses (use reactions relevant to drug discovery and development), purifications, analysis, and the required method developments

Basic principles: *Basic principles* - Conduct Friedel-Crafts alkylation/acylation/ nucleophilic aromatic substitution/electrophilic aromatic substitution reaction

Strategies: Conduct experiments on syntheses that involve/exploit strategies discussed in the theory class.Conduct 2–3 step organic syntheses (use reactions relevant to drug discovery and development), purifications, analysis, and the required method developments

Disconnections: Conduct experiments on syntheses that utilize disconnections/ synthesis discussed in the theory class

Case studies: Conduct 2–3 step organic syntheses (use reactions relevant to drug discovery and development), purifications, analysis, and the required method developments

BST 32442 - Medicinal Chemistry-II (C)

2 credits (15-30-25-30), Prerequisite:

None Theory

DNA-Interactive Agents *(Note: omit all sections which have been discussed in other courses)*: *DNA-Interactive Agents* - Introduction, DNA Structure and Properties; Classes of Drugs that Interact with DNA: Reversible DNA Binders, DNA Alkylators, DNA Strand Breakers; Lead Discovery and Lead Modification of some of DNA-interactive agents

Drug Resistance and Drug Synergism: *Drug Resistance and Drug Synergism* - Drug Resistance: Drug Resistance, Mechanisms of Drug Resistance

Drug Metabolism: *Drug Metabolism* - Introduction, Use of radioactive compounds to trace drug metabolism, Analytical Methods in Drug Metabolism; Pathways for Drug Deactivation and Elimination: Phase I Transformations (Oxidative Reactions, Reductive Reactions); Phase II Transformations: Conjugation Reactions; Toxicophores and Reactive Metabolites (RMs), Hard and Soft (Antedrugs) Drugs

Prodrugs and Drug Delivery Systems *(Note: omit all sections which have been discussed in other courses)*: *Prodrugs and Drug Delivery Systems* - Enzyme Activation of Drugs: Utility of Prodrugs, Types of Prodrugs; Mechanisms of Drug Inactivation: Carrier-Linked Prodrugs, Bioprecursor Prodrugs

Practicals

DNA-Interactive Agents *(Note: omit all sections which have been discussed in other courses)*: *DNA-Interactive Agents* - Lead discovery

Drug Resistance and Drug Synergism: *Drug Resistance and Drug Synergism* - Lead optimization

Drug Metabolism: *Drug Metabolism* - Drug Metabolism studies

Prodrugs and Drug Delivery Systems *(Note: omit all sections which have been discussed in other courses)*: *Prodrugs and Drug Delivery Systems* - Functionalization to yield prodrugs

BST 32462 - Drug Discovery and Development-II (C)

2 credits (15-30-25-30), Prerequisite:

None Theory

Pharmacology: *Pharmacology in Drug Discovery* - Role of Pharmacology in drug discovery, Selectivity: Screening for Selectivity, Interpretation of binding assays; Pharmacological Profiling: In vitro profiling, In vivo profiling, Species differences; Animal Models of Disease: Types of animal models, The choice of models

Drug Development: *Essentials of Drug Development* - Nature, Components, and Decision Points of Drug Development; Interface Between Discovery and Development

Drug Safety: *Assessing drug safety* - Main safety assessment studies during drug discovery and development, Adverse Drug Effects, Safety Pharmacology, Exploratory (Dose Range-finding) Toxicology Studies, Genotoxicity, Chronic Toxicology Studies, Toxicokinetics, Toxicity Measures

Pharmaceutical Development: *Main Aspects of Pharmaceutical Development* - Preformulation Studies: Solubility and dissolution rate, Stability, Particle size and morphology, Routes of Administration and Dosage Forms, Formulation, Drug Delivery Systems: Principles, Polymers and surfactants, Micelles, Liposomes, Nanoparticles/nanotechnology-based preparations, Modified-release drug formulations, Drug delivery to the central nervous system

Clinical Development: *Clinical Development Phases* - Phase I: pharmacokinetics, safety and tolerability and clinical pharmacology: Phase IIa: exploratory efficacy;

Phase IIb: efficacy and dose range finding; Phase III: pivotal efficacy and safety and larger population; Phase IV: post-marketing safety and efficacy evaluation; Regulatory and Ethical Environment

Intellectual Property: *Intellectual property in drug discovery and development* - Patents, Patent Specification, What Can Be Patented, Requirements for Patentability, Patent Documents, Evaluation by The Scientist, Evaluation by The Patent Professional, Sources Of Information, Results Of The Evaluation – NCES, Patenting Of Research Tools, Obtaining Patent Protection For A Development Compound

Regulatory Affairs: *Brief introduction of regulatory affairs in drug discovery and development* - International Harmonization, Roles and Responsibilities of Regulatory Authority and Company, The Drug Development Process: Assessment of quality, safety, and efficacy, Regulatory Procedures, Administrative Rules

Pharmaceutical Marketing: *Role of pharmaceutical marketing* - Product Life Cycle, Pharmaceutical Product Life Cycle, Pharmaceutical Product Life Cycle, Pharmaceutical Marketing, Pricing, Health Technology Assessment (HTA), New Product Launch, Changing Environment – Changing Marketing, The Future of Marketing

Practical

Pharmacology: *Pharmacology in Drug Discovery* - Conduct experiments related to selectivity screenings, and pharmacological profiling

Drug Development: *Essentials of Drug Development* - Conduct experiments related to selectivity screenings, and pharmacological profiling

Drug Safety: *Assessing drug safety* - Conduct experiments related to main safety assessment strategies

Pharmaceutical Development: *Main Aspects of Pharmaceutical Development* - Conduct selected limited experiments on main techniques used in pharmaceutical developments

Clinical Development: *Clinical Development Phases* - Case studies/analyze real experimental data related to clinical development of a limited number of drugs

BST 32452 - Phytochemistry and Pharmacognosy- II (C)

2 credits (15-30-25-30), Prerequisite:

None Theory

Crude Drugs: *Types of crude drugs* - Detailed study of ***a very limited number*** of the following classes of crude drugs by studying source, cultivation, collection, preparation, storage, their characteristics, constituents, chemical test, substituents, etc; Classes: Anthraquinone cathartics, Various alkaloids, Terpenes, Resins, Purines

Quality control of crude drugs: *Quality control of crude drugs* – Morphological, microscopical, physical, chemical, biological analysis of herbal preparations/drugs

Industrial and Medicinal Applications of Phythochemicals: *Industrial and Medicinal Applications of Phythochemicals* - Biotechnology approaches to the production of phythochemicals, secondary metabolites accumulation and production through *in vitro* cell cultures, Cysteine protease (or any other suitable example) from plants and their industrial and medicinal applications, Phythotherepy and encapsulation; Selected examples of semi-synthetic or synthetic drugs based on naturally occurring drugs (eg. Naloxone from Thebaine, sources for Paclitaxel)

Practical

Crude Drugs: *Types of crude drugs* - Identification of some crude drugs by morphological characters; Microscopical study of some selected authentic drugs and some selected powdered drugs

Quality control of crude drugs: *Quality control of crude drugs* – Extract/isolate drugs from natural sources using different techniques, set up quality control procedures necessary for quantitative and qualitative evaluation and detection of adulterants in drugs from natural sources, Perform various chromatographic techniques as a major part of quality control of herbal drugs

Industrial and Medicinal Applications of Phythochemicals: *Industrial and Medicinal Applications of Phythochemicals* - Experiments to exemplify process of obtaining phythochemicals by plant tissue culture. Experiments on encapsulation of phythochemicals, quality control

BST 32472 - Pharmaceutical Analytical Chemistry-II (C)

2 credits (15-30-30-25), Prerequisite:

None Theory

High-performance liquid chromatography: *High-performance liquid chromatography* - Introduction, Instrumentation, Stationary and mobile phases, Structural factors which govern rate of elution of compounds from HPLC columns, stationary phases: normal and reverse-phase, detectors used in HPLC, Performance of a diode array detector, Applications of HPLC to the quantitative analysis of drugs in formulations, Assays involving more specialized HPLC techniques

High-performance capillary electrophoresis: *High-performance capillary electrophoresis* - Introduction, Instrumentation, Control of separation, Applications of CE in pharmaceutical analysis, Use of additives in the running buffer

Introduction to Pharmaceutical Standards: *Introduction to Pharmaceutical Standards* - Introduction of pharmacopeia, Overview BP (six volumes), Overview of USP (3 volumes and 6 appendices) , Monographs

Quality Control of Solid Oral Dosage Forms: *Quality Control of Solid Oral Dosage Forms* - Physical tests: hardness, thickness and diameter, friability, disintegration, weight variation, chemical tests: content uniformity, assay of active ingredients and dissolution tests of powders, granules, tablets and capsules

Quality Control of Monophasic Liquid Oral Dosage Forms: *Quality Control of Monophasic Liquid Oral Dosage Forms* - Organoleptic evaluation, Physical tests for liquid oral dosage forms (viscosity, relative density, and refractive index); Chemical tests for liquid oral dosage forms (identification test, assay of active ingredient, pH and ethanol content), and Microbial limit tests

Quality Control of Biphasic Dosage Forms and Cosmetics: *Quality Control of Biphasic Dosage Forms and Cosmetics* - Organoleptic evaluation of the dosage form, Physical testing of the dosage form (viscosity, phase separation, phase inversion and relative density); Chemical testing of dosage form (assay of active ingredient, pH, Acid value, Peroxide Value); Microbial limit tests

Quality Control of Parenteral Products: *Quality Control of Parenteral Products* - Sterility testing, Pyrogen test, Particulate evaluation, Container closure integrity test, Packaging and labelling test

Practical

High-performance liquid chromatography: *High-performance liquid chromatography* - Applications of HPLC to the quantitative analysis of drugs in formulations

High-performance capillary electrophoresis: *High-performance capillary electrophoresis* - Using CE for pharmaceutical analysis

Introduction to Pharmaceutical Standards: *Introduction to Pharmaceutical Standards* - Investigation of BP, USP and important aspects of monographs.

Quality Control of Solid Oral Dosage Forms: *Quality Control of Solid Oral Dosage Forms* - Tablet weight variation test, Dissolution, Disintegration and Friability tests for tablets and evaluating conformity. Acetaminophen tablet USP Assay

Quality Control of Monophasic Liquid Oral Dosage Forms: *Quality Control of Monophasic Liquid Oral Dosage Forms* - Determination of viscosity and g/cm$_3$ of a syrup

Quality Control of Biphasic Dosage Forms and Cosmetics: *Quality Control of Biphasic Dosage Forms and Cosmetics* - Determination of viscosity and g/cm$_3$ of a syrup

Quality Control of Parenteral Products: *Quality Control of Parenteral Products* - Evaluation market samples, packaging material and labels of parenteral dosage forms, assay of vitamin D.Bioassays of a Selected IV antibiotic

BST 32012 - Proposal Writing and Project Management I (C)

2 credits (30-00-30-40), Prerequisite:

None Theory

Introduction: *Introduction* - What is research; specific characteristics of research?; *Objectives of research* - The three objectives of a research: 1. Theoretical objective 2. Factual objective and 3. Application objective; *Classification of research* - Basic level and applied level; *Kinds of research* - On the basis of objectives of research, on the basis of approach of research, on the basis of precision in research findings, on the basis of nature of findings; *Research methods and research methodology*

Scientific writing: *Scientific writing* - Introduction to scientific writing; *Structure of thesis* - Introduction to thesis; contents of thesis: abstract, introduction, literature

review, materials and methods, results and discussion, conclusion, future suggestions, references, appendices; *Standard scientific research paper components*
- Components of scientific writing: introduction, objective, materials and methods, results and discussion, conclusion, acknowledgement, references

Proposal formulation: *Proposal formulation for final year research and funding agencies* - Introduction to what a proposal is; uses of a proposal; *How to make research proposal* - Preparation needed for making a research proposal; *Content of a research proposal* - Background information, budget, references

How to conduct research: *How to conduct research effectively* - Define question; gathering information; forming hypothesis/hypotheses; planning research; collecting data, organizing and analyzing data, interpreting data, and drawing conclusions; *Problems faced during research* - Communicating results; time limitation, budget allocation, unknown factors; *How to make an effective research presentation at a seminar* - Factors to be considered while making a presentation

BST 32491 - Heterocycles in Drugs and Drug Discovery (C)

1 credit (15-00-15-20), Prerequisite:

None Theory

Introduction: *Introduction* - Introduction, Examples of Heterocyclic compounds and Drug molecules having heterocycles in their structure, main three-, four-, five-, six-membered heterocycles. Other important heterocycles found in drugs

Synthesis, structure, and reactivity: *Synthesis, structure, and reactivity* - Synthesis, structure and important chemical reactions of the some of the following heterocycles:Five membered Heterocycles: Furan, Thiophene, Pyrrole, Thiazole, oxazole, imidazole,Pyrazole. Six membered Heterocycles: Pyridine, pyridazine, Pyrimidine, Pyrazine, Pyrones. Benz-fused Heterocycles: Quinoline, Isoquinoline, Indole

Optimization of drug properties by inclusion of heterocyclic moiety: *Optimization of drug properties by inclusion of heterocyclic moiety* - Investigate effects on potency and selectivity through bioisosteric replacements, change of lipophilicity, influence on polarity, modulation of aqueous solubility, etc. using selected examples/ case studies related to currently marketed drugs. Effects on potency and selectivity through bioisosteric replacements: Heterocyclic bioisosteres in drug design, SAR and optimization of drug candidates, variety of shapes and electronic and physicochemical properties of heterocyles useful optimizations of drug candidates,

benefits on potency and specificity. Change of lipophilicity: ClogP, lipophilicity vs metabolic stability and toxicity.Polarity of drug molecules: polar surface area (PSA) or topological polar surface area (TPSA), druglikeness, and their modulation using heteroatoms/cycles. Aqueous solubility: Aqueous solubility and oral bioavailability of drugs and effects of inclusion of heterocycles on these properties of drugs

Possible liabilities of heterocycle containing drugs: *Possible liabilities of heterocycle containing drugs* - Study selected limited number of examples on possible liabilities of heterocycle containing drugs including some of, pyrrole-containing drugs, indole-containing drugs, furan/thiophene-containing drugs, indazole/pyrazolone -containing drugs, quinoline/isoquinoline ring

BST 32501 - Marketing and Regulation of Drugs (C)

1 credit (15-00-15-20), Prerequisite:

None Theory

General Principles of Pharmaceutical Marketing: *General Principles of Pharmaceutical Marketing* - Development of pharmaceutical marketing, Marketing management, Social positioning of pharmaceutical marketing

General Environment: *General Environment* - Pharmaceutical marketing environment, Economic Environment, Ethical/Cultural Environment, Political Environment, Legal/Regulatory Environment, Technical Environment, Competitive Environment, Internal Environment

Principals of Product Research and Development: *Principals of Product Research and Development* - Product Scope and strategy, New product strategy, Product positioning strategy, Product repositioning strategy, Product elimination strategy, Diversification strategy

Introduction to Regulatory Affairs: *Introduction to Regulatory Affairs* - International harmonization, Roles and responsibilities of regulatory authority and company, Regulatory aspects of novel types of therapy, Regulatory procedures (clinical trials, application for marketing authorization and common technical document)

Good Clinical Practices and Clinical Trials: *Good Clinical Practices and Clinical Trials* - Global Legislation and Ethics of Clinical and Healthcare research, Responsibilities of research team and sponsors, Clinical trial protocols

Regulations and Ethical Considerations in Animal Experiments: *Regulations and Ethical Considerations in Animal Experiments* - An Overview of Global

Legislation, Regulation, and Policies, Ethics regarding animal experiments, 3R concept in Animal Experiments

Sri Lankan Pharmaceutical Legislative Framework: *Sri Lankan Pharmaceutical Legislative Framework* **-** NMRA act, Food act, Veterinary drug act, Homeopathic drug act and Ayurvedic drug act

3.10.3. Year IV Semester I

BST 41016 - Industrial training (C)

6 credits, Prerequisite: None

BST 41413 - Pharmaceutical Technology (C)

3 credits (45-00-45-60), Prerequisite:

None Theory

Manufacturing Plant Design: *Manufacturing Plant Design* - Layout, design and operation of clean room, aseptic practice industrial hazards and safety measures. Discussions on utilities in a manufacturing plant (Boilers, Chillers, Dehumidifiers , Purified water plant and HVAC System)

Rheology: *Rheology* - Introduction and fundamentals of rheology, Elastic solids, Newtonian fluids, Non-Newtonian fluids, Rheological Measurements, General Viscometer and Rheometer Types (Rotational rheometers, Ostwald viscometer, Brookfield viscometers,Capillary viscometers). Calculation of the viscosity of a liquid using readings of Ostwald viscometer and Brookfield viscometers

Filtration and Centrifugation: *Filtration and Centrifugation* - Theory of filtration, filter media, filter aid, classification of industrial filters depth and membrane filters, sterile and filtration, ultra-filtration, gel filtration, molecular filtration, theory and principle of centrifugation, classification of industrial centrifuges: basket, tubular bowl, conical disk, standard operating procedure, evaluation of phase separation of a biphasic dosage form (O/W or W/O emulsion)

Mixing: *Mixing* - Theory of mixing, solid- solid, solid-liquid, liquid –liquid mixing, equipment; tumbler, v-cone, double cone, ribbon blender, sigma blade and planetary, zig-zag mixers, mixing devices; propeller, turbine, paddles and baffles, vortex formation, homogenization, homogenizers, de-mixing. Discussions on overhead stirrer, homogenizer, planetary mixer and v-cone mixer

Drying: *Drying* - Moisture content and mechanism of drying, classification and types of dryers, dryers used in pharmaceutical industries, tray dryer, fluidized bed dryer, drum dryer, vacuum dryer, freeze dryer and spray dryer, discussions on moisture content and loss on drying,drying curves (calcium carbonate, lactose and starch)

Communition: *Communition* - Theory of size reduction, objectives of size reduction factors involved in size reduction, equipment; jaw crushers, ball mill, fluid energy

mill, hammer mill, edge runner mill and end runner mill, dry grinding , wet grinding micronization. Discussions on operation of mills, Determination of particle size by sieve analysis

Particle Properties I: *Particle Properties I* - Different techniques of size separation; sieves, sieve shakers, sedimentation tanks, mechanical classifiers, air separators, bag filters, angle of repose

Particle Properties II: *Particle Properties II* - The solid-air interface, angle of repose, flow rates, mass volume relationship, density, heckel plots, consolidation, compressibility index and Hausner ratio

Pharmaceutical Microbiology I: *Pharmaceutical Microbiology I* - Fundamentals of microbiology, Pharmaceutical applications of microbiological techniques Measurement of antimicrobial activity, Antibiotic assays, Minimum inhibitory concentration determinations, Preservative efficacy tests, Disinfectant evaluation. Microbiological quality of pharmaceutical materials, Non sterile products, Sterile products, Discussions of following aspects: Sub culturing of bacteria and fungus, preparation of nutrient slab and slant, staining methods, isolation of pure culture of microorganism (Streak plate method)

Pharmaceutical Microbiology II: *Pharmaceutical Microbiology II* - Action of physical and chemical agents on microorganisms. Antimicrobial effects of moist and dry heat, ionization radiations, UV radiation, Gases (Ethylene oxide, Formaldehyde,Peracetic acid,Hydrogen peroxide and Gas Plasmas), Discussion of the following aspects: Sterility testing of pharmaceuticals (Membrane filtration /Direct inoculation), Microbiological assay of antibiotics (Well diffusion and Turbidometry)

Standardization of Pharmaceuticals and Good Manufacturing Practice: *Standardization of Pharmaceuticals and Good Manufacturing Practice* - An understanding of quality assurance system adopted in pharmaceutical industry, good manufacturing practices and current good manufacturing practices, discussions on common standard operating procedures in pharmaceutical company, group discussion on Cite Master Files

3.10.4. Year IV Semester II

BST 42011 - Career Development and Progression (C)

1 credit (15-15-10-10), Prerequisite:

None Theory

Career-decision process: *General overview of career-decision process* - Identify the decision to be made; know yourself (raise consciousness); Identify options and gathering information (explore options); evaluate options that will solve the problem; select one of the options; *Managing your career Theory: Prepare for career transitions and effectively manage your career* - Determine your interest and passion; identify your strengths and weaknesses; communication skills, personal confidence, motivation, emotional intelligence; job seeking skills

Relational Approach to Self-Assessment and Career Development: *Career theory* - System theory framework of career development

Job search approaches: *Approaches to job search* - Job hunting preliminaries; informational interviews; internet resources; job search; interviewing; evaluating the offer

Approaching job interviews: *Job interviews* - The selection process; employer perspective; the 3 Ps of successful interviews; tricky questions; other section methods; interview types, interview skills, interview tips; ways to find employment; *Putting it all together: be the master of your career*

BST 42021 - Proposal Writing and Project Management II (C)

1 credit (00-30-10-10), Prerequisite: None

BST 42038 - Research Project (C)

8 credits (00-800), Prerequisite: None

4. DEPARTMENT OF ENGINEERING TECHNOLOGY (DET)

The Department of Engineering Technology aims at producing graduates with sound knowledge on fundamentals of traditional, modern and emerging areas of Mechanical Engineering Technology for the needs and requirements of industry in the country and focusing on modern job market in Industrial Sectors of Manufacturing, Building Services, Automobile and Mechanical Engineering Technology Projects. Mechanical Technology specialist having a foundation in Engineering Technology can fit into diverse roles where graduates can apply their skills and knowledge to operate, develop and improve in accordance with the requirements of the industry. The diversity in Mechanical Engineering Technology field leads to wide range of carrier opportunities even in trading and service sectors which require the competencies in Management and Communication skills. Specific educational objectives of the Department of Engineering Technology are as follows.

4.1. Aims and Objectives

Specific educational objectives of the Department of Engineering Technology are,

1. Develop skills of students that are required to contribute to the Mechanical and related operations in an establishment with an understanding of basic sciences and Engineering fundamentals.

2. Develop the ability to design, develop and maintain systems integrating equipment and/ or subsystems involving Mechanical, Electrical and Electronic nature.

3. Develop the understanding of the role of Technology in the society and apply Engineering Technology towards Economic, Social, Environmental andSustainable Development of the society.

4.2. Degree Programs

Department of Engineering Technology offers the following degree.

Bachelor of Engineering Technology Honors degree: **BET(Hons)**

4.3. Program Learning Outcomes (PLO)

On successful completion of this program student should be able to,

1. Apply knowledge of basic Sciences, Mathematics, Engineering fundamentals and Mechanical Engineering Technology procedures, processes, tools and systems.
2. Select, apply and adapt modern Engineering and IT techniques, resources and tools to broadly-defined Mechanical and Electrical Technology activities with an understanding of the associated limitations.

   Undertake problem identification, formulation and solution of Mechanical and Electrical Technology problems using methods that involve appropriate experiments, analysis and interpretation of data and synthesis of information to reach valid conclusions.
3. Utilize a system approach to design and operational performance.
4. Effectively function as an individual and in multi-disciplinary and multi-cultural teams, with the capacity to be a leader or manager as well as effective team member.
5. Acquire the understanding of the social, cultural, global and environmental responsibilities of the professional Engineer and the need for sustainable development.
6. Acquire the understanding of the principles of sustainable design and development.
7. Acquire the understanding of the professional and ethical responsibilities and commitment to them.
8. Communicate effectively on Engineering Technology activities with the Engineering community and with society at large.

4.4. Minimum BET Degree Requirements

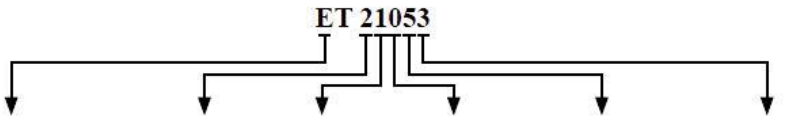
In order to receive a BET Hons degree from the DBET of FT of SUSL, a student must meet the minimum requirements given below:

1. Complete a minimum of 120 credit hours.
2. Complete the Department Core Curriculum requirements outlined in this chapter.
3. Complete the major and support work requirements and the elective requirements for the BET degree.
4. Meet all requirements for an honors degree as put forth by the SUSL Senate.
5. Achieve an overall 2.0 grade point average in all courses attempted at SUSL.
6. Be in good academic standing and free of any punishable misconduct at SUSL to obtain a class.
7. Apply formally for the conferment of degree in the Registrar's office.

4.5. Curriculum

4.5.1. Course Numbering System

FT courses are designated by five-digit numbers following a three-letter abbreviation of the academic discipline.



ET	2	1	0	5	3
Academic Discipline	Year	Semester	Course Number		Number of Credits

4.5.2. Number of Credits

The number of credits assigned to any subject represents the number of hours spent in class, in laboratory, spent on assignments, and estimated to be spent in exam preparation per semester.

4.5.3. BET Curriculum

The BET curriculum has been prepared to satisfy the requirements of Sri Lanka Qualifications Framework (SLQF) Level 6 and to fulfil requirements of international accreditation boards. The program is of 8 semesters duration and the core program is of 120 credits.

4.5.4. Curriculum Component Area Requirements

All the courses offered in Year I, Year II, Year III and Year IV are ***Compulsory***. All students must complete the following component area requirements.

Component Area	Credits
Mathematics, Basic Sciences and Computing	23
Technology Core	21
Communication, Economics, Management	76
Total	**120**

4.5.5. Annual Credit Schedule

Students are highly advised to follow the credit schedule indicated below for them to be able to complete the degree program in four academic years. However, student may take additional credits with prior approval of the faculty board of FT.

Year	Semester I	Semester II	Total
Year I	18	18	36
Year II	18	18	36
Year III	17	06	23
Year IV	10	15	25
Total			**120**

4.5.6. Course Schedule

Students must complete a total of 120 credits and component area requirement following the course schedules given below. Moreover, student wishing follow additional courses may do so provided prior approval of the faculty board of FT

Year I and Year II

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year I Semester I - A student must earn a minimum of 18 credits			
Year I Semester I	ET 11013	Engineering Drawing and Computer Aided Drafting	3	Compulsory
	ET 11023	Workshop Technology and Practice	3	
	ET 11032	Mathematics 1	2	
	ET 11043	Physics for Technology	3	
	ET 11053	Chemistry for Technology	3	
	ET 11062	Computer Fundamentals and PC Applications	2	
	ET 11072	English	2	
	ET 11080	Creative Mini-project	0	
	Year I Semester II - A student must earn a minimum of 18 credits			
Year I Semester II	ET 12013	Fundamentals of Thermodynamics	3	Compulsory
	ET 12023	Applied Mechanics	3	
	ET 12033	Applied Electricity	3	
	ET 12043	Properties and Strength of Materials	3	
	ET 12052	Mathematics 2	2	
	ET 12062	Computer Programming Techniques	2	
	ET 12072	Communication Skills	2	

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year II Semester I - A student must earn a minimum of 18 credits			
Year II Semester I	ET 21012	Automobile Technology	2	Compulsory
	ET 21023	Design of Machine Elements	3	
	ET 21033	Manufacturing Processes 1	3	
	ET 21043	Probability and Statistics	3	
	ET 21053	Applied Electronics	3	
	ET 21062	Professional Communication	2	
	ET 21072	Industrial Metrology	2	
	Year II Semester II - A student must earn a minimum of 18 credits			
Year II Semester II	ET 22011	Field Studies	1	Compulsory
	ET 22023	Computer-Aided Design	3	
	ET 22033	Manufacturing Processes 2	3	
	ET 22043	Mechanical Power Transmission	3	
	ET 22053	Thermodynamics	3	
	ET 22063	Fluid Mechanics	3	
	ET 22072	Computational and Numerical Mathematics	2	
	Year III Semester I - A student must earn a minimum of 17 credits			
Year III Semester I	ET 31013	Electrical Machines	3	Compulsory
	ET 31024	Machine Design	4	
	ET 31033	Automotive Electronics	3	
	ET 31042	Optimization Methods	2	
	ET 31051	Occupational Health and Safety	1	
	ET 31062	Industrial Economics and Accounting	2	
	ET 31072	Introduction to Nano Materials	2	
	Year III Semester II - A student must earn a minimum of 06 credits			
Year III Semester II	ET 32016	Industrial Training (24 weeks of industrial training)	6	Compulsory

Year/ Semester	Course Notation	Name	Credits	Compulsory/ Elective
	Year IV Semester I - A student must earn a minimum of 10 credits			
Year IV Semester I	ET 41016	Integrative Product Design and Research Project	Contd S8	
	ET 41023	Control Systems	Compulsory 3	
	ET 41033	Computer Integrated Manufacturing (CIM) (AMT option)	3	Stream core and Elective for others
	ET 41043	Building Services (energy services option)	3	
	ET 41052	Production Management	2	Compulsory
	ET 41061	Environment Management	1	
	ET 41072	Modern Automotive Technology	2	Elective
	ET 41081	Humanities Module 1	1	Compulsory
	Year II Semester II - A student must earn a minimum of 18 credits			
Year IV Semester II		Project contd….	6	
	ET 42011	Professional Practices	1	Compulsory
	ET 42022	Industrial Management	2	
	ET 42031	Entrepreneurship Development	1	
	ET 42043	Industrial Installations (Energy Services option)	3	Stream core and Elective for others
	ET 42053	Industrial Automation and Robotics (AMT option)	3	
	ET 42061	Project Management	1	Compulsory
	ET 41072	Humanities Module 2	1	

4.6. Course Content

4.6.1. Year I Semester I

ET 11013[1] – Engineering drawing and Computer Aided Drafting (C)[2]

1 credits (Lectures 1.0, Lab 4.0)[3], Prerequisite: None

Orthographic projections: Drawing standards, drawing symbols, practice free hand sketching of simple components, orthographic projections of simple components, First angle projection, third angle projection, sectional views, dimensioning

Assembly drawings: Assembly drawings of simple machines, sectional views, parts/ material list

Isometric views: Isometric scale, isometric views of simple machine parts

Developments: Development of simple components such as Construction of Developments of Prism, Cylinder, Cone, Pyramid

Interpenetration curves: Intersection of simple shaped components, construction of interpenetration curves of objects such as Cylinder, Cone, Sphere, and Pyramid.

Computer aided drafting: Use of computer aided drafting software for the preparation of orthographic projections of mechanical engineering components and assembly drawings. Introduction to 3-dimensional modeling and parametric 3-dimensional modeling using CAD software.

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1. *In the course code: academic discipline (three-letter abbreviation), year/level (first digit), semester (second digit), course number (third and fourth digits), number of credits (fifth digit)*
2. *Module Type: C – Compulsory, O - Optional,CE – Stream core and Elective for others*
3. *Hours/Week*

ET 11023 – Workshop Technology and Practice (C)

3 credits (Lectures 1.0, Lab 4.0), Prerequisite: None

Introduction: Safety practices in the work place, personal safety equipment, use of correct tools, correct use of tools, fitting operations.

Sheet Metal Works: Introduction, sheet metal tools, marking and layout, operations – bending, cutting, rolling, soldering

Foundry Practice: Introduction, casting processes, pattern making, foundry tools, core making, melting furnace – cupola, sand casting, die casting

Forging Practice: Introduction, forging tools, operations – upsetting, drawing,cutting, bending, punching, forging presses and hammers, advantages and limitations

Metal Joining: Safety considerations, introduction, soldering, brazing, welding – gas welding, arc welding, resistance welding, tungsten inert gas welding (TIG), metal inert gas welding (MIG)

Operation of Workshop machinery: Introduction to workshop machinery, their functions, limitations, lathe machines, milling machines, drilling machines.

Carpentry Work: Carpentry shop tools and machinery, their functions and operations

ET 11032 – Mathematics 1 (C)

2 credits (Lectures 2.0, Tutorials/ Assignments 2.0), Prerequisite: None

Matrices and determinants: Matrices and systems of linear Equations, Operations with Matrices, Determinant of a Square Matrix, Inverse of a Square Matrix, Applications of Matrices and Determinants, Solving Systems of Linear Equations.

Vectors: Vectors and Scalars, Vector Algebra, linearly dependence and linearly independence, Vector Fields, Dot and Cross product, Reciprocal sets of Vectors, geometrical applications.

Differentiation: Computation of derivatives, derivatives of trigonometric functions, derivatives of exponential and logarithmic functions, implicit differentiation, and inverse trigonometric functions; Applications of Differentiation: including graphing, max-min problems.

Integration: Anti-derivatives, sums and sigma notation, area under a curve, definite integrals, the First and Second Fundamental Theorems of calculus; Applications: Area between curves, arc length, surface area and volume.

ET 11043 – Physics for Technology (C)

3 credits (Lectures 2.0, Tutorials/ Assignments/ Lab 2.0), Prerequisite: None

Analysis of moving systems: International system of units and standards, Newton's Laws, Forces, Momentum and impulse, Work and Energy, Conservation of energy (Kinetic and Potential energy), Power and Efficiency, Machines (Levers, Ramp, Pulleys and Screw jacks),

Fluid Mechanics: Pressure and Density of fluids, Pascal's Principle and Archimedes' Principle, Fluid flow, Bernoulli's Equation and its Applications and Viscosity. Surface tension

Theory of Electricity: circuit theories, Maxwell's Laws, Fundamentals of electromagnetism,

Thermal Physics: Temperature, Heat energy, Expansion and Contraction of materials, Heat capacities (solid, gas), Gas laws, Propagation of heat (Conduction, Convection and Radiation), Lighting and its hazards, Solar radiation and Greenhouse effect.

ET 11053 – Chemistry for Technology (C)

3 credits (Lectures 2.0, Tutorials/ Assignments 2.0), Prerequisite: None

General Chemistry: Fundamental chemistry, Atomic structure and reactivity, Molecular structure, Chemical reaction, chemical balance,

Organic and Inorganic Chemistry: Hydrocarbons, organic acids, alcohols and other derivatives, chemical production processes, extraction of metals, manufacture of chemicals, petro-chemicals,

Chemistry of metals: Nature, properties such as physical, chemical and mechanical properties, molecular structure, alloys and non-metals in industry; metal corrosion and corrosion prevention; Basic chemical kinetics applicable to industry;

Polymer Chemistry: Nature, chemistry, properties and application of natural and synthetic polymers

Physical Chemistry: Chemical balance, Thermo-chemistry, combustion, basic electro chemistry, electrolysis,

Analytical Chemistry: Environment control related topics, chemical pollution control, standards

ET 11062 – Computer Fundamentals and PC applications (C)

2 credits (Lectures 1.0, Lab/ Assignments 2.0), Prerequisite: None

Computer Architectures: Information systems, computers and components of a computer system, input/output devices, peripherals Classification of Computer software: operating systems and other system software, application software, Interfacing with computer

Internet: Searching and saving Web resources, Communicating through the Internet, Online collaboration Applications, computer ethics

Computer networks: Types of networks, network security, troubleshooting of computer systems

Software applications: Installation of application software, Office applications for word processing, presentations and spreadsheets

Multimedia technologies: Types of multimedia, Use of multimedia digital devices with a computer

ET 11072 – English (C)

2 credits (Lectures 2.0, Tutorials/ Assignments 1.0), Prerequisite: None General construction of text for expression

i. Tenses with their respective forms and uses.

ii. Prepositions, determiners, conjunctions, “be” verbs, “have” verbs, phrasal verbs and modal verbs meaningfully.

iii. Writing simple and complex sentences.

iv. Using word classes.

v. Subject-verb relationship.

vi. Conditional statements.

vii. Speaking and writing on various general / specific topics, greetings and leave taking, marks of courtesy.

viii. Differentiating between facts and opinion.

ix. Making comparisons and contrasts.

x. Finding causes and effects.

xi. Use of dictionaries, glossaries and encyclopedia.

xii. Describe information presented in graphs/charts, procedure.

xiii. Narrations and static descriptions.

xiv. Read and comprehension of complex passages taken from general and specific areas.

xv. Finding facts and opinions.

xvi. Listening and comprehension of general and specific lectures, speeches, texts and conversations.

xvii. Writing formal essays / compositions and official correspondences.

xviii. Extracting required information from spoken or written technology-related materials.

xix. Exchanging technology-related information using appropriate language.

Construction of text for expressing facts and opinions, Construction of text for describing people and places, Construction of text for mathematical expression

ET 11080 – Creative Mini Project (C)

0 credits (Lab/ Assignments 2.0), Prerequisite: None

Problem solving methods: Scientific approaches to Critical Thinking, Decision making, Creative processes, Learning processes

Application of problem solving methods: Breaking problems down, Problem analysis, Role play, Logic, Testing and validating solutions

4.6.2. Year I Semester II

ET 12013 – Fundamentals of Thermodynamics (C)

3 credits (Lectures 1.0, Lab 3.0/2.0, Tutorials 1.0), Prerequisite: None

Introduction: Properties of a pure substance, thermodynamic system, phase equilibrium, gas laws, energy, work and heat,

First law of Thermodynamics : Thermodynamic process, closed systems and open systems, cycle, application of the first law of thermodynamics to thermodynamic systems, relationships between system constants for an ideal gas, concept of control volume, non-flow and steady flow processes, applications

Second law of thermodynamics : Second law, reversible and irreversible processes, entropy, thermodynamic relations, applications

Gas power cycles: Internal combustion engines: application of the second law of thermodynamics to the operation of heat engines, theoretical heat engine cycles, the Carnot cycle, Otto cycle, diesel cycle, dual combustion cycle, performance characteristics of heat engines, efficiencies of IC engines

Combustion: Combustion of fuel, stoichiometric air-fuel ratio, exhaust and flue gas analysis, calorific value of fuel

ET 12023 – Applied Mechanics (C)

3 credits (Lectures 2.0, Lab 3.0/2.0, Tutorials 1.0), Prerequisite: None

Kinematics of Planar linkages and mechanisms: Velocity and acceleration diagrams of mechanisms, quick return mechanisms, Coriolis component of acceleration, applications

Balancing: Static & dynamitic balancing of a single rotating mass by a mass rotating in the same plane, a single rotating mass by masses rotating in different planes; Balancing of several masses rotating in different planes; applications

Balancing of reciprocating mass systems: – in line, v-type, rotary systems, determining the unbalanced forces and moments.

Vibration: Vibration of 1 dof systems (free, forced, without and with damping) Vibration of two degree of freedom systems; Vibration absorbers; Vibration

isolation and measurements Torsional vibration of two and three rotor systems - undamped Transverse vibrations of single rotor systems; Critical speeds; whirling of shafts Introduction to multi degree of freedom system Applications

ET 12033 – Applied Electricity (C)

3 credits (Lectures 2.0, Lab 3.0/2.0, Tutorials 1.0), Prerequisite: None

Fundamentals : Fundamentals of electric circuits, DC circuit analysis, resistors, insulators and conductors, resistivity, electrical power and energy; solutions of RLC circuits, AC theory, single phase AC systems. Phasor diagram & Complex representation; Impedance & Resonance in LCR circuits; Power and Power factor.

Basic Electrostatic and Electromagnetic theory; Force and torque development in magnetic circuits.. Electrical measurements and measuring instruments

Three-Phase Analysis: Review of Phase sequence; star and delta connections; Analysis of three phase balanced circuits; Single Line Equivalent diagrams; Three phase unbalanced circuits; Analysis, symmetrical components

Electric lighting : Basic principles, characteristics of light, lamps and luminaires, average lumen method of lighting calculations.

Electrical wiring : Electrical distribution systems of domestic and industrial buildings. Wiring regulations, protective devices, and circuits and wiring symbols, selection and voltage drop calculations of cables. Earthling. Economics of power utilization. Safety practices.

ET 12043 – Properties and Strength of Materials (C)

3 credits (Lectures 2.0, Lab 3.0/2.0, Tutorials 1.0), Prerequisite: None

Mechanical and physical Properties of material : Cast Iron, Steel; Plain carbon steels and Alloy steels

Non – ferrous metals; Brass, Bronze, Aluminium etc. Comparative Properties, elasticity, UTS, Yield stress, hardness, toughness, fatigue, creep, modes of failure

Non-metallic material, ceramics, polymers, composites, properties and engineering applications tensile, compressive, shear stresses in machine elements and their

combined effect Requirement of material properties for various machine elements

Stress and strain Analysis: Direct and shear stress and strains, boundary conditions, elasticity, Hooke's law, Poisson's ratio, thermal strain and deformation, Saint-Venant's principle, statically indeterminate problems, elastic strain energy, thin-walled spherical and cylindrical pressure vessels. Transformation of stresses in 2D problems, principal stresses, Mohr's circle of stress, combined loading. Applications

Bending of Beams: Shear forces & bending moments in beams, point and distributed loads, simple and rigid supports, theory of simple bending, deflection of beams, bending stress distribution, combined loading, applications

Buckling of Columns : Euler critical loads for combinations of free, pinned and built-in end conditions, limiting stress conditions for columns subjected to axial loads, applications

Torsion of shafts: Torsional shear stress distribution in shafts of circular cross section, angle of twist, torsional strain energy, applications

ET 12052 – Mathematics 2 (C)

2 credits (Lectures 2.0, Tutorials/ Assignments 2.0), Prerequisite: None

Complex Numbers: Introduction, Real and imaginary numbers, Algebra of complex numbers, Complex roots of quadratic equations, Complex number operation, Polar form of the complex number, applications

Differential Equations: Ordinary and partial differential equations, Classification, General form and solution,, Linear and non-linear differential equations, Initial value problem, Boundary value problem, Differential equations of the first orderand first degree Introduction, Separation of variables, Homogeneous equations, Method of solving homogeneous equations, Linear differential equations, Bernoulli's equation, Exact differential equations, Equations reducible to the exact form

Trigonometric functions and Graphs: Angles, radian measure, fundamental identities; addition, product, and half angle formulas, solution of triangles; polar coordinates; inverse trigonometric functions, complex numbers in trigonometric form, DeMoivre's theorem and the theorem of the nth roots, applications of trigonometry

ET 12062 – Computer Programming Techniques (C)

2 credits (Lectures 1.0, Lab/ Assignments 2.0), Prerequisite: None

Introduction to Computer Programming: Basic practical skills in computer sciences, basic terminology used in computer programming, write, compile and debug programs in C language, different data types in a computer program.

Programming and data structures: Design programs involving decision structures, loops and functions. Understand the dynamics of memory by the use of pointers. Different data structures and create/update basic data files.

Managing arrays: Relation between 1D Arrays and Pointers. Pointer arithmetic with arrays.

Debugging and file handling : Understand how to use a debugger to isolate and fix critical errors. Learn computer functions, file handling techniques.

Introduction to Object Oriented Programming : Object Oriented Programming (OOP) concepts

ET 12072 – Communication Skills (C)

2 credits (Lectures 2.0, Tutorials/ Assignments 1.0), Prerequisite: None

Static Description: Tenses with their respective forms and uses. Prepositions, determiners, conjunctions, "be" verbs, "have" verbs, phrasal verbs and modal verbs meaningfully. Structure of simple and complex sentences. Word classes . Subject-verb relationship. Conditional statements. Writing on specific topics, useof greetings, leave taking, marks of courtesy. Making differentiation between facts and opinion. Comparisons and contrasts, identifying causes and effects. Using dictionaries, glossaries and encyclopedia. Describing information presented in graphs/charts. Comprehension of complex technology related passages, general and specific lectures, speeches, texts and conversations and oral and written communication.

Composition, Cause and Effects, Comparison and Contrast Design of flow charts and forms of diagrams Exemplification and classification

4.6.3. Year II Semester I

ET 21012 – Automobile Technology (C)

2 credits (Lectures 2.0, Lab 3.0/3.0), Prerequisite: None

Introduction: Functions, design requirements, operation and performance of main components and sub systems of a vehicle including electrical systems (starting, ignition, charging, lighting etc.)

Automotive engines: Engine types, construction, performance characteristics, performance monitoring, testing.

Suspension System: Passive and Active suspension systems, design, construction, performance and fault diagnosis.

Steering system: Steering mechanisms. Manual, power assisted, electronically controlled power steering systems, construction, operation and diagnosis.

Braking System: Classification of brakes, drum brake & disc brakes, Constructional details, Theory of braking. Mechanical, hydraulic and Pneumatic brakes, Servo brake, Power and power assisted brakes-different types of retarders like eddy current and hydraulic retarder, Anti lock braking systems.

Drive train: Components of the drive train and their functions, manual, semi-automatic and automatic transmissions, drivetrains of hybrid vehicles, comparison of construction and performance of different drivetrains

Tires: Pneumatic tires, their construction, behaviour, wheel alignment, effects of incorrect alignment on the tires, vehicle performance etc.

Exhaust gas emissions: Combustion of fuel, Vehicle emissions, Catalytic converters, Exhaust analysis. National and international standards.

ET 21023 – Design of Machine Elements (C)

3 credits (Lectures 1.0, Lab/ Assignments 2.0+2.0), Prerequisite: None

Design principles: Aspects governing design of machine elements, functional requirements, strength considerations, manufacturability, aesthetic aspects, life cycle, costing

Parametric design of simple machine elements: Loads and stresses, modes of failure, fatigue in machine elements, safety factors, material selection,, designof machine elements for various loading conditions and under various failure criterions.

Joining Methods: Criteria for the selection of joining methods of machine components, design of riveted, welded, bolted and glued joints

Standard Machine components: Criteria for the selection of standard machine components, use of catalogues

Design for manufacture: Selection of manufacturing process, accuracy of manufacturing, tolerancing, process planning,

Use of design and drafting software: Application of design software for the design and analysis of machine components, use of drafting software to produce relevant drawings.

ET 21033 – Manufacturing Processes 1(C)

3 credits (Lectures 1.0, Lab/ Assignments 2.0+2.0), Prerequisite: None

Design principles: Aspects governing design of machine elements, functional requirements, strength considerations, manufacturability, aesthetic aspects, life cycle, costing

Parametric design of simple machine elements: Loads and stresses, modes of failure, fatigue in machine elements, safety factors, material selection,, designof machine elements for various loading conditions and under various failure criterions.

Joining Methods: Criteria for the selection of joining methods of machine components, design of riveted, welded, bolted and glued joints

Standard Machine components: Criteria for the selection of standard machine components, use of catalogues

Design for manufacture: Selection of manufacturing process, accuracy of manufacturing, tolerancing, process planning,

Use of design and drafting software: Application of design software for the design and analysis of machine components, use of drafting software to produce relevant drawings.

ET 21043 – Probability and Statistics (C)

3 credits (Lectures 2.0, Tutorials/ Assignments 2.0), Prerequisite: None

Introduction to statistics: Population, sample, sampling techniques and random sample, Descriptive Statistics: Data presentation and Summary measures

Probability theory: Sample spaces, events, probabilities of simple events, probabilities of combinations of two or more events, statistically independent events, conditional probability, simple rules of probability, Bayes' Theorem

Random Variables and Probability Distributions: Definition of a random variable, discrete and continuous random variables, probability distribution function, probability density function, mean and variance of a random variable.

Discrete probability distributions, binomial and Poisson distributions, Continuous probability distributions: normal distribution, standard normal distribution, Use of standard normal tables.

Sampling and sampling distributions: Principles of sampling, the sampling distribution of sample mean, the sampling distribution of sample proportion. Introduction to inference and confidence interval estimation, parent distribution, estimating population parameters, confidence interval for a population proportion, confidence interval for population mean. Analysis of variance.

Hypothesis testing: Introduction to hypothesis testing, Testing a population proportion, Testing a population mean, Testing a population median.

Correlation and regression: Scatter diagram, sample correlation coefficient, simple linear regression, least-squares method and linear transformations. analysis of categorical data, The chi-square test for goodness of fit, the chi-Square test of independence, the chi-square test of homogeneity.

Application of statistical software: Recommended statistical software: SPSS, Minitab

ET 21053 – Applied Electronics (C)

3 credits (Lectures 2.0, Lab/Tutorials 2.0/2.0 +1.0), Prerequisite: None

Electronic components circuits and applications: Diodes, Diode Circuits and Applications: Operation and characteristics of junction diode, zener diode, varactor diode and light emitting diode, power supply unit, rectification, voltage regulation and stabilisation, inverter, clamping and limiting circuits, thyristors and controlled rectification, filters, oscillators

Bipolar Junction Transistors, Field Effect Transistors and Circuits: Operation and characteristics of Bipolar Junction Transistors (BJT), use as a switch and as an amplifier. Field Effect Transistors (FETs) and Circuits: Operation and characteristics of JFET, use as a switch and as an amplifier, comparison with BJTs, applications

Integrated Circuit Amplifiers: The purpose and use of integration, operational amplifiers, inverting amplifier configuration, voltage amplifiers, power amplifiers, design considerations, applications.

Logic Circuits: Binary codes, logic gates, logic expressions, logic circuits, latches & flip-flops, shift registers, counters, decoders, encoders, multiplexers and de-multiplexers,, logic circuit designing considerations

Sensors and transducer technologies: Performance characteristics of transducers: dynamic range, sensitivity, resolution, input/output impedance, useful frequency range, resistance transducers, opto-conductive transducers, capacitive transducers, inductive transducers, thermocouples, piezoelectric transducers

Instrumentation: Electronic instrumentation and systems of instrumentation, design considerations of instrumentation systems, A/D and D/A convertors, dataacquisition, storage and signal processing, applications.

ET 21062 – Professional Communication (C)

3 credits (Lectures 2.0), Prerequisite: None

Tenses with their respective forms anduses. Prepositions, determiners, conjunctions, "be" verbs, "have" verbs, phrasal verbs and modal verbs meaningfully. Structure of simple and complex sentences. Word classes. Subject-verb relationship. Conditional statements. Writing on specific topics, use of greetings, leave taking, marks of courtesy. Making differentiation between facts and opinion. comparisons and contrasts, identifying causes and effects. Using dictionaries, glossaries and encyclopedia. describing information presented in graphs/charts. Comprehension of complex technology related passages, general and specific lectures, speeches, texts and conversations and oral and written communication

Communication movement: Describing position, motion and direction

Pictorial representation for visualisation and textual communication: Design of graphs, charts, tables and forms of diagrams Design and preparation of documentation for professional communication: Reports, manuals, instruction sheets

ET 21072 – Industrial Metrology (C)

2 credits (Lectures 2.0, Lab/ Assignments 2.0), Prerequisite: None

Measuring Instruments: Basic measuring instruments in precision metrology, accuracy, precision, calibration, selection and use,

Fundamental concepts of Quality: Tolerances, Limits and fits, standards, gauge design, control charts

Methods of measurement and assessment: Measurement of length, angle and geometry, slip gauges, comparators, gauge design

Measurement of shape: Measurement of surface texture, geometric accuracy, roundness, concentricity, cylindricity, flatness, auto-collimator

Instrumentation for the measurement of physical parameters: Instrumentation and techniques for mass, pressure, force, temperature and electrical measurements.

Special measuring machines: Tool-makers microscope, Coordinate measuring machine, Advanced measuring instruments, electronic instrumentation for analogue and digital measurements

4.6.4. Year II Semester II

ET 22011 – Field Studies (C)

1 credits (Field visits/ Assignments 2.0), Prerequisite: None

Determined by a combination of the technology and complementary study areas of the curriculum as appropriate for the field sites planned for spending a period of several days at the end of which the students have to compile reports and makepresentations based on their guided learning.

ET 22023 – Computer Aided Design (C)

3 credits (Lectures 1.0, Lab/ Assignments 4.0), Prerequisite: 11013, 21023

Solid modelling: Concepts of 3D drafting / modelling, Introduction to Solid modelling – Application software (e.g. SolidWorks/CATIA/ProE/Solid Edge…), production of 2D drawings, Model structure, assembly and sub assembly, parametric modelling

Introduction to Finite Element Analysis: Concepts of FEA, element types, mesh size, problem formulation, model and mesh generation, modelling for FEA, analysis methods, finite element analysis in solid mechanics and heat transfer

Applications of FEM: Industry standard FEA software packages and analytical tools, (e.g.ANSYS, COMSOL, Autodesk Simulation…), application of software to solve basic engineering design problems in areas such as solid mechanics, heat transfer and fluid mechanics, analysis and interpretation of results,

Design for manufacture: Introduction to 3D printing, advantages and disadvantages, generation and use of sold models for 3D printing.

ET 22033 – Manufacturing Processes 2 (C)

3 credits (Lectures 2.0, Lab/ Assignments 2.0), Prerequisite: 11013, 21023

Casting Technology: Sand casting, process and accessories, Shell moulding, Slurry processes, Investment casting, Die-casting, Centrifugal casting, Continuous casting,

Melting practice, Casting properties and defects, Basic mould design. Casting defects and prevention

Forming Technology: Cold and hot forming, press work, punching, blanking,piercing, rolling, extrusion, cup drawing, wire drawing, drawing parameters, Forming defects and prevention

Fabrication and welding technology: Fitting, limits and fits, tolerances, Joining and welding methods, process parameters for gas and arc welding, welding fixtures, welding defects and prevention

Polymer moulding: Introduction to Injection moulding, Compression moulding, blow moulding, GRP moulding, moulding defects and prevention

ET 22043 – Mechanical Power Transmission (C)

3 credits (Lectures 2.0, Assignments 2.0), Prerequisite: 21023

Belt drives: Types, performance and applications, design criteria and basic design of flat and v-belt drives

Gears: Types, performance and applications Spur gears: spur gear geometry, design criteria and basic design of spur gear drives. kinematic design of gear trains; velocity ratios of simple, compound and epicyclic gear trains; acceleration of geared systems

Clutches: Types of clutches; Friction clutches, fluid clutches, electro-magnetic clutches; characteristics and applications Friction clutches: Types of friction, laws of dry (Coulomb) friction,, types of friction clutches, design criteria, pivot and collar bearings, uniform wear and uniform pressure, single and multi-plate clutches, cone clutches, centrifugal clutches,

Fly wheel: Function and design criteria, turning moment diagrams for reciprocating engines and presses; determination of required flywheel moment of inertia to satisfy specified operating conditions

Couplings: Types, design criteria, performance and applications, design/selection of couplings.

Universal couplings: Hooke's joint; constant velocity joint; conditions for a constant velocity ratio.

Cams: Types of cams, types of followers, performance and applications cams and followers, design of cam profiles to give desired follower motions, uniform velocity, uniform acceleration and retardation and simple harmonic motion outputs

ET 22053 – Thermodynamics (C)

3 credits (Lectures 2.0, Lab/ Tutorials 3/2+1.0), Prerequisite: ET 12013

Refrigeration and air conditioning: Vapour compression refrigeration cycles, choice of refrigerant, refrigerating effect, capacity, power required, CoP, ; vapourabsorption systems, water-ammonia and lithium-bromide systems; heat pump,its application possibilities; mixtures of gases and vapours, effects of mixtures of gases and vapours on the performance of cooling towers and condensers, air-conditioning plant, use psychrometric charts, Cooling load calculation, air distribution systems.

Compressors and expanders: Positive-displacement expanders and compressors, isothermal and isentropic efficiencies,; reciprocating air compressors, effect of clearance, volumetric efficiency, multi-stage working with intercooling, optimum intermediate pressure, performance characteristics, compressor faults and hazards; rotary positive displacement compressors;

Heat transfer: Mechanisms of heat transfer, conduction, thermal properties of matter, Fourier's law, applications; convection, Newton's law of cooling, natural and forced convection; heat exchangers, parallel and counter flow, cross flow, LMTD, applications ; radiation, Stefan-Boltzman law, black and grey body radiation, emissivity, absorption, reflection and transmission;

Turbines: Properties of steam, dryness fraction, steam turbine, vapour power cycles, Rankine cycle, ideal, reheat and regenerative, effects of superheating, reheating and regenerative feed heating, circuit and property diagrams, performance characteristics of steam power plant. Gas turbine power cycles, effects of intercooling, reheating and heat exchange, principle of operation, constructional details, operating characteristics, applications.

ET 22063 - Fluid Mechanics (C)

3 credits (Lectures 2.0, Lab/ Tutorials 3/2+1.0), Prerequisite: None

Fluid Dynamics: Fluid energy and its forms, Euler's equation, Bernoulli's Theorem,

one dimensional flow, Momentum and impulse of fluids in motion, applications

Laminar Viscous flow: Reynolds number, Navier-Stokes equation of motion, Fluid shear stress, laminar one dimensional flow between parallel plates, laminar flow through circular pipes

Hydraulic pumps: Pump classification, applications, centrifugal pumps, velocity diagrams and work done, pump losses and efficiencies, performance characteristics, system characteristics, pump selection, problems. Axial flow pumps, Deep well pumps, Submersible pumps, construction, performance and applications Reciprocating pumps, work, power and efficiency, effect of air vessels, construction, performance and applications Rotary displacement pumps

Hydraulic systems: Hydrostatic and hydrodynamic principles, energy considerations, transmission of force and motion through liquids, types and properties of hydraulic fluids, Advantages and disadvantages of fluid power systems. applications

Components of hydraulic systems: Function, construction, operation and characteristics of: pumps, motors, fluid couplings, torque converters, actuators valves, strainers and filters, coolers, reservoir, accumulators, connectors, sealing devices etc

Faults and fault diagnosis of hydraulic systems, hydraulic system maintenance,design and construction of hydraulic systems.

Hydraulic turbines: Impulse and reaction turbines, Pelton wheel, Francis turbine, Kaplan turbine, construction, work done and efficiency, performance characteristics, applications

ET 22072 – Computational and Numerical Mathematics (C)

3 credits (Lectures 1.0, Tutorials/ Assignments 2.0), Prerequisite: None

Software for Mathematical Analysis: Introduction to mathematical analysis software and applications of commercial software such as MATLAB.

Numerical Analysis: Numerical solution of linear systems - Jacobi and Seidel Gauss- Numerical solution of nonlinear algebraic equations: Bisection, Newton's method, solving multivariable nonlinear systems.

Curve Fitting: Interpolation, Curve fitting of functions: Lagrange and Newton's interpolating polynomials and piecewise-polynomial interpolates.

Numerical Differentiation and Numerical integration: Finite differences, Trapezium and Simpson's rule.

Numerical solution of ordinary differential equations: Initial value problems: Explicit and implicit Euler and higher order methods.

4.6.5. Year III Semester I

ET 31013 – Electrical Machines (C)

3 credits (Lectures 2.0, Lab 3.0/2.0, Tutorials 1.0), Prerequisite: None

Transformers: Single Phase transformers and three phase transformers, EMF equation, equivalent circuit & phasor diagram, losses & efficiency, voltageregulation, cooling of transformers, test on transformers, performance characteristics, determination of technical specifications, faults and fault diagnosis

AC Machines: Types of rotors and windings, AC motors and alternators, induction motor action, torque speed characteristics, losses and efficiency, starting and speed control, ratings and applications. single phase induction motors and three phase induction motors and their applications; torque and control techniques, speed control of electric motors using semiconductor devices, motor selection

DC machines: Construction, operation and performance characteristics of series, shunt and compound DC motors. Starting and speed control, industrial applications, DC Generators; construction, operation and performance characteristics, applications.

Special purpose motors: Universal motors: constructional and operational characteristics. Stepper motor operation and types, applications. Brushless DC motors and motor drives.

Motors for special purposes, construction, performance and applications

Electrical system maintenance: Operation, maintenance and testing of electrical systems including machinery and devices, individually and as a part of a system, identifying faults and symptoms, fault diagnosis and follow up actions, safety aspects

ET 31024 – Machine Design (C)

4 credits (Lectures 2.0, Lab/ Assignments 4.0), Prerequisite: 21023, 22023

Conceptual Design : Analysis of market requirement, Value Analysis, Evaluation of alternatives, Design requirements, Conceptual design, competitive product, benchmarking, Initial product specification

Parametric Design: Selection of materials, Stress analysis, use of design standardsand trade catalogues, factors of safety, concurrent engineering, design for manufacture

and assembly, design for quality, production and procurement specifications, design of simple assemblies, jig and fixture design

Prototyping : Process planning, part list, preparation of production drawings, use of CAD software, development of sample for testing and improvement

Industrial design: Human factors engineering, design for batch production, design for maintenance, product costing, commercial design

ET 31033 – Automotive Electronics (C)

3 credits (Lectures 2.0, Lab/ Assignments 3.0), Prerequisite: none

Automotive Diagnostic Tools and Equipment: Automotive diagnostic equipment and tools: scanners, fault code readers, engine analysers: their functions, working principles, operating procedures, and interpretation of test results. On-board diagnostics

Sensors and Actuators: Basic sensor arrangement, types of sensors such as-oxygen sensors, crank angle position sensors-fuel metering/vehicle speed sensor and detonation sensor-altitude sensor, flow sensor, throttle position sensors. solenoids, stepper motors, and relays

Engine Control Systems: Open loop and closed loop control systems-engine cranking and warm up control-acceleration enrichment-deceleration leaning and idle speed control, distributor less ignition-integrated engine control systems, exhaust emission control system, electronic dashboard instruments-on-board diagnosis system, security and warning system, feedback carburettor systems, throttle body injection and multi-port or point fuel injection, fuel injection systems, injection system controls, petrol and diesel injection and engine management systems.

Engine systems diagnostics: Engine operation diagnostics, fuel system diagnostics, ignition diagnostics, emissions diagnostics, fuel injection diagnostics, diesel injection systems engine management diagnostics, combined injection and fuel control systems engine management and fault finding information, air supply and exhaust systems diagnostics, lubrication system diagnostics, diagnosing battery faults, diagnosing starting system faults, diagnosing charging system faults

Electrical and Electronic systems diagnostics: Electronic components and circuits, diagnosing lighting system faults, diagnosing auxiliary system faults: in car entertainment (ICE) security and communications, diagnosing ICE, security and communication system faults, diagnosing body electrical system faults, diagnosing instruments system fault.

Vehicle Comfort Systems: Internal heating system, air conditioning system or climatic control system, diagnosis of faults in vehicle comfort systems, cruise control diagnostics, air bags and belt tensioners diagnostics.

ET 31042 – Optimization Methods (C)

2 credits (Lectures 2.0, Tutorials/ Assignments 2.0), Prerequisite: None

Introduction to Optimization: Single variable and multi variable optimization, Calculus-based optimization methods, optimality criteria and optimization methods and applications.

Constrained optimization: conditions, objective functions, Simplex, transportation and assignment algorithms of linear programming, sensitivity analysis, integer and mixed integer formulations, applications in production planning,

Multi criteria optimization: formulation of the problem, principles of multi-criteria optimization, goal programming applications

Optimization software applications: Spreadsheets, spreadsheet simulations, other proprietary software

ET 31051 – Occupational Health and safety (C)

1 credits (Lectures 1.0), Prerequisite: None

OHS concepts: Basic concepts of Occupational Health and Safety, Health and Safety at the workplace

Human factors : Ergonomics, Work Physiology, promotion of healthy and safe workplaces, prevention of occupational accidents and diseases, occupational hygiene and worker welfare, work related disorders, protection of workers‟ health and well-being,

Regulatory practices and standards : Industrial safety standards, OHS legislation, Standards, Rights, responsibilities and duties of employees and employers Hazard management, Hazards and housekeeping requirements associated with the work environment

ET 31062 – Industrial Economics and Accounting (C)

2 credits (Lectures 2.0, Lab/ Assignments 1.0), Prerequisite: None

Introduction to Economics : Introduction to economics, demand and supply,elasticity, utility theory, production functions, cost and revenue, Introduction to the market structures, perfect competition, monopoly, monopolistic competition and oligopoly, Introduction to macroeconomics.

Financial Accountancy : Role of financial accounting, Trading and profit or loss account, balance sheet, manufacturing account, interpretation of accounts, Financial analysis

Management Accountancy : Role of cost accounting, methods of depreciation, allocation of overheads, job costing, process costing, batch costing, standard costing, cost variances, marginal costing, cost-volume-profit analysis, make or buy decisions, pricing

Investment Analysis : Time value of money, payback, discounted cash-flow techniques,

ET 31072 – Introduction to Nano Materials (C)

2 credits (Lectures 2.0, Lab 3.0/3.0), Prerequisite: None

Nanoscale, Atomic and Material Structures, Carbon, Compounds and Alloys, Properties change at nanomaterials, Top-down and Bottom-up nanofabrications, Optical Microscopy, Nanoscale Microscopy (STM, SEM, TEM, AFM), Surface Characterization, Electrical characterization, Optical Characterization

4.6.6. Year III Semester II

ET 32016 – Industrial Training (C)

6 credits, Prerequisite: None

4.6.7. Year IV Semester I

ET 41016 – Integrative Product Design and Research Project (C)

6 credits (Lectures 1.0), Prerequisite: All

System Design : Analysis of market requirement, Analysis of integrative requirements, Evaluation of alternatives, Design for compatibility, Conceptual design, competitive product benchmarking and innovation

Detailed Design : Selection of sub-systems and components, analysis of operational requirements, use of design standards and trade catalogues, health and safety, life cycle costs, design for product reliability and quality, production and procurement specifications

Commercialization : Competitive assessment, operational manuals, maintenance manuals, life cycle costs, after sale service, maintenance contracts, commercialization process

ET 41023 – Control Systems (C)

3 credits (Lectures 2.0, Lab 3.0/2.0, Assignments 1.0), Prerequisite: None

Control theory: Introduction to control engineering; open loop and closed loop control, mathematical model of physical systems, block diagrams; transfer functions;

System Stability: Stability criteria and stability of a system, time domain and frequency domain analysis, proportional, integral and derivative controllers and applications

Control instrumentation and systems - Electric & Electronic controls: Introduction to principles of electric & electronic control systems, sensors, stepper motors, servo drives, servo control systems; micro controllers, micro-processors, Arduino platforms, shields, programming; interfacing electromechanical sub-systems, control hardware, multiplexing, logic gates, Programmable logic controllers(PLCs), programming and applications, design of control systems, faults and fault detection.

Control instrumentation and systems - Pneumatic & hydraulic control: Basic laws & principles of pneumatic & hydraulic systems, control loops, components of pneumatic and hydraulic systems, pneumatic and hydraulic circuits, classification, applications, design of control systems, faults and fault detection.

ET 41033 – Computer – Integrated Manufacturing (CE)

3 credits (Lectures 2.0, Lab/Assignments 2.0), Prerequisite: 21023, 21033, 22033

Scope and role of CIM : Scope for Computer Integration in manufacturing (CIM), elements of CIM systems, CAD, CAM and CAE

Computer-Aided Design : Basics of Computer graphics, Computer Aided Drafting and Design (CAD) software, wire frame, surface and solid models, 2D and 3D models

Computer Numerical Control : History of programmable machinery, Principles of Computer Numerically Controlled (CNC) machines and programming, G-Code, APT, Elements of Computer Aided Manufacturing (CAM) systems, Classification and nomenclature of CNC machines, CADCAM integration, software

Computer-Aided process Planning : Algorithms for computer aided production planning (CAPP), regenerative and variant methods, process knowledge representation

Automated process control : Automatic control systems and instrumentation, Automated measurement and inspection

Group Technology : Production Flow Analysis, Group Technology, coding systems, cluster analysis for group cell design

ET 41043 – Building Services (CE)

3 credits (Lectures 2.0, Lab 2.0/1.0 Assignments 2.0/1.0), Prerequisite: None

Building Services: Functions, requirements, expected performance, design requirements, design considerations of following building services: HVAC systems, solar hot water systems Water supply and drainage systems. Electrical systems. Communication systems and networks. Safety systems: fire alarms, fire fighting systems. Security systems: access control systems, alarms, CCTV systems. Sanitary systems. Waste disposal systems Operation and maintenance of following building services: HVAC systems Water supply and drainage systems. Electrical systems. Communication systems and networks. Safety systems: fire alarms, fire fighting systems. Security systems: access control systems, alarms, CCTV systems. Sanitary systems. Waste disposalsystems

Smart buildings: Application of modern technology in buildings, building automation, energy efficient buildings

ET 41052 – Production Management (C)

2 credits (Lectures 2.0), Prerequisite: None

Role of Production Management : Determining production strategy, Managing the conversion process, facing the competitive challenge

Product and process design: Classification of production systems, product design, process selection and design, choice of technology

Production planning: Strategic capacity management, facility location, facility layout, demand forecasting, aggregate planning

Materials planning and control: Inventory Management, Material requirements planning, manufacturing Resources Planning (MRP).

Operations Management: Network planning, Critical Path method, Operations scheduling, sequencing rules, Just-in-time (JIT) lean manufacturing, lean supply chain

Quality and Reliability Management: Plant reliability, Overall Equipment Effectiveness (OEE), Maintenance policies, Replacement analysis Total Quality Management, Statistical process control, Acceptance sampling, Quality assurance

ET 41061 – Environment Management (C)

1 credits (Lectures 1.0), Prerequisite: None

Introduction to environment management in industry: Sources, composition, nature, fate, and impacts of physical and chemical pollutants found in industry, Management strategies for environment pollution, treatment, control and safe disposal

Environment management strategies: Sustainable development, ISO standardsfor Environmental Management, Tools for environmental assessment, IEE, EIA, SEA, LCA, EPL, EMS, Case studies

ET 41072 – Modern Automobile Technology(E)

2 credits (Lectures 2.0, Lab 3.0/3.0), Prerequisite: None

Data communication and sensors: Can bus protocol and data communication in automobiles. Modern engine management systems

Electrical vehicles: History of Electric Vehicle Technology, Electric Vehicle Battery Technology, Brushless DC Motors, Motor controlling, High Voltage system, Battery charging system, Battery cooling, General Maintenance, Safety precautions and Recycling of Li-Ion batteries.

Hybrid vehicle Technology: Advantage of hybrid Vehicle over Electric Vehicle, Types of Hybrid Architectures, Toyota Series-Parallel Hybrid Technology, Honda Integrated Motor Assistance Hybrid Drive system,, IC engines for hybrid engines and controlling (Engine Mapping), Plug-in Hybrid vehicle Technology

Advanced transmission systems: Automatic transmission, Trip Tronic, CVT and dual clutch systems. Limited Slip Differential: Mechanical, Viscous, Electronic, Electronic Differential controlling, Modern All wheel Drive systems

Passenger comfort and safety: Noise, vibration and harshness controlling in automobiles. Active techniques and passive techniques. Designing for crash safety and automotive crashworthiness. . Advanced automotive sensory systems. Distance sensors, collision avoidance, lane departure, parking assist systems.

Current areas of Research and Development: Fuel cell technology. Dynamic suspension systems. Autonomous vehicle

Future developments: Driver over ride systems. Biometric vehicle access. Vehicle tracking systems. Enhanced Vehicle display systems. Smart vehicles

4.6.8. Year IV Semester II

ET 42011 – Professional Practices (C)

1 credits (Lectures 1.0), Prerequisite: None

Introduction to Professional Ethics : Introduction to codes of ethics, responsible technologist, Honesty, Integrity and reliability, risk, safety and liability in Engineering technology, Technologists as Employees, Technologist and the Environment, Technical Professionalism and Ethics, multi-cultural environment

Law and Ethics: Analysis of the fundamental, legal principles applicable in protecting the rights and interests of technologist and their employers; formationand discharge of contracts; agency relationships; torts; labour laws; patents; trademarks; copyrights; IPR, unfair competition, ethics and professional relations.

ET 42022 – Industrial Management(C)

2 credits (Lectures 2.0), Prerequisite: None

Human Resource Management: Introduction to Human Resource Management, Human behavior, Job Design and Job Analysis and Human Resource Planning, Recruitment and Selection placement and Induction, Training and Development, Performance Evaluation, Compensation, Employee Grievances Handling, Labour-Management Relations

Basic Marketing: Marketing as an organizational function, Evolution of marketing concepts, Marketing goals and strategies, Consumer behavior, Marketing mix and targeting, Pricing strategies, channeling and promoting products, Preparation of a marketing plan

Management of Technology and Innovation: Technology for socio-economic development, Appropriate technology, Different embodiment forms of technology, Path for technology development, Economic restructuring based on make-some and buy-some technology, Technology transfer, Technology strategy, Technology incubators, Introduction to innovation, innovation process, innovation culture in organizations, Research & Development, New product development

ET 42031 – Entrepreneurship Development (C)

1 credits (Lectures 1.0), Prerequisite: None

Introduction to Entrepreneurship: Entrepreneurs, businessmen, managers and the self-employed, entrepreneurial characteristics, self-assessment methods, Role of entrepreneurs in national development

Entrepreneurship Development : Development of entrepreneurs, essential characteristics of techno-entrepreneurs

Business Proposal and Plan: Business proposals and assessing criteria, Developing a business proposal including financial, marketing, organizational and operational plans, Business proposal presentation and defense.

ET 42043 – Industrial Installations (CE)

3 credits (Lectures 2.0, Lab 3.0/2.0, Assignments 1.0), Prerequisite: None

Electrical systems: Functions, expected performance, design requirements, design considerations, Electric power utilization, cost of electric power: fixed, variable and maximum demand charges, tariffs. Demand management: power factor correction. Lightning protection. Generators, solar PV systems, wind power generation etc. Operation and maintenance of electrical systems.

Heating systems: Heating systems: heating methods, Solar hot water systems, Boilers, types, construction, operation, steam distribution, instrumentation ; heat exchangers, pumps, valves, safety devices, safety codes and regulations applications, operation and maintenance

Compressed air systems: Basic principles of pneumatics, advantages and disadvantages of compressed air as the working fluid, Compressor Types: construction, operation, safety devices. Air quality, maintenance: Air Treatment, Stages of air treatment, Filters, Air dryers, intercoolers, aftercoolers, Lubricators

Pressure Regulation: Relief valves, Non-relieving pressure regulators, Relieving pressure regulators, Air Receivers and Compressor Control Operation, applications, design considerations of compressed air systems, safety regulations,safety practices, safety devices.

Energy management in industry: Energy sources, energy supply, energy utilisation, energy auditing, optimisation of energy utilisation.

Industrial communication systems: Introduction to industrial communication

systems, networked systems for manufacturing and automation applications, wireless industrial networks, applications and maintenance.

Industrial waste management: Types of waste, rules and regulations governing waste disposal, waste disposal methods, design and construction of waste management systems, reuse, recycling,

ET 42053 – Industrial Automation and Robotics (CE)

3 credits (Lectures 2.0, Lab/ Assignments 2.0), Prerequisite: 41073

Industrial Automation: Applications of automatic control systems and instrumentation, automated measurement and inspection, elements and operation of vision systems and image processing, methods of illumination in vision systems for shape and surface inspection, Application of PLCs and microcontrollers in manufacturing processes.

Introduction to robots: Synthesis of elements with movability constraints; classification and specification of robots, Laws of Robotics, Elements of robot anatomy

Kinematics of Manipulators: Hydraulic, pneumatic and electrical manipulators; End-effectors and their design

Robot Controllers : microprocessors or fluidics; Sensors – Tactile and non-tactile type

Management issues: Performance analysis of industrial robots and their manufacturing applications; Economics of robotics

ET 42061 – Project Management (C)

1 credits (Lectures 2.0), Prerequisite: None

Formulation and Organization of Projects: Introduction to Project Management, Organizational structures for projects, Formulation and selection of projects, Organizational structures, Defining a project, Project times and costs, Developing a project plan, Risk management,

Planning and Control of Projects: Network Models for Project Scheduling (PERT/CPM):Introduction to PERT and CPM, Scheduling of resources, crashing activity times, planning and scheduling, project costs, Measuring and evaluating performance, Winding up of projects,

Introduction to R&D project management: Role of R&D, Patents and Intellectual property management

5. EXAMINATION CRITERIA

5.1. General

A student who satisfies the following conditions will be awarded a Bachelor of Biosystems Technology Honors degree or a Bachelor of Engineering Technology Honors degree depending on their program of study.

- Be registered at the university as a candidate for the degree program.
- Has completed the program of studies for each semester to the satisfactory level of the expectations of the senate.
- Interlaid, at least 80% attendance for lectures, tutorials, practical assignments,etc.
- Every registered student who wishes to sit the examination should submit an application in the appropriate form within the stipulated period. Each eligible student will be issued an admission card/ form to sit the relevant examination.
- Every candidate should sit the examination in respect of all the relevant subjects studied during the semester.

5.2. Assessment Policy and Strategies

Each credited (GPA) course will have an end semester comprehensive written examination. The practical component of the courses will be assessed as decided by the department and approved by the Faculty Board. The final year project will be assessed by the academic supervisor appointed by the department and a supervisor appointed for each student after the approval of the Faculty Board.

5.3. Examination Structure

5.3.1. Department of Bio systems Technology

5.3.1.1. Evaluation Criteria

Given below is a general description of the evaluation criteria of the Department of Biosystems Technology. A detailed description on evaluation criteria of each course module could be found on the BBST curriculum document, and also it will be made available to students in the first week of the offering of each course during a semester.

In general, continuous assessments (quizzes, tutorials, laboratory practical, field practical, assignments, etc.) will be allocated up to a maximum of 40% while the end semester examination will be allocated minimum of 60%, of the total marks allocated for the course module. The end semester examination may consist of a theory examination and/or practical examination as required by the course module.

5.3.1.2. Examination Structure

(a) Continuous Assessment (quizzes, tutorials, laboratory practical, field practical, assignments, etc.)

Note: - Marks allocation for Continuous Assessment is stated in each Course Outline.

(b) End Semester Examination

5.3.1.3. Theory Examination

Theory paper consists of two parts:

Part I: Multiple-choice questions paper

Part II: Essay paper

Type of paper	No. of credits	Total time allocated	No. of questions to be answered	Marks allocated %
Essay or Essay and MCQ	1 Credit	2 Hours	4 Out of 5	As stated in the Module Outline
	2 Credit	2 Hours	4 Out of 5	
	3 Credit	3 Hours	5 Out of 6	

Note: - If there is a MCQ paper in the Final Examination, it will be allocated 30 minutes within the total time allocation

5.3.1.4. Practical Examination

There shall be a practical examination for some courses of study and will include;

a) A practical examination (spot test/practical paper/practical test) conducted at the end of each semester or as a continuous assessment.

b) A viva voce conducted at the end of each semester.

5.3.1.5. Final Evaluation of Course Modules

The final grade of a course module will be decided upon the cumulative marks calculated based on the marks obtained for continuous assessments, and end semesterexamination.

5.3.1.6. Department of Engineering Technology

(a) Continuous Assessment (Quizzes, Tutorials, Laboratory Practice and Assignments)

Note :- Marks allocation for Continuous Assessment is stated in each Module Outline.

(b) End Semester Examination

Type of paper	No. of credits	Total time allocated	No. of questions to be answered	Marks allocated %
MCQ or/ and Essay	1 Credit	1.5 Hours	3 Out of 7	As stated in the Module Outline
	2 Credit	3 Hours	5 Out of 7	
	3 Credit	3 Hours	5 Out of 7	

Note :- If there is a MCQ paper in the Final Examination, it is allocated 30 mins for MCQ within the total time allocation

5.4. Final Evaluation

The final grade will be decided upon the marks calculated based on the mark distribution among Continuous Assessments, Practical, and Final Examination.

5.4.1. Grades and Grade Point Values

Grades, Grade Point Values and the Descriptions are as follows;

Grade	Grade Point Value	Description
A+	4.0	Excellent
A	4.0	
A-	3.7	
B+	3.3	Good
B	3.0	
B-	2.7	
C+	2.3	Pass
C	2.0	
C-	1.7	Weak Pass
D+	1.3	Conditional Pass
D	1.0	
E	0.0	Fail

Note: In order to earn grade D or above, student must score more than the minimum prescribed marks for both Continuous Assessment (CA) and End Semester Assessment (ESA). If the assessment is only by CA, minimum prescribed mark for CA will apply.

5.4.1.1. References to indicate the status when a module is not completed

Following or similar references may be used to indicate the status when a studenthas not completed a module. This is for record keeping of the university and for the information of the students.

Reference	Grade Point	Description
E(CA& ESA)	0.0	Both CA and ESA marks are below the prescribed minimum. Incomplete CA and ESA
E (CA)	0.0	CA mark is below the prescribed minimum. Incomplete CA
E (ESA)	0.0	ESA mark is below the prescribed minimum. Incomplete ESA
N	-	Academic concession
W	-	Withdrawn

Percentage marks ranges

Percentage marks ranges for the purpose of reference are as follows;

Percentage Marks for Reference	Grade
85 and above	A+
80 to 84	A
75 to 79	A-
70 to 74	B+
65 to 69	B
60 to 64	B-
55 to 59	C+
50 to 54	C
45 to 49	C-
40 to 44	D+
35 to 39	D
0 to 34	E

Note: Percentage marks ranges given above are for the guidance of the Examiner. Marks ranges for a particular module may be decided by the Moderator, in consultation with the Examiner, based on the marks distribution and taking the above reference marks ranges into consideration. Marks ranges adopted for a particular module must be declared to the Board of Examiners.

For non-credit compulsory courses grades will be assigned as “Pass” or “Fail” according to the following criteria.

≥50 marks = Pass
< 50 marks = Fail

Students must obtain Pass grade for each of the non-credit compulsory course to be able to be graduated.

5.4.1.2. Pass/Fail criteria

i) Percentage pass mark for the CA is equivalent to the minimum mark assigned for Grade D. Percentage pass mark for the ESA is equivalent to the minimum mark assigned for Grade D. *(Proportion of marks allocated for CA and ESA must be approved by the university. It is recommended to adopt 30% for CA and 70% for ESA for theory oriented modules and 40% for CA and 60% for ESA for practically oriented modules. There may be modules with higher percentage for CA or assessedentirely by CA)*

ii) Grade D or above is required to earn credit value for a module.

iii) Student failing in CA, ESA or both CA and ESA must repeat respective components.

iv) Grades **C-, D+, D or E,** which can be improved to a Grade **C**, are considered for calculating Semester Grade Point Average (SGPA).

v) Student is considered to have completed a semester successfully only if he/she has achieved a **SGPA** of **2.00** or above, and has, in that semester no **E** grade and no morethan three grades at the levels of **C-**, **D+** or **D**. (Note: E grades will be included in calculating SGPA)

vi) All modules for which the student has registered for the semester will be counted in calculating the SGPA.

5.4.1.3. Criteria for English Language modules

Paragraph 5.1.3. (c) of the Sydney Accord Accreditation Manual specify minimum 15 credits in the category of studies in Management, Engineering

Economics and Communication. Communication modules are for the development of student's capability to effectively communicate both orally and in writing, specially the concise reporting skills. If English Language modules are offered in addition to the Communication modules, two options can be considered in evaluating the performance of those modules.

Option 1 – If the credits allocated to those English Language modules are within 120 credits considered for the degree, normal pass/fail criteria applicable to other compulsory modules will apply. However, credits allocated to English Language modules must be non-GPA credits.

Option 2 – If the credits allocated to those English Language modules are over and above 120 credits, normal pass/fail criteria or special criteria that require the student to pass those modules but not counted towards credits can apply. In any event, passing of those English Language modules (minimum D) is a requirement to earn the degree.

5.5. Semester Grade Point Average

The calculation of the Semester Grade Point Average (SGPA) will be based on the summation of Grade Points earned for all GPA modules registered (except those awarded with academic concession or withdrawn) in a semester weighted according to number of credits as per the following formula, where $\boldsymbol{Ci}$ is the number of credits for the $\boldsymbol{i}_{th}$ module in a given semester and $\boldsymbol{GP_{th}}$ is the grade points earned for that module and $\boldsymbol{n}$ is the number of GPA modules in the semester.

$$SGPA = \frac{\sum_{i=1}^{n} C_i \; GP_i}{\sum_{i=1}^{n} C_i}$$

Note: It must be noted that weightage for Continuous Assessment may vary depending on the module and therefore, fixed weightages must not be brought into the SGPA calculation equation. Industrial Training should be allocated GPA credits.

5.6. Academic Progression

A student who has not successfully completed the first four semesters will not be permitted to register for the fifth semester until the SGPA and grades in each of the first four semesters are improved as required. Grade(s) obtained for English

Language will not be a barrier, provided SGPA and other criteria are satisfied. Successful completionof a semester is defined in paragraph 5.4.1.4 (V) (*Pg 113*).

5.7. Cumulative Grade Point Average

The Cumulative Grade Point Average (CGPA) describes a student's current standing in terms of grade points earned for all GPA modules registered up to a given point of time (except those awarded with academic concession or withdrawn) weighted according to number of credits as per the following formula, where ***Ci*** is the number of credits for the ***i*** th module and GP_i is the grade points earned for that module and ***n*** is the total number of registered GPA modules.

$$CGPA = \frac{\sum_{i=1}^{n} C_i \; GP_i}{\sum_{i=1}^{n} C_i}$$

Note: The weightage for each semester is taken as uniform for the calculation of CGPA. All semesters must be successfully completed for the award of the degree.

5.8. Cut-off levels of CGPA for awarding Classes/Pass

Class/Pass	CGPA
First Class	3.70
Second Class (Upper)	3.30
Second Class (Lower)	3.00
Pass	2.00

All requirements for the award of the degree must be completed in four academic years to earn a Class.

5.9. Maximum period for the completion of the degree

The maximum period for the completion of all requirements for the award of the degree is recommended to be 08 academic years.

6. CONVOCATION MEDALS AND AWARDS

The prizes listed in this section are awarded to the most outstanding graduating student in the Department of Engineering Technology, and to the most outstanding graduating student in each specialization stream of the Department of Biosystems Technology of the Faculty of Technology.

The Department of Engineering Technology and the Department of Biosystems Technology nominates the candidates for these awards, and subsequent approval of the Senate and Council are mandatory.

The first priority criterion of selection for these awards is high grade point average of the particular specialization stream, if several specialization streams are offered in the same department. However, when no specialization is available, the first priority criterion of selection for these awards is high grade point average of the particular degree program.

In addition to aforementioned criterion, other criteria such as outstanding achievements and contributions on internships, research, sports, and extra-curricular activities may also be considered in determining the prizewinner.

Importantly, for a student to qualify for any medal or an award he/she must be free of any punishments including punishment/s related to examination malpractices and disciplinary misconduct/s

The Medals

6.1. Faculty of Technology

Most outstanding student of the faculty, Faculty of Technology

6.2. The Department of Biosystems Technology

Best Performance in Bioenergy Specialization of Bachelor of Biosystems TechnologyDegree Program

Best Performance in Biotechnology Specialization of Bachelor of BiosystemsTechnology Degree Program

Best Performance in Drug Discovery Specialization of Bachelor of BiosystemsTechnology Degree Program

6.3. The Department of Engineering Technology

Most outstanding graduating student in the Bachelor of Engineering Technologyprogram.

Other than aforementioned prizes given through the FT, students are welcomed to apply for the "Student of The Year Medal" awarded by the vice-chancellor of SUSL, once it is advertised by vice-chancellor's office.

7. EXAMINATION PROCEDURES, MALPRACTICES AND PUNISHMENTS

Faculty of Technology strictly adheres By-law No. 03 of 1996 related to examinations approved by the Council of the Sabaragamuwa University on all matters pertaining to examinations.

7.1. Rules and Regulations Governing the Holding of Examinations

1. Candidates should be at the examination hall 15 minutes before the commencement of the relevant examination. They should enter the examination hall only when informed to do so by the supervisor.

2. After entering the examination hall, the candidates should be seated at the desk/ table bearing their index numbers.

3. Candidates are permitted to bring useful items such as pens, pencils, erasers, ink, rulers, geometrical instruments, colored pencils etc. to the examination hall. No candidate is allowed to bring in any written paper or notes or any kind of electronic device or accessories or any other item, which may be misused at the examination.

4. Candidates are not allowed to enter the examination hall 30 minutes after the commencement of an examination and they will not be allowed to leave the examination hall before the lapse of 30 minutes from the commencement of the examination and during the last 15 minutes of the examination.

5. Every candidate must bring the examination entry form (admission card), student record book and the student identity card to the examination hall. While the student record book and the identity card should carry the student's photograph and signature, it should also be certified either by the Registrar or an officer authorized by the Registrar. If the names appearing in the student record book/ identity card and those in the examination entry form differs, the candidate has to submit an affidavit to the Registrar. In the event of such certification not being available, the candidate has to

submit either the national identity card or a recent photograph certified by an authorized officer.

6. When requested by the supervisor of the examination, candidates must surrender all documents in their possession.

7. No candidate should ask another candidate for anything, exchange anything, engage in conversation, copy from another or help or encourage another candidate to copy.

8. Candidates should write their answers only in the answer sheets or answer books issued on the particular date of the examination.

9. Writing paper such as answer sheets, graph paper, drawing paper, ledger and journal sheets required by the candidates will be issued to them at the examination centre. Candidates are advised not to tear, bend crumple or destroy any paper or answer sheet given to them. Writing paper issued only by the supervisor should be used at the examination. Log tables should be used carefully and left on the table after use. All stationery supplied to the candidates, both used and unused, should be left on the desks when candidates leave the examination hall.

10. Before answering the question paper, candidates should write their Index number and the name of the examination in the relevant place in the answer script. The Index number should also be written in all other sheets used for answering questions. No candidate should write his/her name or place any identification mark on the answer script. It should also be noted that using the Index number of another is a breach of examination rules.

11. All paper used for rough work should be crossed with a line and annexed to the answer script. Rough work should not be done on the examination entry form, timetable or question paper.

12. All candidates must maintain strict silence both inside and outside the examination hall and not disturb the supervisor, invigilators and other candidates.

13. Except for a practical or field note book or assignment written by himself/ her self, no candidate is allowed to submit any other document written partly or wholly by someone else, with the answer script.

14. Impersonation of any kind is strictly prohibited.

15. The supervisor or the invigilators have the authority to call for a written statement from a candidate regarding any incident that takes place in the examination hall. Candidates should not refuse to make such a statement or sign such a statement.

16. Answer scripts should be personally handed over to the Supervisor or an Invigilator. Answer scripts should not be handed over to anyone else for whatever reason. All candidates should remain seated until all answer scripts are collected.

17. Candidates must make sure that they don't have in their possession any document, note or device which can be misused at the examination. They must also ensure that they do not indulge in acts, which can give rise to their being suspected of misconduct at the examination.

7.2. Submitting Medical Certificates for Absence at Examination

Internal candidates who absent themselves for the whole or part of an examination due to ill health should report to the Medical Officer of the University about it either before the commencement of the examination or during the examination time.

Candidates who fail to do so for unavoidable reasons must submit a medical certificate from a District Medical Officer or a Medical Officer attached to a government hospital, within 14 days of the commencement of the relevant examination or part of the examination*. Medical certificates issued by private medical officers; Ayurvedic physicians or Homeopaths are not accepted.

* *Such medicals certificates can be handed over to the dean's office or sent by registered post.*

7.3. Examination Malpractices

Examination malpractices are classified as follows:

1. Possession of unauthorized documents.
2. Copying
3. Cheating
4. Removal of examination stationery from the examination hall.
5. Inappropriate behavior
6. Impersonation
7. Gaining or attempting to gain unlawful access to the contents of a question paper.
8. Aiding or abetting someone to cheat or receiving assistance from someone to cheat.
9. Using undue influence on supervisors, invigilators and other examination officials.
10. Any other action considered by the Senate as an examination malpractice.

7.3.1. Procedure for Investigating Examination Malpractices

The supervisor should report any examination malpractice to the Asst. Registrar (Examinations) who will investigate into the matter and submit a report to the sub- committee appointed by the Senate. On the recommendations submitted by the sub- committee, the Senate will impose appropriate punishment on the offenders.

7.3.2. Punishment for examination malpractices

7.3.2.1. Possession of unauthorized documents

Punishment: Banning examination candidacy for a period of two years or imposing alternative punishment considered appropriate by the Senate.

7.3.2.2. Copying

Penalty: Invalidating examination candidacy for a period of three years or imposing alternative punishment considered appropriate by the Senate.

7.3.2.3. Cheating

Penalty: Cancellation of examination candidacy, debarring candidate from sitting for University examinations for a specific period or imposing any other punishment considered appropriate by the Senate.

7.3.2.4. Removing examination stationary belonging to the University

Penalty: Cancellation of examination candidacy and debarring candidate from sitting for university examinations for a period of specified by the Senate.

7.3.2.5. Inappropriate conduct

Penalty: Cancellation of examination candidacy and debarring candidate from sitting for university examinations for a period not exceeding 05 years and imposing any other punishment considered appropriate by the Senate.

7.3.2.6. Impersonation

Penalty: Annulment of candidacy for a period not less than 05 years and not exceeding 10 years and the imposition of any other punishment considered appropriate by the Senate.

7.3.2.7. Gaining illegal access or attempting to gain such access to the contents of a question paper

Penalty: Cancellation of examination candidacy and imposing any other punishment considered appropriate by the Senate.

7.3.2.8. Aiding and abetting examination malpractices and receiving assistance to commit such malpractices

Penalty: Cancellation of examination candidacy and imposing any other punishment considered appropriate by the Senate.

7.3.2.9. Attempting to unduly influence examination supervisors and other officials

Penalty: Any punishment prescribed by the Senate.

7.3.2.10. Being guilty of an examination malpractice for the second time

Penalty: Cancellation of registration as a student of the University.

7.3.3. Compulsory punishments

In addition to the punishments listed above, the following will also be imposed on the recommendation of Senate:

1. Withholding a class for the degree.

   Limiting the maximum marks obtainable to 40% when re-sitting canceled question papers.
2. Either cancelling or withholding scholarships and bursaries.
3. Withdraw residential facilities.
4. Withholding Invitation to graduation ceremony.
5. Delaying graduation and the release of degree results by one year.

The Senate will decide on the punishments to be imposed for any examination malpractice not mentioned above.

8. CODE OF DISCIPLINE FOR STUDENTS

8.1. Section I

8.1.1. General Students' Discipline – Act of Indiscipline and Insubordination

1. The conduct of every student should at all times be exemplary. Throughout his period of studentship he should at all times behave with the decorum to be expected of a graduate.

2. Every student should apply himself to his academic work in such manner as to satisfy the university. No student may absent himself/ herself from lectures or practical work for a period exceeding three weeks in one academic year unless he/ she has obtained special permission or has a valid reason for such absence.

3. No student should commit any of the acts of indiscipline and Insubordination listed below:

(1) Behaving in such manner as to bring into disrepute or endanger the good name of the university; to obstruct the proper functioning of the education, examination, or administrative activities of the university; to prevent or obstruct a member of the academic/ non-academic staff, or an employee of the university from carrying out his duties; to ridicule or humiliate such a person.

(2) Failure or inability to produce the Students Record Book, which will be issued to students, when called up-on to do so by the Vice-Chancellor, Dean of the faculty a member of the academic staff, a member of the administrative staff, or by a person authorized by the Vice-Chancellor, or the Registrar, or failure to identify himself/ herself.

Causing damage to university property; removing such property from the university premises, appropriating it to himself/ herself or to another; defacing, dirtying or defiling the buildings, walls or roads of the university by scratching, writing, drawing, or pasting posters upon them.

(3) Causing or aiding, abetting, encouraging or sanctioning others to cause injury or harm to the self-respect or dignity of other students, staff officials, employees or lawful visitors to the university, or causing loss, ridicule, danger, mental or physical pain to such person or persons.

(4) Establishing, organizing, conducting or assisting any activity, organization, or society within the university, apart from those registered in terms of Clauses 112, 114, 115, 116, 117 and 118 of Part II of the Universities Act No.16 of 1978 as amended by the Universities (Amendment) Act No. 7 of 1985.

(5) Behaving in such manner as to disturb or disrupt, or to gain admittance without permission, or to cause discomfort or harm to participants in any meeting, seminar, festival, procession, exhibition, variety entertainment, play, film show or religious, cultural or social event, which may have been organized with prior approval from the Vice Chancellor or the Dean of the Faculty by a society or organization which has been registered under the provisions laid-out in section (5) above.

(6) Behaving in such manner as to disturb or disrupt, or to gain admittance without permission, or to cause discomfort or harm to participants in any meeting, seminar, festival, procession, exhibition, variety entertainment, play, film show or religious, cultural or social event, which may have been organized, with prior approval from the Vice Chancellor of the university by the university administration or by the academic or non-academic staff or by an external organization.

(07) Organizing staging, encouraging, sanctioning, or participating in any meeting, seminar, festival, procession, exhibition, variety entertainment, play or film show held within the university premises or in its environs without the prior approval of the Vice Chancellor.

(8) Holding meetings, picketing, demonstrating participating in processions or sloganizing, performing satyagraha, satyakriya of fetes, publishing, drawing, writing, putting or distributing hand bills notices, or posters or encouraging sanctioning or assisting others to commit such action, whether in favour of a university teacher or an official or an employee of the university or in favour some cause out side the university.

(10) Ragging in any form (N.B. any person caught ragging is liable to be expelled from the university without any inquiry being held).

Collecting, or encouraging to collect or sanctioning the collection of money or any other items from students of the university, or the retention or disbursement of such funds or items, by any person whether an office bearer of a registered society or not unless it is with the full written consent

(11) Writing, printing, publishing, distributing, exhibiting or pasting either within the university, or in its vicinity, posters, notices, pamphlets or other writing slanderous to any individual or detrimental to the reputation of the university to discipline or to peace.

(12) Publishing, pasting, exhibiting, writing or drawing any notice or poster, in any place other than those authorized for such display, even if such action is in connection with the activities of a society registered with the University in terms of Clause 115 of Part III of the Universities Act. No. 16 of 1978, as amended by the Universities (Amendment) Act. No. 7 of 1985, and even if such notice or posters have been approved by the Vice Chancellor, Dean of the faculty or the relevant teacher.

(13) Publishing, broadcasting, telecasting or releasing to the mass media, whether by the student on his own responsibility, or on behalf of another student or group of students on or behalf a society, any statement article or notice, detrimental to the reputation of the University or insulting or humiliating the university or insulting/humiliating the university authorities, or any official or employee of the university, or any other person connected with the university.

(14) Consumption, distribution sale or storage of drugs, liquor, within or bringing such into the university or been under the influence of liquor or drugs within the university or encouraging assisting or sanctioning such action by any other person.

(15) Bringing into or keeping or storing within the university, any weapon, explosive or dangerous article or encouraging or assisting in such action.

(16) Non-provision or the avoidance of provision of information needed by or requested by the university or the provision of false or distorted information.

(17) Abuse or misuse of university buildings, ground equipment or other property belonging to the university or their use for unsuitable, unsanctioned or improper purposes non-observation of the rules for their rules.

(18) Students will not be provided with residential facilities for remaining within the university premises during times when the university is closed for students (such time may be subject to periodic changes).

(19) Any act for which the student could be convicted by a lawfully constituted court of law for an offense against the laws of the republic of Sri Lanka.

8.2. Section II

8.2.1. Punishments

1. Any student/s found guilty of any offense specified as an act of indiscipline or in subordination in Section (I) above, or of attempting to subvert the provision of this section (Section II – Punishment) may receive one or more of the punishments listed below, as deemed sufficient by the Vice Chancellor acting in accordance with the findings and recommendation of the Disciplinary committee.

(1) A caution or severe warning.

(2) A fine, not exceeding Rs. 500/-

(3) Recovery of any loss sustained by the university.

(4) Suspension from classes, examinations and from the use of all university facilities for a specified period.

(5) Suspension from sitting for examinations of the university for an unspecified period.

(6) Cancellation, postponement or suspension of the release of examination results for an indefinite period.

(7) Regard as having relinquished the course and/ or the university.

(8) Expulsion from the university (The imposition of any one or more ofthe above punishments may be suspended. Note that the punishment for ragging will be expulsion from the university).

2. The Vice Chancellor may impose one or more of the punishments listed in Section II, No. 01 (1) to 97) above without holding any preliminary

inquiry, and without obtaining the sanction of any other person, and so as to take immediate effect, if he has reason to believe that the actions or behavior of any students could lead to a break-down of discipline in the university or render difficulty in the normal running of the University or lead to a breach of the peace.

3. Any student disaffected by the imposition upon him of one or more of the punishments listed in Section II No. 01 (1) to 97) may appeal against the punishments to the Vice Chancellor within 14 days of being notified of the same.

4. The determination that the Vice-Chancellor shall make on such appeal, in consultation with the council shall be final.

Apart from the imposition of the punishment listed in Section II No. 01 (1) to (8), if a student has been guilty of any offence referred to in Section I, the university reserves for itself the right to review and re-evaluate the conduct of such student/s during his/ their period in the university, before conferring upon him any degree, diploma or certificate.

Dean of the Faculty was empowered by Council for temporary suspension of a studentship for two weeks without any inquiry in any student found to be involved in the breach of the code of discipline including ragging and report same to the council.

8.3. Section III

8.3.1. Interpretation

1. "University" means here the Sabaragamuwa University of Sri Lanka
2. "Property" means here university buildings, plantations, library, furniture, and equipment, vehicles and all other moveable and immovable property.
3. "He", "him", "his, etc., indicate both male and female.
4. The interpretation given to any word, phrase or sentence by the Council will be the final interpretation.

(Subject to revision by the council)

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