



# Postgraduate Institute Of Agriculture University of Peradeniya

Student Handbook  
2018

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## MESSAGE FROM THE DIRECTOR



It is a great pleasure to welcome all the students who have registered at the Postgraduate Institute of Agriculture (PGIA) for the degree programmes in the academic year 2015.

The PGIA of University of Peradeniya, Sri Lanka was established in June 1975, in terms of the Ordinance No. 9 of 1979 as the first institution of postgraduate education of its kind in the country, functions as an Institution within the University of

Peradeniya, under the direction of its Board of Management.

At present PGIA offers postgraduate programmes in 31 disciplines and the emphasis is to train and provide most updated knowledge while facilitating research programmes. The programmes of study comprise of course work only, course work and research, and research only. Provisions are available for the research work to be undertaken either in the University System or at a relevant Research Institution in Sri Lanka.

PGIA student population includes local and foreign graduates from different faculties including Agriculture, Veterinary Medicine & Animal Science, Arts, Science, Medicine etc. Students from Bangladesh, India, Peoples' Republic of China, Nepal, Maldives, Myanmar, Oman, Nigeria and Ghana have already completed their postgraduate degrees at the PGIA.

The Panel of Teachers consists of over 300 outstanding academic staff with wide teaching and research experience, the majority of whom are from the Faculty of Agriculture, Peradeniya and the others from other Faculties of the University System, Government Departments, Research Institutes, Corporations, Private Sector Firms, International Institutions and Non-governmental Organizations.

An important challenge facing the PGIA is to develop disciplined, dedicated and hard working students who would devote considerable time to their studies and research and get the widest possible exposure in the relevant fields. Through such commitment, the graduates of the Institute are expected to develop a strong work ethics, which should become an integral part of their character.

The Institute houses the administrative, admissions and financial sections, Computer Units, auditorium and Class rooms. This handbook includes information on courses and the regulations for students pertaining to degree programmes.

**Prof. C.M.B. Dematawewa**  
**Director**

## CALENDAR OF DATES

Activity	First Semester	Second Semester
Pre-registration (for Seniors)	Last week of 2 <sup>nd</sup> semester of the previous year	Last week of 1 <sup>st</sup> semester of the current year
Registration / Submission of Course / Research Enrolment Forms	Early January	Early July
Commencement of Lectures	Mid January	Mid July
Last date for Dropping / Adding Selected Courses	2 <sup>nd</sup> week after Commencement of Lectures	2 <sup>nd</sup> week after Commencement of Lectures
Last date for Lectures	End June	End November
Date for the Submission of the Research Proposal	Any Time	Any time
Date for the submission of final grades for the semester	Within two weeks after the last date of Lectures	Within two weeks after the last date of Lectures
Receipt of Applications for Comprehensive / Thesis Defence Examination	Any time	Any time

Approved Calendar of Dates will be displayed in the Internet and Notice Boards of the Institute.

## FEE STRUCTURE 2018

### (a) Fees for M.Sc./MBA Degree Programmes

Board of Study	Degree Programme	Fee – Rs.
Agricultural Biology	Plant Biology Conservation & Breeding(CW)	125,000*
	Plant Biology Conservation & Breeding(CW&R)	225,000
	Biotechnology (CW)	250,000
	Biotechnology (CW & R)	350,000
Agric. Economics	All programmes (CW)	100,000
	All programmes (CW & R)	200,000
	PG Diploma	70,000
Agricultural Engineering	All programmes (CW)	150,000
	All Programmes (CW & R)	250,000
Agric. Extension	Dev. Com. & Extension (CW)	125,000
	Dev. Com. & Extension (CW&R)	225,000
	Organizational Management (CW)	175,000
	Organizational Management (CW&R)	275,000
Animal Science	All programmes (CW)	125,000
	All programmes (CW & R)	225,000
Business Administration	MBA (CW)	250,000
	MBA (CW & R)	250,000
	Text books	120,000
Bio-statistics	Applied Statistics (CW)	150,000
	Applied Statistics (CW&R)	250,000
	Biostatistics (CW)	150,000
	Biostatistics (CW & R)	250,000
	PG Diploma	125,000
Crop Science	Crop Science (CW)	150,000
	Crop Science (CW&R)	250,000
	Environmental Forestry (CW)	150,000
	Environmental Forestry (CW&R)	250,000
	Floriculture & Landscape Architecture(CW)	150,000
	Floriculture & Landscape Architecture(CW&R)	250,000
	Tropical Agriculture (CW)	400,000
	Tropical Agriculture (CW&R)	400,000
	Plantation Crop Management (CW)	150,000
	Plantation Crop Management (CW&R)	250,000

<b>Board of Study</b>	<b>Degree Programme</b>	<b>Fee – Rs.</b>
Crop Science cont.	Horticulture (CW)	150,000
	Horticulture (CW&R)	250,000
Food Science & Technology	Food Sc. & Technology (CW)	150,000
	Food Sc. & Technology (CW &R)	250,000
	Food & Nutrition (CW)	150,000
	Food & Nutrition (CW&R)	250,000
Plant Protection	Plant Protection Technology (CW)	125,000 **
	Plant Protection Technology (CW&R)	225,000
	Molecular & Applied Microbiology (CW)	125,000***
	Molecular & Applied Microbiology(CW&R)	225,000
Soil Science	All programmes (CW)	125,000
	All programmes (CW&R)	225,000

\* inclusive practicum fee

\*\* inclusive practicum – Rs. 10.000

\*\*\* inclusive practicum – Rs. 20.000

(b) **Fees for Research Students –**

**Course work and Research -** Relevant M.Sc. programme Fee + 100,000

**Research degrees -** M.Phil. - Rs. 250,000

DBA - Rs. 500,000

Ph.D. - Rs. 350,000

(c) **Other Fees**

<b>Other Fees</b>	<b>Rs.</b>
Application Fee	1500
Registration (per semester)	2000
Comprehensive Examination (per attempt)	7500
Thesis Defence Examination (per attempt)	7500
Refundable Library Deposit (per programme)	5000
Non-refundable Library Fee (per programme)	1500
Annual Congress Fee (per year)	1000
Semester Fee (Student Welfare, Health Services and IT payment) (per semester)	1200
Fees for Casual/Research/ Audit student and for Pre-requisite course for each credit unit	1500
Transcript to be sent within Sri Lanka (Regd. Post)	750



Transcript to be sent outside Sri Lanka (Regd. Post)	1000
Transcript issued within one day - Local	1000
- International	1500
Detailed Certificate	400
Provisional Certificate	200
Make-up Examination Fee	3000

#### (d) Fees for Foreign Students - 2018

<b>Programme</b>	<b>SAARC Countries US \$</b>	<b>Other Countries US \$</b>
PG Diploma	2500	3000
All M.Sc. Programmes (CW)	4000	6000
All M.Sc. Programmes (CW&R)	5000	7000
MBA (CW)	6000	8000
MBA (CW & R)	6000	8000
MBA Text Books	700	700
M.Phil Programme	4000	6000
Ph.D. Programme	6000	8000

Partial Scholarships of the programme fees are available for foreign students.

#### Other Fees

<b>Other Fees</b>	<b>USD</b>
Application Fee	-----
Registration (per semester)	15
Comprehensive Examination (per attempt)	75*
Thesis Defence Examination (per attempt)	75*
Refundable Library Deposit (per programme)	50
Non-refundable Library Fee (per programme)	15
Annual Congress (per year)	10
Semester Fee (Student Welfare, Health Services and IT payment) (per semester)	15
Fees for Casual/Research/ Audit student and for	20

Pre-requisite course for each credit unit	
Transcript	20
Detailed Certificate	10
Provisional Certificate	10
Make-up Examination Fee	25

\* Inclusive of Degree Certificate fee

## **FACILITIES FOR STUDENTS**

The students can enjoy following facilities available within the University.

### **a) Computer Units**

The Institute has well equipped Computer Units with Internet Facilities which has over 75 computers and software packages which enable students in their course exercise, data analysis, preparation of theses and research publications etc.

### **b) Library Facilities**

The PGIA Library has a very good collection of text books, journals, monographs, magazines and articles for the subjects of Agriculture, Food Science, Nutrition, Economics, Business administration and other various related fields of Agriculture. Students will be given 2 cards to use the library. Students are requested to contact the library staff if they need any assistance.

### **c) University Health Centre**

The Peradeniya University Health Centre offers medical services to all University Students who can get free consultations and selected medicines from the University Health Centre. Some Laboratory test are also done at the Centre free of charge. Further the Teaching Hospital, Peradeniya is located in walking distance from the PGIA.

### **d) Security within the University Premises**

The safety within the university premises is taken care of by the University Security. In case of emergency the student can contact the University Security by 081-2389182.

**e) Banking Services**

Bank transactions can be done with two state Banks located in Peradeniya. The Peoples' Bank, Peradeniya Branch is located next to the PGIA. Several private banks are also located in and around Peradeniya.

**f) Communication/Mailing Facilities**

Students can use the Internet, email facilities of the PGIA during their study periods free-of-charge. For mailing facilities the nearest is the Peradeniya Post Office which is about 50 m away from the PGIA.

**g) Religious Places**

Peradeniya University has the following Religious Places for the service of the University students and staff.

- Buddhist Temple
- Catholic church
- Hindu Temple (Kovil)
- Mosque

**h) Sports Facilities**

University has adequate facilities for in-door and out-door sports. At the University Gymnasium facilities are available for all sports free of charge for all university students. The PGIA students can use the university swimming pool by paying a nominal fee for the facility.

**i) Shops/Market/Book stores**

The nearest place for buying food stuffs, stationery items or minor shopping is the Peradeniya town. You can also visit shops, supermarkets in and around Kandy. Kandy town is 6 km away from the PGIA.

**j) Canteens/Eating Places**

PGIA Canteen is available for students. There are many other canteens/eating places within the university. Food is available at a subsidized price.

## ACADEMIC YEAR

1. The academic year consists of two semesters, each having duration of fifteen (15) weeks.

## DEGREE PROGRAMMES

### 2. Degree programmes offered by the PGIA

Degree Programme	Minimum requirements (Credits/duration)	SLQFL
Postgraduate Diploma	25	Level 8
Master of Science – M.Sc. (CW)	30 inclusive of 5 credits Directed Study	Level 9
Master of Business Administration – MBA (CW)	36 and 5 credits Project	Level 9
Master of Science - M.Sc. (CW& R)	30 credits course work and one year fulltime or equivalent time of research	Level 10
Master of Business Administration – MBA (CW& R)	36 credits course work and one year fulltime or equivalent time of research	Level 10
Master of Philosophy - M.Phil.	2 years of fulltime or equivalent time of research	Level 11
Doctor of Business Administration – DBA	3 years fulltime or equivalent time of research	Level 12
Doctor of Philosophy - Ph.D	3 years fulltime or equivalent time of research	Level 12

## APPLICATION FOR ADMISSION

### 3. Application for Admission

- Every application for admission must be made on the prescribed form obtained from the Institute. On line application can be submitted through the MIS of PGIA and it is preferred.
- Every applicant has to pass an Aptitude Test conducted by the Institute, prior to admission.

- Each application for admission will be considered by the appropriate Board of Study. The Board of Study may/may not require an applicant to appear for a *viva voce* to consider eligibility for admission.
- The selection of an applicant for admission is dependent upon the academic background and capability for higher studies as disclosed by transcripts of records pertaining to degrees, and other academic distinctions previously obtained and the referees' reports submitted in support of the application.
- The appropriate Board of Study will recommend a programme of study in respect of each applicant selected for admission to the Institute.

#### 4. Admission Criteria

##### a) Admission requirement for Postgraduate degrees

Degree Programme		Admission Requirement
M.Sc. (CW) MBA (CW) M.Sc. (CW & R) MBA (CW & R) PGD	1	A bachelors degree (Level 5 or 6) acceptable to the Board of Study
	2	A qualification equivalent to the bachelors degree acceptable to the Boards of Study and the Senate of the University
M.Phil.	1	M.Sc. degree (Level 9 or 10) in the relevant field
	2	A bachelors hon. degree with a 4 year duration (Level 6) in the relevant field
DBA / Ph.D.	1	M.Phil. degree (Level 11) in the relevant field OR
	2	MBA/M.Sc. degree (Level 9 or 10) in the relevant field OR
	3	A Bachelors hon. Degree of 4 year duration (Level 6) in the relevant field with a minimum GPA of 3.70

- b). **The specific qualifications acceptable to the different Boards of Study for their M.Sc/MBA degree programmes are shown below.**

<b>Board of Study / Program</b>	<b>Bachelor's degree</b>
<b><i>Board of Study in Agric. Biology</i></b> Plant Biology Conservation and Breeding	Agriculture or Natural Sciences
Biotechnology	Agriculture or Natural Sciences
<b><i>Board of Study in Agric. Economics</i></b> Agricultural Economics	Agriculture or Social Sciences
Environmental Economics	Agriculture or Economics
Natural Resource Management	Any Bachelor's Degree from a recognized university in Pure, Applied or Social Sciences. Preference will be given to candidates with work experience in the relevant field
<b><i>Board of Study in Agric. Engineering</i></b> Integrated Water Resources Management	Agriculture, Engineering, Humanities, Medicine, Natural Science
Geographical Information System	Physical and Biological Sciences, Agriculture, Natural Sciences, Geography, Engineering, Medicine or any other related discipline acceptable to the Board of Study
Agricultural and Bio-systems Engineering	Agriculture, Engineering, Natural Science or any equivalent qualification from a recognized institute of higher education
<b><i>Board of Study in Agric. Extension</i></b> All Programs	Agriculture or an allied field
<b><i>Board of Study in Animal Science</i></b> All Programs	Agriculture or an allied field, Biological Science, Veterinary Science, Natural Science or an equivalent qualification
<b><i>Board of Study in Bio-Statistics</i></b> All Programs	A Bachelor's Degree or an equivalent qualification
<b><i>Board of Study in Business Admin.</i></b> Business Administration	Any Degree from a recognized University or Professional Qualifications equivalent to a degree accepted by the Senate of the University of Peradeniya. Preference will be given to candidates with managerial experience
<b><i>Board of Study in Crop Science</i></b> Crop Science	Agriculture or an allied field or Biological Science with at least 2 years experience in crop production or

Environmental Forestry	related fields
Floriculture & Landscape Architecture	Agriculture, Natural Sciences, Social Sciences, or an equivalent qualification
Horticulture	Agriculture or an allied field or Biological Science with at least 2 years experience in crop production or related fields
Plantation Crop Management	Agriculture or an allied field or Biological Science with at least 2 years experience in crop production or related fields
<b><i>Board of Study in Food Sc. &amp; Tech.</i></b> Food Science & Technology	Agriculture or Natural Sciences with at least one year's experience in the field of Food Science related field
Food and Nutrition	Agriculture, Natural Sciences or an equivalent qualification
<b><i>Board of Study in Plant Protection</i></b> All Programs	Agriculture or Natural Sciences
<b><i>Board of Study in Soil Science</i></b> All Programs	Agriculture or Natural Sciences

## 5. Eligibility for Admission

In order to be eligible for admission to a programme of study prescribed for a particular postgraduate degree, a person must have previously satisfied all the admission requirements specified for that postgraduate programme. Under no circumstances, the Institute will grant an exemption from these requirements.

## REGISTRATION PROCEDURE

### 6. Registration

- Every Student is required to register for a programme of Study according to the recommendations made by the relevant Board of Study by paying the programme and other applicable fees.
- Student must ensure to remain registration continuously up to the end of the programme

M.Sc./MBA (CW)	- Completion of Comprehensive Examination
M.Sc./MBA (CW & R)	- Submission of final bound copy of thesis to the PGIA
M.Phil./Ph.D/DBA	– Submission of final bound copy of thesis to the PGIA

- It is required to submit all documents mentioned in the Letter of Admission to complete registration
- Student Identity Card will be issued after completion of registration requirements
- Every student shall complete the registration procedure before the deadline specified for that purpose in the approved Calendar of Dates.
- Every student shall obtain the username and password to access the MIS at PGIA. Each student should check the information displayed in his/her MIS account and in case information found to be inaccurate, it should be informed to the registration branch of the PGIA.

### 7. Date of Registration

#### M.Sc. MBA, PGDip.

The date of commencement of the academic year as stated in the Calendar of Dates of the respective academic year.

#### M.Phil./Ph.D./DBA research degrees

Date of fulfilling all requirements for registration by paying applicable fees etc.

### 8. Confirmation of Admission

The Institute will issue a letter of acceptance of admission for every student stating the effective date of registration and the date of completion of the degree programme.



## **9. Admission Categories**

Students are admitted in one of the three categories given below;

### **Regular student**

A regular student is a person who have satisfied all the appropriate admission requirements, has been admitted and registered by the Institute in order to follow a degree programme.

### **Provisional Student**

A provisional student is a person who cannot be admitted as a regular student because he/she has not satisfied certain requirements other than academic and financial requirements. Such a person showing promise of satisfactory and/or appropriate admission requirements may be admitted as a provisional student and may be transferred to regular student status upon consideration of these requirements. Credits earned may subsequently be transferred to meet the degree requirements.

Those admitted as provisionally are required to satisfy those requirements within one semester and upgrade themselves as regular students. If not, their candidature will be discontinued. Provisional student status is granted until such time as all the admission requirements are completed.

### **Casual Student**

A casual student is a person who has been enrolled as such by the Institute in order to follow one or more of the courses of study offered by the Institute. He/she shall not be a candidate for any degree awarded by the Institute and shall not continue as casual students for more than two semesters. A casual student should not be enrolled for more than 9 credit units per semester.

## **COURSE ENROLLMENTS**

### **10. Course Enrollment Form (Printed in White Colour)**

All students are required to enroll for courses through MIS within the dates of registration specified in the Calendar of Dates of the respective semester of the Academic Year.

### **11. Optional Courses outside the Programme**

If a student needs to follow a course outside the programme package, prior approval should be obtained from the Board of Study/PGIA within the first semester of the student's original registration to do so.

### **12. Drop/Add Form (Printed in Blue Colour)**

Dropping/Adding of courses can only be done within two weeks of the commencement of courses. Under no circumstances requests are entertained to Drop/Add of Courses after the deadline. Such courses are appeared as "I" Incomplete grade until student completes the course. In case of a student has followed a course without enrolling, it will be considered as an invalid sitting and grades of such courses will not be considered for the transcripts and GPA calculation.

### **13. Class Roll**

PGIA sends the class roll for every teacher including the names of students who enrolled for courses. Teachers shall not allow students who have not enrolled for courses to attend classes. Students and Teachers may check the class roll by visiting the PGIA website. This Class roll shall be used for submission of final marks.

### **14. Change of degree programme/Board of Study**

If a student needs to change the degree programme, approval has to be obtained from the Director for such change subject to the recommendation of the relevant Board of Study. Research students should channel their requests with the recommendations of the supervisor/s. Change of Programme and the Board of Study can be done only within the first semester of registration.

Funds paid can be interchange among relevant Boards of Study/programmes. Any excess money which will be refunded after completion of the degree programme.

**15. Audit /Credit Courses**

Students will not be allowed to audit compulsory courses within the Programme of Study. Courses audited are not allowed to credit. Only 2 courses are allowed in a given semester to audit. If a student wishes to follow extra courses to gain knowledge, he/she can follow these extra courses as audit courses only by paying the relevant fee and courses will appear in the transcript.

**16. Attendance**

All students should satisfy 80% of attendance at lectures.

**17. Directed Study Report /Project Report**

M.Sc./MBA students who are required to submit a Directed Study/Project report for 5 credits independent study should submit the same to the Supervisor as per the instructions of the Board of Study.

**18. Repeating of Courses**

If a student needs to repeat a course he/she should complete all the components of such course.

If a student fails to obtain a pass grade he/she has to repeat the course. Only 2 attempts are allowed per course. If a student wishes to upgrade a course he/she can do so after enrolling for the course and if fails to obtain a higher grade at the repeat examination all originally obtained grades will be retained. Higher grade obtained for that course during prescribed period is considered for calculation of GPA.

In giving a grade at a successful repeat examination, all previous unsatisfactory grades shall be eliminated. The maximum grade possible in a repeat examination is a 'B' grade.

**19. Early exit of a degree programme –**

**M.Sc. / MBA degree**

- Postgraduate Diploma or a Postgraduate Certificate may be awarded to those who exit early completing 25 credits or 20 credits respectively in the Master of Science (Course work) degree.
- Postgraduate Diploma in the relevant field of the candidates who has completed 25 credits in course work in the M.Sc. degree (CW & R).

- A student registered for M.Sc. (CW & R) degree may at the request of student and on the recommendation of the Board of Study be permitted by the Director for an M.Sc. (CW) degree after completing all the requirements of that degree.

### **M.Phil. degree**

- An early exit from an M.Phil. degree shall not be awarded.

### **Ph.D.**

- Early exit from a doctoral degree with research not reaching the standards required for a doctoral degree may be considered for the award of M.Phil degree.

## **20. Upgrading for research degrees**

- A student who has registered for M.Phil. degree may upgrade to a Ph.D. after a minimum period of 1 year provided that his or her research competencies are of exceptional merit.
- A student registered for M.Sc. (CW) degree may at the request of the student and on the recommendation of the Board of Study be permitted by the Director to change the degree to M.Sc. (CW & R) after completing all the requirement of that degree.

## **CREDIT REQUIREMENTS**

### **21. Minimum Credit Requirements for a Degree**

Postgraduate Diploma	- 25 credits - course work only
M.Sc. (CW)	- 30 credits course work inclusive of 5 credits Directed Study
MBA (CW)	- 36 credits course work and 5 credits Project
M.Sc. (CW & R)	- Minimum 30 credits of course work and one year full time or equivalent time of Research
MBA (CW & R)	- Minimum 36 credits of course work and one year full time or equivalent time of Research
M.Phil.	- Minimum of two years full time or equivalent time of research
DBA / Ph.D.	- Minimum of three years full time or equivalent time of research

## **RESEARCH STUDENTS**

### **22. Research Proposal Presentations**

#### **M.Sc. / MBA programme**

Every applicant for M.Sc. (CW & R) and MBA (CW & R) degree should submit a research proposal to the Board of Study together with the budget at the end of the second semester of the year of admission or earlier and be approved by the appropriate Board of Study on the recommendation of the Supervisory Committee.

#### **M.Phil. and Ph.D./DBA Degrees**

Every applicant should submit a concept paper together with the application for a research degree. Upon being admitted to the research degree programme, every student shall prepare a proposal, plan of research and budget and present the proposal before the Board of Study within three months of student's original registration. If the proposal is accepted within three months his/her effective date of commencement of research will be backdated to the original date of registration. If not, the date on which his/her proposal is accepted will be treated as the effective date of commencement of research.

### **23. Appointment of Supervisors**

The Board of Study shall appoint in respect of each research student a supervisory committee comprising at least one member from the Faculty of Agriculture representing the relevant discipline.

### **24. Progress Reports**

All research students are required to submit two copies of progress reports at the end of every six months of commencement of research through all the Supervisors to the Secretary of the Board of study up to submission of application for TDE. The student shall submit the progress report including comments of the BS to the Director. One copy will be returned to the student for information.

### **25. Research Seminars**

Every student registering for a research degree programme must give a seminar based on the thesis at the terminal phase of the research, in addition to other seminars as determined by the Board of Study. Attendance at seminars will be compulsory for all students under each Board of Study.

## **26. Compulsory Courses**

All research students are required to follow the two courses CS 5212 Scientific Writing (contact the Secretary of the relevant Board of Study for details) and ST 5102 Basic Statistics, if they have not followed similar courses during their undergraduate level and obtained a “B” grade or above. If similar courses are offered by the relevant Boards of Study these courses could be exempted.

## **27 Research Papers**

All research students are required to publish minimum of one research paper for M.Sc.(CW & R)/MBA (CW & R) and minimum of two research papers for M.Phil. and Ph.D./DBA a refereed journal to be eligible for Comprehensive / Thesis Defence examination. A copy of all Published papers/articles/ patents should be submitted to the PGIA as a proof.

## **28. Funding**

All research projects leading to M.Sc. (CW & R)/MBA (CW & R), M.Phil., Ph.D. and DBA degrees should be supported by funds, either Institutional or personal, to conduct the project to a satisfactory completion. In the case of research projects funded by institutions, a research proposal and budget approved by the Head of the Institution should be provided. The candidates sponsored by Institutions should provide funds to cover,

- i. Monthly stipend/salary of the candidate
- ii. research expenditure
- iii. all prescribed fees relevant to the programme

## **POSTPONEMENTS / WITHDRAWALS /DISCONTINUATIONS**

### **29. Leave of Absence/ Postponements**

Student should inform the Director with documentary proof for leave to be taken and the reasons for postponements of degree programme. However, all students should complete their degree programmes within the stipulated time period from the date of registration.

**30. Withdrawal from Programme**

Any student who has failed to register in respect of given semester or failed to keep the continuity of the registration for two consecutive semesters without the Chairman/Secretary or Director's approval, or has exceeded the time limit fixed for each degree programme he/she shall be deemed to have voluntarily withdrawn from the programme.

**31. Continuation of Programme/Re-registration – for M.Sc./MBA degree**

Students who had been withdrawn /discontinued from the programme but admitted again as a fresh student will come under the new regulations as at the date of new registration. The acceptance of new admission may be conditional upon the students concerned being required to satisfy such requirements as the PGIA/Board of Study may stipulate. Students who had been withdrawn from the M.Sc.degree programme but wish to continue the same programme should apply as a fresh applicant and can transfer 10 credits earned within the period of 10 years to the new programme.

**32. Refund of Fees**

No Fee shall be refunded under any circumstances of a registered student except Section 14 of this Handbook.

**CALCULATION OF GPA****33. Calculation of GPA**

- a) (i) The scheme of grading of courses is given below. The teacher will determine the grade of a student in a course based on his/her performance in different evaluations.

<b>Letter Grade</b>	<b>Grade Point</b>
A+	4.00
A	4.00
A-	3.70
B+	3.30
B	3.00
B-	2.70
C+	2.30
C	2.00
F	0.00

- (ii) The minimum grade for passing a course is "C"
  - (iii) In giving a grade at a successful repeat examination, all previous unsatisfactory grades shall be eliminated. The maximum grade possible in a repeat examination is a 'B' grade.
  - (iv) **Incomplete Grade:** If a student fails to complete the requirements of a course due to illness or some other valid reasons supported by evidence acceptable to the Director, he/ she shall obtain an "I" (Incomplete) grade for that course. Such a student shall complete the requirements for that particular course on the first occasion the course is next offered. In this instance, unlike in (a) (iii) above, on successful completion of the course, he/she will be given the actual grade obtained by him/her for that course.
- (b) The Grade Point Average (GPA) is computed as follows;

$$\text{GPA} = \frac{\sum c_i g_i}{\sum c_i}$$

where  $c_i$  and  $g_i$  are the credit units and grade point of the  $i^{\text{th}}$  course. The **GPA** will be rounded to the second decimal place.

- (c) A student will be required to have a minimum **GPA of 3.00** at the end of the course work component. However, if the GPA is found to be below 3.00 after following prescribed set of courses, he/she should upgrade some course to achieve minimum GPA of 3.00. If the GPA continues to be below 3.00, his /her programme will be terminated.
- (d) A student who obtains a GPA between 2.75 and 2.99 can request for the award of a Postgraduate Diploma/PG Certificate at the end of the course work component. A student who has a GPA of 3.00 or more can also request for the award of a Postgraduate Diploma/PG Certificate if he/she does not want to complete the comprehensive examination. Effective date of the PG Diploma will be the date on which the student make a request within the stipulated time period .



## COMPLETION OF A PROGRAMME

### 34. Time Limits for completion of a programme

Degree Programme	Minimum (yr.)	Maximum (yr.)
M.Sc (CW)	1	4
MBA (CW)	2	4
M.Sc. (CW & R)	2	5
MBA (CW & R)	2.5	5
M.Phil. (Full time Research)	2	5
Ph.D. (Full time Research)	3	6
DBA (Full time Research)	3	6
PG Diploma/PG Certificate	1	2

### 35. Eligibility for a Degree

1. In order to be eligible for the award of a M.Sc. (CW) / MBA (CW) degree, a student shall first have successfully completed the examinations in all courses of study. Upon completion of the course requirements, students should obtain a satisfactory grade “S” at the Comprehensive examination.
2. In order to be eligible for the award of a M.Sc.(CW & R) / MBA (CW & R) degree, a student shall first have successfully completed the examinations in all courses of study. Upon completion of the course requirements, students should obtain a satisfactory grade “S” at the Comprehensive examination and the Thesis Defence Examination.
3. M.Phil./DBA/Ph.D. students should obtain a satisfactory grade “S” at the Thesis Defence Examination.

### 36. Completion of a Programme

A candidate shall be deemed to have successfully completed his study program when he/she satisfies all requirements of the respective degree programme. A student whose programme of study has been completed shall return to the office of the Deputy Registrar of the Institute, the Identity/ Registration Card properly invalidated by the Library, along with a certificate of clearance issued by the Librarian. Notwithstanding the fact that he/she may be otherwise eligible, no student shall be awarded a degree or given an examination certificate or a transcript of record unless the student has satisfied this requirement.

### 37. Effective Date of the Degree

PG Diploma	<b>1</b>	Date of the completion of all the requirements of the programme
	<b>2</b>	Date of the second Comprehensive Examination of M.Sc. candidates who failed at both attempts of the M.Sc. Comprehensive Examination
	<b>3</b>	Date of the request of M.Sc. candidates who have successfully completed the course work component of M.Sc. Degree Programme with a minimum GPA of 2.75
	<b>4</b>	Date of the request of M.Sc. candidates who require an early exit having completed 25 credits in the relevant course work component with a minimum GPA of 2.75. ( in case only 20 credits have been completed with minimum of GPA 2.75 PG certificate can be requested)
M.Sc.(CW) MBA (CW )		Date of successful completion of the Comprehensive Examination
M.Sc.(CW & R) MBA (CW&R)		Date of submission of the bound copy of thesis
M.Phil/DBA/Ph.D.		Date of submission of the bound copy of the thesis

### EXAMINATION MATTERS

#### 38. Application for Comprehensive Examination

Students who have completed the course work requirements with GPA of 3.00 or above should apply for the comprehensive examination and it should be at least six months before the completion date of the stipulated time period.

#### 39. Application for the Thesis Defence Examination

Research students should apply for Thesis Defence Examination at least 1 year prior to the stipulated time period of the relevant degree programme.

#### **40. Absence from Comprehensive and Thesis Defence Examinations**

Except for any justifiable reason supported by valid document or on medical grounds supported by valid medical certificate, if a student fails to attend the scheduled examination, an Unsatisfactory grade “U” will be given and it will be treated as first attempt.

#### **41. Make-up Examination**

- i. If a student fails to sit for any examination of a course, a make-up examination may be arranged with the approval of the Director for the students who submitted valid reasons supported by the acceptable documentary evidence, making a payment of Rs.3000/- for such examination.
- ii. Students should inform the Director or PGIA Office immediately if they are unable to attend for any examinations (except for medical reasons) well in advance of the reasons supported by documentary proof.
- iii. Medical certificate or any other valid documents (original copy) should be submitted to the Director’s office within five days of the examination.
- iv. A student who fails to sit at for an examination on valid reasons and does not want a separate examination as a makeup examination may request to complete the requirements for that particular course at the next available opportunity when the course is offered without any charges being levied.
- vi. If the permission is not granted for a make-up examination will have to follow the course again at the next available opportunity when the course is offered and the examination will be considered as a repeat examination with maximum eligible grade of “B”.

#### **42. Comprehensive Examination (CE)**

- Applications should be submitted to the Director's office within 3 months from the time a student completes all the courses inclusive of Directed Study/Project report
- Examination shall be held within 3 months from the date of application
- GPA should be 3.0 or above
  - i. After completing 25 credits of course work
  - ii. After completing 30 credits of course work

- iii. After completing 30 credits of course work and research
- iv. After completing all course work including extra courses
- Should obtain a Satisfactory grade at the comprehensive examination
- Shall be repeated only once ( 2 attempts)
- Students repeating a comprehensive examination should re-apply after a period of 2 months but not later than 6 months from the time of the first comprehensive examination within the stipulated time period.
- The same Examination Committee will be re-appointed for the repeat CE
- In case if any examiner is not available for repeat examination the Board of Study can appoint a suitable examiner with the consent of the student and subject to the approval of the Board of Management for change in the repeat examination.
- Those who fail at both attempts at the M.Sc./MBA CE could opt for a Postgraduate Diploma.

NOTE : Web based CE may be allowed for any student who is studying /living/ employed/migrated in a foreign country for a long period of time and unable to be present for CE due to a reason acceptable to the respective Board of Study and after officially informing the PGIA about his/her overseas leave

#### **43. Thesis Defence Examination (TDE)**

- Should complete the necessary course/s prescribed by the Supervisor/s
- Should submit progress reports in every six months until submission of draft thesis to the evaluators
- Should submit certification of the Board of Study through the supervisor of any minor revision in the title of research to the PGIA when submitting draft thesis for evaluation
- should submit a Thesis prepared in accordance with the guidelines
- Should submit three (required number of) spiral bound copies of thesis with the certification of all supervisors that the research programme has been completed and the thesis is suitable for submission to the Examination Committee.
- No TDE shall be held without giving at least six weeks time for the Examination Committee to evaluate the thesis
- If all examiners have rejected the thesis, student will not be eligible to sit the TDE
- Should bring along the final draft to the TDE
- Should submit within 3 months of the TDE the final copies of the thesis whose thesis has been accepted with minor revisions.

- If the thesis has been accepted subject to major revisions may re-submit the thesis in a revised form after a period of 6 months and before one year from the date of first attempt for re-examination.
- 

#### **44. Final Submission of Thesis**

Two properly paginated and bound copies of the accepted thesis and the soft copy (both in PDF format and MS Word format) shall be prepared according to the format approved by the Institute and submitted by the candidate to the Director of the Institute within 90 days from the date of the TDE. These shall become the property of the Institute. A thesis submitted after the expiry of 90 days will not be accepted.

In case if examination Board recommends minor revisions a certification of Supervisors to the effect that all revisions have been incorporated into the revised thesis should be submitted by the candidate.

#### **Colour of Cover for Thesis**

The colour of the cover used for the thesis shall be Green.

Other rules and regulations approved by the PGIA should be adhered by all students.

## **GENERAL REGULATIONS**

### **45. Special Declarations**

Student should declare that any members of the family or relations in the administration/Panel of Teachers of the Institute.

### **46. Concurrent Registration**

Any concurrent registration the student has in any of the Universities in Sri Lanka will not be allowed.

### **47. Requests of Students**

All correspondences of students should be addressed to the Director of the Institute, if necessary with a copy to the Secretary of the relevant Board of Study. Students should mention their registration number and contact details in all requests for reference.

### **48. Change of Name/Addresses**

If a student wishes to change his/her name it should be done while the registration is in force. Change of name will be allowed only if the relevant legal procedure has been followed. No student shall be allowed to change the name under which he originally registered at the institute, after the release of results of the degree programme.

### **49. Participation in the Annual Congress**

It is compulsory for all students to participate in the Annual Congress of the Institute held on 3<sup>rd</sup> Thursday and Friday of the month of November in each year. Students will be able to register themselves to participate in the Annual Congress during May - October each year.

### **50. Transcripts of Academic Records**

Every student may, at the end of each semester, on a written request made to the Director, receive a semester results of his/her academic performances in respect of that semester on a prescribed fee. Such a semester results is issued to the student only for his/her information and it shall not be used for any official purpose.

- Transcripts will not be issued to the students until they make all fees.
- A certified transcript of a student's academic record authenticated by the signatures of the Director and Deputy Registrar of the Institute may be sent

under confidential cover direct to another University / Institute / Ministry / Embassy / student's Employer, on receipt of an application made by the student concerned with the prescribed fee for such a transcript.

- Transcripts for completed programmes will be issued for the students after approving results of such students for the award of degrees by the Senate of the University.

#### **51. Requests for Certificates/ Letter of Reference**

Student may submit a written request to the Director for issuing a Provisional Certificate/letter of reference of his/her studentship and academic performance at the Institute on a prescribed fee.

#### **52. Claims for Refundable Deposits**

- Students who have completed the degree programme cannot claim for the refundable deposits after one year from the date of completion of the degree programme.
- Students who have not completed the degree programme within the stipulated time period should claim for the refundable deposits within 03 months of the stipulated time period of the respective degree programme.

#### **53. Graduation**

The Director shall send the names and relevant details of all candidates who successfully complete their study programs to the University. The degrees will be awarded by the University Senate and will be effective from the dates described in this Handbook.

Every student who has satisfied the prescribed requirements for award of a degree may submit his/her application for participation at the Convocation held annually by the University of Peradeniya.

#### **54. Website and On-line Resources**

Students can access the details on class rolls, enrolments, time tables, Panel of Teachers and their email addresses, course capsules, exam results through the MIS of the PGIA.

## **SEMESTER BASED COURSE UNIT SYSTEM**

The syllabus set out here consists of Course Units. Each course unit has been assigned a credit value depending upon the number of hours of lectures and practicals involved – one credit unit being the equivalent of 15 hours of lectures or 30 hours of practicals, as the case may be. In the listing of the courses, the course prefix which represents the Board of Study concerned is followed by the course number and the title of the course. The figure in parenthesis at the end of the title of a course denotes its credit value.

### **Pre-requisite courses**

Pre-requisite courses will not be counted for credits but will be graded as Pass (P) or Fail (F). The teacher will determine the grade based on the performance in different evaluations. Student should follow pre-requisite courses within the first semester on making a prescribed fee.

All students have to follow the courses, Calculus and Matrix Algebra (ST 5101) and Basic Statistics (ST 5102) as prerequisite courses. Exemptions will be given to students who had followed similar courses and obtained a grade “B” (or Pass grade in the case the grades are of the form Pass/Fail) or above.



# Boards of Study

## Chairpersons and Secretaries of the Boards of Study

<b>BOARD OF STYDY</b>	<b>CHAIRPERSON</b>	<b>SECRETORY</b>
<b>Agricultural Biology</b>	<b>Dr. H.M.V.G. Herath</b> venurah@pdn.ac.lk, venuraherath@gmail.com	<b>Dr. D. Jayatilake</b> djayatilake@yahoo.com
<b>Agricultural Economics</b>	<b>Dr. S.P. Waligamage</b> parakw@gmail.com	<b>Dr. D.V. Pahan Prasada</b> pahan1@gmail.com
<b>Agricultural Engineering</b>	<b>Dr. (Ms.) N.D.K. Dayawansa</b> dammid@pdn.ac.lk	<b>Dr. A.K. Karunaratne</b> akk@pdn.ac.lk
<b>Agricultural Extension</b>	<b>Dr. M.W.A.P. Jayatilake</b> wjpgia2015@gmail.com, wijayajayatilaka@yahoo.co.uk	<b>Dr. L.N.A.C. Jayawardena</b> chandanacj@gmail.com
<b>Animal Science</b>	<b>Dr. A.R.S.B. Athauda</b> sbathauda@pdn.ac.lk	<b>Dr. K.K.S.P. Kodituwakku</b> surangap@pdn.ac.lk
<b>Business Administration</b>	<b>Prof. L.H.P. Gunaratne</b> lhpguna2010@gmail.com lhpguna@pdn.ac.lk	<b>Dr. D.V. Pahan Prasada</b> pahan1@gmail.com
<b>Bio-statistics</b>	<b>Dr. T. Sivananthawerl</b> tsiva@pdn.ac.lk	<b>Dr. L. Weerasinghe</b> lasanthaw@pdn.ac.lk
<b>Crop Science</b>	<b>Prof. B. Marambe</b> bmarambe@pdn.ac.lk	<b>Dr. CK Beneragama</b> chalindab@gmail.com
<b>Food Science &amp; Technology</b>	<b>Prof. D.G.N.G. Wijesinghe</b> wijeng@yahoo.com	<b>Mr. PC Arampath</b> pcarampath@gmail.com
<b>Plant Protection</b>	<b>Dr. (Ms) D.M. De Costa</b> devikacos@yahoo.com	<b>Dr. K.S. Hemachandra</b> kshema@pdn.ac.lk
<b>Soil Science</b>	<b>Dr. RS Dharmakeerthi</b> dharmakeerthis@gmail.com	<b>Dr. (Ms) WS Dandeniya</b> warshisd@gmail.com

## **DEGREE PROGRAMMES**

Every candidate for a degree shall register with the Institute and enroll under a Board of Study. Those applying for degrees involving course work (Levels 7 and 8) shall

also enroll for a program of work within the Board of Study.

The Boards of Study are listed below, together with the current programs offered by each.

- a) Agricultural Biology**
  - a. Plant Biology Conservation and Breeding
  - b. Biotechnology
- b) Agricultural Economics**
  - a. Agricultural Economics
  - b. Environmental Economics
  - C. Natural Resource Management
  - D. Postgraduate Diploma in Development Practice & Management (PDDPM)
- c) Agricultural Engineering**
  - a. Integrated Water Resources Management
  - b. Agricultural and Bio-systems Engineering
  - c. Geographical Information System
- d) Agricultural Extension**
  - a. Organizational Management
  - b. Development Communication and Extension
- e) Animal Science**
  - a. Animal Science
  - b. Poultry Science and Technology
  - c. Dairy and Meat Product Technology
  - d. Aquatic Bio-resources Management and Aquaculture
- f) Bio-Statistics**
  - a. Applied Statistics
  - b. Bio-Statistics
  - c. Postgraduate Diploma in Applied Statistics
- g) Business Administration**
  - a. Business Administration

**h) Crop Science**

- a. Crop Science
- b. Environmental Forestry
- c. Floriculture and Landscape Architecture
- d. Tropical Agriculture
- e. Horticulture
- f. Plantation Crop Management

**i) Food Science and Technology**

- a. Food Science and Technology
- b. Food and Nutrition

**j) Plant Protection**

- a. Plant Protection Technology
- b. Molecular and Applied Microbiology

**k) Soil Science**

- a. Environmental Soil Science
- b. Tropical Soil Management
- c. Soil and Environmental Microbiology

## PROGRAMME COORDINATORS

<b>Board of Study</b>		<b>M.Sc./MBA Degree/PG Diploma Programme</b>	<b>Coordinator</b>
Agricultural Biology	1	Biotechnology	Prof. VA Sumanasinghe
	2	Plant Biology Conservation & Breeding	Dr. HMVG Herath
Agric. Economics	3	Agric. Economics	Dr. D Hemachandra
	4	Natural Resource Management	Dr. P Koralegedera
	5	Environmental Economics	Dr. DV Pahan Prasada
Agricultural Engineering	6	Agric. & Biosystems Engineering	Dr. AK Karunarathne
	7	Integrated Water Res. Management	Dr. S Pathmarajah
	8	Geo-Informatics	Dr. NDK Dayawansa
Agricultural Extension	9	Organizational Management.	Dr. LNAC Jayawardena
	10	Development Com. & Ext.	Prof. WADP Wanigasundera
Animal Science	11	Animal Science	Dr. SP Kodituwakku
	12	Poultry Sc. & Technology	Prof. K Samarasinghe
	13	Dairy & Meat Product Tech.	Dr. J. Vidanarachchi
	14	Aquatic Bio-Res. Mgt. & Aqua.	Dr. ARSB Athauda
Business Administration	15	Master of Business Administration	Prof. S Kodituwakku
Bio-statistics	16	Biostatistics	Dr. BL Peiris
	17	Applied Statistics	Dr. BL Peiris
	18	PG Diploma in Applied Statistics	Dr. LDB Suriyagoda
Crop Science	19	Crop Science	Dr. M Ariyaratne
	20	Environmental Forestry	Prof. SP Nissanka
	21	Floriculture & Landscape Arch.	Dr. C Beneragama
	22	Tropical Agriculture	--
	23	Horticulture	Prof. JP Eeswara
	24	Plantation Crop Management	Dr. L Weerasinghe
Food Science & Technology	25	Food Science & Technology	Mr. PC Arampath
	26	Food and Nutrition	Prof. N Wijesinghe
Plant Protection	27	Molecular & Applied Microbiology	Prof. DM De Costa
	28	Plant Protection Technology	Dr. KS Hemachandra
Soil Science	29	Environmental Soil Science	Dr. U Vitharana
	30	Tropical Soil Management	Dr. S Dharmakeerthi
	31	Soil and Envir. Microbiology	Prof. RMCP Rajapakse

## MEMBERS OF THE TEACHING PANEL

### **Agricultural Biology**

Bandara, D.C. (Ms.), B.Sc. Agric. (Peradeniya); M.Sc.; Ph.D. (Penn. State)  
Dematawewa, C.M.B., B.Sc. Agric. (Peradeniya); PG Dip. (Edin.); M.S.; Ph.D. (Iowa)  
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Fonseka, H. B.Sc. Agric.(Peradeniya), M.Sc. (Belgium), M.Sc.; Ph.D. (Japan)  
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Liyanage K., B.Sc. Agric. (Peradeniya); M.Phil. (Peradeniya)  
Perera, A.L.T., B.Sc. Agric. (Peradeniya); M.Sc. (Obihiro); Ph.D. (Birmingham)  
Perera, A.A.F.L.K., B.Sc. Agric. (Peradeniya); Ph.D. (Dundee)  
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Samaraweera, P., B.Sc.Agric.(Peradeniya); Ph.D.(Arizona)  
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Yakandawala, D.M.D. (Ms), B.Sc.(Peradeniya); Ph.D. (Reading)  
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Weerasinghe A. (Ms), M.Sc., Ph.D. (Czechoslovakia)

### **Agricultural Economics**

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Suriyagoda, L.D.B., B.Sc. Agric.(Peradeniya);M.Sc. (Saga);M.Sc.(Peradeniya), Ph.D. (Australia)

Sumanasinghe V.A., B.Sc.Agric. (Sri Lanka), M.Sc., Ph.D. (Penn. State, USA)

Sumithraarachchi, D.B., B.Sc.(Cey.); M.Sc.(Reading)

Thattil R.O., B.Sc.Agric. (Ceylon); M.Sc. (UPLB, Phillipines); Ph.D. (VPI&SU, USA)

Vitharana W.A.U., B.Sc.Agric., M.Phil. (Peradeniya); Ph.D. (Ghent, Belgium)

Weerahewa, J. (Ms.), B.Sc. Agric.; M.Sc. (Peradeniya); Ph.D. (Guelph)

Weerakkody, W.A.P., B.Sc. Agric. (Peradeniya); M.Sc. (Hiroshima); Ph.D. (Sri Lanka)

Weerakoon, W.M.W., B.Sc.Agric.(Peradeniya);M.Sc. (UPLB, Philippines); Ph.D. (USA)

Weerasena S. L., B.Sc.Agric. (Ceylon);M.Sc. (USA); Ph.D. (USA)

Weerawardena N.D.R., B.Sc.Agric. (Peradeniya); Ph.D. (Edinburgh, UK)  
 Wickramasinghe I.P., B.Sc.Agric. (Sri Lanka), M.Sc. (Texas A&M, USA), Ph.D. (Peradeniya)  
 Wijesundara, S., B.Sc.; M.Phil. (Peradeniya); M.Phil, Ph.D. (New York)  
 Yakandawela, K., B.Sc. (Peradeniya); M.Sc. (Reading); Ph.D. (Colombo)

## **Food Science and Technology**

Amarathunga, K.S.P., B.Sc.Agric.(Peradeniya); M.Agric.; Ph.D.(Kyushu)  
 Arampath, P.C., B.Sc.Agric.(Peradeniya); M.Sc.(AIT)  
 Chandrasekera, A., B.Sc.Agric. (Peradeniya); M.Sc. Agric. (Peradeniya); Ph.D. (NSW)  
 Chandrasekera, G.A.P.(Ms.), B.Sc.Agric.; M.Phil. (Peradeniya); Ph.D. (Newfoundland, Canada)  
 Cyril, H.W., B.Sc.(Peradeniya), M.Sc.; Ph.D.(Nottingham)  
 Hettiarachchi, C.A., B.Sc. Food Sc. & Tech. (Peradeniya); Ph.D. (Auckland, Newzealand)  
 Himali, H.M.C., B.Sc. Agric.(Peradeniya) M.Sc., (Peradeniya); Ph.D. (Iowa)  
 Illeperuma, D.C.K. (Ms.), B.Sc.Agric.(Peradeniya); M.Sc.Agric.(Peradeniya); Ph.D.(Maryland)  
 Jayawardana, B.C., B.Sc. Agric.(Sri Lanka); M.Sc., Ph.D. (Obihiro, Japan)  
 Kalupahana, N.S., MBBS(Peradeniya); M.Phil.(Peradeniya); Ph.D. (Tennessee, USA)  
 Karunarathne, D.G.G.P., B.Sc. Eng (Peradeniya); Ph.D.(Lisben)  
 Madhujith, W.M.T., B.Sc.Agric.(Peradeniya); M.Sc.(Canada); Ph.D.(Canada)  
 Mahawithanage, S., B.Sc. (SUJP); Ph.D. (Colombo)  
 Mendis, B.E.P., B.Sc.Agric.(Peradeniya); M.Sc.(S.Korea); Ph.D.(S.Korea)  
 Peiris, B.L., B.Sc. Agric.(Peradeniya) M.Sc. (Colombo); M.Sc., Ph.D.(Iowa State Univ., US)  
 Prasantha, B.D.R., B.Sc.Agric.(Peradeniya); M.Sc.Agric.(Peradeniya); Ph.D.(Humboldt Berlin)  
 Premaratne, P.G.N., M.D.(Russia); M.Sc. (Peradeniya); M.I.Bio.R.Nutr (SL); RD (SL)  
 Rajapakse, R.P.N.P., B.Sc.Agric.(Peradeniya); M.Sc.Agric.(Peradeniya); M.Sc.(S.Korea);  
 Ph.D.(S.Korea)  
 Samita, S., B.Sc. Agric.; M.Phil. (Peradeniya); Ph.D. (Edin.UK)  
 Sarananda, K.H.S., B.Sc.Agric.(Peradeniya); M.Sc.(UPLB, Philippines); Ph.D.(U.K.)  
 Sarathchandra, U., B.A.(Cey); M.P.S.(UPLB, Philippines); Certifi in.TMRP (Belgium)  
 Silva K.D.R.R., B.Sc.Agric.(Peradeniya); Ph.D.(Reading)  
 Silva, K.F.S.T., B.V.Sc.( Peradeniya); M.Sc.(Arizona); Ph.D.(California)  
 Sivakanesan, R., B.V.Sc.(Cey.); Ph.D.(London)  
 Thattil, R.O., B.Sc.Agric. (Ceylon); M.Sc. (UPLB, Philippines); Ph.D. (VPI & SU, USA)  
 Vidanarachchi, J.K., B.Sc. Agric.(Peradeniya);M.Sc. (Memorial); Ph.D. (New England)  
 Weerahewa, J., B.Sc. Agric. (Peradeniya); M.Sc. (Peradeniya); Ph.D. (Guelph)

Wijesinghe, D.G.N.G., B.Sc.Agric.(Peradeniya); M.Sc.(UPLB, Philippines); Ph.D.(London)  
 Wilfred, N.D., B.A.(Cey); M.P.S.(UPLB, Philippines)  
 Weligamage, P., B.Sc. Agric. (Peradeniya); M.Sc. (Peradeniya); Ph.D. (Washington State)  
 Wimalasiri, K.M.S. (Ms.), B.Sc.(Peradeniya), Ph.D.(Peradeniya), M.I.Chem.C.,C.Chem (Sri Lanka).

## **Plant Protection**

Ahangama, D .(Ms.), B.Sc. Agric.(Cey.); M.Sc. (Leipzig); Ph.D. (Texas A & M)  
 Bamunuarachchige, C., B.Sc.(Sri Lanka); Ph.D (Peradeniya)  
 Bandara, J.M.R.S., B.Sc.Agric. (Cey.); Ph.D. (London); D.I.C.M.I. Biol.  
 De Costa, D.M. (Ms.), B.Sc. Agric. (Peradeniya); M.Sc..(Reading, UK); Ph.D. (Japan)  
 De Zoysa, IJ., B.Sc. Agric. (Peradeniya); DIC (London); Ph.D. (London)  
 Gnaneswaran, R., B.Sc. (Jaffna), M.Phil. (Peradeniya); Ph.D. (Peradeniya)  
 Gunawardena, G., B.V.Sc. (Sri Lanka), Ph.D. (Australia)  
 Hemachandra, K.S., B.Sc. Agric. (Peradeniya,); M.Phil (London), Ph.D. (Manitoba)  
 Jayakody, A.N., B.Sc., M.Sc. (Leipzig), Ph.D. (Giessen, West Berlin)  
 Jayatilake, DV., B.Sc. Agric. (Peradeniya); M.Sc. (Kansas, USA); Ph.D. (Australia)  
 Kudagamage, c., B.Sc. (Cey.), M.Sc., Ph.D. (Purdue, USA)  
 Marambe, B., B.Sc. Agric. (Peradeniya); M.Sc.; Ph.D. (Hiroshima)  
 Mohotti, K.M., B.Sc.Agric. (Peradeniya.); Ph.D.(Reading, UK).,  
 Panagoda, .G.J., B.Sc.; M.Sc. (Kelaniya); Ph.D. (Honkong)  
 Samarajeewa, U., B.Sc.(Cey.), Ph.D.(Sri Lanka); F.I.Chem.C.; C.Chem.; F.I.Biol. (Sri Lanka)  
 Silva, K.F.S.T., B.V.Sc. (Sri Lanka); M.Sc. (Arizona); Ph.D. (California)  
 Sirisena, U.G.A.I., B.Sc. Agric. (Rajarata); M.Sc., Ph.D. (Peradeniya)  
 Wijayagunsekera, H.N.P., B.Sc.Agric.(Cey.); M.Phil. (New Castle)  
 Wickramasinghe, H.A.M.(Ms.), B.Sc. Agric (Peradeniya); M.Phil.(Sri Lanka); Ph.D. (Japan)

## **Soil Science**

Amarasiri, S.L., B.Sc. (Cey); Ph.D. (Colorado)  
 Attanayake, A.M.C.P.K., B.Sc. Agric. (Peradeniya); M.Sc. (Peradeniya); Ph.D. (Kansas, USA)  
 Balasooriya, B.L.W.K. (Ms.), B.Sc.Agric.; M.Sc. (Peradeniya); M.Sc.; Ph.D. (Ghent, Belgium)  
 Bandara, W.M.J., B.Sc. (Peradeniya); M.Sc. (Philippines); Ph.D. (Peradeniya)  
 Dandeniya, W.S. (Ms.), B.Sc. Agric.; M.Phil.(Peradeniya); Ph.D. (Cornell)  
 Dharmakeerthi, R.S., B.Sc. Agric.; M.Sc. (Peradeniya); Ph.D.(Guelph)  
 Dharmasena, P.B., B.Sc., M.Sc. (Peradeniya); Ph.D. (Sri Lanka)

Gunawardena, J., Dip. Agric.; Attorney in Law (Sri Lanka)  
 Indraratne, S.P. (Ms.), B. Sc. Agric.; M.Phil (Peradeniya); Ph.D (Manitoba)  
 Jayakody, A.N., B.Sc., M.Sc.; (Leipzig); Ph.D. (Giessen, West Berlin)  
 Kendaragama, K.M.A., B. Sc. Agric.; M.Phil. (Peradeniya)  
 Leelamanie, D.A.L. B.Sc. Agr.c.(Peradeniya); M.Sc. (Peradeniya); Ph.D. (Japan)  
 Lathiff, M.A., B. Sc. Agric. (Peradeniya); Ph.D (Manitoba)  
 Mapa, R.B., B. Sc. Agric. (Peradeniya); Ph.D (Hawaii)  
 Nandasena, K.A., B. Sc. Agric. (Peradeniya); Ph.D (Leuven, Belgium)  
 Nayakakorale, H.B., B.Sc. Agric. (Peradeniya); M.Sc. (Texas Tech); Ph. D (Sri Lanka)  
 Nissanka, N.A.A.S.P., B.Sc. Agric. (Peradeniya); M.Sc.; Ph.D. (Guelph)  
 Peiris, B.L., B.Sc. Agric. (Peradeniya), M.Sc.; Ph.D.(Iowa State Uni., US)  
 Rajapaksha, R.M.C.P., (Ms) ,B. Sc. Agric.; M.Phil. (Peradeniya); Ph.D (Saskatchewan)  
 Vajira Neelamanie, D.A.L., B.Sc. (Ruhuna); M.Sc. (Peradeniya); Ph.D. (Tokyo)  
 Vitharana, W.A.U., B.Sc. Agric. (Peradeniya); M.Sc.; Ph.D. (Ghent, Belgium)  
 Weerasooriya, R.V.R., B.Sc.(Peradeniya); Ph.D. (Peradeniya)  
 Wickramasinghe, W.M.A.D.B., B.Sc. Agric. (Peradeniya); Ph.D. (Reading)



**LIST OF COURSES  
AND  
COURSE CAPSULES**

## BOARD OF STUDY IN AGRICULTURAL BIOLOGY

### LIST OF COURSES

Course No	Course Title	Credits
<b>First Semester</b>		
AB 5101	Cell Biology	2
AB 5102	Water Relation and Nutrition	2
AB 5103	Plant Systematics	2
AB 5104	Plant Ecosystems	2
AB 5105	Cellular Genetics	2
AB 5106	Exploring the Genomes: Principles & Techniques	2
AB 5107	Microbial Genetics	2
AB 5108	Principles of Plant Breeding	2
AB 5109	Plant Reproductive Biology	1
AB 5110	Crop Genetic Resources	1
AB 5111	Exploration and Characterization of Plant Genetic Resources	2
AB 5112	Environmental Physiology I – Microclimate	2
AB 5113	Photosynthesis and Plant Productivity	2
AB 5114	Biosensing	2
AB 5115	Assessment of Genetic Diversity	1
AB 5116	Plant Biochemistry	2
AB 5118	Polygenic Inheritance	2
AB 5119	Molecular Biology	1
AB 5120	Theory and Techniques of Plant Gene Manipulation	2
AB 5121	Characterization and Evaluation of Plant Genetic Resources	2
AB 5122	Gene Manipulation	2
AB 5125	Protein Engineering	1
AB 5126	Enzyme Production Technology	2
AB 5127	Natural Product Chemistry	2
AB 5154	Valuing Plant Genetic Resources	1
AB 5155	Molecular and Functional Glycobiology	2
AB 5195	Practicum 1 – Biology	1
AB 5196	Practicum in Biotechnology I	1

<b>+Second Semester</b>		
AB 5202	Advanced Genetic Analysis: Genes, Genomes and Networks	2
AB 5203	Plant Breeding Techniques	2
AB 5204	<i>In Vitro</i> Techniques for Biotechnology	2
AB 5205	Stress Physiology	2
AB 5207	Environmental Physiology II – Root Environment	2
AB 5208	Plant Physiology Techniques	2
AB 5209	Nutritional Quality Improvement of Food Crops	1
AB 5210	Statistical Genomics in Biotechnology	2
AB 5211	Methods in Plant Genetic Resources Conservation	2
AB 5213	Plant Growth and Development	2
AB 5214	Biotechnology in Crop Improvement	1
AB 5215	Population Genetics	2
AB 5216	Genetic Designs	2
AB 5217	Breeding strategies of Economic Crops	2
AB 5218	Character Inheritance Mechanisms	1
AB 5220	Marine Biotechnology	1
AB 5222	Gene Expression and Developmental Genetics	2
AB 5223	Cereal Biotechnology	1
AB 5224	Secondary Metabolite Production	1
AB 5225	Biological Nitrogen Fixation	1
AB 5227	Cellular Immunology	1
AB 5228	Molecular Breeding and DNA Fingerprinting	2
AB 5229	Genetically Modified Organisms, Food, Feed and Processed Products and Biosafety	1
AB 5230	Plant Variety Protection, Intellectual Property Rights and Policy Issues	1
AB 5232	Variety Testing for Adaptability	1
AB 5233	Nanotechnology in Agriculture	1
AB 5235	Scientific Communication in Biology	1
AB 5236	Production of Transgenics	1
AB 5251	Bioindustry	1
AB 5252	Bioinformatics	2
AB 5253	Utilization of Plant Genetic Resources in Crop Improvement	1

AB 5254	Environmental Physiology III – Stress Physiology	2
AB 5256	Environmental Physiology IV – Simulation of Plant Growth	3
AB 5258	Documentation and Information Management of Plant Genetic Resources	2
AB 5295	Practicum 2 – Crop Improvement	1
AB 5296	Practicum in Biotechnology II	1
AB 5298	Directed Study	5
AB 5299	Seminar	1

## **COURSE CAPSULES**

### **First Semester**

#### **AB 5101. Cell Biology (2)**

Prokaryotic and eukaryotic cells, Cell fractionation, Ultra structure of cells- Cell Wall. Plasma membrane and endomembrane system, Nucleus, Plastids, Mitochondria, Ribosomes, Golgibodies, Microbodies and other cellular organelles, vacuoles and cytoplasm.

#### **AB 5102. Water relations and Nutrition (2)**

Soil-Plant-Air-Water relationship ; Water potential concepts; principles of water movements; cell water relations; roots as absorbing organs - absorption, radial movement of water, ascent of sap ; stomatal physiology ; Essential elements for plant growth - their physiological role. Ion uptake and transport of nutrients. Hydroponics and water culture methods. Phloem transport.

#### **AB 5103 Plant systematic (2)**

General definitions, aims and uses of plant taxonomy; Historical development of classification systems; Species concepts and plant nomenclature; Taxonomic data and cyt-taxonomy; Modern field and herbarium methods; Taxonomic literature

#### **AB 5104. Plant Ecosystems (2)**

The ecosystem concept in biology and agriculture. Nutrient cycling, energy flow and productivity of natural and man made ecosystems. Floristic, composition, structure and succession of terrestrial and aquatic eco-systems. Soils in Sri Lanka.

#### **AB 5105. Cellular Genetics (2)**

Interphase nucleus. Repetitive and unique DNA sequences, Architecture of eukaryotic chromosome, Mitosis and Meiosis, Euploidy and aneuploidy, simple and multiple translocations and inversions, Deviant cytogenetic systems, cytogenetics in plant breeding and evolution., Molecular aspects of cytogenetics, Cytoplasmic inheritance.

#### **AB5106: Exploring the Genomes : Principles and Techniques: (2)**

Basic concepts of Genomic exploration, Tools and Techniques of genomic analysis, Genome Mapping, Genome assembly, Transcriptomics, Bridging the Gene-to-Function Knowledge Gap

#### **AB 5107. Microbial Genetics (2)**

Bacterial chromosome, episomes and plasmids, mutations, , recombination in bacteria (transformation, conjugation, transduction), viral genetics: SS and DS viruses, DNA and RNA viruses, Life cycle , genomics and recombination of viruses, mutations, transposons, genetics of yeast – 2  $\mu$  plasmid, twin hybrid systems, nitrogen-fixing genes, genes responsible for antibiotic resistance, quorum sensing, biofilms

**AB 5108 Principles of Plant Breeding (2)**

Introduction & challenges of Plant breeding, Goals in plant breeding , Traits considered in plant breeding [qualitative & quantitative ] sexual vs asexual reproduction , Characteristic features of self & cross pollinated plants, Emasculation methods & pollination techniques , Male sterility and production of F1 hybrids , Incompatibility systems and its genetic manipulation . Conventional breeding strategies : Self pollinated crops and Cross pollinated crops . Crop improvement of Asexually reproducing crop plants. mutation breeding , protoplast fusion . Wide hybridization , Inter-specific hybridization , Di-haploids . Importance & use of crop genetic resources in plant breeding .

**AB 5109. Reproductive Biology (1)**

Significance of the knowledge of species' reproductive biology; Flowering and fruiting phenology (stigma receptivity and pollen phenology at individuals and population levels), synchrony of flowering , sex ratio ; Pollination vectors; Histology of reproductive tissues, breeding systems ( self and cross ), compatibility, apomixis, agamospermy, outcrossing rates; Seed dispersal and regeneration of species; Application of molecular techniques; Application of the knowledge of species reproductive biology on *in situ* and *ex situ* conservation, evolutionary biology and seed collection strategies.

**AB 5110 Crop Genetic Resources (1)**

Significance of biodiversity, Threats to BD, Values of BD , Importance of PGR, Origin of Agriculture & dynamics of plant speciation, Centers of origin & Centers of diversity , significance of polyploidy in the origin of plant species, gene pool classification, Utilization of PGR in crop improvement - Identifying the potential importance of wild relatives, weedy races , farmer collections. Gene pool classification, Utilization of gene pools in conventional breeding: Case studies of rice, wheat , maize and tomato.

**AB 5111 Exploration and Characterization of Plant Genetic Resources (2)**

Introduction to Exploration & collection of PGR: Types of exploration missions, preparation for the exploration, Collection sources & general guide lines for exploration .Collecting method of seed crops from farmers fields , farmer's stores markets, shops & orchards & kitchen gardens. Sampling methods / sample size, Collecting strategies : vegetatively propagated crop germplasm, wild germplasm of crop plants and fruits & timber crops , germplasm exchange and quarantine requirements.

Characterization : Introduction, seed multiplication, purity maintenance ,isolation distances, preliminary evaluation. Characterization techniques : Morphometric and isozyme analysis/ cytogenic / biochemical & molecular characterization . Preparation of descriptor lists. Documentation plant genetic resources .

**AB 5112. Environmental Physiology I - Microclimate (2)**

Introduction to the Quantitative Approach in environmental plant physiology, Plants and radiation, Heat, mass and momentum transfer within and above canopies, Plant and cell water relations, Leaf temperature, energy balance and evapotranspiration, Stomata, Photosynthesis and respiration, Light and plant development, Control of tissue temperature, Effects of wind,

altitude, CO<sub>2</sub> and atmospheric pollutants on plant productivity Environmental physiology and yield improvement.

**AB 5113. Photosynthesis and Plant Productivity (2)**

Significance of photosynthesis in agriculture; early and recent research on photosynthesis. Photosynthetic pigments, radiation energy, and its capture by plants, photosystems and their interactions, CO<sub>2</sub> fixation mechanisms, photorespiration, CO<sub>2</sub> enrichment, environmental and physiological control of photosynthetic productivity in crop plants. Efficiency of photosynthesis in species.

**AB 5114. Biosensing (2)**

Interaction properties of biological macromolecules, Types of biosensors, biosensor analysis and application, Optical biosensors, Acoustical biosensors, real time biosensor instrumentation, optical system, Kinetic measurements, Practical consideration in biosensing, Application of biosensing.

**AB 5115 Assessment of Genetic Diversity (1)**

Genetic diversity analysis using morphological, Physiological and molecular data; Measuring variation with-in population, Similarity and dissimilarity measures, Principle Component Analysis (PCA), Cluster analysis, MANOVA , Factor Analysis and Canonical Correlation Analysis.

**AB 5116 Plant Biochemistry (2)**

Metabolism, free-energy and equilibrium constants, energy charge, enzyme kinetics, reaction types, biological redox molecules. Biosynthesis, biodegradation and distribution of carbohydrates, proteins, lipids and nucleic acids in plants, ;Biochemistry of plant respiration.

**AB 5118. Polygenic Inheritance (2)**

Genetic & environmental variation; components of means & variances; basic generations; hybrid vigor; heritability; correlations; G x E.

**AB 5119 Molecular Biology (1)**

The molecular nature of genes, the central dogma, DNA functions; replication, transcription, translation, post-transcriptional modifications, genome and organization in bacteria and higher organisms, chloroplast and mitochondrial DNA.

**AB 5120 Theory and Techniques of Plant Gene Manipulation (2)**

The central dogma of molecular biology, Structure of plant genes, functions of DNA; replication and gene expression, DNA cloning and transformation, hybridization techniques, construction of genomics and cDNA libraries, PCR and DNA Fingerprinting

**AB 5121 Characterization and Evaluation of Plant Genetic Resources (2)**

Introduction; Characterization Techniques - Morphometric characterization, Biochemical characterization using isozymes, cytogenetics characterization & Molecular characterization

using RAPDs, RFLPs, AFLPs and microsatellites; Genetic diversity analysis using morphological & molecular data; Measuring variation within populations; Similarity and dissimilarity measures, Diversity index, Gene diversity, Genetic diversity among populations, Phylogenetic analysis, genetic distance, Evaluation for biotic and abiotic stress.

#### **AB 5122 Gene Manipulation (2)**

Introduction to gene manipulation, cutting and joining DNA molecules, cloning vectors, cloning for gene libraries, cDNA libraries, transformation in *E. coli*, recombinant selection and screening, cloning and transformation strategies in bacteria, plants and animals, analysis of DNA sequences; DNA sequencing and synthesis, labeling and hybridization techniques, polymerase chain reaction and its different applications.

#### **AB 5125 Protein Engineering (1)**

Protein structure, function and their relationships, post-translational modifications and their effects, folding and stability, determination of protein interactions, protein structure prediction and modeling, protein dynamics, chimeric protein construction, proteome analysis; 2D gel electrophoresis, chromatography, HPLC, mass spectrophotometry, amino acid sequencing, protein structure determination; X-ray diffraction, NMR spectroscopy, databases for protein structure.

#### **AB 5126 Enzyme Production Technology (2)**

Enzyme properties, nomenclature and classification, isoenzymes, enzyme production technology, downstream processing, microorganisms important in industrial enzymes, microbial derived enzymes, commodity enzymes and their production, fine enzymes and their production, genetic engineering and industrial enzyme production

#### **AB 5127 Natural Product Chemistry (2)**

Plant analysis for natural products, extraction, separation and identification methods: chemistry and distribution of phenolic compounds, essential oils, other terpenoids, nitrogenous compounds, lipids and plant acids, applications of natural product chemistry in different disciplines of plants.

#### **AB 5154. Valuing Plant Genetic Resources (1)**

Concept of valuation; Economics, ethics and values; Loss of biodiversity as an economic process; Rationale for valuing genetic resources; Monetizing the value of PGR - instrumental (direct, indirect, option and quasi option) vs intrinsic values; Valuation techniques for biodiversity; Conservation cost and willingness to pay.

#### **AB 5155. Molecular and Functional Glycobiology (2)**

Glycobiology and its biological significance, central dogma of glycobiology, enzymes of glycosylation – the glycosyltransferases, glycoproteins, glycolipids, species – specific glycoprotein glyssylation, glycosphingolipids (GSL), carbohydrate – binding proteins (Lectins), tools for carbohydrate analysis, carbohydrate – based drugs and therapeutic



compounds, disease process in which carbohydrates are involved, xenotransplantation, carbohydrate biotechnology.

#### **AB 5195 Practicum 1 Biology (1)**

Introduction to principles and practice of biological techniques, centrifugation, spectrophotometry, chromatography, use of radio isotopes, determination of photosynthesis and respiration, determination of and plant water relations, hydroponics and sand cultures, enzyme assays, determination of pigments, Isolation of DNA, Gel electrophoresis.

#### **AB 5196 Practicum in Biotechnology I (1)**

Plant DNA extraction, plasmid DNA extraction, RNA extraction from plant tissues, total protein extraction from plant tissues, DNA, protein quantification, Agarose gel electrophoresis for DNA, acrylamide gel electrophoresis for proteins, silver staining of proteins.

### **Second Semester**

#### **AB 5202 Advanced Genetic Analysis: Genes, Genomes and Networks: (2)**

The logic of genetic analysis, Mutations, Linking a Phenotypes to DNA Sequences, Identification and screening of mutants, Genome-wide mutant screens, Gene Interactions

#### **AB 5203 Plant Breeding Techniques (2)**

Reproductive systems in cultivated plants. Emasculation and pollination techniques, self & cross breeding methods, Incompatibility and male sterility, non-conventional breeding, Mutation Breeding, production of hybrids & pure varieties; traditional knowledge; uses of genetic resources and benefit sharing; breeding strategies of local and regional institutes.

#### **AB 5204 *In vitro* Techniques for Biotechnology (2)**

Principles of in vitro culture, Micropropagation, Germplasm establishment in vitro, Multiplication Techniques, Somaclonal variation; In vitro storage and reestablishment in soil, Callus and cell suspensions, Cell culture establishment; maintenance and plant regeneration, Haploid production, Anther/micropore culture. Chromosome elimination, ovule/ovary culture, Protoplast technology, Protoplast isolation, culture, fusion and regeneration of plants and animals.

#### **AB 5205 Stress Physiology (2)**

Environment as a stress factor, stress concepts, measuring plant stress, light, temperature, oxygen deficiency, water deficiency, osmotic stress, heavy metals, biotic stress, production of stress tolerant plants, Role of phytohormones and other signaling molecules on plant stress response, Genomic technologies & their applications for environmental research.

#### **AB 5207. Environmental Physiology II - Root Environment (2)**

Physiology of roots from germination to senescence, Source-sink conditions affecting root growth and development, Rooting and root physiology in well aerated soils,

Biochemistry of roots under waterlogged conditions, Root physiology in swamps and mangroves, Effects of temperature on root growth and functioning, Hormones, plant growth regulators and roots, Saline conditions and root reactions, Industrial waste effects on root physiology, Rhizosphere and biochemistry of roots, Soil less agriculture - hydroponics, Aquaculture, tissue culture and the root system, Root physiology in different potting media.

**AB 5208. Plant Physiology Techniques (2)**

Use of centrifugation, Spectrophotometry, Chromatography and radio isotopes, Determination of photosynthesis, Respiration, Plant water relations and nitrogen fixation. Plant tissue culture and hydroponics.

**AB 5209 Nutritional Quality Improvement of Food Crops (1)**

Nutritional quality parameters, Factors affecting nutritional quality of foods, Genetic basis of nutritional quality parameters, Pre and post harvest practices for quality improvement, Breeding for quality improvement, Transgenic approaches in quality improvement, Present perspectives and future trends

**AB 5210 Statistical Genomics in Biotechnology (2)**

Introduction to statistical genomics, DNA markers as the land marks of the genome, Structure of genomes and mapping, QTL, QTN, eQTL and QTP as the jewels of genomes, Association mapping, Haplotype analysis and molecular breeding, Case studies, Interpreting gel data, Interpreting high throughput genomic data, Genome mapping, Quantitative genetics and genomics, QTL analysis and its practical applications in Biotechnology.

**AB 5211. Methods in Plant Genetic Resources Conservation (2)**

Introduction; Fundamentals on plant genetic resources conservation; Strategies of plant genetic resources conservation; Choice of conservation strategies; Species vs habitat or ecosystem based conservation; *In situ* conservation (natural, exploited and enriched habitats); *Ex situ* conservation (seed storage, field conservation, in vitro conservation, DNA libraries, gene banks, botanical gardens and herbariums, on farm conservation); Design and management of genebank facilities; Institutions involved in plant genetic conservation

**AB 5213 Plant Growth and Development (1)**

Biology of growth and development; Embryonic and post embryonic development, Seed germination, Organ development; flowering, Internal and external factors on development; Phytohormones and Light and temperature, Biological rhythms, Plant movements, Photomorphogenesis, Photoperiodism,

**AB 5214 Biotechnology in Crop Improvement (1)**

Development of molecular markers, Marker-assisted breeding, Plant genetic engineering, *Agrobacterium* mediated transformation and monocot transformation, Prospects for improving the efficiency of transformation, screening and improving transgenic plants, cisgenesis Tissue culture in advanced breeding, doubled haploid populations, functional and

comparative genomics in plant improvement Impact of plant genomics and molecular breeding on Cereals, vegetables and fruit crops, root and tuber crops, other crops.

**AB 5215. Population Genetics (2)**

Hardy-Weinberg equilibrium and its assumptions. Multiple alleles. Race and species formation. Changes in gene frequency. Mutation, drift, migration, selection, meiotic drive and mating behavior. Self-pollinated and Cross-pollinated populations. Inbreeding depression.

**AB 5216. Genetic Designs (2)**

Basic generations, BIPs, diallel genetic designs and data analysis; use of 'Microsim' software package for analysis of simulated data

**AB5217 Breeding strategies of Economic crops (2)**

Visit to Research stations and Institutes to understand the breeding procedures of the following crops: Rice , Plantation, field, vegetable , spice and Fruit crops. Scientists from various Research Institutes will be identified [up to 3 – 4 scientists ] to deliver breeding methodologies of relevant crops. Assessment will be based on the report submitted by the candidate after each field visit and also end term and oral examination conducted at the end of the semester .

**AB 5218 Character Inheritance Mechanisms (1)**

Major genes and poly genes, sources of variation, genetic basis of quantitative variation, components of means of basic generations and predictions, association and dispersion of genes, components of variances, heritability, hybrid vigor/heterosis

**AB 5220 Marine Biotechnology (1)**

Marine biology: organisms, diversity, environmental adaptations, biochemical production by different marine organisms and their activities, drugs and other pharmaceutical products from marine organisms, waste management and bi-product utilization, new techniques of culturing sea weeds and other marine organisms, genetic tagging of marine organisms, sex changing of fish, use of marine organisms for detection of environmental contaminants, anti-fouling techniques, environmental protection, transgenic marine organisms, quality and safety of sea foods.

**AB 5222. Gene Expression and Developmental Genetics (2)**

Gene expression and control of gene expression of prokaryotes and eukaryotes; operons, transcriptional regulation through regulatory elements and proteins, DNA binding domains, DNA methylation, chromatin remodeling, gene regulation through signal transduction, post transcriptional regulations, translational and post-translational regulatory mechanisms, cell cycle and growth regulation, cell death and apoptosis, oncogenes, developmental genetics, homeotic genes and plant development, regulation of plant growth and scope for manipulation, current perspectives.

**AB 5223 Cereal Biotechnology (1)**

Cereal genomics; genome structure, comparative genetics among cereals, GM cereals, current perspectives, quality characters of cereal grains and correlations of them with cereal end products, inheritance of major quality characters; physical, chemical (starch, protein), physico-chemical and other quality characters, analyzing quality characters; amylose content, swelling power, gelatinization temperature, alkali spreading score, SDS-PAGE for proteins, breeding for product quality improvement and diversification in rice, wheat and other cereals.

**AB 5224 Secondary Metabolite Production (1)**

Plant secondary metabolites and their occurrence, biosynthetic pathways, regulatory factors of secondary metabolite production, application of transgenic plants to secondary metabolite production, medicinal plants and screening for new compounds, pharmacological evaluation of new compounds.

**AB 5225 Biological Nitrogen Fixation (1)**

Nitrogen fixation in perspective, N-fixing organisms, biochemistry of nitrogen fixation, nitrogenase enzyme, nitrogen fixation and metabolism, new diazotrophs, agricultural and industrial applications of biological nitrogen fixation, current trends in nitrogen fixation research.

**AB 5227 Cellular Immunology (1)**

Immune response, immunoglobulins, monoclonal antibodies, polyclonal antibodies, histocompatibility, antigen-antibody reactions, cell-mediated immunity and humoral immunity, complement, hypersensitivity, immunological defects, immunoassays.

**AB 5228 Molecular Breeding and DNA Fingerprinting (2)**

Recap of classical breeding methods and their limitations, MAS for major genes and polygenes, linkage drag and linkage analysis, gene pyramiding, novel breeding methods, DNA fingerprinting methods, mapping populations, assessing genetic distance, Nei methods, current trends of transgenics.

**AB 5229 Genetically Modified Organisms, Food, Feed and Processed Products and Biosafety (1)**

Convention on Biological Diversity- CBD and its relation to biotechnology, status of Genetically Modified Organisms (GMO), Food, Feed and Processed Products (;FFPs), advantages, risks and concerns, Cartagena Protocol, risk assessment and management, biosafety policy, detection of GMO and FPP, legislations.

**AB 5230 Plant Variety Protection, Intellectual Property Rights and Policy Issues (1)**

Patents, plant variety protection, farmers' rights, relevant legislations, Intellectual Property Rights, national policies, international policies, international agreements (WTO etc.), bilateral agreements, plant quarantine.

**AB 5232 Variety Testing for Adaptability (1)**

History of variety development in Sri Lanka, present status of variety development, role of public and private sector in variety development, early testing of varieties, national coordinated varietal test, variety adaptability test, , hybrid variety testing, DUST test, over view of statistical methods in variety testing and variety release procedures.

**AB 5233 Nanotechnology in Agriculture (1)**

Introduction to nanotechnology, nanoagrochemicals, nanoemulsions and nano plant growth regulators, synthetic biology, nano genetic manipulation of agricultural crops, nanoarrays, nanosensors for precision farming, health risks of nanomaterials, nanomaterials in foods, food packaging, food coatings, nutritional supplements, fertilizers, pesticides and seed treatments, nanomaterials and ecological risks.

**AB 5235 Scientific Communication in Biology (1)**

Research proposals, components of a research proposal, criteria for developing effective research proposals, preparation of research articles; research papers, extended abstracts and abstracts, poster presentations, submission and communications with publishers.

**AB 5236 Production of Transgenics (1)**

Historical background, uses of transgenic organisms, procedure for transgenesis, advantages of transgenesis over traditional breeding for animals and plants, procedure for transgenesis, genetic transformation of medicinal plants for pharmaceuticals, designing symbionts for control of plant diseases, transgenic insects, problem of transgenic insect fitness, transgenic fish.

**AB 5251 Bioindustry (1)**

Fermentation technology, Organic acid fermentation, Vitamins, Antibiotics, Animal feeds, Secondary metabolites. Biomass utilization, , Biopolymers, biofertilizer waste as renewable force of energy, Petroplants, Bioreactors, Molecular diagnosis (1) ELISA / IFA, MAB, PAB, antigen and antibodies, Microbial synthesis of pharmaceuticals and gene therapy.

**AB 5252 Bioinformatics (2)**

Organizing and managing biological data, web based information - access search and retrieval of biological information and literature. analyses of biological data and interpretation. mathematical basis and algorithms in analytical tools. sequence analysis, structure and alignment of nucleic acids and proteins using data banks-NCBI, EMBL, swiss-prot. software in bioinformatics, phylogenetic analysis.

**AB 5253 Utilization of Plant Genetic Resources in Crop Improvement (1)**

Relevance of PGR in crop improvement, identifying the potential importance of wild relatives, weedy races, land races farmer collection etc. for crop improvement. Utilization their gene pools in conventional breeding, protoplast fusion and molecular breeding to transfer specific genes. Case studies - utilizing PGR to improve rice wheat, maize, tomato etc. Visits to breeding stations.

**AB 5254 Environmental Physiology III - Stress Physiology (2)**

Definition of stress, Environmental stress factors, Drought stress, Temperature stress, Salinity stress, Impact of disease induced stress, Thigmomorphogenesis/ effect of mechanical perturbations under growth of plants, Ionic stress, Air pollution, The role of plant stress research in future agriculture productivity.

**AB 5256 Environmental Physiology IV - Simulation of Plant Growth (3)**

Presentation of problems and available data, Presentation of available models, Process-models and their parameterisation, Maintenance respiration, Growth respiration, Morphological development, assimilate partitioning and remobilization, Leaf and root development, Transpiration and water uptake, Soil water balance.

*Practical:* Students should work with a problem and prepare a report on obtained results.

**AB 5258 Documentation and Information Management of Plant Genetic Resources (2)**

Ex situ and in situ documentation systems. PGR information processing and Data recording - using Descriptors, dealing with heterogeneous data and data exchange. Manual documentation systems. Ethnobotanical and botanical information. Geographical information systems. Use of gene bank software (GMS, PCGRIN, MGIS, CGRD, SINGER). Data security.

**AB 5295 Practicum 2 - Crop Improvement (1)**

- i) **Classical breeding techniques** – Practice in hand Pollination - Rice, chilli , brinjal & tomatoes , Testing for pollen viability, Inheritance studies , Quantitative character studies
- ii) **Molecular breeding** - Laboratory safety, Plant DNA Extraction, DNA Quantification, Agarose Gel Electrophoresis & Visualization , PCR – DNA Finger Printing [ RAPD or SSR ]

Double Haploid Plant Production [RRDI - Batalagoda , Embryo Culture - CRI

**AB 5296 Practicum in Biotechnology II (1)**

Restriction digestion of plasmid DNA and electrophoresis, cloning and transformation, Randomly Amplified Polymorphic DNA (RAPD) analysis and electrophoresis, data interpretation, DIG labeling, blotting techniques.

**AB 5298 Directed Study (5)**

Each student is required to conduct and complete a research project on topic falling within the disciplines of Plant Biology, Breeding and Conservation or Molecular Biology and Biotechnology. The students are expected to present a pre-proposal at the commencement of the project. Each student has to present a seminar on the research conducted and submitting a project report for the final evaluation of the research project. The selection and planning of the project should commence during the second academic semester. This research project

will be supervised by an academic staff member of the PGIA and also an external supervisor in case the student is from a research institute or conducting the project outside the university. This course will be offered during every semester as decided by the Board of Study.

**AB 5299 Seminar (1)**

Students will be provided with the knowledge and skills required to make a scientific presentation. They will be guided to prepare for the presentation; selection of topics, preparation of presentations, visual aids etc. At the end of the course students should make a scientific presentation and they will be evaluated based on the presentation made. This course will be offered during every semester as decided by the Board of Study.

## BOARD OF STUDY IN AGRICULTURAL ECONOMICS

### LIST OF COURSES

Course No	Course Title	Credits
<b>First Semester</b>		
EC 5101	Microeconomic Theory I	2
EC 5102	Mathematical Economics	2
EC 5103	Mathematical Programming	2
EC 5104	Agricultural Marketing I	2
EC 5105	History of Agricultural Policies in Sri Lanka	2
EC 5106	Resource and Environmental Economics I	2
EC 5107	Project Analysis	2
EC 5108	Water Resource Economics I	2
EC 5109	Resource Management in Tropical Farming Systems	2
EC 5110	Introduction to Economics	2
EC 5111	Ecology, Conservation and Management of Natural Resources	2
EC 5112	Macroeconomic Theory I	2
EC 5113	Econometrics I	2
EC 5114	Quantitative Methods	2
EC 5120	Land Economics	2
EC 5153	Resource Planning and Management	2
EC 5154	Agricultural Finance	2
EC 5156	Livestock Economics and Marketing	2
PDEC 5101	Contemporary Issues in Development	2
PDEC 5102	Principles of Development Management	2
PDEC 5103	Techniques in Development Project Planning	2
<b>Second Semester</b>		
EC 5203	Development Economics	2
EC 5204	Applied Production Economics	2
EC 5207	Food and Nutrition Economics	2



EC 5208	Water Resource Economics II	2
EC 5209	Special Topics in Agricultural Economics	1
EC 5210	Managerial Resource Economics	2
EC 5212	Seminar in Sustainable Development	2
EC 5213	Agricultural Policies in Developing Countries	2
EC 5214	Agricultural Marketing and Price Analysis	2
EC 5215	International Trade	2
EC 5216	Macroeconomic Theory II	2
EC 5217	Dynamics of Resource Economics	2
EC 5218	Quantitative Policy Analysis	2
EC 5219	Resource and Environmental Economics II	2
EC 5221	Environmental Valuation	3
EC 5222	Microeconomic Theory II	2
EC 5223	Econometrics II	2
EC 5226	Field Visits	1
EC 5237	Agriculture Value-chain Management	1
EC 5297	Research Project (EE/NRM)	5
EC 5298	Directed Study	5
PDEC 5201	Research Skills for Community Development	2
PDEC 5202	Agribusiness and Enterprise Development	2
PDEC 5203	Poverty and Social Impact Analysis	2

## **COURSE CAPSULES**

### **First Semester**

#### **EC 5101. Microeconomic Theory I (2)**

Introduction. Theory of firm; technology, profit maximization, cost minimization, duality. Theory of consumer behavior; utility maximization, choice, demand, duality. Theory of market structures; competitive markets, imperfectly competitive markets.

#### **EC 5102. Mathematical Economics (2)**

*Prerequisite: ST 5101*

Differential calculus; applications in graphing, maxima and minima, production, cost, revenue and profit functions. Exponents and logarithms; present values, annuities. Linear algebra; first order and second order conditions. Constrained and unconstrained optimization. Homogeneous and homothetic functions. Economic applications of optimization

#### **EC 5103. Mathematical Programming (2)**

Introduction to mathematical programming; Linear programming (LP), Post-optimal analysis, Special types of LP problems, Shortcomings of LP. Extensions of LP to MOTAD, integer, separable, and stochastic programming. Nonlinear programming; Kuhn-Tucker conditions. Extensions of linear programming, game theory, Markov chains, inventory control and situation to agricultural planning and management.

#### **EC 5104. Agricultural Marketing I (2)**

Introduction to the basic concepts and definitions of agricultural marketing. Topics include market systems, grading of foods, price discovery, marketing efficiency, marketing by farmer groups, market system analysis and need for effective market system.

#### **EC 5105. History of Agricultural Policies in Sri Lanka (2)**

Review of post-independent agricultural policies in Sri Lanka. Economic analysis of agricultural policies. Impacts of agricultural policies on economic growth and efficiency, farm income and poverty alleviation. Comparative agricultural policy analysis.

#### **EC 5106. Resource and Environmental Economics I (2)**

Introduction to resource economics. Review of market economic system. Introduction to welfare economics. Market failures; property rights, externalities, public goods. Common property resources. Classification of natural resources. Economics of renewable resource management; fisheries economics, forest economics, water resource economics. Economics non-renewable resource management.

#### **EC 5107. Project Analysis (2)**

A survey of the theoretical underpinnings of public sector cost-benefit analysis. The project cycle. Valuation of costs and benefits. Shadow pricing. Discounting. Measures of project worth. Shortcomings of project analysis. Extended cost-benefit analysis.

**EC 5108. Water Resource Economics I (2)**

Introduction to economics of water resource allocation. Sectoral allocation of water. Economic principals of water resource allocation in agriculture. Water demand and supply characteristics. Water pricing; irrigation, industrial, and domestic sectors. Fundamental concepts of integrated water resource management.

**EC 5109. Resource Management in Tropical Farming Systems (2)**

Tropical environment and farming, Shifting cultivation systems, Fallow systems, Permanent upland systems, Irrigation systems, Perennial cropping systems, Farming systems research, Agroforestry systems, Ecological agriculture.

**EC 5110. Introduction to Economics (2)**

Economics as a social science. Nature and scope of economics. Economic elements and structures. Introduction to human behavior. Classical vs neoclassical schools of thought. Micro vs Macroeconomics. Introduction to environmental economics. Basic concepts of supply and demand and price mechanism. Competitive markets and economic efficiency.

**EC 5111. Ecology, Conservation and Management of Natural Resources (2)**

Introduction. Energy flows in ecosystems. Nutrient cycles. Population ecology. Ecology and evolution. Human ecology. Ecology and conservation. Eco-ethics. Economics of conservation.

**EC 5112. Macroeconomic Theory I (2)**

Measurements of macroeconomic performances. Analysis of determination of income, employment, interest rates and inflation. Monetary and fiscal policy. Classical and Keynesian approach to macroeconomic policy.

**EC 5113. Econometrics I (2)**

Review of probability and statistical theory. Regression analysis; concept, assumptions and estimation. Interval estimation and hypothesis testing. Functional forms; elasticity and economic applications. Dummy variables; applications and interpretation.

**EC 5114. Quantitative Methods (2)**

Computer literacy. Linear and multiple regression, applications to natural resource management. Mathematical programming, applications to natural resource management.

**EC 5120. Land Economics (2)**

Principal of Land Utilization, Objectives of rational land use, Elements of land use planning, Political economy of land. Soil surveys and land classification methods, Relationship between land use classification and economic utilization of land, Farm management techniques for the optimization of land use. Interrelationship and conflicts between optimum micro land utilization principals and macro land use objectives, Principals of conservation; forestry, land reclamation and Soil conservation as land policies, Land settlement policies; Economic and

social evaluation of land settlement policies and multi-purpose project Land reform principals and policies, Land policies of Sri Lanka Since the 1920's.

#### **EC 5153. Resource Planning and Management (2)**

Introduction to planning theory. Planning process. Regional approaches to resource planning. Natural and physical analysis. Socio-economic analysis. Carrying capacity. Vulnerability and susceptibility. Watershed management. Rapid rural appraisal. Application of agro-ecosystem analysis. Environment impact assessment. Cost - benefit analysis in resources planning and management.

#### **EC 5154. Agricultural Finance (2)**

This course provides a fundamental knowledge of economic and management principles and analytical procedures that facilitate in obtaining control over capital use and its efficiency. This covers the topics, principals of agricultural finance, principles of financial management of the farm business, financial markets and agricultural credit institutions.

#### **EC 5156. Livestock Economics and Marketing (2)**

Introduction to livestock economics, Theory of factor-product, factor-factor, product-product, Theory of demand, theory of markets, Government policies in livestock industry, Vertical horizontal interaction in livestock industry, Farm records, Farm planning and budgeting, Linear programming with examples in livestock industry. Cost-benefit analysis of egg production, marketing of eggs, broilers, meat and meat products, milk and milk products, fish and fish products.

#### **PDEC 5101. Contemporary Issues in Development (2)**

Concepts in Development and underdevelopment, Development programming, Development issues (with a special emphasis on rural communities); Culture, Gender, Capacity building and empowerment, Politics, Corruption and governance, Participation and accountability, Social mobility and migration, Natural disasters and conflicts.

#### **PDEC 5102. Principles of Development Management (2)**

Economic fundamentals, Institutional economics, Development theories, Role of agriculture in economic development, Development planning, Development administration, Management for development.

#### **PDEC 5103. Techniques in Development Project Planning (2)**

Fundamentals for development projects, Project planning stages, Project planning tools, Evaluation and monitoring tools, Issues in development project planning, Case studies in rural development, Results based monitoring and evaluation.

## **Second Semester**

### **EC 5203. Development Economics (2)**

Concepts and approaches to economic development and human welfare, including theories of growth, structural change, income distribution and dual economy ;models. Role of agriculture in economic development. Role of government in developing countries. Planning and development.

### **EC 5204. Applied Production Economics (2)**

Special topics in production economics. Estimation of production, cost, supply and profit functions using flexible function forms. Frontier production functions; stochastic frontier functions and data envelopment analysis. Decision making under risk and uncertainty. Expected utility theory and stochastic dominance. Applications including output response, input adjustments and diversifications.

### **EC 5207. Food and Nutrition Economics (2)**

Basic economic concepts and role of income and prices in determining nutritional status. Household income analysis. Intra-household Issues. Farm household behavior and price policy. Markets; functions and failures. Consumer price interventions and income interventions.os2.odt Macroeconomic policies and structural adjustment.

### **EC 5208. Water Resource Economics II (2)**

Surface and ground water development and challenges. Decisions support system for water pricing and management. Frontiers in water resource economic research.

### **EC 5209. Special Topics in Agricultural Economics (1)**

This course is conducted in seminar format. Current topics relevant to agricultural sector in Sri Lanka, which are not covered in other courses, will be the focus of this course.

### **EC 5210. Managerial Resource Economics (2)**

Introduction; review of free market economic system. Market failures. Property rights. Common property resource management. Population and environment. Definitions and classification of natural resources. Economics of non-renewable resource management. Economics of renewable resource management. Land and water resource economics. Economics of pollution control.

### **EC 5212. Seminar in Sustainable Development (2)**

Sustainable development; definitions, evolution of the concept, ecology and economics, eco-ethics, strong and weak sustainability criteria. Population and sustainable development. Development financing agencies and sustainability. Sustainable development in Sri Lanka.

### **EC 5213. Agricultural Policies in Developing Countries (2)**

Rationales for government intervention; Criteria for policy evaluation. economic, social and political; Quantitative policy analysis; Irrigation and land settlement policies in the

developing world; Price policies; Interventions in marketing; Trade policies; Food and nutrition policies; Environmental policies.

#### **EC 5214. Agricultural Marketing and Price Analysis (2)**

Introduction to price theory and agricultural price analysis. Temporal price behaviour, derived demand, marketing margin, harmonic analysis. Risk and uncertainty in marketing. Role of commodity futures. Hedging strategies. Advertising effectiveness. Market segmentation.

#### **EC 5215. International Trade (2)**

Topics include global and regional trade agreements, WTO, SAPTA, SAFTA. Bi-lateral trade agreements in South Asia. International trade theory; absolute advantage, comparative advantage, Heckscher-Ohlin theory. international trade policy; tariffs and non-tariff barriers, economic integration.

#### **EC 5216. Macroeconomic Theory II (2)**

International economics; exchange rates, capital flows. Business cycle theory. Growth theories; Solow model, infinite horizons and overlapping generations models, new growth theory. Selected advanced topics.

#### **EC 5217. Dynamics of Resource Economics (2)**

Differential equations. Calculus of variation. Optimal control theory. Dynamic programming. Applications to natural resource management. Optimal harvesting of renewable resources; forests, fisheries, water. Optimal extraction of non - renewable resources.

#### **EC 5218. Quantitative Policy Analysis (2)**

Rationale for government interventions and the role of quantitative policy analysis. Analysis of irrigation and land settlement policies; Price policies, interventions in marketing; Trade policies food and nutrition policies; Environment policies. Quantitative techniques: Estimation and simulation of demand, supply, cost and profit systems. Measurement of market distortion; Partial equilibrium analysis and general equilibrium analysis.

#### **EC 5219. Resource and Environmental Economics II (2)**

Advanced analysis on externalities. Overview of environmental policies. Quantity control and price controls. Command and control methods. Pigouvian taxes and charges. Subsidies. Tradable permits. Liability rules; non-compliance fees, bond, and deposit refunds. Criteria for policy selection. General equilibrium effects and double dividend.

#### **EC 5221. Environmental Valuation (3)**

Economic values, benefits/costs and human welfare. Valuation using market prices; productivity change method, replacement cost method, human capital approach, cost of illness approach, defensive expenditure method, and opportunity cost approach. Surrogate market approaches; property value models, hedonic wage models, travel cost models. Stated preference methods; contingent valuation and choice experiments. Benefit transfer method.

**EC 5222. Microeconomic Theory II (2)**

General equilibrium analysis. Economic efficiency in general equilibrium context. Welfare measurements. First and second theorem of welfare. Special topics; labor leisure choices, risk and uncertainty, information economics, asset markets.

**EC 5223. Econometrics II (2)**

Violation of assumptions. special topics in econometrics; limited dependent variable models such as linear probability, profit, logit and tobit models, simultaneous equation models, seemingly unrelated models and their applications, deterministic and stochastic time series analysis, cointegration analysis.

**EC 5226. Field Visits (1)**

Visits to development projects and sites of academic interest on environmental and natural resources.

**EC 5237 Agricultural Value Chain Management (1)**

The Value Chain Approach, Value Chain Promotion as an Approach to Economic Development, Analyzing Agricultural Value Chains in Sri Lanka, Role of Related Sector in Promoting Value Chains in Agriculture Sector, Structured Learning Visits (assignment/presentation).

**EC 5297. Research Project (EE/NRM) (5)**

Students will be assigned to work on an on-going development project or to develop an environmental project under the supervision of an instructor. Based on the findings and/or work experience, students will be required to submit a written report and make a seminar presentation.

**EC 5298. Directed Study (5)**

A student should carry out an empirical project based on the guidance provided by an academic staff member and make an oral presentation.

**PDEC 5201. Research Skills for Community Development (2)**

Role of data and analysis in development, Development problem identification, Research planning, Data issues, Enumeration and survey techniques, Standard qualitative and quantitative techniques.

**PDEC 5202. Agribusiness and Enterprise Development (2)**

Role of business in community development, Phases in business development, Marketing environment, Business and growth linkages, Institutional issues in local enterprise development, Opportunities and constraints for business development, Rural entrepreneurship, Case studies and development of a local toolkit.

**PDEC 5203. Poverty and Social Impact Analysis (2)**

Definition and classification of poverty, Poverty measurement (monetary approach and non-monetary approach), Poverty concerns in development planning.

## BOARD OF STUDY IN AGRICULTURAL ENGINEERING

### LIST OF COURSES

Course No	Course Title	Credits
<b>First Semester</b>		
AE 5101	Water for Agriculture	2
AE 5102	Thermodynamics	2
AE 5103	Hydrology and Meteorology	3
AE 5104	Engineering Drawing	2
AE 5105	Water and Society	2
AE 5106	Physical Properties of Agricultural Products	2
AE 5107	Water Quality for Agriculture and Environment	2
AE 5108	Groundwater Development	2
AE 5109	Soil Mechanics	2
AE 5110	Watershed Management	2
AE 5111	Engineering Mechanics	2
AE 5112	Farm Mechanization	2
AE 5113	Principles of Farm Machinery	2
AE 5114	Agricultural Structures and Environment	2
AE 5115	Electronics and Instrumentation in Agriculture	2
AE 5116	Farm Machinery Testing and Evaluation	1
AE 5117	Numerical Analysis in Agricultural Engineering Applications	2
AE 5118	Principles of Post-harvest Biology and Technology	2
AE 5119	Water and Industry	2
AE 5151	River Basin Planning and Management	2
AE 5152	Environmental Impact Assessment	2
AE 5153	Principles of Ergonomics in Agriculture	2
AE 5154	Application of Remote Sensing in Agriculture	2
AE 5155	Financing Water Development	2
AE 5156	Environment and Industry	3
AE 5157	Solid Waste Management	2
AE 5158	Organic Produce Certification and Marketing	1
AE 5159	Grading Packaging and Transportation of Fruits and Vegetables	2



AE 5160	Advanced Power and Machinery	2
AE 5161	Solar Energy Applications in Agriculture	2
AE 5162	Tillage Engineering	2
AE 5163	Analysis of Agricultural Systems	2
AE 5164	Combustion of Biomass	2
AE 5165	Natural Fibre Technology	2
AE 5166	Water Resources Management for Tropical Agriculture	3
AE 5166	Process control and automation	2
AE 5198	Directed Study	5
AE 6101	Advanced Irrigation Water Management	2
AE 6102	Advanced GIS and Geo-informatics	2
AE 6103	Modeling Hydrological Systems	1
AE 6106	Innovative Technologies for Mechanization in Plantation Industry	1
GS 5101	Introduction to Geographical Information systems (GIS)	2
GS 5102	Introduction to Remote Sensing	2
GS 5103	Spatial Database Management	2
GS 5104	Fundamentals of Global Positioning Systems (GPS)	1
GS 5105	Surveying and Spatial Measurements	2
GS 5198	Directed Study	5
GS 6101	Statistical Methods for Spatial Data analysis	2
GS 6102	Advanced Remote Sensing and Applications	2
GS 6103	Recent Advances in Geo-Informatics	2
GS 6104	Spatial Data Infrastructure	1
<b>Second Semester</b>		
AE 5202	Water Application Systems	2
AE 5203	Food Process Engineering	2
AE 5204	Power and Energy for Agriculture	2
AE 5205	Ecologically Sustainable Industrial Development	1
AE 5206	Fluid Mechanics	2
AE 5207	Applied Heat Transfer	2
AE 5209	Geographical Information Systems (GIS) for Natural Resources Management	2

AE 5210	Health, Sanitation and Wastewater Management	2
AE 5211	Hydraulics of Erosion and Sediment Transport	2
AE 5212	Water Supply	2
AE 5213	Bioreactor and Bio-Environment Design and Control Systems	2
AE 5214	Electrical Power and Machines	2
AE 6104	Interdisciplinary Field Research Methodology	3
AE 6105	Gender in IWRM	2
GS 5201	Fundamentals of Spatial Statistics	2
GS 5202	Thematic Mapping, Cartography and Photogrammetry	2
GS 5203	Spatial Modeling and Analysis	2
GS 5204	Advanced GIS and Applications	3
GS 5205	Advanced Digital Image Processing	2
GS 5206	Microwave Remote Sensing	2

## **COURSE CAPSULES**

### **First Semester**

#### **AE 5101. Water for Agriculture (2)**

Soil-water-plant relations, Soil moisture availability, Water movement through soil, Plant and atmospheric systems, Impact of water stress on crop yield, Consumptive use, Determinations of crop water requirements, Estimation of field irrigation requirements, Irrigation scheduling, Determination of water requirements for field, Minor and major irrigation projects, Paddy vs. other field crops, Determination of water requirements under rainfed conditions.

#### **AE 5102. Thermodynamics (2)**

Fundamental concepts, Work and heat, Laws of thermodynamics and their applications, Properties and relationships, Cycles, Mixtures and psychometrics.

#### **AE 5103. Hydrology and Meteorology (3)**

Atmospheric physics, Formation and classification of clouds, Formations of disturbances, Depressions and cyclones, Rainfall governing mechanisms of Sri Lanka, Global weather events and their impact on rainfall of Sri Lanka. Hydrology cycle, Identification and quantification and analysis of hydrological processes, Ground water, Stream flow measurement, Hydrograph analysis, Runoff prediction, Reservoir and flood routing, Introduction to computer modeling.

#### **AE 5104. Engineering Drawing (2)**

Introduction to engineering drawing and projection systems, Lines and planes, Sections of solids, and interpenetration, Tolerance, Limits and fits, Line conventions and dimensioning of drawings, AUTOCAD and drawing projects.

#### **AE 5105. Water and Society (2)**

Importance of societal issues in relation to IWRM, Irrigation civilization and its origin; decline and resurgence of irrigation, Agrarian system and livelihood in Sri Lanka from early beginning to the present, Historical perspective of livestock production and fisheries, Communication skills for improved management systems, Community/Social/Capacity mobilization, Participatory approach in management systems for water and sanitation, Social theory and IWRM, Water rights, Water law and water as human rights, Decentralization, participation, privatization and regulatory authorities.

#### **AE 5106. Physical Properties of Agricultural Products (2)**

Introduction to physical characteristics of food and agricultural products, Volume and density measurements, Separation methods, aero- hydrodynamics, moisture isotherms, Centrifugation, Thermal Properties, Rheological Properties, Optical Properties, dielectric properties, Structural and textural characteristics.

**AE 5107. Water Quality for Agriculture and Environment (2)**

Introduction to water quality, water quality parameters, surface and groundwater pollution due to domestic, agricultural and industrial activities, impacts of water pollution, contaminant transport in soil and water system, water quality monitoring, pollution modelling, pollution control, water quality issues in Sri Lanka (Case studies).

**AE 5108. Groundwater Development (2)**

Occurrence of groundwater: aquifers, aquifer characteristics, Groundwater movement: determination of hydraulic conductivity (in-situ), Groundwater flow, Groundwater and well hydraulics: steady and unsteady unidirectional and radial flow into well, Multiple well systems, Surface investigation of groundwater: geologic method, Electro resistivity method, Seismic refraction method, Well construction: testing wells for yield, pumping equipment, Groundwater levels and Environmental influences, Quality of groundwater and Pollution.

**AE 5109. Soil Mechanics (2)**

Definitions/Mass volume relationships, Particle size distribution/Engineering classification of soils, Compression and Compaction, Settlement and Consolidation, Capillarity and Permeability, Unsaturated water flow/steady state flow, Flow nets and Seepage, Effective stress and pore pressure, Soil strength, Stress, strain and failure criteria, Earth pressure and slope stability, Bearing capacity and shallow foundations, Ground investigation and ground improvement techniques.

**AE 5110. Watershed Management (2)**

Concepts and definitions of watershed management, Current problems in watersheds. Processes operating in a watershed. Quantification of hydrological and soil erosion processes. Impacts of land management on quantity and quality of water resources. Strategies to prevent watershed degradation. Formulation of watershed management projects. Methodologies for cost/benefit assessments. Integration of participatory approaches to watershed management. Case studies.

**AE 5111. Engineering Mechanics (2)**

Stress-strain relationships, Elastic constants, Direct stresses, Combined stresses due to bending, Deflection of beams, Torsion in circular shafts, Fluid static, Steady, Unsteady, uniform and Non-uniform flows, Laminar and turbulent flows, Bernoulli's equation and its application, Momentum equation and its application, Flow in pipes, Kinematics and dynamics of a particle, Plane kinematics of a rigid body, Velocity and acceleration diagrams (application of vectors) of simple mechanisms, Belt drive, Vibration of a single degree of freedom systems.

**AE 5112. Farm Mechanization (2)**

Introduction to mechanization and farm machinery, Measuring field performance and introduction to crop production equipment. Costing of farm machinery, Selection of optimum power requirements; Human factors and safety on operations.

**AE 5113. Principles of Farm Machinery (2)**

Research and development of farm machinery, Agricultural tractor, Mechanical and hydraulic power transmission. Soil tillage and traction. Tillage implements. Tractor stability. Design of field equipment.

**AE 5114. Agricultural Structures and Environment (2)**

Functional planning and principles of environmental control, cost estimation, structural component analysis and properties of building materials. Design of storage structures.

**AE 5115. Electronics and Instrumentation in Agriculture (2)**

Basic concepts and terminology. Electrical circuit analysis, bridge circuits. Semiconductor components; Diodes, Transistors, Thyristors. Basic electronics; Rectification and power supplies, OPAMPS and their uses, Logic circuits, Number systems, counters. Instrumentation;

sensors and transducers for measurement of pressure, temperature, force etc. Introduction to control systems. Computer interfacing; introduction to computer hardware, A/D and D/A conversion, Data acquisition and storage, automatic control.

**AE 5116. Farm Machinery Testing and Evaluation (1)**

Introduction to testing and evaluation of tillage machinery, Testing and evaluation of walking type tractors, Testing and evaluation of reapers and threshers, Ergonomic appraisal and safety testing, Testing and evaluation of four wheel tractor, PTO, Draw bar, Testing and evaluation of four wheel tractor, ROPS, Hydraulic handing, Testing and evaluation of water pumps and sprayers, Instrumentation for power measurements.

**AE 5117. Numerical Analysis in Agricultural Engineering Applications (2)**

Introduction to computer based analysis software, Special features in MS excel, Solution of equations by iteration, Solving sets of equations, interpolating polynomials, Curve fitting and approximation of functions, Numerical differentiation and numerical integration, Numerical solution of ordinary differential equations, Boundary value problems and characteristic value problems, Numerical solution of partial differential equations, Hyperbolic partial differential equations.

**AE 5118. Principles of Post-harvest Biology and Technology (2)**

Cereal grains and other durable commodities: Cereals; Structure, composition and functional constituents of commercially important grains. Pulses: classification and physical properties. The spices and nuts: a brief overview on post harvest techniques. Grain harvesting, threshing, drying and storage, milling processes and quality control especially paddy, rice and seed paddy. Perishables and semi-perishables: Post harvest sites of losses and principles of post harvest physiology, handling stress management, Design principles of temperature and humidity management systems. Post harvest handling of commercially important tropical fruits and vegetables. Quality control, cost benefit analysis and appropriate technology for post harvest systems. Field visits to post harvest handling and processing centres.

**AE 5119. Water and Industry (2)**

Water use in industry: Quantity & Quality of water in different types of industries- agro based, textile, garments, leather, chemical, organic fiber, mineral and manufacturing, Impact of industrial use of water on resources, pollution levels - quality of water, Abatement measures and technology for water use: Minimize reduction and reuse, effluent treatment systems, Interaction of enterprises in managing water and sanitary systems.

**AE 5151. River Basin Planning and Management (2)**

History of river basin management, Natural river basins and transfer systems, Land and water interactions, Planning systems, Assessment of water requirements for agriculture, domestic industrial and environmental sectors, Supply and demand management, Runoff modifications in developed river basins, Dams and alternatives, Impact of dams on eco-systems, Importance of wetlands and environmental releases, Climate change and river basin management, River basin institutions, conflict management Case studies in river basin planning and management.

**AE 5152. Environmental Impact Assessment (2)**

Need for EIA, Definitions, EIA process, Methods in EIA, Multidisciplinary approach to EIA, Assessment of impacts, implementations, EIA legislation, policy & institutions, Case studies.

**AE 5153. Principles of Ergonomics in Agriculture (2)**

Introduction to human factors engineering, Human factors and work efficiency, Biomechanics and materials handling techniques; lifting, carrying, other handling operations and packaging ergonomics. Ergonomics for safe work, Organization of work, design of work places and applied ergonomics for office and the use of ergonomic check list for evaluation of work places.

**AE 5154. Applications of Remote Sensing in Agriculture (2)**

Introduction to remote sensing, Basic principles of electromagnetic energy, Types of sensors, Data sources and platforms, Visual interpretation, Software for image processing, Digital image processing including radiometric and geometric corrections, Enhancement, Classification. Accuracy assessment, Applications in agriculture and related disciplines, Case studies.

**AE 5155. Financing Water Development (2)**

Economic value of water and cost reflective pricing, Commercial, fixed asset accounting. Analysis of financial statements, Tariff principles, increasing block tariffs and lifeline tariffs, Average historical cost accounting and long run marginal costing, Demand responsiveness: Ability to pay and willingness to pay. Pricing and service differentiation for the poor. Sources of finance for a long-term asset based industry, Decision-making for financial management: The Waterman Simulation.

**AE 5156. Environment and Industry (3)**

Location theory of industrial development. Impact of industry on environment. Inter Relationship between industry, environment, resource base and agriculture. Rural industrial development and alternative land use. Industrial waste disposal. Energy used in industry and

environment considerations. Scale of operations, Infra structure development and impact on environment. Transport and disposal of hazardous wastes. Regulation - local and international relating to industrial development and environment. Environmental carrying capacity for industries. Greenhouse effects.

**AE 5157. Solid Waste Management (2)**

Classification of wastes, Agricultural, Industrial, Domestic, Municipal and Hazardous, Available methods of waste management, Design of Landfills, liner material, leachate formation and seepage, gas generation and migration, Landfill management and final closer, Design of aerobic and anaerobic digesters, Combines systems with constructed wetland, Incinerators: Design and operation open and close looped systems, Hazardous waste management, Secure landfills, incinerators and management of clinical wastes, Application of Cleaner Production (CP) and Green Productivity Concepts.

**AE 5158. Organic Produce Certification and Marketing (1)**

Organic produce concepts and problems, controlling organizations and certifiers, IFOAM. Consumer attitudes, market trends and packaging requirements. Standards and procedures in certification: growers, packers and shippers. Standards and procedures in certification. Marketing procedures. Canceling and renewing licenses and charges made for inspection.

**AE 5159. Grading Packaging and Transportation of Fruits and Vegetables (2)**

Introduction to primary processing of perishables for fresh market protection required by fresh fruit and vegetables, pack house operations and ergonomics of packing, International quality standard and commercial requirements, Transportation environment, Types of packaging and package design, Testing and evaluation of transport packages, packing patterns and analysis of packing forces in containers.

**AE 5160. Advanced Power and Machinery (2)**

Analysis of agricultural machine components and systems. Emphasis on hydraulic power transmission, Controls and management of machinery systems.

**AE 5161. Solar Energy Applications in Agriculture (2)**

Solar energy and available solar radiation, Heat transfer applied in solar energy, Theory of flat plate collectors, Concentrating collectors, System thermal calculations and experiments, Solar heating, Solar process economics, Design of solar systems, Solar industrial process heat, Conversion to mechanical energy, Evaporative processes and salt gradient ponds, project.

**AE 5162. Tillage Engineering (2)**

Analysis of stresses and strains in soils due to machine applied loads, Optimum soil conditions for tillage and relevant soil properties, Mechanics of interaction between agricultural soils and tillage equipment and traction devices, Tillage equipment.

**AE 5163. Analysis of Agricultural Systems (2)**

Identification and definition of systems, Systems Approach and its importance, Dynamic system modeling and interactions, Stocks and flows, Problems solving in agriculture through

system analysis approach, Model formulation and estimation, Stereo type models, Model validations and evaluations.

#### **AE 5164. Combustion of Biomass (2)**

Introduction to energy management, Consumption in Sri Lanka and present systems of energy generations and utilization and comparisons with developing and developed countries, Combustion of Biomass and fossil fuels: Chemical reactions of combustion, physical and dynamic aspects of gas in combustion, Spontaneous expansion, Combustion of premixed gases, Diffusion flames, Laminar and turbulent, Biomass, Pyrolysis, Gasification and liquefaction, Review of existing furnaces, gasifiers, Incinerators and dendro thermal systems, Design and control systems for new reactors with atmospheric pollution control systems.

#### **AE 5165. Natural Fibre Technology (2)**

Introduction to natural fibre use and management, Physical and chemical properties of wood, bamboo and other natural fibres, Martial fibre use in agriculture and forestry, 'technologies for manufacturing fibre materials for soil conservation measures and planting media, Preservation and treatment of natural fibres, Fibre board manufacture from agriculture wastes and other materials, Manufacture of organic resins and other tubes of glues, Paper manufacture, Construction methods using materials, Bamboo, thatch, grass, reeds, coir wastes, Assessment of future needs.

#### **AE 5166. Water Resources Management for Tropical Agriculture (3)**

Introduction to tropical climate, rainfall occurrence, patterns and distribution, Hydrological measurements, hydrological data analysis and interpretation, Surface water resources, Ground water resources, Soil moisture analysis and determination, Water movement through soil, plant and atmosphere, Hydrological processes and interactions, Consumptive use and crop water requirements, Irrigation scheduling, Water resource assessment and inventory, Sustainable management of tropical water resources.

#### **AE 5167 Process Control and Automation (2)**

Automation in process engineering; Sensors and transducers; Sensitivity and accuracy; Basic components used in robotic controls; Embedded systems; Micro-controllers; Programmers; Programming techniques; Debugging; In-circuit serial programming; Programming micro-controllers using the "C" language; Data acquisition (analog and digital); Minimizing errors in acquiring data; Development of a simple microprocessor based control system; Actuators; Operating actuators through a microprocessor; Operating relays/SSR, LCD displays, seven segment displays, stepper motors using microprocessors.

#### **AE 5198. Directed Study and Seminar (2)**

#### **AE 6101. Advanced Irrigation Water Management (2)**

Climatic environment in relation to irrigation. Selection, classification and preparation of irrigable land. Problems and procedures in determining water supply requirements irrigation projects. Water measurements. Selected problems on farm water management Importance of agricultural drainage, Determination of drainage spacing under steady state and unsteady state conditions Leaching requirement. Determination of drainage design parameters. Drainage systems design.



**AE 6102. Advanced Geographical Information Systems (GIS) and Geo-informatics (2)**

Introduction to Geo-informatics, Geo-informatics and spatial data quality, Temporal dimension in spatial data, Software and hardware for GIS/ Geo-informatics, Global Positioning Systems (GPS) for GIS and Geo-informatics, Remote Sensing (RS) and Geo-informatics, Spatial modeling, Simulations and Geo-computations, Legislation and Digital Data Products, Training and Education in Geo-informatics, Development of Geographical Information science.

**AE 6103. Modeling Hydrological Systems (1)**

Hydrological modeling concepts, Modeling approaches and applications, Process based modeling, Spatial dynamics and modeling, Temporal modeling, Scale issues in modeling, Data requirements and limitations for modeling.

**AE 6106 Innovative Technologies for Mechanization in Plantation Industry (1)**

Mechanization gaps in plantation industry, harvesting machines, processing machines, improvement of efficiency of existing machinery, future trends in mechanization.

**GS 5101. Introduction to Geographical Information Systems (GIS) (2)**

Introduction to GIS, Overview, History and concepts of GIS, Scope and application areas, Purpose and benefits of GIS, Functional elements of GIS, Mapping concepts, Map elements, Map scales and representation. Map projections and coordinate systems, Geometric rectification, Data structure, Data Compression techniques for data acquisition: Thematic mapping in GIS, Hardware and Software for GIS, Case studies.

**GS 5102. Introduction to Remote Sensing (2)**

Introduction to RS image processing: Pixel, Sampling & quantization, File formats. Image Enhancement: Image Statistics, Contrast enhancement, Color and color composites, Math Operation.

Geometric correction: Internal and external distortions, Map projection, Coordinate transformation formulae, Resampling and interpolation. RS Image classification: Classification of multi-spectral data, Unsupervised classification, Supervised classification, Principal component analysis, Post classification

**GS 5103. Spatial Database Management (2)**

Basic Concept of database management, database management systems, Spatial databases, Design and implementation of spatial databases, Spatial algorithms with application in GIS, Linking non-spatial and spatial database, database editing and updating, GPS data integration in GIS, Data manipulation and processing, Spatial analysis, Map generation, Charting and tabular representation. Mini-project for GIS database applications, Case studies

**GS 5104. Fundamentals of Global Positioning Systems (GPS) (1)**

GPS system description, Applications and status, GPS performance and Policy, GPS Constellation, Coverage and performance, GPS system concept and operation, Error sources & receiver effects, Introduction to DGPS, GPS receivers, Architectures and equipment

**GS 5105. Surveying and Spatial Measurements (2)**

Introduction to surveying, Surveying equipment, Mapping from surveying data, surveying and digital elevation models, Spatial measurement from surveying data, Accuracy estimations

**GS 5198. Directed Study (5)**

A brief study should be conducted on the advice of the Directed study coordinator and a submission of Study report is required.

**GS 5199. Seminar (1)**

A seminar presentation on an appropriate topic in consultation with the seminar coordinator is required.

**GS 6101. Statistical Methods for Spatial Data Analysis (2)**

Enhancement techniques, spatial sampling techniques, spatial data classification, Resampling techniques, Error of spatial data, Scale problems, Boundary problems, Modifiable unit problems.

**GS 6102. Advanced Remote Sensing and Applications (2)**

Digital remote Sensed data types and formats, Digital classification algorithms, Microwave remote sensing, Backscattering, Ground radar applications, Soil moisture and bathymetric measurements. Overview of RS application: Disaster management; Volcano, Flood, Forest fire, Agriculture application, Land use / land cover monitoring, Fishery and marine application, Coastal zone management, Urban monitoring, interaction between electromagnetic wave and targets: definition of radiometry, Refraction, absorption, diffusion, emission with radiometric terms and units, Spectral responses at various targets, Radiometric distortion and correction, Atmospheric correction, Satellite system and sensor, Higher-resolution optical satellites: LANDSAT, SPOT, ASTER, IRS, Moderate low resolution satellites: NOAA, MODIS synthetic Aperture Radar (SAR)

**GS 6103. Recent Advances in Geo-Informatics (2)**

Introduction to Geo-informatics, Geo-informatics and spatial data quality, software and hardware for Geo-informatics, Global Positioning System (GPS) for Geo-informatics, remote sensing (RS) and Geo Informatics, Simulations and Geo-Computations, Legislation and digital data products, Training and education in Geo-Informatics.

**GS 6104. Spatial Data Infrastructure (1)**

Introduction to Spatial data infrastructure, Global initiative for SDI, the need for national SDI, Data sharing, ownership and copy right issues, Spatial data for national initiatives.

**Second Semester****AE 5202. Water Application Systems (2)**

Selection of water application methods. Introduction to basin, border furrow and other surface irrigation methods, design, evaluation, operation and maintenance of surface irrigation

systems, Introduction to design, Evaluation, Operation and maintenance of sprinkler and drip irrigation.

#### **AE 5203. Food Process Engineering (2)**

Introduction to processing food: Basic principles, raw materials, processing methods, Preliminary operations, Pre-treatments: trimming, peeling blanching: cross infection hazards, Flow: viscous and turbulent flow; multi-phase flow. Diffusive transfer of heat and mass, Conductive heat transfer. Thermal processing for microbial destruction, Non thermal processing for microbial destruction. Chilling and freezing, principles and practice, Freeze drying, theory of extrusion, Mixing, Distillation, Extraction, Concentration, Solid-Liquid separation. Equipment for filling, closing and heat sealing, Aseptic packing, Waste water treatment and disposal of food waste.

#### **AE 5204. Power and Energy for Agriculture (2)**

Principles and practices of renewable energy systems including solar-thermal solar-electric, dendro, hydro, wind, ethanol, biodiesel. Basic principles of thermodynamics, hydraulics and economics involved in the analysis of renewable energy systems in food and agricultural operations. Environmental impact of energy systems.

#### **AE 5205. Ecologically Sustainable Industrial Development (1)**

Introduction to Ecological sustainable Industrial Development Concepts (ESID); Environmental disasters, importance of ESID. Productivity concepts: Green productivity methodology, strategies and case studies, Cleaner production methodology, CP success stories. Environmental management systems; ISO 14000 methodology.

#### **AE 5206. Fluid Mechanics (2)**

Fundamentals of fluid flow, continuity, momentum and energy equations and their applications. Behaviour of real fluids, laminar flow, turbulent flow, steady flow in pipes, pipelines systems. Steady flow in open channels. Dimensional analysis and hydraulic similitude. Fluid machinery.

#### **AE 5207. Applied Heat Transfer (2)**

Introduction to heat transfer, Modes of heat transfer, Multimode heat and mass transfer, Diffusion mass transfer, Applications in agriculture.

#### **AE 5209. Geographical Information Systems (GIS) for Natural Resource Management (2)**

Introduction to GIS, Historical background, Development of GIS, Contributing disciplines and Technologies, Spatial information for decision making, Geographical Entities, Attribute data, Scale of spatial data, Spatial data Acquisition, Sources of Spatial data, Map References & Scales, Feature representation, Projections speciation in GIS, Digital Cartography, Data models, Comparison of model structures, Strengths & weaknesses, Data model selection, Storage structures of data base, Shared databases, Database design & management, GIS selection criteria, Data sources, Essential functionality, System specifications, Maintenance & log term sustainability, Training and awareness.

**AE 5210. Health, Sanitation and Wastewater Management (2)**

Health and Hygiene: Classification of water and excreta-related diseases, risk behaviors in relation to water and excreta-related diseases. On-site excreta disposal system: unimproved pit latrines, VIP latrines, pour-flush latrines, composting latrines, septic tanks and soaking systems. Urban sanitation: Excreta disposal in high density settlements, Wastewater treatment and reuse, Conventional low-cost sewage treatment, Unconventional systems, wastewater stabilization ponds and reed beds, Wastewater for irrigation

**AE 5211. Hydraulics of Erosion and Sediment Transport (2)**

Mechanism of soil erosion by rain drops and sheet flow, Erosion problems in irrigation lands, Open channels, Streams and watersheds. Principles of cohesive and non-cohesive sediment transport, Bed load functions and sedimentation problems in estuaries.

**AE 5212. Water Supply (2)**

Estimation of yield, surface and underground sources, Existing type of reservoirs and its efficiencies, Improvement of water supply reservoirs, river intakes, wells, including bore holes, Water quality control and management, Hydraulic of water conveyance systems and distribution, pumping plants, open channels, pipes valves and its repair and maintenance.

**AE 5213. Bioreactor and Bio-Environment Design and Control Systems (2)**

Introduction to bioreactors: Bio-Mathematics applied in chemical kinetics, Identification of depended & independent variables & functional relationships of kinetics with enzymes and microbes (Inhibition, Toxicity, Catalytic & Process conditions), Design & operation of bioreactors for processing and effluent treatment, Constructed wetlands, Design & Development of control systems for bioreactors, Heat & mass transfer in bio-environment, Controlled environment in agriculture & constructed wetlands.

**AE 5214. Electrical Power and Machines (2)**

Measurement of AC voltages & currents, Average and RMS values, Use of complex numbers in AC circuit analysis, Transformers, Measurement of AC power, DC and AC motors, generators, Machinery.

**AE 6104. Interdisciplinary Field Research methodology (3)**

Introduction to the course, disciplinarity (discipline, multi-disciplinary, inter-disciplinary and trans-disciplinary), SPQR analysis, stakeholder identification; Sampling: qualitative and quantitative methods, data collection and PRA tools, data analysis (stakeholder analysis), report writing; Field visits – Formulation of research questions, conceptual frameworks and research proposal presentations & discussions; Water management: problem based learning (field works): water allocation, water measurements and demand management, conflict resolution, stakeholder participation, hydrological analysis.

**AE 6105. Gender in Integrated Water Resources Management (2)**

Importance of gender as a concept in IWRM, issues in gender and IWRM, Sex role stereotyping; Influence of social institutions in gender stereotyping, Gender tools in IWRM,

Gender impact assessment, Behaviour and attitude about farming, irrigation, land and water development, Division of responsibilities and rights, Gender biases in agrarian institutions, Gender issues in domestic water sector, health and sanitation, industrial water sector, How water related technology influence on gender, Gendered impacts of large dams, Women empowerment and advocacy, Gender mainstreaming, Global trends in gender and water, National laws, policies and measures, Strategies for empowerment and advocacy.

#### **GS 5201. Fundamentals of Spatial Statistics (2)**

Introduction to spatial statistics and GIS, Problems of descriptive statistics for spatial data, Univariate spatial statistics, Spatial distribution of data, Conversion of point to aerial data, Temporal analysis of spatial data, Spatial correlations, map comparison and analysis.

#### **GS 5202. Thematic Mapping, Cartography and Photogrammetry (2)**

Introduction Overview and history, Concepts of cartography, Fundamentals of digital photogrammetry, analytical and digital photogrammetry, Point extraction, line extraction, Region extraction, classification, Examples, Matching methods and application, Image matching, DEM generation, Orthophoto generation, Digital mapping methods: Topographic mapping, Thematic mapping Applications.

#### **GS 5203. Spatial Modeling and Analysis (2)**

Introduction to spatial modeling, Digital Elevation Model (DEM) and Digital Terrain Models (DTM), raster modeling, Modeling Functionality in GIS.

#### **GS 5204. Advanced GIS and Applications (3)**

Development of GIS, Geographical information science, Temporal dimension in spatial data, Advanced GIS analysis and applications.

#### **GS 5205. Advanced Digital Image Processing (2)**

Types of Digital data, Digital Image corrections, Ground radiometric measurements, Field radiometry, Comparison of Classification methods, Photo scanning and geometric correction, Image filtering, Image Segmentation, Image feature extraction, Acquisition of digital images: continuous and discrete images, Direct digital recording, Scanning of analog images, Basic operations of digital images: Statistical characteristics of digital images, Homogeneous and inhomogeneous point operation, Geometric transformations, Resampling, Convolution, Segmentation and classification

#### **GS 5206. Microwave Remote Sensing (2)**

Introduction to Microwave Remote Sensing, Imaging RADAR signals and platforms; transmission and reception, Digital encoding, imaging geometry; spatial resolution, range resolution, Principles of SAR; frequency bands, RAR and SAR comparison, Geometric distortions; scale distortions – slant vs ground range, relief displacement, layover and foreshortening, shadow, parallax, motions, Radiometry of RADAR; effect of wavelength, incident angle, polarization, effects of surface roughness, speckle, SAR interferometry; DEM generation, earthquake detection and monitoring, monitoring volcanic movements and landslides, Applications of microwave remote sensing including SRTM data.

## BOARD OF STUDY IN AGRICULTURAL EXTENSION

### LIST OF COURSES

Course No.	Course Title	Credits
<b>First Semester</b>		
EX 5101	Principles of Communication	2
EX 5102	Principles of Organizational Management	2
EX 5103	Adult Psychology	2
EX 5104	Developmental Sociology	2
EX 5105	Community Development	2
EX 5106	Communication for Development	2
EX 5107	Organizational Theory and Behaviour	2
EX 5108	Human Resource Management	2
EX 5109	Information Retrieval	1
EX 5110	Developmental Extension and Education	2
EX 5111	Gender and Development	2
EX 5112	Social Psychology	2
EX 5113	Organizational Leadership	2
EX 5114	Corporate Relations	2
EX 5115	Human Resource Management in the Plantation Sector	1
EX 5196	Internship	2
EX 5198	Directed Study	5
EX 5199	Seminar	1
<b>Second Semester</b>		
EX 5201	Developmental Journalism	2
EX 5202	ICT for Development	2
EX 5203	Project Management	2
EX 5205	Human Resource Development	2
EX 5206	Participatory Methods for Development	2
EX 5207	Management Information Systems	2
EX 5208	Social Research Methodology	2
EX 5209	Organizational Development and Change	2
EX 5210	Marketing Communication	2

EX 5211	Communication in Environment Management	2
EX 5212	Environmental Sociology	2
EX 5213	Social Impact Assessment	2
EX 5214	Extension for Livestock Production	2

## **COURSE CAPSULES**

### **First Semester**

#### **EX 5101. Principles of Communication: (2)**

Communication theories and models; Interpersonal communication, Verbal and non-verbal communication; Mass media and organizational communication; Communication campaign. Role of information in decision making, Effectiveness of communication.

#### **EX 5102. Principles of Organizational Management (2)**

The concept of management; Behavioural sciences in management; Process of organizational management, managerial roles and competencies; Organization of work; Characteristics of an organization; Types of organizations; Group behaviour in the organization

#### **EX 5103. Adult Psychology (2)**

Determinants of human behaviour; The concept of self; Motivation theory; Theories of adult learning; Psychological roots of social participation; Stress management and conflict management; Psychological aspects of self-management and inter-personnel relationships; Organizational culture and behaviour from a psychological perspective.

#### **EX 5104. Developmental Sociology (2)**

Theories of social change; Functionalism; Human ecology, conflict theory; Dependency and under-development; Basic concepts in sociology; Social differentiation and stratification; Value systems; Social institutions, social cohesion and disintegration; Sociological aspects of organizational culture and behaviour.

#### **EX 5105. Community Development (2)**

The concepts of community, development, and community development; The social, institutional, economic and political environments of projects; Approaches to community development; Community action theory, group dynamics, leadership, and power structures; Project planning in community development; Role of NGOs in community development.

#### **EX 5106. Communication for Development (2)**

Development communication strategies; Principles and practices in the promotion of social-development; Communication policies and new international information order; Stakeholder dialogue; Essential characteristics of development communicator, Participatory communication –principles and applications.

**EX 5107. Organizational Theory and Behaviour (2)**

The individual in the organization; perception, motivation, learning, personality; Group dynamics in organizations; Leadership, management style & team work, Power politics & conflicts in an organization; Organizational culture.;

**EX 5108. Human Resource Management (2)**

Importance of effective human resource management; Strategic human resource management; Acquiring human resources; Developing human resource; Performance appraisal & management; Employee relations; Career development; Commercial & industrial laws.

**EX 5109. Information Retrieval (1)**

Introduction to information science; Information systems; Functions of information centres; Scientific primary and secondary sources; Evaluation of major indexing and abstracting services; Search strategies; Vocabulary control; Thesauruses; Subject heading lists; Free text searching, computer-based searching; Boolean logic; electronic databases; CD-Rom and online; ; Creation of a bibliography, citation methods.

**EX 5110. Developmental Extension and Education (2)**

The philosophy, goals and guiding principles of extension; Extension models & approaches; Adoption and diffusion of innovations; Supporting activities for extension; Group action and participation of community groups; Role of NGOs in extension; Trends in extension; Basic principles of adult education; Planning, implementation and evaluation of training programs.

**EX 5111. Gender and Development (2)**

Gender and sex roles in social change; Sex roles stereotyping; Family, work and social responsibilities; Role of women in sectoral development; Gender bias in technology development and transfer; Technology & women; Gender issues in professional success, policy implications.

**EX 5112. Social Psychology (2)**

Scope of social psychology; Social cognition; Social perception; Self- knowledge; Attitudes; Prejudice and discrimination; Attraction and relationships; Pro-social and anti-social behaviour; Aggression and violence; Group processes; Work related stress and issues related to organizational environment.

**EX 5113. Organizational Leadership (2)**

What is leadership; Leadership and power; Charismatic leadership, leader-member exchange; Transformational, social cognitive, and substitutes for leadership; Leadership styles in practice; Leadership roles and functions; Skills for effective leadership; Team leadership; Women and Leadership; Leadership across cultures; Approaches for leadership development in Sri Lanka; Leadership ethics

**EX 5114. Corporate Relations (2)**



The different facets of work in the corporate world, Manager in a corporate environment; Employer relations and public relations; Relationship marketing; Basic labour laws and important enactments; Employee discipline and misconduct; Industrial relations; Salient features of the Companies Act No 07 of 2007; Corporate social responsibility; Ethics in corporate relations.

#### **EX 5115 Human Resource Management in the Plantation Sector (1)**

Introduction to management in the plantation sector; Strategic human resource management; acquiring human resources: managerial skills and leadership qualities; Developing human resources; Motivation (remuneration and incentives) in plantation agriculture; Workers involvement in decision making; Managing technology and change; Grievance handling; industrial relations and unions; Health, safety and employee welfare; Plantation labour acts / laws; HRM in the smallholder sector.

#### **EX 5196. Internship (2)**

Scope of internship; Linking assignments of other courses; Obtaining professional and managerial experience in a workplace; Conducting an independent research/development project on a topic related to the area of specialization.

#### **EX 5198. Directed Study (5)**

Carry out an independent research/development project on a topic related to the area of specialization.

#### **EX 5199. Seminar (1)**

Types of seminar presentations, Planning and preparing for a presentation, Deciding and obtaining content, Structure of a presentation, Outline and script, Preparation and use of presentation aids, Evaluation of seminar presentations

### **Second Semester**

#### **EX 5201. Developmental Journalism (2)**

Role of journalism in agricultural development; Principles of effective writing; Readability of publications, Planning & preparation of written materials; Writing of scientific papers; Editing; Production and use of electronic media; Electronic desk-top publishing; Management of publication process; Evaluation of publications.

#### **EX 5202. ICT for Development (2)**

Role of audio-visual and electronic media in development; Use of information and communication technology (ICT) for agricultural and rural development; Design principles of producing multimedia programs, Digital technology for the production of audio-visual aids; Writing for electronic media; Use of radio and television in development programs.

#### **EX 5203. Project Management (2)**

Need for programs; Types of programs; Principles of program development; Program development process; Need identification, objective setting, managing, monitoring and evaluation of programs; Involving people in program development.

**EX 5205: Human Resource Development (2)**

Basic issues in human resource development; Adult learning; Identifying training needs; Designing training; Training methods; Assessing training; Performance management and HRD; Creativity and HRD; Organizational Learning; Approaches to management of human resource development; Management issues in HRD.

**EX 5206. Participatory Methods for Development (2)**

Concept of participation, Role of participation in development, Participatory and rural appraisal methods; Participatory communication; Participatory technology development; Participatory planning & evaluation.

**EX 5207: Management Information Systems (2)**

Information Systems and their role in organizations; Management Information Systems for operational, control, and strategic levels; Databases; Enterprise applications; Knowledge Management; Ethical and social Issues; Information technology infrastructure; Internet & mobile technology; Information systems security; Obtaining information systems.

**EX 5208. Social Research Methodology (2)**

Science, theories and problems; Social research process and research methods; Social research proposals; Sampling and data collection methods; Data manipulation; Presentation of research findings; Scientific criticism; Ethics in social research; Research management.

**EX 5209. Organizational Development and Change (2)**

Definitions of organizational development; Basic concepts of organizational change; Phases of change; Organizational diagnosis; Organizational development process; Theory & practice of organizational development; Overcoming resistance to change; Contemporary issues of organizational development; Organizational development interventions; Power, politics & organizational development.

**EX 5210. Marketing Communication (2)**

Nature and purpose of marketing communication; Theoretical background; Communication and brand; Marketing communication process management; Marketing research and communication; Nature of advertising; Direct marketing communication; Ethical & technological aspects of marketing communication.

**EX 5211. Communication in Environment Management (2)**

Introduction to environmental communication; Interpersonal communication, mass media and organizational communication; Verbal and non-verbal communication; Communication campaign; Public relations, social mobilization & advocacy; Effectiveness of communication; Environmental journalism.

**EX 5212. Environmental Sociology (2)**

Structure of agriculture and rural industry in Sri Lanka; Attitudes, values and institutional development and change in relation to environment, social institutions Environmental movements and lobbies; Politics of development and environment; International aid and resource conservation; Traditional knowledge systems and regenerative environment; Socio-cultural context of transfer of technology for natural resource management and allocation.

**EX 5213. Social Impact Assessment (2)**

Human ecology, Centre periphery relationship; Dependency and dominance; Appropriate technology; Gender impact assessment; Family and child welfare; Flow of benefits to individual and society; Inequality concept and measures; Decision making and participation; Leadership and collective decision making models; Social legislature children's and women's charters; Culture and values in a changing society; Ethics of development and conservation.

**EX 5214. Extension for Livestock Production (2)**

Extension methods and supporting services; The adoption and diffusion of innovations; Social groups and organizations, leadership and social power; Communication processes, components and effectiveness; Structures and approaches in livestock extension in Sri Lanka; Information and technology needs of the livestock industry and small holders; Case studies in the livestock industry.

## BOARD OF STUDY IN ANIMAL SCIENCE

### LIST OF COURSES

Course No.	Course Title	Credits
<b>First Semester</b>		
AS 5101	Introduction to Aquaculture and Fisheries	3
AS 5102	Comparative Anatomy and Physiology of Farm Animals	3
AS 5103	Introduction to Animal Production	2
AS 5104	Principles of Animal Nutrition	2
AS 5105	Anatomy and Physiology of Fish	2
AS 5106	Aquaculture Based Farming Systems	2
AS 5108	Avian Reproduction, Embryology and Hatchery Management	2
AS 5109	Dairy Chemistry	2
AS 5110	Health Management of Fish	2
AS 5113	Fish Systemics and Morphometrics	2
AS 5114	Integrated Livestock Systems	3
AS 5115	Laboratory Techniques in Animal Nutrition	2
AS 5116	Laboratory Techniques in Fisheries and Water Quality	2
AS 5117	Layer and Parent Stock Management	3
AS 5118	Mariculture	2
AS 5119	Meat Science	2
AS 5120	Endocrinology of Farm Animals	2
AS 5121	Monogastric Nutrition	3
AS 5122	Physiology of Lactation	2
AS 5124	Procuring, Processing and Marketing of Fluid Milk	2
AS 5125	Processing of Dairy Products	2
AS 5126	Quantitative and Molecular Genetics of Farm Animals	2
AS 5127	Ruminant Nutrition	3
AS 5128	Reproductive Physiology of Farm Animals	3
AS 5129	Selection Index and Mixed Model Methodology	3
AS 5130	Shrimp Production	3
AS 5131	Slaughter House Planning and Management	2

AS 5132	Aquatic Microbiology	1
AS 5133	Fish Biotechnology	1
AS 5134	Poultry Meat Processing Technology	1
AS 5135	Egg Technology	1
AS 5136	Introduction to Molecular Biology in Animal Science	3
AS 5151	Biochemical Genetics and Cytogenetics	2
AS 5152	Livestock Bio-diversity and Conservation	2
AS 5154	Tropical Animal Production I	3
AS 5155	Fisheries Management	3
AS 5197	Proposal Formulation and Scientific Writing	2
AS 5198	Directed Study	5
AS 5199	Seminar	1
<b>Second Semester</b>		
AS 5201	Advances in Forage Production and Utilization	2
AS 5202	Animal Biotechnology	3
AS 5203	Animal-Environment Interactions	2
AS 5204	Aquatic Resources Management	2
AS 5205	Avian Health and Hygiene	2
AS 5206	Broiler Production	2
AS 5207	Dairy Engineering	2
AS 5209	Fish Feeds and Nutrition	3
AS 5210	Fish Population Dynamics	2
AS 5211	Genetics and Breeding of Fish	2
AS 5212	Genetics and Breeding of Poultry	2
AS 5213	Livestock Breeding	3
AS 5214	Livestock Health and Hygiene	2
AS 5215	Marine Fisheries Management	2
AS 5216	Meat Processing Technology	2
AS 5217	Microbiology of Dairy, Meat, Fish and Egg Products	3
AS 5218	Non-ruminant Animal Production	3
AS 5219	Ornamental Fisheries Management	3
AS 5220	Ruminant Livestock Production	3
AS 5221	Shrimp and Fish Processing	2

AS 5222	Wildlife Environment	3
AS 5251	Advances in Equine Nutrition and Feeding	2
AS 5252	Animal Quarantine, Welfare and Legislation	1
AS 5253	Animal Waste Handling and Management	2
AS 5254	Tropical Animal Production II	3
AS 5255	Fish Farm Designing, Construction & Management	2
AS 5256	Slaughter House By-Product Technology	2
AS 5257	Fish Seed Production and Larval Rearing	3
AS 5258	Animal Food Safety	2
AS 5259	Dairy Biotechnology	2
AS 5260	Dairy Sanitation and Hygiene	1
AS 5261	Coast Conservation and Management	1
AS 5262	Marine Environment Pollution Prevention	1
AS 5263	Global Warming and Animal Production	2
AS 5264	Cell Biology in Animal Science	2
AS 5297	Field Visits - Animal Science	1
AS 5298	Industrial Visits - Poultry Science	1
AS 5299	Industrial Visits - Dairy and Meat Product Technology	1

## **COURSE CAPSULES**

### **First Semester**

#### **AS 5101 Introduction to Aquaculture and Fisheries (3)**

Status of global fisheries and fisheries in Sri Lanka; Fishery potential of Sri Lanka; Present and future trends of aquaculture; Importance of aquaculture; Types of aquatic environments; Physico-chemical and biological characteristics of aquatic systems; Important biological characteristics of fish; Breeding patterns and practices; Feeding and management of fish; Pond fish culture; Coastal aquaculture; Impact of aquaculture on environment; Mariculture; Ornamental fish and aquatic plant production; Culture based fisheries; Fishing gear and methods of fishing; Capture fisheries; Reservoir fisheries.

#### **AS 5102 Comparative Anatomy and Physiology of Farm Animals (3)**

Structures, functions and regulation of the neuro-endocrine system, Digestive system, Reproductive system and mammary system of farm animals: mechanism of thermoregulation and adaptation. Reproductive system and photoperiodism in avian; Techniques in reproduction (semen technology, artificial insemination).

#### **AS 5103 Introduction to Animal Production (2)**

Status of the livestock & poultry industry in Sri Lanka; State sponsored programmes; Involvement of NGO & cooperate sector; Animal feed industry; Important breed characteristics of farm animals; Principles of housing, breeding, feeding and general management of farm animals; Farm records.

#### **AS 5104 Principles of Animal Nutrition (2)**

Classification, importance, digestion, metabolism and requirements of nutrients in farm animals; Anti-nutritional factors in feeds; Feed additives; Principles of feed evaluation; Energy and protein evaluation of feeds; Estimation of nutrient requirements.

#### **AS 5105 Anatomy and Physiology of Fish (2)**

Anatomy and physiology of nervous system, endocrine system, sensory system, circulatory system, digestive system, reproductive system and osmoregulatory system of fish; Physiology and endocrinology of growth, reproduction, thermo-regulation and osmoregulation.

#### **AS 5106 Aquaculture Based Farming Systems (2)**

Different aquaculture based farming systems; Selection of fish species, culture systems and management; Mitigatory measures for pollution through aquaculture based farming systems; Rational resource utilization and aquaculture; Case studies, Applications to local situations; Benefits and constraints. Different aquaculture based farming systems; Selection of fish species, culture systems and management; Mitigatory measures for pollution through aquaculture based farming systems; Rational resource utilization and aquaculture; Case studies, Applications to local situations; Benefits and constraints.

**AS 5108 Avian Reproduction, Embryology and Hatchery Management (2)**

Poultry reproduction: Physiology of avian reproduction, Photoperiodism, Manipulation of reproduction, Techniques in reproduction (semen technology, artificial insemination), Embryology: Gametes and fertilization, cleavage, formation of the primitive streak, establishment of germ layers, extra embryonic membranes and their functions; Critical stages of embryonic development, Nutrition and other requirements of the embryo; Hatchery management: Production and selection of eggs for hatching; Systems of incubation; Types of incubators; Management and maintenance of incubators and equipment; Bio-security in hatcheries; Hatchery record keeping; Factors affecting hatchability, candling; Sexing, culling, handling and transportation of chicks; Regulations for franchise breeders.

**AS 5109 Dairy Chemistry (2)**

Composition of milk and milk products; Milk constituents and their physico-chemical characteristics; Milk coagulation and protein denaturation; Milk clotting enzymes and cheese chemistry; Milk fermentation. Processing - induced changes of milk constituents; Nutritive value and health implications of milk & milk products; Quantitative analysis of milk and milk products; Testing of physico-chemical quality parameters related to dairy products.

**AS 5110 Health Management of Fish (2)**

Principles of health management and immunity in fish; Etiology, diagnosis, control, prevention and treatment of common viral, bacterial, fungal, parasitic and metabolic diseases of finfish and shellfish; Handling of fish for observation and sample collection; Laboratory diagnostic techniques for common diseases; Effect of environment and management on diseases; Application of bio-security measures.

**AS 5113 Fish Systematics and Morphometrics (2)**

Principles of classification of aquatic biota; Basic morphology of finfish and shellfish; Development of identification keys for finfish and shellfish species; Parameters used in nomenclature and classification of fish; Morphometrics and meristics of fish, molecular systematics of fish; Specimen collection and preservation.

**AS 5114 Integrated Livestock Systems (3)**

Livestock based farming systems with special reference to the different Agro-ecological zones and their cropping patterns in Sri Lanka; Resource base and their allocation for crop and livestock components; Criteria for monitoring and evaluating crop-livestock systems. Models to describe livestock based production systems; Livestock databases; Livestock simulation programs; Exercises on databases and simulation programs

**AS 5115 Laboratory Techniques in Animal Nutrition (2)**

Laboratory safety, handling of glassware and equipment; Preparation of feed samples; Analysis of animal feeds for proximate, detergent fibre, mineral & energy; Digestibility and metabolism experiments in farm animals by in-vitro, in-sacco and in-vivo methods; Enumeration of gut microflora; Estimation of microbial protein synthesis in the rumen.



**AS 5116 Laboratory Techniques in Fisheries and Water Quality (2)**

Use and maintenance of laboratory equipments; Analysis of water for physical, chemical and biological parameters; Analysis of fish and feed samples; Quantitative and qualitative analysis of plankton; Sampling and tagging.

**AS 5117 Layer and Parent Stock Management (3)**

Review of the parent stock and layer industry in Sri Lanka; Production systems in Sri Lanka and the World; Breeder farm operation, Regulations for franchise breeders, Bio-security in breeder farms, vaccination of breeders and layers, Planning of poultry farms; Criteria for selection of layers; Commercial breeds, crosses and their characters; Brooding and grower management; Management, housing, feeding of layers and parent stock; Management for continuous egg production and improved fertility; Feeding and egg quality.

**AS 5118 Mariculture (2)**

Biology of Mariculture species; Selection of species (Marine finfish, Mollusc, edible Echinoderms etc.); Site selection; Culture systems and management; Collection of spats; Brackish water and coastal farming, deep water farming, depuration; Corals and their role; Coastal pollution; Economics and constraints.

**AS 5119 Meat Science (2)**

Introduction; Structure of muscle; Myogenesis: Composition of muscle; Conversion of muscle to meat; Ante & post mortem changes; Carcass quality; Meat quality; Sensory evaluation; Nutritive value & health aspects of meat.

**AS 5120 Endocrinology of Farm Animals (2)**

Classes of hormones, modes of action, quantification of hormones; Neuro-endocrine system; Origin, chemistry, biosynthesis, specific mode of action and functions of metabolic hormones (pituitary hormones, adrenal hormones, thyroid hormones, pancreatic hormones, parathyroid hormones and gastro-intestinal hormones); Endocrine disorders.

**AS 5121 Monogastric Nutrition (3)**

Review of digestion, absorption and metabolism of nutrients in monogastric animals. Review of the animal feed industry in Sri Lanka; Feedstuffs available in Sri Lanka for pigs and poultry; Energy and protein evaluation of pig and poultry feeds, Estimation of energy and protein requirements of pigs and poultry, Nutrient requirement and feeding standards of poultry & swine; Recent advances in the use of feed additives, nutrigenomics and metabolomics in monogastrics; Special topics in pig and poultry nutrition. Balance experiments and metabolism trials, Respiration experiments, Fibre digestion in non-ruminants and the effects of dietary fibre; Feed microbiology and micotoxins; Feed processing methods and equipment; Animal feed legislation; Feed formulation. Practical feeding of poultry & swine.

**AS 5122 Physiology of Lactation (2)**

Primitive and higher order mammals; Mammogenesis and endocrine control; Indices of mammary growth and differentiation; Lactogenesis and endocrine regulation; Biosynthesis of

milk components in ruminants and non ruminants; Lactation, galactopoiesis and endocrine control; Mechanism of milk secretion; Nutrient partitioning for lactation; Mammary gland involution; Metabolic and other disorders of the mammary gland.

#### **AS 5124 Procuring, Processing and Marketing of Fluid Milk (2)**

Global dairy industry; Production zones and milk collection network in Sri Lanka; Clean milk production; Processing and quality control of liquid milk products ; Fluid milk processing equipment; Dairy hygiene and sanitation of dairy plants; Administrative, commercial and legal aspects of milk procuring, handling and marketing.

#### **AS 5125 Processing of Dairy Products (2)**

Manufacturing and Quality Management of fermented milk products; Cheese & panneer; Frozen desserts: ice cream & frozen yoghurt; Cream-based products: butter & ghee; Concentrated and dry milk products; Whey processing & products; Dairy plant waste management.

#### **AS 5126 Quantitative and Molecular Genetics of Farm Animals (2)**

Basic genetics; Genes in populations, forces changing gene frequency; changes in small populations; Relationship and inbreeding, inbreeding depression; Genetic and phenotypic variance components; Estimation of heritability; Analysis of full-sibs and half-sibs; Pedigree analysis; Correlation among relatives; Genotype-Environment interaction; Specific and common environments; Repeatability; Prediction of breeding values; Selection intensity, accuracy and response to selection; Breeding value and heritability estimation using SAS; Molecular genetics in animals; Nucleic acids and their manipulations; PCR; DNA sequencing; DNA markers in animals; Gene mapping; Marker assisted selection

#### **AS 5127 Ruminant Nutrition (3)**

Review of digestion, absorption and metabolism of carbohydrates, proteins and fats in ruminants. Kinetics and theories of rumen fermentation; Methanogenesis& its control; Manipulation of rumen fermentation for better digestion and nutrient utilization; Importance of minerals in animal feeding; Absorption, metabolism and excretion of essential minerals; Interaction of minerals in animal body. Present problems related to feed resources, feeds and feeding of ruminants; Green forage/Roughage feeds & feed supplements; Importance of supplementary feeding; Balancing nutrients to improve productivity; Application of biotechnology in animal nutrition. Modern techniques in the estimation of digestibility.

#### **AS 5128 Reproductive Physiology of Farm Animals (3)**

Sexual differentiation and development; Regulation of gonadal function; Physiology and endocrinology of gametogenesis, puberty, ovulation and its manipulation, fertilization and implantation; Maternal recognition of pregnancy; Physiology and endocrinology of parturition and post-partum; Physiology and endocrinology male reproduction ; epididymal & accessory glandular functions; Seasonality of reproduction in males and females; Nutrition and reproduction interaction; Reproduction disorders in males & female.

### **AS 5129 Selection Index and Mixed Model Methodology (3)**

Matrix algebra; Prediction of breeding values: with own and relatives records, single and repeated records; Accuracy of prediction; Genetic gain and correlated response; Derivation of selection index; Formulation of indices with repeated and relatives records of multiple traits; Accuracy of indices; Restricted selection index; Determination of economic values; Constituent indices. Fixed, random and mixed models; Ordinary and generalized least squares; Estimability. Deviation of mixed model equations; Best linear unbiased prediction; Sire model, sire-maternal grand sire model, animal model; Relationship matrix; Multiple trait analysis; Repeated records; Group effects; Reduced animal model; Multiple trait analysis; Partition of phenotypic variance; Sib analysis; Henderson methods; Maximum likelihood and restricted maximum likelihood concepts; Computational aspects.

### **AS 5130 Shrimp Production (3)**

Global shrimp production; Shrimp farming systems; Site selection; Use of supra-tidal and inter-tidal zones for farming; Reproductive biology of shrimps; Artificial spawning; Broodstock selection and management; Management of post larval production systems;; Construction of backyard and intensive hatcheries; Hatchery and nursery management; Assessment of post larval quality; Transport of larvae; Water quality management; Harvesting & marketing of shrimp; Environmental pollution and mitigation.

### **AS 5131 Slaughter House Planning and Management (2)**

Introduction; Site selection for slaughter house; Requirements and layout of slaughter house; Planning and design of slaughter houses; Sanitary and hygienic conditions; Slaughter house equipment; Operation and management; Labour management; Handling & transportation of animals; Waste handling & disposal; Capital and running costs; HACCP.

### **AS 5132 Aquatic Microbiology (1)**

Culturing, sampling and enumeration of microbes from water and aquatic food; Factors affecting the growth of microorganisms; Detection and identification of bacteria, fungi, and viruses in aquatic environments; Pollution indicator organisms; Microbial problems associated with aquatic food products; Control of microbial problems in aquatic environment.

### **AS 5133 Fish Biotechnology (1)**

Importance of Biotechnology over conventional methods; Ploidy manipulation of fish and production of Mon-sex fish for commercial purposes; Improvement of nutrition, growth, disease prevention of fish by bioencapsulation, microencapsulation and probiotics use in Aquaculture; Development of new fish species and strains using biotechnological application. Molecular biology of fish; Nucleic acids and their manipulations; PCR; DNA sequencing; Molecular markers in fish and their use; Disease diagnosis.

### **AS 5134 Poultry Meat Processing Technology (1)**

Introduction to poultry meat industry; Processing fresh poultry; Quality maintenance of poultry carcass; Microbiology of poultry meat; Carcass decontamination; Composition and nutritive value; Classification & grading of carcasses; Preservation of poultry meat:

refrigeration, caning, dehydration, curing, and smoking; Value addition; Poultry slaughter house design; HACCP; Poultry welfare and slaughter house regulation; By-products of poultry industry.

### **AS 5135 Egg Technology (1)**

Introduction to egg industry; Structure and composition of egg; Physical, chemical, nutritional and functional properties of egg, Egg quality; Grading of eggs; Storage of eggs; Processing of eggs; Microbiology of egg and egg products; Production of functional eggs; Quality assurance in production and processing of eggs.

### **AS 5136 Introduction to Molecular Biology in Animal Science (3)**

Nucleic Acids: Types, extraction/purification, quantification, manipulating enzymes and methods; Genes and gene expression: Central dogma, transcription, translation and gene expression regulation, post transcriptional regulations; PCR: Principle, methods and applications, gel electrophoresis; DNA sequencing; Nucleic acid labeling and hybridization; Microarrays, next generation sequencing; RNA-seq, small RNAs; Recombineering: Vectors, cloning, transfection, selection of clones; Molecular markers; Types, uses; Proteins: Synthesis, structures, protein/peptide purification and identification, polyacrylamide gelelectrophoresis (PAGE), immuno-precipitation, CHIP-seq, “Omics” in Molecular Biology; Concepts of Epigenetics; Basic Bioinformatics: Databases, software and applications.

### **AS 5151 Biochemical Genetics and Cytogenetics (2)**

Inborn errors metabolism; Sex limited inheritance; type of gene action and type of disease; Inherited Breeding disorders: sexual Abnormalities; Familial disorders; Liability and threshold; Multifactorial models; Genetic and environmental control of inherited diseases. Cytogenetics and animal breeding; Chromosomes and their identification; Standard karyotype of different farm animals; Sex determination; Chromosomal aberration; Frequency and effect of aberrations; Genetic polymorphism; Importance of cytogenetics in animal breeding.

### **AS 5152 Livestock Bio-diversity and Conservations (2)**

Definitions of Bio-diversity; Levels of Bio-diversity; Livestock diversity and its importance; Agro-biodiversity and livestock diversity; Livestock Production Systems and diversity; Animal genetic resources; Conservation of animal genetic resources; World states of conservation of AnGR; Sri Lankan situation of conservation AnGR; Tools for genetic conservation of livestock; Monitoring genetic diversity using DNA technology; Community participation in AnGR conservation and Livestock bio-diversity; Research and policy priorities.

### **AS 5154 Tropical Animal Production I (3)**

Breeds and breeding of poultry species (chicken, ducks, turkey, guinea fowl and quails), pigs and rabbits; swine and rabbit production systems in tropical countries; planning of houses to hot/humid environments; Feed resources for non-ruminants and compounded feed industry in tropical countries; General management practices of layers, broilers, swine and rabbits under tropical conditions, Product technologies under tropical conditions.

**AS 5155 Fisheries Management (3)**

Fisheries industry; History of fisheries management; Management zones; Stock assessment; Fishery and interaction of its components, case studies in reservoir fisheries, coastal fisheries and deep sea fisheries; Regulations in fisheries management, licensing; Top-bottom management; Community based fisheries management; General administrative functions; Resource management technologies and tools; Coastal fisheries extension methodology, welfare activities, co- operative societies; Kattudel and Beach-seine fisheries management, selected case studies; Types of fishing gear and crafts, monofilamentous nets; Post-harvest handling. Code of Conduct, IUU and Ghost Fishing.

**AS 5197 Proposal Formulation and Scientific Writing (2)**

Proposal development, problem identification and hypothesis development, research design, methodology and budgeting, application for funding; Literature search and reference management system, literature review, analysis of scientific papers and writing a critique, abstract writing; Thesis and manuscript writing, writing statistics, data presentation and interpretation.

**AS 5198 Directed Study (5)**

Independent learning exercise guided by a supervisor to carry out a limited study or produce a publishable review manuscript.

**AS 5199 Seminar (1)**

Features of an effective scientific presentation; development of structure, preparation of visual aids, rehearsal and delivery, effective discussion.

**Second Semester****AS 5201 Advances in Forage Production and Utilization (2)**

Role of forages in productive Agriculture; Novel techniques of forage Evaluation; Forage – Animal- soil relationships; Importance of trees & shrubs in animal feeding; Nutritional limit to animal production from tropical forages; Identification and mitigation; Importance of forage conservation in tropics; Advances in forage conservation as silage and hay; Feed conservation; Biological residues; Measurement of forage intake by grazing ruminants.

**AS 5202 Animal Biotechnology (3)**

Principles and techniques used in animal reproduction: Semen technology, Artificial insemination; Superovulation; Surgical and ultra sound guided oocyte retrieval; *In vitro* maturation of oocytes; In vitro fertilization, Intra- cytoplasmic spermatozoa injection; *In vitro* embryo culture; Embryo transfer; Transgenic animal technology. Principles and techniques used in animal nutrition: Use of molecular techniques to study and manipulate rumen function; Reduction of Methanogenesis; Use of nuclear and colorimetric techniques for the estimation of rumen microbial protein supply; Use of nuclear and related techniques for predicting and improving the efficiency of feeding ruminants on tanniniferous tree foliage; Biodegradation of lignocellulosic materials.

**AS 5203 Animal-Environment Interactions (2)**

Definitions and Terminology; Ecological rules; Abiotic and biotic components and their variations; Conformers and regulators; Thermal environment; Thermoregulatory mechanisms; Integrated behavioural, biochemical, physiological and morphological responses; Thermal zones and thermal stress; Altitude and its effects; Effects of nutrition on growth, production and reproduction; Psychometrics; Strategies to alleviate thermal stress.

**AS 5204 Aquatic Resources Management (2)**

Water as a resource; Physical and chemical properties of aquatic resources and biota; Environmental laws and aquatic resources management, Water harvesting; Anthropogenic influence and role of fish in aquatic resources; Influence of introduced fish on the aquatic ecosystems; Aquatic pollution and mitigation; Development of co- management and other suitable management strategies.

**AS 5205 Avian Health and Hygiene (2)**

Nature and importance of poultry health and hygiene; Role of disease control measures in the development of the poultry industry; Management skills in maintaining flock hygiene and Biosecurity; Effect of housing and feeding on health; Viral and bacterial diseases, parasitic infestations, and their control; Vaccination procedures, schedules and techniques; Nutritional disorders and prevention; Egg borne diseases and transmission; Hatchery sanitation and disease control operations.

**AS 5206 Broiler Production (2)**

Review of the broiler industry in Sri Lanka, past and present; Selection and breeding of broilers; Broiler production systems in Sri Lanka and the World, Out-grower contracts, Planning of broiler farms; Management of broilers: housing, feeding and disease prevention; measurement of broiler performance, Factors affecting broiler performance; Feeding and meat quality; Records, Cost-benefit analysis of broiler production;

**AS 5207 Dairy Engineering (2)**

Dairy farm automation; Machine milking: Principles, different classes of milking machines; Robotic milking; Heat measurement, transfer and control; Steam generation and its uses in dairy industry; Electrical power and equipment; Hydraulics and pumping ; Principles of refrigeration; Insulation and cold storage rooms & tanks; Heaters & coolers, modes of heat-exchange & equipment; Cream separation, clarification, ultra filtration & reverse osmosis, homogenizing, pasteurizing and sterilizing & UHT equipment; Evaporation and drying equipment; Mechanical can & bottle washing equipment; Filling units; Equipment for cream, butter & cheese manufacture ; Equipment maintenance; Dairy plant design & construction; Energy and its use in dairy plant.

**AS 5209 Fish Feeds and Nutrition (3)**

Nutritional requirements and deficiencies of shellfish and fin-fish larvae, post-larvae and adults; Digestion, absorption and metabolism of nutrients in fish; Forms of fish feeds; Feed quality; Application of HACCP system for feed management; Feed storage and packing; Preparation and processing of fish feeds; Supplementary and complete feeds; Additives in

compounded feeds; Formulation of feeds, Methods of feeding and feeding standards; Nutrients and energy balance experiments. Role of live food organisms in Aquaculture; Selection of live food organisms for hatcheries; Techniques used in mass culture, isolation and application to local conditions; Management of cultures.

#### **AS 5210 Fish Population Dynamics (2)**

Catch and effort statistics, fish growth, age composition, length-weight relationship; von Bertalanffy, Ford, Brody and logistic curves; Total, natural and fishing mortalities; Equilibrium among reproduction, natural mortality and fishing intensity; Estimation of population size: Petersen estimates, swept area method, Leslie's method, Stratified sampling; Virtual population and cohort analysis; Yield-per-recruit assessment; Surplus-yield models; Multispecies models; Model development and parameter estimation using computer packages.

#### **AS 5211 Genetics and Breeding of Fish (2)**

Structure and behavior of fish chromosomes; Evolution of Karyotypes and fish species; Mutation and Lethal genes in fishes; Pleiotrophic effects; Sex determination and non-chromosomal heredity; Inheritance of economic traits; Selection methods for qualitative traits in ornamental fish; Development and maintenance of colours and shapes; Genetic variability of qualitative traits; Estimation of genetic parameters; Offspring-parent regression; Formation of varieties and inbred lines; Hatchability; Survival and growth of young fish with inbreeding; Exploitation of heterosis; Hybridization and breeding strategies for different fish species. Selection of brood fish and their characteristics; Breeding techniques; Production of different desired strains for commercial aquaculture; Genetic differences among cultured, wild and aquarium fishes; Development of fish breeds.

#### **AS 5212 Genetics and Breeding of Poultry (2)**

Poultry Breeding: Evaluation of fowl species; types of poultry breeds; Karyotype of domestic fowl; Sex determination and sex linked inheritance; Genes controlling feathers, muscles, nerve and skeleton; Lethal genes in domestic fowl; Traits of economic importance; Heritability estimates: Correlation Among traits; Breeding objectives, Selection; Performance recording; Inbreeding in poultry; Breeding stock; Development of lines and strains; Cross breeding methods; Breeding of miscellaneous poultry species.

#### **AS 5213 Livestock Breeding (3)**

Traits of economic importance of dairy cattle, beef cattle, buffaloes, goats and swine; Breeding objectives; Economic aspects of breeding; Profit maximization and efficiency; Selection differential; Intensity and Accuracy of selection; Response to selection; Generation interval; Rate of genetic gain; Selection criteria for different animal species; Single trait and Multiple traits selection; Prediction of breeding value; Correlation between traits; Genetic abnormalities; Inbreeding depression; Development of breeds, varieties, lines and strains; Cross breeding methods; Individual, maternal and parental heterosis; Genetic and environmental interaction; Synthetic breeds; Use of reproductive technologies in animal breeding; Breeding methods for cattle, buffaloes, goat and swine; Design of breeding programs for different species; Breeding policy planning.

**AS 5214 Livestock Health and Hygiene (2)**

Livestock diseases of major importance; ; Basic Principles of disease recognition; Control and preventing bacterial, viral, protozoan and fungal diseases of livestock; Internal and external parasites and their control: Regulations and acts related to contagious diseases; Livestock sanitation, prevention, control and eradication of diseases of farm animals.

**AS 5215 Marine Fisheries Management (2)**

Classification of marine waters and fisheries resources; Deep sea fisheries; Multi day boats, trawling; Law of the Sea and international laws; Technology development and management issues; Effect of fish and fisherman migration on management; Kattudel and Beach-seine fisheries management; Case studies in marine fisheries management.

**AS 5216 Meat Processing Technology (2)**

Introduction; Processing of meat: sausage making, curing and smoking, non-meat ingredients; Meat cookery and cooked meat products; Chemical preservation of meat, radiation, low temperatures, high temperatures, high pressure, drying and fermentation; Testing of quality parameters related to meat products. Labelling and packaging, Functional meat products.

**AS 5217 Microbiology of Dairy, Meat, Fish and Egg Products (3)**

Classification of bacteria, fungi and viruses encountered in food; Microbiology of raw & heat treated milk products; Control and destruction of micro-organisms; Types, metabolism and bacteriophages of starter cultures; Microbiology of cheese, fermented milk, butter & cream, frozen desserts and dry & concentrated milk products; Quality assurance in dairy value chain; Importance & applications of probiotics and prebiotics in dairy products; The incidence and types of micro-organisms & spoilage in meat & meat products, eggs and sea food; Detection of microbial populations in dairy, meat fish & egg; Animal product borne diseases.

**AS 5218 Non-Ruminant Animal Production (3)**

Management of pigs: Genetic selection and breeding; Growth, reproduction and lactation; Feeding management; Planning of swine farms; Housing; Management of stock. Management of rabbits: Planning of rabbit farms; Breeds; Breeding, selection and reproduction; Housing and equipment; Rabbit production systems; Record keeping; Handling and management of kids, growers, does and bucks of rabbits; Health and diseases; Slaughtering process. Importance of microlivestock; Breeds, management and production of crocodile, wild boar. Origin and domestication of miscellaneous poultry species; Breeds of ducks, turkeys, geese, guinea fowl, Japanese Quails, Ostrich, Pigeons; Their importance and utility; Methods and practices of rearing; Special aspects of management of the above species; Housing requirements; Nutrient requirements; Feeding standards and production rates; Disease control.

**AS 5219 Ornamental Fisheries Management (3)**

Ornamental fish and aquatic plant industry; Global situation; Types and scales of ornamental fish farms; Maintenance of fresh water and marine ornamental fish tanks; Management of ornamental fish and aquatic plants; Selection of species for commercial production,



Development of a commercial farm, Broodstock and back ups; Farm lay out; Management strategies for sustainable development; Specialized harvesting technologies; Mitigatory measures for genetic, mutational and disease conditions; Ornamental aquatic plants; Methods of collection, propagation and transport; Economics of ornamental fisheries enterprises: cost-benefit analysis, IRR; Trade; Export requirements; Legal aspect of import and export of ornamental fish and aquatic plants; Environmental issues.

### **AS 5220 Ruminant Livestock Production (3)**

Dairy cattle and buffalo production: Critical analysis of dairy production systems and breeds in different agro- climatic zones of Sri Lanka; Evaluation of available resources for dairy animal production; Planning cattle and buffalo farms for commercial milk production; Management of dairy cattle and buffalo during different physiological stages; Factors influencing production of quality and hygienic milk. Goat and sheep production: Present status, potentials and constraints; Feed resources and strategic feeding; feeding, social and sexual behavior; Advances in reproduction, breeding and health; management for sustainability and high productivity.

### **AS 5221 Shrimp and Fish Processing (2)**

Gross chemical composition of fish and shrimp; Post-harvest biochemical changes in fish and shrimp; Grading and processing of shrimp; Processing and preservation of fish; Utilization of by-products from fish and shrimp processing industries; HACCP in fisheries industries.

### **AS 5222 Wildlife Environment (3)**

Introduction to wildlife ordinance; Wildlife as integral component of ecosystem; Potentials and limitation of wild life conservation; Animal behaviour; Feed resources and feeding patterns; Habitat degradation, conservation and development; Zoonotic diseases; Human-animal conflict & competition; Nonconsumptive value of wildlife; Eco-tourism.

### **AS 5251 Advances in Equine Nutrition and Feeding (2)**

Concentrate and roughage feeds; Types of feeds; Digestive system and digestion of carbohydrates, proteins and fats in the peptic stomach and small intestine; Hind gut fermentation and microbiology; Nutritional requirements for different functions and growth stages; Poisonous substances in feeds; Nutritional disorders.

### **AS 5252 Animal Quarantine, Welfare and Legislation (1)**

Introduction; Quarantine requirements for import and export of animals and products; Animal welfare norms and regulations; Animal experimentation and welfare; Legislation and implementation.

### **AS 5253 Animal Waste Handling and Management (2)**

Introduction; Defining and understanding the problems related to waste disposal; Waste collection and characteristics: Poultry, Dairy, Swine, other animals; Waste management: Control of animal waste pollutants, In- house alterations, Lagoons; Waste utilization: Methane, Fuels, Manure; Treatment of livestock wastes. Statistics of fish wastes; Trawler and

fish processing wastes; Characteristics of fish wastes; Effluent discharge to sedimentation tanks; Waste water and recirculation systems; Effects of fish wastes on environment; Use of probiotics; Regulations on waste handling.

#### **AS 5254 Tropical Animal Production II (3)**

Adaptation of breeds of ruminants (cattle, buffaloes, goats and sheep) to tropical environments; Critical analysis of ruminant production systems in the tropics; Evaluation of available resources and constraints for ruminant animal production; Feeds and feeding strategies for ruminants; Reproduction, breeding, disease control, housing and product processing in ruminants under tropical conditions.

#### **AS 5255 Fish Farm Designing, Construction and Management (2)**

Site selection; Environment impact assessment; Principles of designing and planning, Construction program; Constructions of fish ponds and hatchery jars; Pumps and pumping; Aeration and flow patterns; Maintenance and record keeping, Budgeting; Mitigation of environmental problems.

#### **AS 5256 Slaughter House By-product Technology (2)**

Introduction; Processing of by-products: blood, organ meat, offal, horns, bones, hoof, wool, hair and feather; Nutritive value of by-products; Utilization of by-products: pet food, gelatin, pharmaceutical, bile acid, enzymes and hormones, meat and blood meal, bone meal; Manufacturing of lard & tallow; Silage production. Leather Processing Technology.

#### **AS 5257 Fish Seed Production and Larval Rearing (3)**

Overview of endocrinology in fish reproduction; Manipulation of reproduction, ovulation induction, collection of fish and spawning methods; Artificial and semi-artificial propagation; Hypophysectomy; Ovarian biopsy, Preservation of gametes; Management of brood stock; Estimation and evaluation of eggs, post larvae, fry and fingerlings; Nursery management; Seed production planning and marketing.

#### **AS 5297 Field Visits – Animal Science (1)**

Visits to government and non-government cattle, poultry, and swine enterprises including production & breeder farms. Assessment will be based on the report submitted by the candidates after every field visit.

#### **AS 5298 Industrial Visits – Poultry Science and Technology (1)**

Visits to poultry feed manufacturers: poultry breeders: small, medium and commercial scale poultry producers: processing units/plants; Visits to government and non-government poultry farms. Assessment will be based on the report submitted by the candidates after every field visit.

#### **AS 5299 Industrial Visits - Dairy and Meat Product Technology (1)**

Visits to small, medium and large scale commercial dairy & meat processing plants; Visits to government and non-government cattle, poultry, swine enterprises including production &

breeder farms. Assessment will be based on the report submitted by the candidates after every field visit.

#### **AS 5258 Animal Food Safety (2)**

Introduction; Animal food hygiene and sanitation, quality assurance of animal food products and processing facilities; Presence, analysis & effects of food additives, adulterants, contaminants and natural toxins in animal food products; Microbial hazards, antimicrobial resistance and antibiotic residues in animal food products; Emerging pollutants and environmental issues related to animal food products and processing. Genetically modified feed additives and safety of animal food products. Animal food products and non-communicable diseases.

#### **AS 5259 Dairy Biotechnology (2)**

Introduction to biotechnological intervention on GM starter cultures, Food grade bio-preservatives, Recombinant dairy enzymes and proteins, Accelerated cheese ripening, Bioactive peptides, Functional foods and nutraceuticals, Recombinant chymosin, Development of starter cultures using food grade vectors, Metabolic engineering of Lactic Acid bacteria, Molecular cloning techniques, Expression of gene for recombinant dairy enzymes and proteins, Bacteriophage resistance development.

#### **AS 5260 Dairy Sanitation and Hygiene (1)**

An introduction to sanitation and dairy hygiene in cow - consumer dairy value chain; Types of microorganisms encountered in dairy industry; Spoilage organism, milk -borne pathogens including zoonotic agents: detection, bio-safety, impact on human health; Residues in milk and their effects; Bio-film & milk stone formation, HACCP (ISO 22000); Hygienic requirements of a dairy processing plant. CIP procedure for plants and equipments; Application of processing technologies & quality assurance tests to eliminate milk borne pathogens.

#### **AS 5261 Coast Conservation and Management (1)**

Importance of coastal resources; Coastal habitats; Coastal erosion; Coastal pollution; Regulations and compliance monitoring; Initial environmental examination; Environmental impact assessment; Demarcation of refuge areas; Conservation strategies; Case studies.

#### **AS 5262 Marine Environment Pollution Prevention (1)**

International organizations related to marine environment pollution; Law of the sea; Internal waters and ports; Delimitation and Jurisdiction; Territorial waters; Territorial sea convention; Contiguous zone; Exclusive economic zone; The high seas; Deep seabed mining; Ballistic waters; Oil spills; Marine Environment Pollution Prevention Act; Preventive measures; Case studies.

**AS 5263 Global Warming and Animal Production (2)**

Introduction to global warming, agriculture related contributors to global warming, role of livestock, means of contribution from livestock sector, effects on sustenance and improvement of animal productivity, health and feed resources, management strategies in mitigating the influence through livestock sector.

**AS 5264 Cell Biology in Animal Science (2)**

Cellular Components; Structures of biological membranes, lipids and lipid modification, membrane proteins, localization of cellular proteins, identification of functions; Cell signaling and signal transductions: membrane receptors, ligands, second messengers, signaling pathways (protein kinases, VEGF, Wnt, JAK/STATS, Notch, JNK, IGF-1, TGF,  $\text{Ca}^{2+}$  signaling); Protein synthesis and secretion; Cell Cycle: check points, control; Cell Death: Apoptosis, mechanisms, measurement of cell death, induced cell death; Cytoskeleton; Cell–Cell Interactions: cell adhesion and mechanisms, motility, extra-cellular matrix; Principles of Glycobiology; Angiogenesis; Cancer; Stem Cells.

## BOARD OF STUDY IN BUSINESS ADMINISTRATION

### LIST OF COURSES

Course No.	Course Title	Credits
<b>First Semester</b>		
BM 5101	Organizational Behaviour and Analysis	3
BM 5102	Strategic Human Resource Management	2
BM 5103	Accounting	2
BM 5104	Business Statistics	2
BM 5105	Business Law	2
BM 5106	Business Economics	2
BM 5107	Quantitative Management Techniques	2
BM 5108	Management Information Systems	2
BM 5109	Agribusiness Management	2
BM 5110	Organizational Diagnoses and Change	2
BM 5111	Project Management	2
BM 5112	e-Business Strategy	2
BM 5113	Business Development Seminar	2
BM 5114	Real Estate Investment and Development	2
BM 5115	Supply Chain Logistics Management	3
BM 5198	Project	5
<b>Second Semester</b>		
BM 5201	Corporate Finance	2
BM 5202	Managerial Economics	2
BM 5203	Marketing Management	3
BM 5204	Strategic Management	2
BM 5205	Entrepreneurship	2
BM 5206	International Business	2
BM 5207	Research Methods for Managers	2
BM 5208	Principles of Management	2
BM 5209	Enterprise Planning and Operations Management	2
BM 5210	International Corporate Finance	2
BM 5211	International Marketing	2
BM 5212	Consumer Behaviour	2
BM 5213	Quality Management Systems	2
BM 5214	GIS for Business and Management	2
BM 5215	Planning and Entrepreneurial Venture	2

## **COURSE CAPSULES**

### **First Semester**

#### **BM 5101. Organizational Behavior and Analysis (3)**

This course module will enable the students to understand the nature of the business organization and its determining characteristics and the importance of the human behavior in managing tomorrow's organization. The topics covered include: introduction to organizational and prospective on organizational effectiveness, evolution of organization and management theory, organization and the environment, organizational structure: basic concepts, organization design: from traditional structures to virtual organization, individual behaviour in organizations – role of perception, attitudes, aptitudes and role of personality, interpersonal and organizational communication, teams and team development, motivation: theoretical perspectives, application of motivational strategies for employee empowerment, managing organizational conflict, organizational culture, managing organizational change post modern organization.

#### **BM 5102. Strategic Human Resource Management (2)**

This course will enable the students to appreciate the strategic nature of human resource management and amalgamate it with the overall organizational strategy in pursuing the organizations mission and the vision. The topics covered include: the strategic nature of business in age of discontinuity, the relationship between business strategy and human resource strategy, competitive labor market analysis, human resource planning, recruitment and selection for strategic competitive advantage, training and development, performance management, rewards management, managing the employment relationship from traditional industrial relations to current approaches, international human resource management.

#### **BM 5103. Accounting (2)**

Introduce students to the need for accounting information, its purpose and uses. Understanding and analysis of financial reports prepared by businesses for use by owners, shareholders, lenders and other interested parties. Internal management accounting information used for decision-making, planning and control.

#### **BM 5104. Business Statistics (2)**

Introduction to Business Statistics, Types of business data, graphical descriptive techniques, numerical description techniques, probability and probability distributions, Sampling and the sampling distribution, Concept of hypothesis testing, inference about the single population, inference about two populations. Analysis of variance, tests for qualitative data, introduction to nonparametric statistics, regression and correlation, statistical process control, introduction to advance

**BM 5105. Business Law (2)**

This module will provide students comprehensive exposure to all the major concepts of business and company law in Sri Lanka. The topics covered include sources of law, legal systems, law of contracts, law of agency, law of employment, negotiable instruments, sale of goods and hire purchase and the law of association, small-partnership. Company law and its major issues.

**BM 5106. Business Economics (2)**

Introduction to microeconomics, the theory of consumer choices, business organization and behaviour, perfect competition and monopoly, government interventions in markets, introduction to macroeconomics and national income accounting, aggregate demand, physical policy and foreign trade, monetary policy and the central bank, inflation, macroeconomic policy in an open economy.

**BM 5107. Quantitative Management Techniques (2)**

Decision analysis, forecasting in business, linear programming with applications, transportation, assignment and transshipment problems, project scheduling using PERT/CPM, inventory management, queues and congestion, multi criteria decision management, simulation, conjoint analysis.

**BM 5108. Management Information Systems (2)**

Introduces students in management to information systems and its uses. It consists of strategic planning for information systems, marketing information systems and studies in relational databases. It first introduces the students to the strategic role of management information systems and strategic planning and management of them within a modern organization. It then specializes in marketing information systems and the managerial aspects of developing, implanting and operation of such information systems. Finally, it aims to provide a sound understanding of a modern business data base and programming environment.

**BM 5109. Agribusiness Management (2)**

This course will provide students a comprehensive exposure on the nature and scope of agribusiness and how they can be restructured in order to achieve a competitive advantage. The topics covered include the nature and scope of agribusiness, the economics of the food system, consumer behaviour in agro-food marketing, agricultural food marketing, supply chain management, international agribusiness and agricultural food market communications.

**BM 5110. Organizational Diagnoses and Change (2)**

The aim of this course is to improve students' knowledge and skills in carrying out organizational diagnoses and in planning organizational interventions for enhancing organizational performance.

**BM 5111. Project Management (2)**

This course will enable the students to appreciate the practicalities of the project evaluation management to understand and use the techniques for the evaluation, planning and management of projects, examines the use of project manager, experience and use computer software in project management and evaluation. The topics covered include, project life cycle, project scheduling, time-cost, trade off, managing the risk, project human resource management and sub contract to relationships.

**BM 5112. e-Business Strategy (2)**

This course has been designed to impart students with knowledge on *e-Business* which will eventually enable them to improve their ability to understand and anticipate customer needs, in order to venture into new products, services and new markets. The course will provide the students with fundamentals of *e-Business* driving forces comparison of existing alternative solutions and the means of strategizing *e-Business* development solutions on re-engineered business processes.

**BM 5113. Business Development Seminar (2)**

Seminar is an integrative course to build on the full range of MBA course work, and is geared towards students who are already employed professionally in the corporate sector. Students will be required to do a comprehensive diagnostic study on one of the key business areas of their company. The study should lay out an overview of the particular industry, the company's business model, key strategies, competitive advantages, and operations advantages. It should also identify weaknesses and threats to the business, and possible growth opportunities. Students should then develop a strategy to either address existing weaknesses/threats, or to develop the business in identified growth areas. Oral presentation as well as a written submission will be required.

**BM 5114. Real Estate Investment and Development (2)**

This course will cover the basic concepts of real estate finance, investment, and development, and is geared towards students who may be interested in professional careers in the real estate sector. Students will gain an understanding of the key phases in real estate development including initial due diligence, planning and design, financial analysis, investment structuring, development and harvest. Students will also be given an overview of the various property types, investment strategies and common pitfalls in the real estate sector.

**BM 5115. Supply Chain and Logistics Management (3)**

Introduction to supply chain management, logistics network configuration, inventory management and risk pooling, the value of information, supply chain integration, strategic alliances, procurement and outsourcing strategies, international issues in SCM, coordinated product and SCM design, customer value and SCM, information technology for SCM, decision-support systems for SCM.

**BM 5198 Project (5)**



## **Second Semester**

### **BM 5201. Corporate Finance (2)**

This course is structured to demonstrate how the theory of financial management is applied to real world situation thus enabling students to apply the theory they learn in managerial situations. The topics covered include the time value of money, capital budgeting techniques, measuring risk and returns, portfolio theory, the capital asset pricing model and its applications, working capital management, the role and functioning of stock markets, financing the firm with debt and equity capital, the cost of capital, the effect of financial leverage on shareholders returns, capital structure theory and dividend policy

### **BM 5202. Managerial Economics (2)**

Introduction to financial management provided by the courses in accounting and finance. Application of economic techniques to problems encountered in project appraisal. Topics covered include investment appraisal techniques, discounted cash flow, capital budgeting under conditions of uncertainty, identification of relevant cash flows, risk, expected value and sensitivity analysis, capital rationing, public sector investment appraisal, sources and cost of capital rationing, financial institutions, and the theory of efficient markets.

### **BM 5203. Marketing Management (3)**

Introductory course in marketing that introduces marketing discipline to non marketers and shows how non marketing functions contribute to organizational marketing effectiveness. It provides a conceptual basis for the development of marketing management skills and techniques. Topics include role and relevance of marketing to managers, the marketing concept, marketing environment, understanding the customer, product issues, communicating and delivering values.

### **BM 5204. Strategic Management (2)**

An understanding of the needs, contexts and processes involved in managing strategic changes within organizations, principles underlying approaches towards strategic management, prescriptive and descriptive approaches which draw from observations, experience and analysis of real management issues, contexts and behavior.

### **BM 5205. Entrepreneurship (2)**

This course broadens the understanding of the role of entrepreneurship in business, economy and society and develops some insights on the practical skills needed in new business ventures. This consists of understanding of international perspectives on small business management, Entrepreneurship and new venture management and corporate entrepreneurship. The first provides understanding on the international processes that have led to the revival of the small firm. The second provides an overview of the business status processes from theoretical and practical standpoint. The third explores how managers in large corporate firms exploit new business opportunities through entrepreneurial strategies of management.

**BM 5206. International Business (2)**

Multidisciplinary course, which considers the macro and microeconomic, political, legal and social issues currently affecting the international business community. Topics include theories of international trade, foreign direct investment and its impact on host country, comparative advantage to product life cycle theory, role of government intervention on trade and industry, business.

**BM 5207. Research Methods for Managers (2)**

The course aims to introduce a range of research designs and methods, which will help the students to solve practical business problems. Topics covered include a variety of research methods, sampling techniques, data analysis techniques, and ethical issues in conducting business research along with effective report writing skills.

**BM 5208. Principles of Management (2)**

This course intends to provide non-MBA students an introduction to the theory and practices of management. This covers the topics, nature of management, managerial decision making, managerial issues in planning, managers' responsibilities for the organizational function, managerial function of directing and the controlling function of directing.

**BM 5209. Enterprise Planning and Operations Management (2)**

This course will enable the students to be aware of the role of operations management in business competitiveness, business drivers for business operational designs, the effect of people and technology on operations management and the contribution of supply chain management and integration in operations. This also enables students to recognize the critical measurement of control in operations management and to analyze relatively complex cases and draw conclusions about operations management. The topics covered includes, business operations and assistance, operations strategy and module, product design product, process, capacity supply chain and job design. Operations planning and ERP structures, MRP and MRPII structures relative operations/lean systems, supply chain operations and operation system control.

**BM 5210. International Corporate Finance (2)**

This course aims to provide an understanding of key area of finance within an international environment. Topics covered includes, the operations of the foreign market, the relationship between exchange rates, interest and inflation rates, foreign exchange risk and its management, the use of the main derivative products (futures and options) in international finance, international portfolio diversification and foreign direct investment.

**BM 5211. International Marketing (2)**

This course includes the application of marketing, across cultures the posses of internationalization, barriers of international activities, applying the marketing cycle, in understanding creating, communicating and delivering values, the impact of globalization and the international growth of finances.

**BM 5212. Consumer Behavior (2)**

The purpose of this course is to provide the student with the usable, managerial understanding of consumer behavior. The topics covered include a perspective on consumer behavior, affect and cognition and marketing strategy, behavior and marketing strategy, the environment and marketing strategy and consumer analysis.

**BM 5213. Quality Management Systems (2)**

The aim of this course is to make aware the students of the contents of international quality systems standards such as ISO9000/2000. This also will enable the students how to set up an international quality system. To make them aware the difference between systems based on auditing, sometimes by the third party, and those based on self-assessment. This will also enable them to assess the cost of prevention, appraisal and failure and their influence on the financial health of the organization and analyze complex cases on quality systems, auditing and costing situations.

**BM 5214. GIS for Business and Management (2)**

This course aims to provide students with the basic knowledge of Geographical Information Systems (GIS) and potential applications of GIS technology for business and management. The topics includes introduction to GIS for business management, spatial data for GIS, Map projections and scales, hardware and software for business GIS, GPS navigation and business management, spatial data management, sharing and ownership, application of GIS for business management, case studies on application of GIS for real estate management, application of GIS for market and consumer surveys, use of GIS for profitability analysis and GIS applications: Sri Lankan experience, constraints and potentials. Practical sessions will be conducted using ARC.

**BM 5215. Planning the Entrepreneurial Venture (2)**

This course is a hands on integrative and practical course designed to help students who are planning to pursue new entrepreneurial opportunities on their own, or within existing businesses. Students will be required to have initial ideas for their planned ventures prior to beginning the course, and will be guided through the process of assessing and refining their ideas through the preparation of a detailed business plan suitable for presentation to potential investors. The course will build on the full range of MBA coursework, with an emphasis on its practical application. Students are expected to develop individual business plans over the course duration.

## BOARD OF STUDY IN BIOSTATISTICS

### LIST OF COURSES

Course No.	Course Title	Credits
<b>First Semester</b>		
ST 5101	Calculus and Matrix Algebra	2
ST 5102	Basic Statistics	2
ST 5103	Data Analysis using Statistical Software	3
ST 5104	Sampling Techniques	2
ST 5105	Time Series Analysis	2
ST 5106	Computer Programming	2
ST 5151	Statistical Theory	4
ST 5152	Exploratory and Robust Data Analysis	2
ST 5153	Modeling Binary Data	2
ST 5154	Statistical Genetics	2
ST 5155	Design and Analysis of Experiments	2
ST 5198	Directed Study	5
ST 5199	Seminar	1
ST 6101	Vector Analysis	2
ST 6102	Measure Theory	2
ST 6103	Group Theory	2
ST 6104	Graph Theory	3
ST 6151	Variance Components Estimation	2
PGD 5101	Basic Mathematics	2
PGD 5102	Basic Statistics	2
PGD 5103	Experimental Techniques	2
PGD 5104	Regression Analysis	2
PGD 5105	Sampling Techniques	2
PGD 5106	Use of Statistical Software	2
<b>Second Semester</b>		
ST 5201	Advanced Calculus	2
ST 5203	Regression Analysis	2
ST 5204	Nonparametric Statistics	2

ST 5205	Categorical Data Analysis	3
ST 5251	Statistical Methods for Analysis of Spatial Data	3
ST 5252	Design and Analysis of Epidemiological Studies and Clinical Trials	2
ST 5253	Crop Experimentation	1
ST 5254	Animal Experimentation	2
ST 5255	Statistical Quality Control	2
ST 6201	Linear Models	3
ST 6202	Multivariate Statistical Methods	3
ST 6203	Stochastic Processes	2
ST 6251	Statistical Computing	2
ST 6253	Statistical Methods for Behavioral Sciences	2
ST 6254	Advanced Design and Analysis of Experiments	2
PGD 5201	Categorical Data Analysis	2
PGD 5202	Non parametric Statistics	2
PGD 5203	Multivariate Data Analysis	2
PGD 5204	Binary Data Analysis	2
PGD 5205	Studies in Medical Research Investigations	2
PGD 5206	Statistical Applications in Business	2
PGD 5207	Special Topics	1
PGD 5208	Seminar/Independent Study	2

## **COURSE CAPSULES**

### **First Semester**

#### **ST 5101. Calculus and Matrix Algebra (2)**

Preliminaries: Number system, Concept of sets, Intervals, Inequalities, Relations and functions, Types of functions. Trigonometry: Basic trigonometric identities, Trigonometric functions and inverse functions, Additive formulas. Differentiation: Concept of limit, Concept of derivatives, Techniques of differentiation, Differentiation of algebraic, logarithmic, exponential and trigonometric functions, Determination of maxima and minima, partial derivatives, Total differential. Integration: Basic rules of integration, Definite integral, Application of integral calculus. Matrix algebra: Different forms of matrices, Matrix operations, Determinants, Conditions for non singularity, Matrix inverse, Solution of set of linear equations, Cramer's rule, Quadratic forms, Jacobian and Hessian determinants, Eigen vectors and Eigen values.

#### **ST 5102. Basic Statistics (2)**

Variability in observations, Frequency distributions and histograms, Stem and leaf and box plots, Population and sample, Probability structure and cumulative distribution functions, Expected values and moments, The family of normal distributions, Statistical inference, Point and interval estimation, Tests of hypothesis, Introduction to Analysis of variance (ANOVA), Linear regression and correlation, Estimation and tests on proportions, Contingency tables and test of associations.

**Note:** Both ST 5101 and ST 5102 are prerequisite for all the courses listed below.

#### **ST 5103. Data Analysis Using Statistical Software (3)**

Operation modes of statistical software, Special features with different modes, SAS and its basic features, Writing SAS programs, Creating SAS datasets and modifying created SAS datasets, Permanent SAS datasets, Advanced features in programming with SAS, Implementing common statistical methods using SAS, Analyzing unbalanced data.

Introduction to R statistical software, Basic features, Data input, Data management, Concurrent use of R with other software, Import data functions and foreign data types, Data exploration with R, Graphics using R, Descriptive statistics, Recoding variables and creating factors and new variables, Append and merging files, Implementing common statistical methods using R. Analyzing unbalanced data.

#### **ST 5104. Sampling Techniques (2)**

Scope of sampling, Probability and non-probability sampling, Multiple response techniques, Composite scales and reliability, Sampling theory, Sampling proportions, Simple random sampling, Stratified random sampling, Proportional allocation, Optimum allocation, Neyman allocation, Precision of estimates under different allocations, Ratio and regression estimators, Systematic sampling, Multi – stage sampling schemes, Cluster sampling, Spatial sampling, Sampling from animal populations (capture-recapture analysis), Adoptive sampling and their uses, Lot quality assurance sampling (LQAS).

**ST 5105. Time Series Analysis (2)**

Trend Analysis, Smoothing techniques (Moving averages, Weighted moving averages), Decomposition techniques, Seasonal adjustments, Stochastic process; Stationary process; white noise stochastic process, Markov Chain process. General Linear Process, Auto-covariance and autocorrelation functions, Estimation of Auto-covariance and Autocorrelation functions, Estimation of partial autocorrelation, Backshift operation notation, Stationary and inevitability conditions for a linear process, Autoregressive (AR) process, Moving average (MA) process, Auto-covariance generating function of AR and MA process, Stationary and inevitability conditions for AR and MA process, Mixed autoregressive moving average process (ARMA and ARIMA), ARCH and GARCH models, Diagnostic checking and forecasting, Fourier Analysis, Multivariate Time series.

*Practical: Analysis of large data sets with R.*

**ST 5106. Computer Programming (2)**

Fundamentals of computer programming, Concepts of structured programming: data types, expressions, loops, control structures, functions, arrays, input/output, running, testing, and debugging. UNIX and Linux operating systems, Programming in C, Object-oriented paradigm, Concepts of object-oriented programming: classes, objects, abstraction, encapsulation, inheritance and polymorphism, Java programming, R programming for statistical computing.

**ST 5151. Statistical Theory (4)**

Probability: Properties of random vectors, Conditional probability, independence. Discrete random variables; Probability mass functions and cumulative distributions. Some common discrete distributions, Continuous random variables: Expected values and moments, moment generating and characteristic functions, Marginal and conditional distributions, Bayes' Rule, Expectations and Central Limit Theorem, Sampling from the Normal distribution, Point and interval estimation, Test of Hypotheses: Simple and composite hypothesis, Maximum likelihood estimation, Generalized Likelihood Ratio Tests, Tests of means and variances.

**ST 5152. Exploratory and Robust Data Analysis (2)**

Basic data displays, The box-plot, The empirical cumulative distribution plot, Some comments on order statistics, Transformation of data, The symmetry plot and probability plotting, Data mining. Tests for normality, Review of some concepts of statistical theory, Least squares and weighted least squares estimation in the location model, Approximate variance of functions of random variables, Parameters and the estimation as functional, The influence curve, The general concepts of Robustness, Robust efficiency, L-estimators, M-estimators, The Monte Carlo method, The Bootstrap method. Comparing two or more groups of data: Exploratory, Classical inference and other forms of analysis, One way ANOVA, Transformation in one way ANOVA, The box-cox transformation, Robust estimation in the SL, Multiple linear and nonparametric regression.

**ST 5153. Modeling Binary Data (2)**

Experiments with binary outcomes, Distributions for binary data, Fitting distributions of binary data, Goodness of fit tests, Testing two proportions; Approximate tests and exact tests, Methods of parameter estimation for binary data, iteratively weighted least square and maximum likelihood estimates, Profile and conditional likelihood, Fitting models for binary data; logit and probit models, Strategies in model selection, Conditional logit model and exact inference, Overdispersion with binomial data, Random effects and mixed models, Quasi-likelihood methods, Generalized estimating equation method, Multilevel modeling, Mixed models for longitudinal data analysis, Multivariate binary data.

**ST 5154. Statistical Genetics (2)**

Genetic structures, Hardy-Weinberg equilibrium, Estimation of gene frequencies, Sex linked gene, Inheritance of quantitative characters, Covariance among relatives Coefficient of inbreeding, Estimation of genetic variance components, conventional crossing systems, Index selection, Genotype-environment interactions, DNA micro-array analysis, Mapping QTL.

**ST 5155. Design and Analysis of Experiments (2)**

Principles of experimental design, Completely randomized, Randomized Complete Block, and Latin square designs, Covariance analysis, Transformation of data, Factorial Experiments. Fixed effects and random effect models, Subsampling, nested factor designs, Confounding in  $2^n$  factorial experiments, Fractional factorials ( $2^n$ ), split-plot designs, Incomplete Block Designs, BIB and PBIB designs, Analysis of repeated measures.

**ST 5198. Directed Study (5)****ST 5199. Seminar (1)****ST 6101. Vector Analysis (2)**

Vector Algebra: Scalars and Vectors; Addition and multiplication by a scalar; Unit vectors; (i,j,k) Components of a vector; Linear dependence and independence; Scalar and vector fields; Scalar product of two vectors;  $\underline{a} \cdot \underline{b}$  Vector product of two vectors;  $(\underline{a} \times \underline{b})$  Triple scalar and vector products; Solution to vector equations.

Vector Analysis: Ordinary derivative of a vector; Unit tangent vector and principal normal to a space curve; Partial derivatives of vectors; Differentials of vectors; Differential geometry and applications; Gradient, Divergence and curl operators; in rotational and solenoidal fields; Line, Surface and volume integrals, Stoke's theorem and Gauss' divergence theorem; Tensors and their fundamental operations.

**ST 6102. Measure Theory (2)**

Lebesgue measure on the real line and its properties; Abstract measure space and measurable functions; Lebesgue integral; Fatou's Lemma, the Monotone and Dominated Convergence Theorems;  $L^p$ -space; Models of convergence; convergence almost everywhere, convergence in norm and in measure; Signed measures; product measures and Fubini-Tonelli Theorems.



**ST 6103. Group Theory (2)**

Introduction to Groups, Cyclic Groups, Abelian Groups, Permutation Groups, Normal Subgroups, Factor Groups, Homomorphism and Isomorphism theorem on Groups, Class of Groups, Radicals and residuals, Action of Groups on sets, Semi-direct products, Series, Soluble Groups, Sylow theorems,  $p$  – Groups, and Nilpotent Groups.

**ST6104. Graph Theory (3)**

Introduction: Types of Graphs, Isomorphism of Graphs, Adjacency Matrix, Incidence Matrix, Paths and Cycles; Eulerian and Hamiltonian Graphs: Euler's Theorems and Properties of these Graphs; Applications : Shortest Path Problem, Chinese Postman Problem and Travelling Salesman Problem, Graph Coloring: Four Color Theorem, Timetable Scheduling and Planar Graphs, Trees: Spanning Trees, Kruskal's and Prim's Algorithms and Tree Searching, Line Graphs : Properties, Total Graphs, Block Graphs and Cutpoint Graphs, Directed Graphs: Isomorphisms and Applications, Menger's Theorems: Transversal Theory,  $(0, 1)$ - matrices and Network Flows, Infinite Graphs : Introduction and Examples.

**ST 6151. Variance Component Estimation (2)**

*Pre-requisite: ST5151 & ST 6201*

Mixed and random effect models, Properties of quadratic forms, Methods of variance components estimation; Henderson methods, MIVQUE, EM Algorithm, Maximum likelihood, Restricted maximum likelihood, Derivative free methods, Bayesian Estimation, Gibbs sampling, Emphasis on application and computing strategies.

**PGD 5101. Basic Mathematics (2) *prerequisite***

Preliminaries, Polynomials, Limits and concept of derivative, Rules of differentiation, Applications of derivatives, Integration, Matrix algebra.

**PGD 5102. Basic Statistics (2) *prerequisite***

Frequency distribution and histogram, Measurement of central tendency and dispersion, Stem and Leaf plots and Box plots, Expected value, Normal distribution, Statistical inference, Point and interval estimates, Concept of hypothesis testing, Test for means and variance, Analysis of variance.

**PGD 5103. Experimental Techniques (2)**

Principles of experimentation, Basic experimental designs, Factorial Experiments, Mean separation, Covariance analysis, Split-plot type designs, Incomplete block designs, Nested designs, Confounding in factorial experiments, Fractional factorials.

**PGD 5104. Regression Analysis (2)**

Simple linear regression, Correlation, Multiple regression, Test for goodness of fit, Heteroscedasticity and Autocorrelation, Model selection, Introduction to Non-linear regression.

**PGD 5105. Sampling Techniques (2)**

Population and sample, Simple random sampling, Stratified random sampling, Proportional allocation, Sample size determination, Cluster sampling, Systematic sampling, Multistage sampling, Nationwide surveys, Non-Probability sampling techniques

**PGD 5106. Use of Statistical Software (2)**

Introduction of different statistical software, Basic features of Minitab, SPSS and SAS, Data entry and Analysis using statistical software.

**Second Semester****ST 5201. Advanced Calculus (2)**

Determination of maxima and minima with two variables, Maclaurin and Taylor series,  $N^{\text{th}}$  derivative test for relative extremum. Indeterminate forms, Curve tracing, Advance integration techniques, Application of integration. Constrained optimization with Lagrange multipliers.

Differential equations of the 1st order; Definitions, formation of differential equations, particular integrals and complementary functions, methods of solution, Clairaut's equations, Orthogonal trajectories, Differential equation of higher orders: Linear equation with constant co-efficient, Linear differential operators, Simultaneous linear equations with constant coefficient., Elementary partial differential equations; Numerical solutions., Mathematical modeling for biological systems.

**ST 5203. Regression Analysis (2)**

Matrix approach to linear regression, Multiple linear regression; General Linear Models, Least Squares procedure, Inferences in regression, Model selection procedures, Analysis of residuals, Influence diagnostics, Detecting and combating multicollinearity, Nonstandard conditions, Violation of assumptions, Transformations. Non-linear regression; Non-linear least squares, Gauss-Newton procedure for finding estimates, other modifications of Gauss-Newton procedure.

**ST 5204. Nonparametric Statistics (2)**

Scales of measurements, Parametric vs. nonparametric statistics, One sample test: Sign test, Two sample tests: Wilcoxon Rank Sum and Wilcoxon Signed Rank, Multi sample tests: Kruskal-Wallis, Friedman, Aligned Rank and Durbin test for IBD, Rank correlations, Empirical cumulative distribution function, Kolmogorov and Smirnov one sample and two sample tests, Tests for Randomness, Randomization (permutation) tests, Introduction to nonparametric regression, LOWESS

*Practicals: Analysis of nonparametric data using SAS.*

**ST 5205. Categorical Data Analysis (3)**

Probability distributions for multi-category responses, Partitioning of  $\chi^2$  and  $G^2$ , Testing independence for nominal, ordinal two-way tables, Analysis of Multi-dimensional Tables and log-linear models, Parameter estimates from log-linear model, Log-linear models for ordered categorical data, Logit models for multinomial data, Logit models for ordered multinomial responses, Generalized estimating equation method for multinomial responses, Bayesian models for categorical data, Analysis of multi-response categorical data, Overdispersion with multi-category responses, Generalized linear mixed models for multinomial data

**ST 5251. Statistical Methods for Analysis of Spatial Data (3)**

Introduction to spatial data, Co-ordinate / projection systems, Raster data, Vector data, Dimensions of spatial data, Statistics and spatial data, Probability concepts related to remote sensing theories, Network data, Quantitative geometry of stream network. Problems of descriptive statistics for spatial data, Temporal analysis of spatial data, Processing of spatial data (image data), Enhancement techniques, Spatial sampling techniques, Spatial data classification, Resampling techniques, errors of spatial data, Other applications statistical techniques for spatial data.

Practical: Use of Statistical and Spatial information system software, SAS, SPANS, GIS, ERDAS

**ST 5252. Designs and Analysis of Epidemiological Studies and Clinical Trials (2)**

Measuring risk factors, Intervention and observational studies, Response and assessment bias, Assessing diagnostic tests, Receiver operating characteristic plot of sensitivity and specificity, Designs for aetiological studies; cross sectional, cohort and case-control studies, Matched case-control studies, Clinical trial protocol and management, Design for clinical trials: Cross over trials, Parallel group trials, Cluster randomized trials and Equivalence trials. Meta-analysis of clinical trials, Models for data from observational and intervention studies, Confounding and interaction, Analysis of infectious disease and longitudinal data, Survival curve and survival curve estimation, Survival function and hazard functions, Models for survival data.

**ST 5253. Crop Experimentation (1)**

Selection of site, Size, shape and orientation of plots and blocks, Systematic spacing designs, Design and analysis of intercropping experiments, Use of control, choosing levels of a factor, Number of replications, Yield density models, Growth curves, Sequential and partial SS., Partial correlation, Experimentation with perennial crops.

**ST 5254. Animal Experimentation (2)**

Experimental units (large and small animals), Selection of animals for experimentation, Adaptation period, Preliminary and sample collection period, Carry over effects, herd %, year %, Seasonal effect, Covariates in animal experimentation, Lactation and growth curves Exercises using Statistical Analysis System (SAS).

**ST 5255. Statistical Quality Control (2)**

Introduction to statistical quality control and quality system, Basic quality tools, Statistical Process Control using Variable charts;  $\bar{X}$ , S, R and MA charts. Attribute Charts; P, NP, C, U charts. Operating characteristic curve, Acceptance Sampling Plans by Attributes and Variables: single, double, multiple and sequential sampling plans (AOQL and LTPD plans). Capability and Reliability analysis using capability and performance indices. Practical exercises using MINITAB

**ST 6201. Linear Models (3)**

Matrix concepts, Distribution of quadratic forms, General Linear Models (Full rank); Estimation and Hypothesis testing, Less than full rank models, Methods to combat Multicollinearity; Ridge regression.

**ST 6202. Multivariate Statistical Methods (3)**

*Pre-requisites: ST 5155*

Aspects of multivariate analysis, Mean vectors and covariance matrices, Mean vector and covariance matrix for linear combinations, Marginal and conditional distributions, Expected values, Generalized variance, Multivariate normal distribution, Sampling distribution of  $\bar{\mathbf{X}}$  and  $\mathbf{S}$ , Inference about  $\bar{\mathbf{X}}$  and Hotelling's  $T^2$ , Confidence regions, Principal component analysis, Factor analysis and structured covariance matrices, LISREL models and path analysis, MANOVA, Canonical correlation analysis, Discriminant function analysis and classification, Cluster analysis and ordination, Multidimensional scaling, Correspondence analysis, Multivariate regression analysis.

**ST 6203. Stochastic Processes (2)**

*Pre-requisite: ST 5151*

Markov chains on discrete space in discrete and continuous time (random walks, Poisson processes, birth and death processes) and their long-term behavior. Branching processes, renewal theory, Brownian motion.

**ST 6251. Statistical Computing (2)**

*Pre-requisite: ST5151 & ST 6201*

R programming language. Numerical computations and algorithms with application in statistics; Solution of equations, Matrix Computations, Linear algebra applications, Numerical integration, Linear and nonlinear least squares and regression computations, random number generation, application of Monte Carlo methods in statistical research, Optimization methods; Newton- Raphson, Linear Search and Gradient Methods, Direct Search: Neider-Mead Simplex Algorithm, Gauss-Newton Algorithm, Levenberg-Marquard and other modifications of Gauss- Newton. Computations associated with estimation; EM Algorithm, Maximum Likelihood Estimation: N-R and Scoring, Robust Regression Computations, Re-sampling Methods: Bootstrapping.

**ST 6253. Statistical Methods for Behavioural Sciences (2)**

*(only for students registered in the BS of Agric. Extension)*

The role of statistics and other quantitative techniques in behavioural sciences; Data collection in behavioral science studies; Uniform, Binomial and Poisson distribution; Simple and multiple linear regression; Identifying direct and indirect relationships; Nonparametric procedures in behavioural sciences; Analysis of nominal data; Construction of indices; Grounded theory methods, Semiotic conversation analysis.

*Practical exercises using SPSS.*

**ST 6254. Advanced Designs and Analysis of Experiments (2)**

*Pre-requisite: ST 5155*

Incomplete Block Designs, Extended Block Designs, and modifications, Construction of designs (BIB and PBIB), Confounding and fractional factorials in  $2^n$ ,  $3^n$ , and  $p^n$  experiments, Asymmetric factorials, Lattice designs, Unbalanced designs.

**PGD 5201. Categorical Data Analysis (2)**

Two-way table, Testing for goodness of fit and interdependence, Structural models for count data, Log linear models, Maximum likelihood and weighted least square estimation, Model selection, Residual Analysis.

**PGD 5202. Nonparametric Statistics (2)**

Scale of measurement, Rank correlation, other measures of associations in ranked data, Rank tests to compare two treatments, Tests to compare more than two treatments, Blocked comparisons.

**PGD 5203. Multivariate Data Analysis (2)**

Multivariate normal distribution, Variance and Covariance metrics, Principle component analysis, Factor analysis, Cluster analysis, Discriminant function analysis, Multivariate analysis of variance, Canonical correlation.

**PGD 5204. Binary Data Analysis (2)**

Binomial distribution, Odds ratio and relative risk, Testing two proportions, Logit and Probit models, Conditional logistic regression, Model diagnostics.

**PGD 5205. Studies in Medical Research Investigations (2)**

Sampling in clinical sciences, Sampling in epidemiological studies, Case control studies, Survival data analysis, Reference intervals, Analysis of mortality and population structure.

**PGD 5206. Statistical Applications in Business (2)**

Forecasting in business, Analysis of productivity and efficiency, Quality control, Conjoint analysis, Use of multivariate statistical methods in business.

**PGD 5207. Special Topics (1)**

(Special topics may vary from year to year). Suggested topics are: project analysis, linear programming, statistical analysis of genetic designs and epidemiological modeling.

**PGD 5208. Seminar/Independent Study (2)**

## BOARD OF STUDY IN CROP SCIENCE

### LIST OF COURSES

Course No.	Course Title	Credits
<b>First Semester</b>		
CS 5101	Principles of Crop Production	3
CS 5102	Plant Water Relationships I	2
CS 5103	Weed Biology	2
CS 5104	Advanced Horticulture	2
CS 5105	Crop Physiology	3
CS 5106	Seed Physiology and Technology	2
CS 5107	Protected Culture	2
CS 5108	Fruit Crop Management	2
CS 5109	Olericulture (Vegetable Crop Culture)	2
CS 5110	Forest Ecology	2
CS 5111	Agroforestry	2
CS 5112	Plantation Forestry and Environment	2
CS 5113	Forest Influences on Soil, Water and Climate	2
CS 5114	Biodiversity	2
CS 5115	Policy and Legislation Related to Forestry and Environment	1
CS 5116	Forest Systematics	2
CS 5117	Economics of Environmental Forestry	2
CS 5118	Forest Products and Utilization	1
CS 5119	Landscape Horticulture	3
CS 5120	Commercial Nursery Management	2
CS 5121	Landscape Architecture	2
CS 5122	Plant Growth Regulators	2
CS 5123	Plant Tissue Culture – Micropropagation	2
CS 5124	Field Crops in the Tropics	2
CS 5125	Tropical Cropping Ecosystems	2
CS 5126	Tropical Environments and Farming Systems	2
CS 5127	Tropical Plant Diversity and Ethno-Botany	2
CS 5128	Integrated Crop-Livestock Systems in the Tropics	2

CS 5129	Production Horticulture	3
CS 5130	Cultivation and Processing of Plantation Crops	3
CS 5131	Tropical Field Crop Production	3
CS 5132	Sustainable Garden Management	2
CS 5133	Plant Nutrient Management in Horticultural Crops	2
CS 5134	Propagation Techniques for Horticultural Crops	2
CS 5135	Horticulture in the Temperate Regions	2
CS 5136	Value addition for Horticultural Produce	1
CS 5137	Agronomy of Plantation Crops	2
CS 5138	Plantation Crop and Forestry Sector Policy and Legislation	1
CS 5139	Climate Change Adaptation, Mitigation and Carbon Trading	1
CS 5140	Quality Assurance in Plantation Industries	1
CS 5141	Emerging Trends in the Plantation Industry	1
CS 5142	Industrial Training	2
CS 5143	Disaster Risk Reduction Through Ecological Approaches	1
CS 5144	Integrated Plantation Crops-Other Crops-Animal-Fish Based Farming Systems	1
<b>Second Semester</b>		
CS 5201	Crop Ecology	2
CS 5202	Weed Control	2
CS 5203	Climate Change and Crop Production	3
CS 5204	Crop Management Techniques	3
CS 5206	Postharvest Physiology and Management of Horticultural Produce	2
CS 5207	Physiology of Cereal Production	2
CS 5208	Organic Crop Production	2
CS 5209	Plant Water Relationships II	2
CS 5211	Tree Crop Physiology	2
CS 5212	Scientific Writing and Proposal Formulation	2
CS 5213	Participatory Forest Management	2
CS 5214	Natural Forest Management	2
CS 5215	Ecological Interaction of Trees and Crops	2
CS 5216	Urban Forestry and Arboriculture	2
CS 5217	Forest Tree Improvement and Genetic Conservation	2



CS 5218	Quantitative Techniques in Forestry	2
CS 5219	Advances in Agroforestry	1
CS 5220	Forest Growth Modeling	2
CS 5221	Forest Biometrics	2
CS 5222	Commercial Floriculture	3
CS 5223	Indoor Gardening for Interior Decorations	2
CS 5224	Landscape Designs	3
CS 5225	Advanced Plant Tissue Culture	2
CS 5229	Plantation Agriculture in Tropics	2
CS 5230	Tropical Horticulture	2
CS 5231	Crop Simulation Modelling	2
CS 5232	Physiological Basis of Horticultural Crop Production	2
CS 5233	Bioactive Compounds in Fruits and Vegetables	1
CS 5235	Entrepreneurship development in horticulture	1
CS 5236	Biotechnology in Horticultural Crops	2
CS 5237	Agricultural Value-chain Management	1
CS 5238	Yield Physiology of Plantation Crops	2
CS 5239	Processing and Value Addition of Plantation Crop Products	2
CS 5240	Plantation Crop Improvement	2
CS 5298	Directed Study	5

## **COURSE CAPSULES**

### **First Semester**

#### **CS 5101. Principles of Crop Production (3)**

Principles of field crop and horticultural crop production to include climate and ecology, seeds and sowing, measurement of crop growth, plant nutrition and fertilizers, weed control, irrigation, harvesting and storage.

**Field visit:** To an agricultural research station or a production farm.

#### **CS 5102. Plant Water Relationships I (2)**

Physiological and ecological importance of water in plant growth and agriculture, quantification of water availability in soil-plant-atmosphere system, principles and mechanisms of water transfer, factors determining water absorption by crop root systems, radial and axial translocation of water within plants, transpiration and water use efficiency.

#### **CS 5103. Weed Biology (2)**

Domestication of plants, agricultural and environmental weeds, survival mechanisms of weeds, weed-crop interactions, common weeds and their biology.

**Practical:** Identification of weeds and their propagules, field visits to identify the diversity of weeds in agricultural and natural ecosystems

#### **CS 5104. Advanced Horticulture (2)**

Introduction, scope of the horticulture sector, role of fruits and vegetables in food and nutrient security, recent advances and future trends in horticultural technology, environmental manipulation in horticultural crop production, principles and commercial application of photobiology/photomorphogenesis, advancements in perennial and herbaceous horticultural crop research, preharvest management, IPNS, IPM, value chain analysis, public sector inventions and incentives for the development of the horticulture sector, phytosanitary and other regulations.

#### **CS 5105. Crop Physiology (3)**

Framework for analysis of crop growth and yield formation, principles of radiation interception by crop canopies, radiation use efficiency, determination of crop development by temperature and photoperiod, photosynthesis and respiration at crop canopy level, biomass partitioning and determination of harvest index, physiology of crops, environmental stress conditions, water use efficiency, root and nutrient physiology, nutrient use efficiency.

#### **CS 5106. Seed Physiology and Technology (2)**

Importance and value of seeds in Sri Lanka, influence of environment on seed formation and development, seed viability and survival curves, seed dormancy, physiology of seed germination, seed vigour and vigour testing, seed production and post-harvest aspects of seeds, seed quality and seed testing, seed laws, seed certification, varietal characterizations.

legislative enactments in Sri Lanka pertaining to seed industry development. Business opportunities in the seed and planting materials industry.

**Field visits:** seed production farms and seed storage warehouses.

#### **CS 5107. Protected Culture (2)**

Introduction: designing and microenvironment control, soilless culture, hydroponics systems and plant nutrient management; sanitation and growing media use, supporting technologies, greenhouse crops and crop management, plant protection, use of micro-irrigation technologies, recent developments in research and technology, global review on high value crop industry, present status and improvement needs in the protected culture subsector of Sri Lanka.

**Field visits:** To production centres and materials.

#### **CS 5108. Fruit Crop Management (2)**

Natural history, evolution and domestication of fruit crops, the science of fruit production in tropical climates, present status and future potential of fruit industry in Sri Lanka, fruit crops grown in Sri Lanka and their ecological and climatic requirements, evolution, breeding history and physiology of high priority and other fruit crops, cultural practices that influence productivity, fruit quality and pest damage, marketing and economics, alternative production practices for commercial and home gardeners, related topics with respect to current literature, experimental techniques and applied technologies.

#### **CS 5109. Olericulture (Vegetable Crop Production) (2)**

Introduction, present status and improvement needs in Sri Lanka, cropping systems and crop management, sustainable vegetable production, vegetable crop improvement, value chain management, use of ICT for production planning, global review, advances in research and developments.

**Field visits:** Exposure visits on production and produce handling

#### **CS 5110. Forest Ecology (2)**

Ecosystem concepts, the physical and biotic environment, ecological energetics, transfer and storage of energy in ecosystems, ecosystem structure and species interactions, ecological succession, species strategies, pioneer and climax, productivity of forest ecosystems, nutrient cycling, major forest types, their climatic control and characteristics, role of forests, disturbance in ecosystems and regeneration of soil and vegetation, gap theory.

**Field visits :** To natural forests

#### **CS 5111. Agroforestry (2)**

Concepts and definitions, role of trees in agroforestry, systems of classification, advantages of agroforestry, ecological and socio-economic, structure, composition and functions of common agroforestry practices in Sri Lanka, species selection, tree-crop interface and ecological interactions in agroforestry, criteria used and evaluation of agroforestry, designing agroforestry practices, diagnosis and design (D&D).

**Field visits :** To different agroforestry systems

### **CS 5112. Plantation Forestry and Environment (2)**

Impact of plantation forestry on environment, afforestation/reforestation objectives, choice of tree species, tree seed problems, nursery techniques, field planting, fertilizer application, weeding costs, silvicultural treatments, cleaning, pruning, thinning, timber stand improvement, regeneration techniques/silvicultural systems, high forest method and low forest method, growth and dynamics of stands, forest mensuration, age, diameter, height, stem form, bark thickness, tree crown, tree growth.

**Field visits :** To a well-managed forest plantation, measuring different stand parameters and evaluating the stand

### **CS 5113. Forest Influences on Soil, Water and Climate (2)**

Introduction: Environmental problems in Sri Lanka, addressing environmental problems through forestry and related activities, current situation and future of the forestry sector; soil ecosystems; soil biodiversity, ecological significance of forest soils, sustainable soil management, hydrology of forest ecosystems, concepts of watershed management and current problems in watersheds, quantification of hydrological processes and soil erosion. climatic conditions and agro-ecological zones of Sri Lanka, global climate change, impacts of climate change on forest ecosystems, clean development mechanisms, forests as carbon sinks.

### **CS 5114. Biodiversity (2)**

Introduction; levels, uses and threats, systematics, evolution and extinction, biodiversity in Sri Lanka, assessment, monitoring and interpretation of biodiversity information, biodiversity indices, biodiversity as an indicator, options for conservation: in situ, ex situ and circa situ, Agro-biodiversity in Sri Lanka, special topics related to biodiversity, red listing, biodiversity prospecting, benefit sharing, traditional knowledge, ecotourism, laws, treaties, agreements, conventions and international cooperation; use of biodiversity in developmental planning.

**Practical:** Investigation and quantification of biodiversity of different ecosystems and preparation of a biodiversity conservation plan for a selected area

### **CS 5115. Policy and Legislation Related to Forestry and Environment (1)**

Introduction; Processes and products of policies, Evolution of forest, wildlife and environmental policies in Sri Lanka, policy formulation and stakeholder participation; policy objectives of forestry and environment, quantitative information for decision making, paradigms of forestry and agroforestry, sustainable, multiple use and multi resources management, institutional organization of forests, wildlife and environmental policies, politics and policies, gaps in existing policies, case study on policy development (group work).

### **CS 5116. Forest Systematics (2)**

Principles and practices of plant systematics, nomenclature and identification of forest plants, patterns of variations of forest plants; experimental approaches to establish evolutionary relationships; value of systematics in conservation and management of forests.

**CS 5117. Economics of Environmental Forestry (2)**

Principles of market economic theory, investment appraisal in forestry, economics decisions related to rotation length, thinning and other operations, environmental valuation techniques in forestry, economic principles in natural resource allocation, economic perspective of sustainability.

**CS 5118. Forest Products and Utilization (1)**

Harvesting processes, systems and equipment, anatomical structure of wood, properties of wood, wood conversion, uses of wood, wood defects, seasoning and preservation of wood, wood products: composite products, pulp and paper; non-timber forest products: extraction, processing and utilization, environmental friendly forest production techniques.

**Field visit :** To timber processing centers

**CS 5119. Landscape Horticulture (3)**

Introduction to landscape Horticulture. History of landscaping. Materials used in landscape designs. Establishment and maintenance of soft landscape materials. Theories and principles of landscape garden designs. Application of garden design principles and techniques. Landscape gardening with emphasis on design construction. Planting designs, Principles and practices, Plant materials for landscape work, Relevant nursery stocks. Contract procedures, preparation of specifications, quantities, cost estimates, etc.

**Practical:** Identification of plants used in landscape designs. Introduction of design project, instructions, site investigation and evaluation.

**CS 5120. Commercial Nursery Management (2)**

Selection of nursery sites. Commercial nursery management. Nursery structures. Construction and maintenance of propagators according to climatic standards. Different types of nurseries. Nursery media. Compost preparation. Nursery bed preparation, shade, sterilization, cultural practices. Acclimatization and training, labor management, budget preparation and profit and loss management of a commercial nursery.

**CS 5121. Landscape Architecture (2)**

Principles and applications of landscape architectural design theories. Land development. Importance of regional landscape concepts. Ecological studies, landscape conservation. Studies on recreation potential. Application of design concepts to site planning. Landscape architectural site development concepts. Theories and techniques of site development, drainage principles and utilization of materials.

**Practical:** Development of a design for a proposed site.

**CS 5122. Plant Growth Regulators (2)**

Introduction, History and nature of endogenous growth regulators; Biosynthesis, Properties and modes of action. Physiological effects of growth regulators. Plant growth retardants. Targets for manipulation of crop growth and application of plant growth regulators.

### **CS 5123. Plant Tissue Culture - Micropropagation (2)**

Introduction and history of plant tissue culture. Requirements to establish a commercial and a domestic laboratory. Laboratory cleanliness and maintenance. Tissue culture media, explant materials, aseptic procedures, and pathways of regeneration and tissue culture systems. Stages of micropropagation. Programmed production. Cost calculation of micropropagated plants. Low cost techniques in micropropagation, micropropagation of economically important plant species.

**Practicals:** Introduction and demonstration of laboratory equipment; chemical calculations and stock solution making, preparation of media for explant establishment, preparation of explant materials and *in vitro* establishment (Stage I); Transfer of cultures for Stage II and III. Acclimatization of tissue cultured plants. Establishment of explants and transfer of *in vitro* cultures of economically important species using CSUP low cost technique .

### **CS 5124. Field Crops in the Tropics (2)**

Overview of tropical field crops and their present status with respect to food security; Climatic requirements of field crops; Management and yield improvement of tropical field crops with emphasis on crop physiology using one specific crop in cereals, legumes, root and tuber crops, sugar crops, fibre crops, spices, and narcotics; constraints to increasing production of tropical field crops, post-harvest technologies, issues of concern to students in tropical field crops.

### **CS 5125. Tropical Cropping Ecosystems (2)**

Ecosystems in the tropics, crop communities, ecological resiliency, biomass accumulation, ecological systems, structure and functioning of crop ecosystems, niches and interactions, ecological features of tropical cropping systems, crop responses to limiting factors, crop-weed interactions and population dynamics in crops and weeds in the tropics, vegetation analysis, ecological basis of sustainable cropping, current developments in crop-ecosystem research.

### **CS 5126. Tropical Environments and Farming Systems (2)**

Introduction to tropical environments: climate, edaphic, biotic; common landuse systems: lowland and upland annual/perennial cropping, traditional farming systems: shifting cultivation, dryland farming, ecological agriculture, organic farming; cropping systems and patterns; crop-livestock integration, evaluation of farming systems; Agroforestry and exploitation of agroforestry in the tropics, role of different farming systems in sustainable management of natural resources, understanding, sustaining and using tropical environments for food production.

### **CS 5127. Tropical Plant Diversity and Ethno-Botany (2)**

Introduction; Tropical plant biology, taxonomy, identification and classification; Issues in tropical plant diversity: biodiversity, endemism, hotspots, diverse plant characters, measurements of diversity, mega diversity countries, tropical wilderness areas, eco-regions; Major monocot and dicot plant families; Plant diversity and development of tropical agriculture: past, present and future; Centers of plant origin and cultivation; Domestication; Introduction to ethnobotany; Methods in ethnobotanical studies; Phytochemistry and

agriculture; Medicinal plants and tropical agriculture; Ethnobotany and future of tropical agriculture; Economic botany; Practical assignment on plant ingredients with respect to their botanical identification, classification, origin of cultivation and customary mode of preparation

#### **CS 5128. Integrated Crop-Livestock Systems in the Tropics (2) (pass/fail course)**

This practical program is designed to provide the students with a sound knowledge and understanding of scientific, technological, managerial, economic and sociological principles associated with crop-livestock integration, and post-harvest/product technologies in tropical environments.

#### **CS 5129- Production Horticulture (3)**

Crop requirements and regions of production, selection of cultivars, propagation and nursery management, field planting and crop management of major vegetable, fruit and floricultural species.

**Practicals:** Seed treatment, vegetative propagation, nursery management, training perennial crops, supporting annual crops, pest and disease prevention, harvesting indices and safety and work ethics.

#### **CS 5130 - Cultivation and Processing of Plantation Crops (3)**

Importance and scope of plantation crops in the Sri Lankan economy; Estate and smallholding sectors; Institutional support for growing plantation crops. Introduction to plantation crops: Botany, origin, uses, varieties, tea, rubber, coconut, export agricultural crops, oil palm, cashew; Cultivation practices, Climate and soil, propagation, planting, nutrition, irrigation, plant protection, harvesting, tea, rubber, coconut, export agricultural crops, oil palm, cashew, processing, quality and marketing, tea, rubber, coconut, export agricultural crops, oil palm, cashew.

#### **CS 5131 - Tropical Field Crop Production (3)**

History, usage and botany of tropical field crops ( Rice, highland cereals, Grain legumes, Oil crops, Root and tuber crops, Sugar crops, Fiber crops, Spices and Narcotics). Climatic adaptations, Production technologies, Post-harvest handling and marketing, Issues related to food security, sustainability and climate change in tropical field crop production, Constraints to field crop production, Future developments.

**Field visits:** Field Crop Research Institute, Mahailuppallama, Rice Research and Development Institute, Batalagoda. Visits to farmer fields

#### **CS 5132-Sustainable Garden Management (2 units)**

Concepts and determining factors, eco-farming of fruits and vegetables, plant identification and value of native plants, optimum use of natural resources in garden environments, availability of organic inputs, soil and water conservation, minimizing energy needs, design criteria, eco-friendly greenhouse technologies, evaluation of garden models for sustainability.

**CS 5133 Plant Nutrient Management in Horticultural Crops (2)**

Importance of plant nutrition for increasing productivity and produce quality of Horticultural crops, crop nutritional physiology, nutrient functions and the effects of fertilization and fertility management to achieve high yields and quality of specific Horticultural crops, crop adaptations and ways and means to improve nutrient use efficiency under optimum and stressed conditions specific to Horticultural crops, use of good agricultural practices (GAPs) to improve the quality and productivity of specific Horticultural crops, diagnosis of nutrient deficiency symptoms in specific Horticultural crops

**CS 5134 Propagation Techniques for Horticultural Crops (2)**

Introduction to cellular basis for sexual and asexual propagation, Methods of plant propagation, seed / vegetative propagation; Principles and practices of vegetative propagation techniques – cuttings, grafting and budding and layering; Current trends in propagation of Horticultural Crops; Literature survey, and presentation of findings

**CS 5135 Horticulture in Temperate Regions (2)**

Distinguish horticulture and related sub-sectors in temperate regions, relate characteristics to ecological, agricultural and social and economical identities of the region, minor deviations of horticulture based on regions and cultures, evaluation of selected horticultural systems, analysis of the horticultural trends in growing economies in the tropics.

**CS 5136 -Value addition for Horticultural Produce (1)**

Value added fruits and vegetables, principles and technologies of processing: canning, dehydration, extrusion and freezing; raw material quality; nutritional losses during processing; unit operations; case studies for assessing development needs of processing units.

**CS 5137- Agronomy of Plantation Crops (2 )**

Status of the plantation crop sector, Land suitability classification, Land selection, sustainable land and soil management, and land preparation for plantation crops, agronomic practices used in plantation crops, effective and efficient resource utilization and productivity improvements, Harvesting practices and management aspects, product technology and machinery used in processing, Product value addition, by-products and new products.

**CS 5138 Plantation Crop and Forestry Sector Policy and Legislation (1)**

Profiles of Plantation crop and forestry sectors, economic and social benefits of plantation forestry, local and international scenario, critical issues in the sector: Issues, challenges, opportunities and strategies in the plantation and forestry industry, Organizational aspects of the sectors: ministries, state-owned and private sector organizations, trade unions; Policies and subsidy schemes relevant to the two sectors, Global and regional trade agreements, Social aspects related to workers and management; Estate and smallholder sectors; Record keeping; Possible improvements to face future challenges



### **CS 5139- Climate Change Adaptation, Mitigation and Carbon Trading (1 )**

Introduction to Global Climate change (CC), Contributing sectors for CC, Green House Gas (GHG) emission from the agricultural sector (specifically from plantation crop and forestry sectors), Climate change trends in Sri Lanka and vulnerable regions and sectors; Climate change (including the influences of *El-Nino*, *La-Nina* and UV change) and its impacts on plantation crop and forestry sectors, adaptation measures, technology needs for adaptation, mitigation strategies and options, carbon foot prints and greener products, dendro-thermal power generation and energy saving for plantation crop processing, energy plantations, Kyoto and newly emerging mechanisms for carbon trading (Clean development mechanisms [CDM], and REDD.)

### **CS 5140 - Quality Assurance in Plantation Industries (1)**

Standards: requirements; Standards for quality, food safety, traceability & sustainability; International market; organizations involved; Certification systems, CCP's, MRL's, Certification processes, Corporate Social Responsibility initiatives & value chain, organic production; Waste handling, by-products; Ergonomics.

### **CS 5141- Emerging Trends in the Plantation Industry (1)**

Colloquium on current and important issues in the plantation sector. 15 topics will be selected based on current issues in the plantation sector covering following topics: Improved techniques on cultural practices, Maximum land utilization, GAP's, GMP's, Occupational safety & health; Ergonomics; Introduction of 'bio' & 'GAP' products; MRL's; enhanced energy efficiency, Modernization of processing; Waste & energy auditing; Pollution prevention; Value addition by product diversification, packaging & incorporation of quality control, Implementation of internationally & locally recognized standards & certification systems; Organic farming, Plantation crop produce as health & natural products; Blending/ branding/ garden/ land marks/ logos; EIA; Cut flower production/ floriculture/ fruit crop production in plantations; Ecotourism.

### **CS 5142- Industrial Training (2)**

Practical, on-farm training in selected estates of plantation crops for two (02) weeks, on the management and manufacturing / processing of a crop/s based on the student's preference, report writing. (Limited number of places may be available for a training in a tea estate/ UPASI in South India. Selection is based on the performance in other courses).

### **CS 5143 -Disaster Risk Reduction through Ecological Approaches (1)**

Weather related natural hazards including land degradation and landslides, disaster risk reduction measures, agro-ecology and plantation crop based risk reduction technologies, livelihood improvements as a measure of disaster risk reduction.

### **CS 5144- Integrated Plantation Crops- Other Crops-Animal-Fish Based Farming Systems (1)**

Crop selection in relation to soil type, climatic conditions and socio-economic resources, evaluation of different plantation crop / tree-based farming systems, Kandyan home garden

systems, potential of using agroforestry and intercropping approaches in plantation crop husbandry, land evaluation and diversification, integration with animals and fish, evaluation of productivity of farming systems.

## **Second Semester**

### **CS 5201. Crop Ecology (2)**

Introductory ecology, Individuals, Populations, Communities, Ecosystems, Ecological Resiliency, Biomass accumulation, Ecological systems, structure and functioning of ecosystems, Niches, Interactions, Ecosystems in the tropics with emphasis on Sri Lanka. Ecological features of tropical cropping systems, Crop responses to limiting factors, Crop-weed interactions, Population dynamics in crops and weeds, Vegetation analysis, Ecological basis of sustainable cropping. Current developments in Crop-Ecosystem research.

### **CS 5202. Weed Control (2)**

Prevention, eradication and management of weeds, methods of weed control (practices, advantages and disadvantages), Weed control in crop production systems.

*Practicals:* Calibration of sprayers, field visits to identify impact of different weed control techniques in annual and perennial crop production systems

### **CS 5203. Climate Change and Crop Production (3)**

Introduction to climate and its relationship to agricultural production. Effects of climatic parameters on crop production. Measurement of climate and weather, recording and mapping. Changes in climate and their causes: Rising concentrations of carbon dioxide and other greenhouse gases, Green house effect and global warming, Increased UV radiation, ozone concentrations and air pollutants, Rise in sea levels and ocean temperatures, Natural climatic variations. Impact of climate change on productivity of agricultural crops, forestry and other natural ecosystems. Prediction of climate change and its impact, Adaptation to climate change.

*Field visit:* The Department of Meteorology, Colombo

### **CS 5204. Crop Management Techniques (3)**

Conventional agriculture vs. alternative agriculture, cropping patterns and cropping systems, Integrated Plant Nutrient Management Systems (IPNS), Integrated Weed Management (IWM) and Integrated Pest Management (IPM), Integrated farming systems (crop-animal integration).

### **CS 5206. Postharvest Physiology & Management of Horticultural Produce (2)**

Post-harvest management and problems in developing countries, Channels of food losses, Influence of pre-harvest factors on storage, Physiology and biochemistry of fruits and vegetables after harvest, Major causes of losses, post harvest handling of cut flowers, Reduction of post-harvest losses.

### **CS 5207. Physiology of Cereal Production (2)**

Environmental influence of growth and development of cereals, Morphology and physiology of cereals in vegetative and reproductive phases of growth, Physiology of grain production.

**CS 5208. Organic Crop Production (2)**

Introduction to organic crop production, scope for organic crop production in Sri Lanka, techniques of organic crop production, constraints to increasing organic crop production in Sri Lanka. Sustainable agriculture systems, principles of organic agriculture, distinction from other farming systems, constraints in conventional agriculture, basis of organic certification, organic crop production, crop protection, soil fertility and plant nutrition management, biodynamic agriculture, organic livestock, diversified organic farming

*Field visits:* to organic farms.

**CS 5209. Plant Water Relationships II (2)**

Drought and its relevance to crop productivity in Sri Lanka, Quantification of drought, drought resistant cultivars, canopy stomatal conductance and crop productivity, environmental and plant control of stomatal conductance of crop canopies and forests, theory of optimal stomatal functioning in crop canopies, non-stomatal sources of water loss, basic principles of modelling crop growth and yield formation in water-limited environments, modelling of stomatal behaviour in crop canopies.

**CS 5211. Tree Crop Physiology (2)**

Physiological basis of growth, development and productivity of perennials, physiology of yields of major plantation crops: tea, rubber, coconut, export agriculture crops and physiology of major plantation forest species. Response of tree crop yields to environmental stress and climate change (nutrient, water, light, CO<sub>2</sub>, temperature, UV etc.). Yield improvement of tree crops.

*Practical:* Field visit to study yield improvement programs in major tree crops

**CS 5212. Scientific Writing and Proposal Formulation (2)**

Research Methodology, definition, types of research. Research classification, identification and preparation of research projects. Scientific methodologies, hypothesis. Review of past work. Need for good scientific writing, structure and layout of a scientific paper, Title, Introduction Materials and Methods, Results, Discussion, Preparation of Abstracts, Synopses, Summaries, Resumes, Bibliographical identification, Acknowledgements. Style of reporting, Construction of sentences, Use of words, Use of international standards, Quantity units and symbols, Symbols for physical quantities, Use of abbreviations. Presentation of illustrations, Criteria, type of illustrations, their merits and demerits. Review process, Responsibilities of authors, editors and printers. Proof correction, Use of symbols. Oral presentation, Communication aids and their correct use, Practical assignments.

**CS 5213. Participatory Forest Management (2)**

Rural environment: Functions of woody biomass, biophysical and socio-economic features. Human ecology: farmer attitudes on trees and environment, origin and definition of participatory forestry approaches. Typology of participation, experiences and potentials of Rural Development Forestry (RDF) in Sri Lanka. Tools for RDF, indigenous ecological knowledge, farmer experimentation, methods of rural appraisal and forest resources

assessment. Major issues: land and tree tenure, gender roles, institutions. Classical and new forester.

#### **CS 5214. Natural Forest Management (2)**

Rationale behind natural forest management, role of managed forests in conservation. Ecosystem concept and ecological basis of management, forest zoning, logging and its impact on natural forests. Criteria and indicators for sustainable management, rehabilitation, reclamation and restoration of degraded forests. Natural forest silvicultural systems. Ecological implications of social, political and economic elements of management. Successful case studies.

**Practical:** Preparation of a management plan for a selected forest

#### **CS 5215. Ecological Interactions of Trees and Crops (2)**

Introduction to abiotic interactions. Principles of resource capture and utilization of light, water and nutrients, Root and canopy distribution of trees and crops and microclimatic modifications, quantification of tree crop interactions, introduction to biotic interactions. Symbiotic and non symbiotic interactions in annuals and perennials; Nitrogen fixation; Mycorrhizal relationships. Environmental factors affecting symbiotic relationships. Measurements of symbiotic relationships and advantages. Ecological significance of symbiotic relationships in forestry and agroforestry systems. Allelopathic effects of trees and crops.

#### **CS 5216. Urban Forestry and Arboriculture (2)**

Introduction to urban forestry; Composition, role and benefits. Management of urban forests; Introduction to arboriculture; Role and benefits of plants in the landscape; Selection of plants; Inspection of plants; Land preparation for planting, root balling techniques, fertilization, irrigation, pruning and thinning; Pest and disease control; Wounds, decay and wood treatments.

**Practical:** Evaluation of urban ecosystems of major cities

#### **CS 5217. Forest Tree Improvement and Genetic Conservation (2)**

Essentials of genetic conservation and improvement in forest trees, current problems of conservation and tree improvement, tree improvement philosophies, achieving genetic gain and maintaining diversity, natural variation as the basis for genetic improvement and conservation, quantitative aspects of forest tree improvement, a conceptual approach for tree improvement, breeding strategies as the framework for improvement and conservation, non industrial tree improvement, innovation in tree improvement, practical applications and case studies.

**Practical:** Field visit to conserved and improved forest stands to elaborate potential and strategies of conservation and improvement

**CS 5218. Quantitative Techniques in Forestry (2)**

Introduction; Sampling methods in Forestry, fixed-area plot sampling, variable-area plot sampling, angle-count sampling, cluster sampling, block sampling, systematic sampling. Other aspects of sampling: temporary and permanent sample units; Types of forest models; Stand density; Canopy cover; Site Index; Diameter distributions; Diameter-height relations; Predicting growth and yields; Predicting current and future yield; Model evaluation.

**Practical:** Practicing different sampling methods in natural and plantation forests

**CS 5219. Advances in Agroforestry (1)**

Research and developments during the past two decades: trends and lessons learnt; Confronting complexity and dealing with difference, characteristics of long-established agroforestry practices; Performance and adoption of packaged agroforestry technologies; Agroforestry design: FSR/E and knowledge-based systems approach; Ecological approaches: transformation and analogue; Permaculture; Local and scientific knowledge on selection, arrangement and management of components; Agroforestry practices and policy.

**CS 5220. Forest Growth Modelling (2)**

Introduction; data requirements & types of forest models, Stand Density and Structure: stand density, crown cover, basal area percentile, C66, BALMOD, basal area-diameter-index; Point density; Neighbour tree relations; Modelling Stand Structure: anamorphic, disjoint polymorphic & non-disjoint polymorphic height models; Basal area; Generalized & bivariate diameter-height relations; Estimating product yield: volume ratio methods, modelling stem profiles; Classification of yield prediction models; Explicit & implicit prediction of yield; individual tree growth models; Qualitative & quantitative model evaluations.

**CS 5221. Forest Biometrics (2)**

Role of statistics in forestry and agroforestry; Experimental designs in forestry and agroforestry; Determination of plot size, number of blocks and orientation; Non-orthogonal data analysis; Non statistical considerations in forestry and agroforestry; Conventional and non-conventional sampling techniques in forestry and agroforestry; Growth models in forestry.

**CS 5222. Commercial Floriculture (3)**

Introduction. Requirement for establishment of a floriculture commercial nursery. Propagating structures. Market demand; export regulations, Commercial cut flower production. Propagation, cultivation practices, postharvest handling, post-harvest treatments. Flower drying and floral arrangements. Flower colour and fragrance; hybridization techniques. Potted plant productions, cultural practices, propagation systems, characteristics of commercial plants. Cut foliage: varieties, demand, harvesting, postharvest handling, postharvest treatments, Bonsai Production.

**Practical:** Identification of cut flowers and potted plants, Pollination techniques; post-harvest treatments for cut flowers and foliage, flower arrangements. Propagation techniques, commercial nurseries: commercial practices of cut flowers and potted plants (1 visit)

**CS 5223. Indoor Gardening for Interior Decorations (2)**

Use of potted plants for interior decorations and its advantages, Interior environment and its effect on plants. Acclimatization of potted plants for interior environments. Principles of interior decoration with potted plants. Categories of interior arrangements. Application of plant requirements for their selection and maintenance in interior environments, Eco-friendly ornamental house plants. Interior decoration as an enterprise.

**Practical:** Identification of plants for interior utilization; Identification of new plant species; Applications of interior decorations; dish garden; bottle garden, totem pole, window boxes.

**CS 5224. Landscape Designs (3)**

Application of landscape theories. Design planning, urban, suburban and home garden designs. Recreation and park designs. Roadside development designs. Landscape evaluation, Site analysis, Visual Impact Assessment (VIA) of plants. Introduction to Landscape Impact Assessment (LIA) using Computer Aided Designing (CAD)

**Practical:** Designing a given Project using Auto CAD.

**CS 5225. Advanced Plant Tissue Culture (2)**

Principles of plant cell culture; Types of isolated cell systems, callus cultures, cell suspension cultures, isolated cell culture and cell plating, artificial seeds for mass propagation. Expression of organogenesis and embryogenesis. Crop improvement techniques; protoplast isolation and fusion. mutagenesis; *in vitro* fertilization; embryo rescue; gene transformation and transgenic plants; haploid production. Molecular marker systems to identify new mutants

**Practical:** Isolation of explants, establishment of callus cultures; subculture of callus and establishment of cell suspension cultures, establishment of anther cultures, isolation of protoplasts, protoplast fusion, *in vitro* fertilization, embryo rescue. Molecular marker system demonstration

**CS 5229. Plantation Agriculture in Tropics (2)**

Introduction and overview to plantation agriculture and its contribution to national economies of the tropics, agro-climatological and ecological requirements, agronomy of tea, rubber, coconut, and export agricultural crops under tropical environments; harvesting processing and manufacture, economics and marketing of plantation agriculture, Challenges faced in managing plantations.

**CS 5230. Tropical Horticulture (2)**

Introduction, climatic conditions in tropical environments, horticultural crops in tropical climates, cultural requirements of fruits, vegetables and flowers, techniques of culture and management of horticultural crops, factors affecting the production of fruits and vegetables in the tropics in relation to food security, post harvest technologies, study and discussion of significant topics and problems.

**CS 5231. Crop Simulation Modelling (2)**

Introduction to simulation models, empirical and mechanistic models, quantification of essential crop physiological processes, leaf and canopy photosynthesis models, components of respiration estimation models, models of biomass partitioning, quantification of crop water relations, crop water uptake and evapotranspiration models, Quantification of plant nutrient demand and uptake, modelling nutrient movement in soil, root growth and nutrient uptake, Introduction to currently used crop simulation models.

**CS 5232. Physiological basis of Horticultural Crop Production (2)**

Growth physiology of herbaceous and woody horticultural species, physiological basis of yield and quality management of horticultural crops through crop husbandry, environmental influences on the physiology of crop growth and development; physiological basis of post-harvest management of ornamental species, determining physiological indices through phyto-monitoring

**CS 5233. Bioactive Compounds of Fruits and Vegetables (1)**

Definitions and properties bioactive compounds, criteria used for classification.

Characterization, biosynthesis and functional properties, role in human nutrition and health, composition in edible horticultural products, optimization through crop management and post-control

**Practical:** Laboratory analysis, information collection, analysis and presentation; teamwork through group assignments

**CS 5234. Directed Study in Horticulture (2 units)**

**The course is a combination of two components**

**Component 1:** Course work on Problem identification, proposal preparation, literature survey, technical writing and evaluation of research proposals

**Component 2:** Conducting data collection, analysis and scientific reporting based on a fact finding survey, laboratory/ field research on a proposal approved by a panel of evaluators (from the teaching panel) and under the supervision of an academic supervisor appointed by the Board of Study

**CS 5235. Entrepreneurship Development in horticulture (1)**

Introduction; design principles of entrepreneurship; categories of horticultural enterprises, production, produce handling, service provisions; elements of success and failures, need identification and case studies in horticulture entrepreneurship.

**CS 5236. Biotechnology of Horticultural Crops (2 units)**

Biotechnology in the Horticulture Industry; Applications of different molecular biological tools including plant transformation, gene expression, transgenic, over expression, gene silencing and RNA in different aspects of horticulture industry. Role of biotechnology in changing the physiology and architecture of horticultural crops.

**CS 5238. Yield Physiology of Plantation Crops (2 )**

Introduction to the physiology of dry-matter production, crop yield and yield components; Canopy characteristics and light environment, canopy productivity (photosynthetic efficiency), source sink balance, dry matter partitioning, Physiological basis of productivity of plantation crops (tea, rubber, coconut, sugarcane, and export agricultural crops. Impact of abiotic interactions on crop yield (limitation of achieving genetic potentials), stress coping mechanisms to abiotic stresses, yield improvement strategies and techniques.

**CS 5239. Processing and Value Addition of Plantation Crop Products (2)**

Manufacturing and processing of plantation crops, Biochemistry of manufacturing and processing, quality attributes, biochemical basis of quality, relation with primary and secondary metabolic products, quality variations with different weather patterns, management and manufacturing processes; adulterations, improvements in processing to meet competitiveness, Waste management, Sensory/organoleptic evaluation, Product differentiation, value addition, by-products, new products; Energy conservation strategies

**CS 5240. Plantation Crop Improvement (-2)**

Breeding cycle as a conceptual basis for identification of current and future breeding requirements of plantation crops; Major problems of breeding and production of quality planting material of plantation crops; Tea breeding, rubber breeding, coconut breeding, breeding of other plantation crops, innovations in breeding of plantation crops.

**Practical:** Demonstration of breeding practices of tea, rubber, coconut and other plantation crops; Assignment: Development of breeding program for a selected crop

**CS 5298. Directed Study and Seminar (5)**

This course is designed to allow students to undertake an independent investigation in a selected field with the approval of the Board of Study. Results of the study will be presented at the seminar



## BOARD OF STUDY IN FOOD SCIENCE AND TECHNOLOGY

### LIST OF COURSES

Course No	Course Title	Credits
<b>First Semester</b>		
FT 5101	Principles of Food Science	2
FT 5102	Food Physics	2
FT 5103	Biochemistry	3
FT 5104	Food Chemistry	2
FT 5105	Food Microbiology	2
FT 5106	Food Preservation	2
FT 5107	Science and Technology of Commodity Processing	2
FT 5111	Food Safety	2
FT 5112	Food Protection Systems	2
FT 5113	Human Nutrition	3
FT 5114	Nutritional and Health Aspects of Food	2
FT 5151	Sociology of Food and Nutrition	2
FT 5152	Sports Nutrition	2
FT 5153	Nutrition Advocacy and Counseling	2
FT 5154	Functional Foods and Nutraceuticals	2
FT 5155	Food Biotechnology	2
FT 5156	Food Regulations and Quality Management Systems	2
FT 5157	Beverage Technology	2
FT 5199	Seminar	1
<b>Second Semester</b>		
FT 5201	Food Plant Layout and Operations	1
FT 5203	Production and Marketing Operations in Food Manufacturing Organizations	2
FT 5204	Industrial Exposure	1
FT 5205	Cereal Chemistry and Bakery Products Technology	3
FT 5206	Horticultural Products Technology	2
FT 5207	Meat and Fish Science and Technology	3
FT 5208	Poultry and Egg Products Technology	2
FT 5209	Processing of Milk and Milk Products	2

FT 5210	Processing of Kernel and Nut Products	1
FT 5211	Spice Processing Technology	1
FT 5213	Techniques in Research and Scientific Writing	2
FT 5214	Community Nutrition	2
FT 5215	Assessment of Nutritional Status	2
FT 5216	Planning and Management of Food and Nutrition Programmes	2
FT 5217	Dietetics	2
FT 5218	Nutrition Epidemiology	2
FT 5221	Food Lipids	2
FT 5222	Food Process Engineering and Unit Operations	2
FT 5223	Food Analysis	3
FT 5224	Sensory Evaluation of Foods	2
FT 5225	Current Topics in Nutrition	1
FT 5226	Consumer Driven Food Product Development	2
FT 5298	Directed Study	5

## **COURSE CAPSULES**

### **First Semester**

#### **FT 5101. Principles of Food Science (2)**

Definition and scope; Constituents of foods: Carbohydrates - functional properties of mono-oligo- and polysaccharides; Lipids- functional properties, lipid oxidation and antioxidants; Proteins- functional properties; Water; Organic acids, Emulsifiers: Food enzymes, Food colours- natural and approved synthetic colours, Meat pigments, Food flavors; Food systems Browning reactions; Food deterioration and their control; Principles of food preservation; heat preservation, cold preservation, dehydration, concentration, chemical preservatives, food fermentation, food irradiation.

#### **FT 5102. Food Physics (2)**

Units & dimensions, Laws of motion force & energy, Properties of gases and vapors, Physical properties of food materials, measurements and applications in the food supply chain, Rheological properties, rheological models, viscoelastic ;properties of foods, Newtonian & non-Newtonian behavior, fluid flow (laminar & turbulent), pressure drops in fluid flow, force & deformation, Viscosity measurements, Food emulsions, properties of emulsifiers & stabilizers, Surface tension, interfacial phenomena. Stabilization of emulsions, Destabilization processes, Role of surfactants in the above processes & methods of determining the changes in system stability, Food microscopy & applications.

Practical: Determination of physical properties, viscosity.

#### **FT 5103. Biochemistry (3)**

Carbohydrates, Lipids & Proteins: structures, properties & reactions, Nucleoproteins: structure, properties, protein synthesis, Enzymes: properties, classification, activity & inhibition, Vitamins: structures, properties, deficiency symptoms & co-enzyme relationship, Digestion & energy relationships, Metabolism of Carbohydrate, Lipid, Protein & Mineral, Metabolic interrelationships, Hormone ;action.

**Practical:** Quantitative and qualitative detection of carbohydrate, protein and fat; enzymatic digestion; chemical hydrolysis

#### **FT 5104. Food Chemistry (2)**

Role of water activity in food stability, freezing and food stability, functions and reactions of carbohydrates, reactions of lipids, environmental effect on protein, food pigments, food flavors, food additives, enzymes and food industry, enzymatic browning.

#### **FT 5105. Food Microbiology (2)**

Major groups of microorganisms and their action on foods; Intrinsic and extrinsic parameters in foods controlling microbial activity, Ecology and distribution of spoilage & other microorganisms in food, Food-borne illnesses and detection of causative microorganisms, Rapid methods for detection & enumeration of microorganisms, Indices of food sanitary

quality and microbiological standards & criteria, Molecular biology of microorganisms in foods, Metabolic pathways for fermentation and fermentation products, Microbial food spoilage.

**Practical:** Laboratory techniques for isolation, cultivation, cultural characterization and staining of microorganisms of food origin; determination of biochemical activities of microorganisms, enumeration of microorganisms in food samples, microbiological analysis of food products, microbiology of milk and water.

#### **FT 5106. Food Preservation (2)**

Principles and application of hurdle technology, Chemical preservation (sugar, salt, chemicals, acid, smoke), Alcoholic and acidic fermentation, Preservation by radiation, Preservation through temperature reduction (chilling, refrigeration, freezing), Preservation through water removal (drying, dehydration, evaporation, freeze concentration, concentration by membrane processes, freeze drying), Preservation by heat (cooking, blanching, pasteurization, sterilization), Controlled and modified atmosphere storage, Preservation by microwaves and electric resistance, Preservation using hydrostatic pressure and high voltage electric pulses, Preservation by microbial decontamination and use of natural anti-microbials

#### **FT 5107. Science and Technology of Commodity Processing (2)**

Sources of raw materials & their processing potential, Food colloids and stabilizers, Processes as a series of unit operations, Processing equipment & processing conditions, Principles of thermal processing, Heat penetration curves, Lethality calculations, Time-temperature profiles for aseptic systems, Applications of dehydration and drying, Applications of IQF, freezing and refrigeration, Confectionaries & product development, Construction of flow charts, cost estimation & work force, Strategies for product development R & D process

#### **FT 5111. Food Safety (2)**

Concepts of food toxicology, Epidemiology of food borne diseases, Adulterants and contaminants and chemical residues in foods, Chemical contaminants (Natural toxicants of plant origin, Mycotoxins, Sea food toxins, Environmental contaminants, Toxic substances generated during processing, Chemical residues, Microbiological contaminants (intoxicants and infective agents), Preservatives and additives, Genetically modified materials, Hazard analysis and critical control points, Scientific basis of safe use of additives, Field visit

#### **FT 5112. Food Protection Systems (2)**

Transport, cleaning and storage of raw materials, Fumigation and disinfection of storage systems, Protection of foods from pests, Effects of humidity and ambient temperature on stored foods, Reduction of postharvest crop losses, Study report on problems in food protection measures in industry.

#### **FT 5113. Human Nutrition (3)**

Integrated metabolism; Nutrient interrelationships; Composition of the body, compartments of the body, growth; Energy content of foods, measurement of energy expenditure, energy requirement, energy balance and body weight; Protein: sources, protein turnover, nitrogen

balance, protein requirements, protein quality; Fats: adipose tissue, deposition of fats, dietary needs of fats; Vitamin and mineral requirement and deficiencies; Nutrition for different stages of the life cycle; basis of determining nutrient requirements.

**Practical:** Measurement of blood pressure, blood sugar, total protein and lipid profile.

#### **FT 5114. Nutritional and Health Aspects of Food (2)**

Definition of terms; Global and Sri Lankan nutrition situation, role of nutrition in human development and its impact on the society; food pyramid; the balanced diet, Nutritional aspects of: cereals and tubers, pulses and animal proteins, protein quality, breast feeding and formula feeding, fruits and vegetables, fats and oils, coconut and heart diseases. Role of fibre in nutrition, alcoholic and non-alcoholic beverages, vegetarianism, organic foods, junk foods and functional foods; food allergy, toxicants in foods, losses of food and nutrients during processing and cooking.

#### **FT 5151. Sociology of Food and Nutrition (2)**

Broad overview of sociological issues in food and nutrition: Understanding the culture, food and man, population food and nutrition, structural aspects of food production, sustainability of food systems, food habits and consumption patterns.

#### **FT 5152. Sports Nutrition (2)**

Exercise, energy requirements and weight maintenance; Review of muscle anatomy and physiology; Review of cardiovascular physiology; Energy metabolism, Exercise and dietary habits of Sri Lankan population; role of exercise in health maintenance and weight loss; Review of legal nutritional supplements: Theoretical and practical aspects of dietary manipulation Nutritional concerns of exercise: Exercise and the female athlete: The young athlete: nutrition and sport; international consensus view on the optimal diet.

#### **FT 5153. Nutrition Advocacy and Counselling (2)**

Social mobilization and advocacy, community participation and participatory development approaches, principles of nutrition advocacy, nutrition advocacy strategies, ABCD model, message preparation. The concept and importance of counselling, principles, process and methods of counselling, skills needed for counselling, difficult moments of counselling and potential counselling functions.

#### **FT 5154. Functional Foods and Nutraceuticals (2)**

Introduction to functional foods and nutraceuticals – history, present status and outlook, Classification of functional foods and nutraceuticals, Nutraceuticals in health promotion and disease prevention, Techniques utilized in the production of functional foods and nutraceuticals and their practical aspects, Stability, quality and safety aspects of functional foods and nutraceuticals, Economic and marketing issues of functional foods and nutraceuticals, Current regulatory systems for functional foods, nutraceuticals and dietary supplements in the world.

**FT 5155. Food Biotechnology (2)**

Introduction to food biotechnology, Techniques in food biotechnology and practical aspects, Improving plant and animal - derived food products through biotechnology; applications, Biotechnology in food additive industries, Fermentation biotechnology of traditional foods in Asia, safety and diagnosis of biotechnologically - derived foods, regulations controlling the application of food biotechnology, Major concerns about biotechnologically-derived foods.

**FT 5156. Food Regulations and Quality Management Systems (2)**

Codex Alimentarius Commission, WTO, and other international and national food standards, National food laws, regulations, guidelines & specifications and the national food regulatory system, Food testing and regulatory mechanisms, Food inspections, Quality control in food industry, Role of quality controllers, Quality assurance, GMP, HACCP, ISO and laboratory accreditation, Total quality management in food industries, Science based quality management principles.

**FT 5157. Beverage Technology (2)**

Global trends in beverage products. Introduction, Statistic & trends in tea products, Black tea & green tea processing, Tea grades & blends, Value added tea products, Sensory attributes & tea tasting, Quality standards for tea, Health & Nutrition of tea, Herbal tea, local traditional beverages, Introduction, Statistic on cocoa, Cocoa bean processing, quality attributes, Cocoa products, Introduction & Statistics on coffee production, Processing of Coffee beans, Quality attributes & coffee products, Carbonated & non- Carbonated beverages, Fruits based beverages, Sports drinks, Energy drinks, Potable and Mineral water.

**FT 5199. Seminar****Second Semester****FT 5201. Food Plant Layout and Operations (1)**

Planning a layout for a food processing plant, Identification of locations and facilities and equipment, Regulatory and environmental requirements, Provision of services and safe operations in food plants, Plant sanitation, Sanitary and personnel health requirements, Waste disposal systems and waste management, Raw material handling and storage requirements, Testing facilities, Product storage requirements, Other support services, facilities and their maintenance, Auditing, accreditation and management, Trouble shooting in food processing.

**FT 5203. Production and Marketing Operations in Food Manufacturing Organizations (2)**

Environment of a business organization, Financial aspects of a business organization, Work study and productivity, Concepts of quality: Quality control, Quality assurance, ISO series, Total quality management, Production planning and control, Marketing & custom orientation, Information for marketing decisions, Marketing mix considerations, Integration of total marketing efforts.

**FT 5204. Industrial Exposure (1)**

The students are expected to visit at least 3 food processing industries, observe and make notes on aspects of processing, hygiene and storage. A report submitted by the students will be assessed for grading.

**FT 5205. Cereal Chemistry and Bakery Products Technology (3)**

Cereal grains structures and chemical composition, Starch chemistry, Characteristics of cereal starches, Gelatinization and retrogradation, Processing of cereal grains, Rice Processing. Flour milling. Flour Characteristics, Role of water, salt, yeast, shortening, chemical leavening agents, spices and flavourings in baking, Baking process, Dough process; Rheological characteristics of dough, Staling of bread; composite flour; fortification, Extrusion products, Processed cereal foods.

*Practical:* Theological properties of starch and flour; baking process and bakery products development; milling performances of cereals.

**FT 5206. Horticultural Product Technology (2)**

Handling of commodities during harvesting, transportation and storage, Commodity treatments, Packaging house operations, Control of postharvest ripening of fruits, Extension of postharvest life of vegetables, Postharvest control of insects and diseases, Application of canning, dehydration and freezing technologies, Processing of ready-to-use products from fruits and vegetables, Theories for preparation of fruit preserves, Horticultural products for exports.

**FT 5207. Meat and Fish Science and Technology (3)**

Introduction, Slaughtering of farm animals, Composition and structure of muscle, Color and flavor of meat, Textural properties of meat, Processing & preservation of meat & meat products, Processing & preservation of fish & fish products, Spoilage of meat and fish products, Food regulations relating to meat and fish products.

**FT 5208. Poultry and Egg Products Technology (2)**

Introduction to poultry Science, Slaughtering of poultry, Quality and factors determining quality of poultry meat, Slaughter house management, Composition and nutritive value of poultry and eggs, Product development in poultry, Structure, composition and functional properties of eggs, Processing of egg products, Storage of egg products, Contamination problems associated with poultry products.

**FT 5209. Processing of Milk and Milk Products (2)**

Dairy chemistry, Introduction to milk processing, Testing and quality control in milk products, Legal definitions and physical parameters and sanitation in milk processing, Methods of milk preservation, Milk spoilage and milk borne diseases, Hygienic quality of milk and low temperature storage, Hazardous materials in milk, Processing of fluid milk, Manufacture of powdered, condensed, flavoured, toned and low fat milk products, Formulation of milk products, Manufacture of curd and yoghurt, Manufacture of butter and ghee, Milk coagulation and cheese manufacture, Frozen desserts and ice cream manufacture.

**FT 5210. Processing of Kernel and Nut Products (1)**

World trends in kernel & nut products, Composition and nutritional significance, Processing of copra, fresh coconut kernel (wet process), value added commercial coconut products, coconut cream, coconut milk powder, liquid coconut milk, Desiccated coconut, Processing of palm fruit & palm kernel, Products from palm oil & palm kernel oil, value added industrial palm oil products, Processing of cashew nut, peanut, almond, walnut, hazel nut and value addition. Other local nuts used in food industry.

**FT 5211. Spice Processing Technology (1)**

Spices & condiments and their constituents, Pre-harvest and post-harvest factors affect on quality characteristics of spices, Processing of spices, cinnamon, pepper, nutmeg, ginger, cardamom, cloves, chili, vanilla, turmeric, onion *etc.* Drying, storage and packaging of spices, Extraction of essential oil and oleoresins from spices, value added spice products & condiments. Quality parameters of spices and their products, Spice based food additives. Flavor chemistry, Sensory characteristics & changes during processing.

**FT 5213. Techniques in Research and Scientific Writing (2)**

Elements and practice of research, Planning a publication, Preparation of a publication Preparation of a research proposal, Practical.

**FT 5214. Community Nutrition (2)**

Guidelines for healthy living, Preparing meals for the family, breast feeding, breast feeding code, complementary feeding, feeding and caring of infants, children, sick children, adults and elderly; Nutrition of the girl child; Diet during pregnancy and lactation; Major nutritional deficiency diseases in the community: PEM, vitamin A deficiency, iron deficiency anemia and iodine deficiency disorders; Diet and lifestyle diseases; Maternal and child health services, Nutrition and infection; Primary health care, Growth monitoring; Impact of population growth on nutrition, Family planning; Nutrition surveillance system; Food security; Urban nutrition problem; Nutrition education in the community.

**Practical:** Use of food composition tables for preparation of balanced diets, analysis of nutritional information of foods available in supermarkets.

**FT 5215. Assessment of Nutritional Status (2)**

Assessment of nutritional status in the community: Dietary assessment; Biochemical assessment; anthropometric assessment; clinical examination for nutritional deficiencies, Methodology for nutritional surveys; Nutrition rehabilitation. The course will include practical and group assignments on dietary surveys and anthropometry.

**FT 5216. Planning and Management of Food and Nutrition Programmes (2)**

Approaches in food and nutrition planning; The planning process, Implementation and management process, Monitoring and evaluation process; Management information systems; Planning of Food and nutrition programmes: problem identification, analysis of food and nutrition situation, analysis of resources and constraints, setting goals, objectives and targets,



staffing, directing and coordinating; general policies and directions, alternative approaches; Nutrition criteria in project analysis and appraisal; Nutrition in area development and sectoral programmes; Implementation, management and evaluation of food and nutrition programmes; Provision for programme implementation and management: Support services and programmes: Complementary programmes, national research programme, training and extension programmes; Existing nutrition intervention programmes.

**Practical:** Includes case studies and individual and group exercises.

#### **FT 5217. Dietetics (2)**

Principles of nutritional support and Diet Therapy, Introduction to hospital diets, Existing hospital diets, Assessment of nutritional status of patients, Diet and diseases of the gastro-intestinal tract, Diet of mal-absorption disorders, Diet for liver and Gallbladder diseases, Dietary management of obesity, Diabetes, cardiovascular diseases, Kidney Disorders, Nutritional support for surgical, trauma & burns, Diet and the cancer patient, Diet and other diseases- neurological and psychiatric disorders, AIDs.

**Practical:** Will consist of hospital visits and practical on diet preparations.

#### **FT 5218. Nutrition Epidemiology (2)**

Use of epidemiology and other nutrition research methods to address specific nutrition research questions; definition, objectives, cause and risk, types of epidemiological study, experimental and observational; Descriptive studies: surveys, sampling, survey bias; Cohort studies: Principles advantages and disadvantages of retrospective and prospective, case-control and intervention studies; Interpretation of epidemiological data; basic statistics. Introduction to nutritional epidemiology and important scientific concepts in study design.

#### **FT 5221. Food Lipids (2)**

Nomenclature and classification of fats and oils, physical properties; extraction, isolation and analysis of dietary lipids; fats and oil processing; refining, bleaching, deodorizing, hydrogenation; recent advances in fats and oil processing, utilization of fats and oils in shortening technology, margarine and specialty lipids, lipids as functional foods and nutraceuticals, potential sources, health benefits of specialty lipids, sphingolipids, conjugated linoleic acids, marine oils, structured lipids, trans fatty acids, biotechnological advances in lipid technology, deep fat frying.

#### **FT 5222. Food Process Engineering and Unit Operations (2)**

Physical characteristics of foods materials , Mass and energy balance , Rheology of foods; stress-strain behavior rheological parameters & models in materials, Viscoelastic behavior and rheometers, Laminar & turbulent flow, friction factor, pressure drop and pumping of fluid foods, Heat transfer: forms of heat: conduction, forced & free convection, radiation, steady & unsteady state heat transfer, Overall heat transfer coefficient, performance of heat exchangers & types, Food dehydration & drying: Psychometrics, Equilibrium moisture content, estimation of drying rates & time for dryer types , Properties of frozen foods, ice-crystal formation & freezing point depression, cooling rate determination, Aero &

hydrodynamic characteristics, Size reduction equipment / machines, Mechanical separation techniques

### **FT 5223. Food Analysis (3)**

Sampling, Proximate analysis, Kjeldahl nitrogen estimation, Potentiometry, pH and ion selective electrodes, Colorimetry, Chromatography, Spectroscopy, Spectrophotometry, Flame photometry, Atomic Absorption Spectrophotometry, Fluorometry, Refractometry and polarimetry, Food microscopy, Analysis of milk & milk products, Laboratory quality assurance, Microanalytical methods for pesticides, vitamins, & mycotoxins, Interpretation and presentation of results, Food texture measurements, Product evaluation based on laboratory analysis.

**Practical:** Food sampling; instrumentation: HPLC, GLC, AAS & UV visible Spectroscopy; analysis of carbohydrate, protein and fat; detection of food colors, food additives and contaminations.

### **FT 5224. Sensory Evaluation of Foods (2)**

Concepts of sensory evaluation, Sensory attributes, Product oriented tests, Consumer oriented tests, conducting sensory tests, Training panelists, Application of sensory testing, Descriptive sensory analysis, Flavor profile analysis, Texture profile analysis

**Practical:** Paired comparison test, Triangle test, Using line-scales, Ranking test (product oriented test), Paired preference test, Ranking test (consumer oriented test), Hedonic test.

### **FT 5225. Current Topics in Nutrition (1)**

Food and nutrition related topics of current interest will be discussed at length. Students will be motivated to gather information and critically examine facts in order to have a better understanding and judgment on issues and remedial approaches.

### **FT 5226. Consumer-Driven Food Product Development (2)**

Consumer responses to food products, Sensory perception as a basis of food acceptance and consumption, Effect of culture, Ethics and beliefs on the choice of food, Psychobiological mechanisms in food choice, Consumer attitudes towards food innovation and technology, Methods to understand consumer attitudes and motivations in food product development, Sensory research and consumer-based food product development, Consumer driven-concept development and innovation in food product development, Case study of consumer-oriented food product development.

### **FT 5298. Directed Study (5)**

Self-learning exercise guided by a supervisor to carry out a limited study or produce a review manuscript publishable in a refereed journal.

## BOARD OF STUDY IN PLANT PROTECTION

### LIST OF COURSES

Course No	Course Title	Credits
<b>First Semester</b>		
PP 5101	General Microbiology	2
PP 5102	Plant Pathology	2
PP 5103	Insect Morphology	3
PP 5104	Insect Physiology	2
PP 5105	Clinical Plant Pathology	2
PP 5106	Pesticide Toxicology	2
PP 5107	Pesticide Technology	1
PP 5108	Methods in Microbiology & Microbial Technology	3
PP 5109	Molecular Microbiology	2
PP 5110	Microbial Genomics	2
PP 5151	Plant Molecular Biology	2
PP 5152	Indigenous Technology for Plant Protection	2
PP 5153	Soil Borne Pathogens and Root Diseases	2
PP 5154	Epidemiology	2
PP 5155	Immunology	2
PP 5156	Integrated Pest Management in the Tropics (for M.Sc. in Tropical Agriculture)	
PP 5158	Methods of Invertebrate Ecology	2
PP 5196	Practicum in Molecular and Applied Microbiology	2
PP 5197	Practicum in Plant Protection Technology	2
PP 5198	Directed Study	5
PP 5199	Seminar	1
<b>Second semester</b>		
PP 5201	Insect Systematics and Identification	2
PP 5202	Insect Ecology and Behaviour	2
PP 5203	Nematology	2
PP 5204	Biological Control of Agricultural Pest	2
PP 5206	Integrated Pest Management	2

PP 5207	Plant Resistance to Insect Pests	2
PP 5208	Molecular Diagnostic for Plant Protection	2
PP 5209	Post Harvest Protection	2
PP 5210	Acarology	2
PP 5211	Microorganisms with Medical Importance	2
PP 5212	Aquatic Microbiology and Water Quality	2
PP 5213	Industrial Microbiology and Biotechnology	2
PP 5214	Molecular Plant Microbial Interactions	2
PP 5251	Insect Toxins and Insect Transmission of Plant Disease	2
PP 5252	Molecular Virology	2
PP 5253	Insect Pests and Diseases of Forests	2
PP 5254	Disease Management in Floricultural Crops	2
PP 5255	Insect Pathology and Microbial Control of Insect Pests	2
PP 5256	Techniques and Strategies in Plant Molecular Biology	3
PP 5257	Crop Protection in the Tropics	2
PP 5259	Insect Pest Management in Horticultural Crops	2
PP 5260	Advances in Plant Protection Methods for Plantation Crops and Forest Species	1

## **COURSE CAPSULES**

### **First Semester**

#### **PP 5101. General Microbiology: (2)**

General introduction. Evolution of microorganisms. Classification. Sub cellular structure. Nutrition and growth. Microbial genetics and physiology. Overview of general methodology in microbiology. Prokaryotic diversity, Ecophysiology and habitat. Microbial ecology and environmental activities. Microorganisms and industry. Control of microorganisms.

#### **PP 5102. Plant Pathology (2)**

Concepts of diseases in plant, Pathogenesis. Molecular biology of plant infection. Inoculum and disease severity. Host parasite relations. Environment and disease development. Defense mechanisms. Disease Management.

#### **PP 5103. Insect Morphology (3)**

The external structure of insects: exoskeleton, metamerism, body regions, and the appendages: antennae, mouthparts, legs, wings and abdominal appendages. Maintenance systems: enteron; circulatory, respiratory, and reproductive systems; Control systems: nervous system; sensory receptors; endocrine system and exocrine glands.

#### **PP 5104. Insect Physiology (2)**

The functions of insect structures. Life processes and metamorphosis of insects. Physiology of moulting and body wall: formation of chemical properties of cuticle. Consequences of the possession of exoskeleton. Digestion, nutrition and metabolics. Respiration in terrestrial and aquatic insects. The blood constituents, circulation; homeostasis. Excretion. Senses: Chemoreception; mechanoreception; tactile senses; sensitivity to gravity, pressure, movement; hearing and sound production. Vision. Physiology of reproduction. Mating process and methods of sperm transfer; impregnation; oviposition; sex determination. Muscle action: strength and activity; energy source. Body temperature and humidity. Coordination: nervous and endocrine systems. Insect hormones, pheromones and defensive secretions.

#### **PP 5105. Clinical Plant Pathology (2)**

Clinical procedures and diagnostic techniques, Specialized techniques for identification and study of disease causing agents and plant diseases. Analysis of field problems. Field assignments and reports.

#### **PP 5106. Pesticide Toxicology (2)**

Principles and methods used in toxicology of pesticides. Chemical composition of insecticides and fungicides and their effects in plant and animal tissues. Toxicity to fauna and flora including domesticated animals and wildlife. Acute and chronic toxicity in humans.

**PP 5107. Pesticide Technology (1)**

Importance and need of pesticide legislations; Pesticide legislation, Registration of pesticides, FAO international code of conduct. Pesticide legislation in developed countries. Pesticide formulations; Application techniques, equipments. Safety procedures in pesticide management.

**PP 5108. Methods in Microbiology and Microbial Technology. (3)**

Safety in microbiology. Culture methods of bacteria, fungi, algae & protozoa, microbial consortia and communities. Biochemical and molecular approaches to measurements of biomass density, diversity and phylogeny. Microorganisms and recombinant DNA technology. Plasmids and phages as cloning vectors, Cloning procedures, cDNA and genomic libraries; construction and screening, DNA probes and labeling techniques, Colony and plaque hybridization methods, Solution hybridization, Yeast two hybrid systems and phage displays, Polymerase chain reaction and its applications in microbiology, Bacterial transformation methods, Expression of mammalian genes in bacteria, Use of Agrobacterium vectors An integrated discussion of recent genetic, biochemical and engineering approaches to microbial processing from Antibiotic, Biomass and Citric acid to Zymomonas.

**PP 5109. Molecular Microbiology (2)**

Macromolecular Synthesis and Processing: DNA, RNA, and Protein Synthesis. Protein molecules. Macromolecular interactions, Biological membranes and bacterial cell wall. Membrane transport, Mode of action of antibiotics. Bacterial two component signal transfer systems, Growth, Physiology and metabolic regulation in Bacteria, Quorum sensing, Microbial stress responses. Biofilms-structure, phenotypic changes and distribution. Bacterial Genetics: Genetic material, DNA Exchange and transformation, Repair. Transposons, Regulation of Prokaryotic Gene Expression. Bacteriophage Genetics.

**PP 5110. Microbial Genomics (2)**

Introduction to genome and structural and functional genomics, Structural diversity of microbial genomes, Techniques essential to determine genome biodata, Construction of physical and genetic maps for microbial genomes, High resolution maps and linkage maps (gene encyclopedia), chromosome walking, Identification/mapping of genes, Genomic fingerprinting, Genome sequencing strategies, bioinformatics and genome analysis, Mutational studies and functional assays at phenotypic and gene expression level.

**PP 5151. Plant Molecular Biology (2)**

Introduction to plant molecular biology, Structure, regulation and function of plant genes and multi gene families, Signal Transduction ,Control of plant developmental and physiological processes at molecular level, Scope for genetic manipulation of different plant processes, Current perspectives.

**PP 5152. Indigenous Technology for Plant Protection (2)**

Evolution of monoculture farming systems from chena to date. Kandyan forest garden systems. Hazards of modern agriculture. Ecological concepts of traditional agriculture. Plant protection as a holistic process in ecological farming for higher sustainability. Concept of

spiritual, ecological and biodynamic farming for minimal pest damage. Survey of traditional herbal pest management techniques used in Sri Lanka. Case studies of spiritual and biodynamic pest management techniques used in Sri Lanka. Nawakekulama, Organic farming Biodynamic sowing and planting calendar, Kem and religious methods for prevention of pest infestations in plants and farm animals.

( Field trip). Methodology to test indigenous knowledge.

**PP 5153. Soil borne Pathogens and Root Diseases (2)**

Population dynamics of soil borne pathogens, Rhizosphere influence on pathogens, effects of soil environment on root diseases of crops of economic importance. Disease management.

**PP 5154. Epidemiology (2)**

Epidemiology, disease assessment and crop losses, pathogen factors in epiphytotics, Analysis and forecasting of epidemics, Control of plant diseases, Pesticides and their mode of action, use and abuse of pesticides.

**PP 5155. Immunology (2)**

General introduction to mammalian immune system. Barriers to infection. Evolution. Complement system. Biological effect of complement. Antibodies and their receptors. Antibody effect or functions. T cell receptors. Major histocompatibility complex. Antibody formation and generation of diversity. Antigen recognition and Antigen presentation. B-cell and T-cell interaction. Immunochemical techniques: Estimation of antibody- Antigen antibody interactions in solution. Immunoassay with solid phase antigen. Identification and quantitative assessment. Electrophoresis, SDS-PAGE, Single radial Immunodiffusion SRID, Immunoblotting, Immunoassay of antigens. Monoclonal Antibodies, Engineering Ab.Cellular techniques: Separation of leukocytes based on physical, biological parameters and antibody coating. Immunohisto-chemistry.

**PP 5156. Integrated Pest Management in the Tropics (pass/fail course)**

This practical training program is designed to provide the students the basic idea behind area-wide IPM, understand how to develop a site survey and IPM plan, improve plant health through cultural strategies, monitor pest populations, maintain records and determine when pesticide use is appropriate in an integrated approach.

**PP 5158. Methods of Invertebrate Ecology (2)**

Methods of invertebrate sampling, handling, rearing; Assessment methods of insect populations; Modeling of invertebrate populations; Methods in insect behaviour studies; Assessment methods of bio-control agents; Host specificity testing; Assessment methods of non-target effects of bio-control agents; Assessment of parasitism; Assessment of host parasitoid synchronization; current research in invertebrate ecology.

**PP 5196. Practicum in Molecular and Applied Microbiology (2)**

Practicum in Molecular and Applied Microbiology covers essential techniques in Molecular Microbiology including, culturing of microorganisms, extraction of nucleic acids, analysis of

DNA and RNA, quantification of nucleic acids, PCR and different versions of standard PCR (PCR-RFLP, RT-PCR), nucleic acid hybridization techniques (DNA blotting, Southern hybridization, RFLP, colony blots), transformation, electroporation, preparation of competent bacterial cells, cloning of DNA, selection of recombinant clones

**PP 5197. Practicum in Plant Protection Technology (2)**

Practicum in Plant Protection Technology includes a series of practicals and field visits; curation of adult and immature insects; curation of insects damaged plant specimens; preparation of a life cycle of a selected insect pest species; Preparation of a digital image collection on insect damages on crop plants; Preparation of microscopic slides (dissected mouth parts) and parasitoids for taxonomic studies; Pesticide appliances (operation); General techniques in plant pathology; identification of plant pathogenic microbes; Field visits to selected research stations and to vegetable farming areas.

**PP 5198. Directed Study (5)**

Candidates will conduct a research project on a selected topic recommended by the advisor. The student will receive an adequate training on proposal writing, research hypothesis, literature survey, research methodology, data collection, data analysis, report writing and presentation.

**PP 5199. Seminar (1)**

**Second Semester**

**PP 5201. Insect Systematics and Identification (2)**

The species concept. Diversity of insect world. Principles of nomenclature and classification, Diagnostic and special features of major taxa of Superclass Hexapoda, Use and construction of identification keys, Procedures adopted in identification of insects up to species level. Use of chemotaxonomy and morphometric studies in subspecies level identification.

**PP 5202. Insect Ecology and Behaviour (2)**

Principles of ecology and analysis of the insect environment. Effect of climate and abundance and distribution of insect populations. Biotic factors in the environment, Intraspecific and interspecific competition. Models of growth and stability of insect populations, Life table studies, Use of population dynamics strategies in insect pest control. Forms of insect behaviour. Functional aspects of behaviour and feeding, flight and defensive behaviour, Physiology of behaviour of social and non-social insects, Mating behaviour, Photoperiodism and insect behaviour, Communication in insects, hormonal and Pheromonal control of insect behaviour, Manipulation of ecological factors and insect behavior in insect pest management

**PP 5203. Nematology (2)**

The morphology, taxonomy, ecology and symptomology of nematodes, parasitic on cultivated crops. Biological, cultural, chemical and non-chemical management of nematodes in plantation crops, vegetables and other crop production systems. Field sampling, damage



estimation. mapping and forecasting of nematode incidences for effective management. Research applications in nematology

**PP 5204. Biological Control of Agricultural Pests (2)**

Historical landmarks of Biological control; Scope of Biological control; Concept of natural regulation. Ecological interactions in a biocontrol system; Approaches of Biological control: Classical biological control, conservation, and augmentation & release. Taxonomy of entomophagous insects, Predator-Prey systems and Host-parasitoid systems. Microbial control. Research trends in biological control.

**PP 5206. Integrated Pest Management (2)**

History of IPM, Economics Injury level and pest status, Assessment of Pest population and crop losses, Natural regulation of Pest populations, IPM components (Cultural control, Physical and mechanical control, Regulatory control, Biological control, Host Plant Resistance, Sterile Insect Techniques and Chemical control). IPM for different cropping systems, Research Extension and Farmer training, Institutional Aspects of IPM.

**PP 5207. Plant Resistance to Insect Pests (2)**

Insect Plant Interaction, Host Plant Selection by phytophagous insects, Mechanisms of resistance, Factors affecting expression of resistance, Implementation of Host-plant resistance program, Role of vector resistance in virus disease control in plants, current trends in host plant resistance.

**PP 5208. Molecular Diagnostics for Plant Protection (2)**

Importance of using molecular techniques for the identification of pathogens and pests; field collection of plant and animal specimens for DNA work; DNA and RNA extraction techniques from plants, insects and microorganisms; DNA probes and their use in identification of pathogens and pests, PCR as a diagnostic tool; PCR and Non-PCR based diagnostic techniques to identify plant pathogens and pests; RAPDS, AFLP, SSCP, SSR. Use of special gel electrophoretic techniques for diagnostics TGGE & DGGE Sources of probes and primers for diagnostics; Nuclear DNA, CpDNA, mtDNA, rDNA, RAPDS & SSRs. Screening for genetic diversity among plant pathogens and insect pests using molecular tools. Molecular taxonomy, phylogenetics and data analysis, Case studies.

**PP 5209. Post Harvest Protection (2)**

Causes of postharvest losses, Economic importance, Identification of insect pests and diseases. Bionomics of organisms that cause postharvest losses including higher animals. Cross infestations, secondary pests, (fungus feeders, scavengers). Microorganisms infecting durable and perishable products, Mechanisms of deterioration of the produce. Management of post harvest pests and diseases in Sri Lanka, Control measures, Clean products, drying, cold storage, pest proof buildings and sealable containers, storage hygiene, avoidance of mechanical damage and other disease producing situations, removing surface wetness, Chemical methods including fumigation.

**PP 5210. Acarology (2)**

External morphology of acarina; segmentation and body regions; integument; mouthparts; legs. Internal anatomy. General biology: life cycles; feeding habits and habitats. Classification and identification of acarina. Collection, preservation and preparation of mites for studies, Description of economically important species of ticks and mites. Control of phytophagous mites and exoparasitic ticks and mites.

**PP 5211. Microorganisms with medical importance (2)**

Microbial pathogens of man. Bacterial pathogens, viruses including HIV as human pathogens. Laboratory Diagnostic tests, procedures and techniques for identification of human pathogens, Opportunistic infections, Laboratory requirements and proper lab practice in a medical microbiology lab, Antibiotics and other chemotherapeutic agents, Mode of action of antibiotics. Microbial resistance to drugs, mechanisms of acquired resistance, Prevention of drug resistance, common Immunizations. Recombinant vaccines and drug design.

**PP 5212. Aquatic Microbiology and Water Quality. (2)**

Water microbiology aquatic microorganisms. Quality parameters of drinking water. Quality standards and other indicator microorganisms. Quality tests. Common pollutants of drinking water and disease associated with them. Pollution and impact of pollution of waterways and reservoirs. Purification of drinking water and assessment of efficacy. Wastewater management. Taxonomy & Physiology of Marine Microorganisms. Distribution and metabolic activities of various marine microbes in Open Ocean, coastal areas and artificial environments such as harbors. Deep sea habitats. High-pressure laboratory techniques. Biofilms. Diseases caused by marine microorganisms in seaweeds, fish and algae.

**PP 5213. Industrial Microbiology and Biotechnology (2)**

Microorganisms in food, their application in agriculture, industry, environment and health sector. Bioreactors. Biogas production and utilization. Survey of application of Microbiology in biotechnology emphasizing the microbial pesticides, biofertilizer, efficient microorganisms, the operation of fermentation systems and pharmaceutical industry (recombinant pharmaceuticals). Case studies of down stream separation & purification protocols on an industrial scale. Protein engineering and Enzyme biotechnology.

**PP 5214. Molecular Plant - Microbial Interactions (2)**

Molecular Biology of Plant Microbe systems. : Beneficial interactions such as legume-Rhizobia symbiosis, Non-legume N fixing endosymbiosis. PGPR, Mycorrhiza, Endophytes, Epiphytes etc. Pathogenic systems. Bacterial pathogens. Molecular approaches to achieve durable disease resistance. Virulence factors and pathogenesis. Modulators of resistance and susceptibility. Cell to cell interaction. Microbial hormones in Plant development. Signal transduction.- Bacterial type III effectors . Regulation of plant defense reactions. Recognition of plants by microbes. Plant virus interactions. Cellular dynamics of interactions. Coordinated expression of plant and mycorrhizal genes and their fate in plant. Molecular basis of plant response to microbial invasion, plant pathogen co-evolution.

**PP 5251. Insect Toxins and Insect Transmission of Plant Disease (2)**

Studies on the chemical and biological effects of insects feeding on plants and the transmission of plant disease by insects.

**PP 5252. Molecular Virology (2)**

Introduction to Molecular Virology, Plant viruses and virus-like agents, Investigation, biochemistry and physiology of virus diseases, symptomatology, transmission, isolation and identification of plant viruses and virus-like agents, Principles of electron microscopy and serology, Specific diseases of important crops and control. Genomes of plant viruses, replication strategies, cell to cell transport, molecular methods for detection and identification of viruses, molecular strategies to achieve viral resistance, benefits of viruses in biotechnology.

**PP 5253. Insect Pests and Diseases of Forests (2)**

Introduction to pathological stress of forest trees, major grouping of leaf, stem and root diseases, rust, wilt and wound disease, -decay and discoloration, disease diagnosis and management and tree surgery, Introduction to insect pest damages in forest, factors affecting abundance of forest insects, bionomics of insect pests of common forest trees in the tropics, assessment of pest population and extent of their damages in forest, management of forest insect pests.

**PP 5254. Disease Management in Floricultural Crops (2)**

Introduction to disease problems in floriculture industry, Pathology, dissemination and principles of disease management in indoor and outdoor floricultural plants, Diagnosis and treatments, Recent developments in disease management in floricultural crops.

**PP 5255. Insect Pathology and Microbial Control of Pests (2)**

Types of diseases, recognition and pathology, isolation of insect pathogenic microbes, maintenance of cultures, testing against pest species, uses in IPM programs, production and formulation of microbial insecticides, problems of insect pathogens in beneficial insects (silk worm, honey bees).

**PP 5256. Techniques and Strategies in Plant Molecular Biology (3)**

Arabidopsis methods in plant science, Advanced PCR strategies and PCR primer design, Sources of information for plant scientists on the web, Computer based molecular sequence analysis and image analysis, Techniques to isolate and characterize novel plant genes, Localization techniques to study gene and protein expression in plants, methods in functional genomics.

**PP 5257. Crop Protection in the Tropics (2)**

Prevalence and assessment of damages caused by insect pests, diseases and weeds in tropical environments, Management strategies for insect pests, diseases and weeds in tropics: cultural, biological, chemical, physical and mechanical, genetic, regulatory and traditional methods; Case studies in insect pests, diseases and weed management; Farmer education on eco-

friendly pest and crop management; Pesticide management problems in the tropics, emergence of resistance; Quarantine aspects of insect pests, diseases and weeds in the tropics.

**PP 5259. Insect Pest Management in Horticultural Crops (2)**

Concepts of pest management; Conventional and traditional pest management strategies; Integrated pest management; Ecological pest management. Bionomics and management of insects attacking horticultural crops: common polyphagous insects, aphids, whitefly, thrips, and fruit fly. Bionomics and management of insects attacking fruit crops; mango, pineapple, banana, papaya, rambutan, strawberry and other minor crops. Bionomics and management of insects attacking vegetables: crucifers, legumes, cucurbits and leafy vegetables.

**PP 5260 Advances in Plant Protection Methods for Plantation Crops and Forest Species (1)**

Plantation crop protection: overview, need and significance, historical developments, economics in pest control; Overview of insect pest species of tea, rubber, coconut and sugarcane; Overview of insect pests of economically-significant forest tree species; Pest population monitoring techniques; Pest control techniques in plantation crops and forests: Biological control; pheromonal control, chemical control, host plant resistance; Future trends in crop protection in plantation crops and forest tree species; Diseases of economic-significance in Tea, Rubber, Coconut and Sugarcane plantations (i.e. causal organisms, symptoms/signs, damage, disease identification); Diseases/disorders of forest trees; Integrated disease management with special reference to non-chemical methods; Impact of climate change on population dynamics of pathogens/microorganisms and disease development; Genetic and management improvements to tolerate/resist the effects of pathogens.

## BOARD OF STUDY IN SOIL SCIENCE

### LIST OF COURSES

Course No	Course Title	Credits
<b>First Semester</b>		
SS 5101	Fundamentals of Soil Science	2
SS 5102	Physical Properties and Processes in Soils	2
SS 5103	Mineralogical and Chemical Properties of Soils	3
SS 5104	Plant Nutrition	2
SS 5105	Introduction to Tropical Soils	1
SS 5106 *	Environmental Pollution and Control	2
SS 5107	Formation and Characteristics of Tropical Soils	2
SS 5108 *	Soil Ecosystems and their Functions	2
SS 5109 *	Microbial Ecology	3
SS 5110	Environmental Soil Physics	3
SS 5111	Environmental Soil Chemistry	3
SS 5112 *	Soil Plant - Water Systems	3
SS 5113	Environmental Microbiology	2
SS 5114	Digital Soil Mapping	2
SS 5151	Management of Soil Organic Matter	2
SS 5152	Analytical Techniques in Soil, Plant, Water & Fertilizer	3
SS 5153	Soil Morphology and Classification	2
SS 5154	Plant- Microbe Interactions	2
SS 5155	Management of Tropical Soils	3
SS 5156	Water Quality and Environment	2
SS 5198	Directed Study	5
SS 5199	Seminar	1
SS 6101	Tracer Techniques in Soil and Plant Studies	2
<b>Second Semester</b>		
SS 5201	Soil Fertility and Fertilizers	3
SS 5202	Advanced Plant Nutrition	2
SS 5203	Degradation and Conservation of Tropical Soils	2
SS 5204	Management of Tropical Uplands	1

SS 5205	Management of Tropical Wetlands	1
SS 5206	Social and legal Aspects of Land Management	2
SS 5207	Reclamation & Management of Problem Soils in Sri Lanka	2
SS 5208	Field Characterization of Soils	2
SS 5209	Land Use Planning	2
SS 5211	Soil Enzymology	1
SS 5212	Soils of Sri Lanka	1
SS 5251	Organic Pollutants and Environment	2
SS 5252	Environmental Impact of Inorganic Pollutants and Radio-nuclides	3
SS 5253	Solid Waste and Environment	2
SS 5254	Environmental Biotechnology	2
SS 5255 *	Special Topics Related to Microbiology	2
SS 5298	Directed Study	5
SS 5299	Seminar	1
SS 6201	Techniques for Efficient Plant Nutrient Management	2
SS 6202	Environmental Soil Mineralogy	2
SS 6203	Land Use and Environment	1
SS 6204	Remediation of Contaminated Soil and Water	2
SS 6205	Advanced Instrumentation in Environmental Research	2
SS 6206	Soil Environmental Modeling	2
SS 6207	Applications of Digital Soil Mapping	2

- Offered for non Environmental Soil Science degree students

## **COURSE CAPSULES**

### **First Semester**

#### **SS 5101. Fundamentals of Soil Science (2)**

Soil formation. Physical, chemical and biological properties of soil, Soil as a medium for plant growth, Soil as a sink and source of environmental pollutants.

#### **SS 5102. Physical Properties and Processes in Soils (2)**

Physical properties of soils. Mass volume relationships. Soil rheology and trafficability. Soil water. Measurements of water status in soil. Flow of water in soil. Water and energy balance. Tillage and soil structure management. Soil strength. Soil temperature. Heat and gas flow.

#### **SS 5103. Mineralogical and Chemical Properties of Soils (3)**

Basic chemical, structural and crystallographic concepts. Classification, structure, surface chemistry, genesis, weathering, identification and distribution of soil minerals. Influence of minerals on soil properties. Mineralogy of Sri Lankan soils. Nature and properties of organic constituents, chelates and clay humus complexes. Ionic distribution on colloids. Flocculation and dispersion of soil colloids. Adsorption / Desorption of ions and ion exchange in soils. Soil acidity, alkalinity, salinity and sodicity. Reactions of submerged soils and redox phenomena. Kinetics of soil chemical reactions.

#### **SS 5104. Plant Nutrition (2)**

Occurrence and availability of plant nutrients and beneficial elements in soil. Mechanisms of nutrient absorption, translocation and excretion. Functions of nutrients in plants. Deficiencies and toxicities of nutrients in plants and their diagnosis. Managing nutrient imbalances.

#### **SS 5105. Introduction to Tropical Soils (1)**

Tropical environment; climates and moisture regimes, Characterization of highly weathered soils, Soils of tropics; fertility, productivity, and sustainability. Compare and contrast tropical and temperate soils.

#### **SS 5106. Environmental Pollution and Control (2)**

*(Offered for non- Environmental Soil Science Degree students)*

Sources of pollutants and contaminants; fertilizers, pesticides, solid wastes, sewage sludge, toxic metals, metalloids, soluble salts, radio-nuclides, soil sediments and atmospheric depositions. Transformation, mobility and persistence of pesticides, toxic metals, metalloids and other organic and inorganic pollutants in soil environment. Impact of pollutants on ecosystem health; eutrophication, siltation of reservoirs, pollution of groundwater, soil and air, narrowing of soil biodiversity. Remediation of contaminated soil and water bodies. Regulatory measures and policies to control pollution.

#### **SS 5107. Formation and Characteristics of Topical Soils (2)**

Tropical environment and the soils of the tropical belt. Management of tropical soils. Differences between tropical and temperate soils. Sustainability and productivity of tropical soils.

**SS 5108. Soil Ecosystems and their functions (2)**

*(Offered only under Soil and Environmental Microbiology Program)*

Population ecology, structure, dynamics and interactions. Food webs, Biogeochemical cycles and flow of energy. Primary production. Community succession and disturbances. Biodiversity and soil productivity. Soil quality and sustainability. Ecosystem conservation.

**SS 5109. Microbial Ecology (3)**

*(Offered only under Soil and Environmental Microbiology Program)*

Microbial Evolution. Microorganisms in their natural habitats-air, water and soil. Spatial heterogeneity and temporal variability of microorganisms in aquatic and terrestrial habitats. Response of soil and aquatic microorganisms to environmental perturbations. Adaptations to extreme environmental conditions and to host. Microbial interactions, communities and ecosystems. Techniques in microbial ecology, enrichment, isolation and characterization. Ecological theories in microbial ecology - Neo Darwinism vs. Communities, Diversity vs. Stability.

**SS 5110. Environmental Soil Physics (3)**

Soil as a product of environment, Environmental Significance of Soil Texture, Structure, Density and Porosity, Field water cycle. Infiltration, sorptivity, redistribution including saturated and unsaturated flow of water and their effects on the environment. Solute movement with special emphasis on transport of contaminants. Relationship of soil orders with the Environment. Spatial and temporal variability of soils and their environmental impact. Application of geo-statistics in studying the spatial structure.

**SS 5111. Environmental Soil Chemistry (3)**

Review of chemical principles. Application of thermodynamics to soil systems; mineral/solid phase solubility, precipitation, sorption, complexation, ion exchange equilibria. Activity-ratio diagrams for describing chemical equilibria in soil systems. Advanced techniques used for solid and solution phase speciation including hands-on experience with geochemical speciation models. Application of chemical kinetics to soil reactions. Oxidation-Reduction reactions and their environmental significance. Sources, reactions, transport, fate and bioavailability of chemical species in soils. Predicting fate of contaminants and pollutants using mathematical modeling.

**SS 5112. Soil-Plant-Water Systems (3)**

*(Offered only for non-soil science M.Sc. degree programs)*

Soil, their properties and functions. Soil resources of Sri Lanka. Nutritional aspects of plants. Fertilizers, organic manures, crop residues, their uses and effects on environment. Soil management and conservation. Soil degradation and desertification. Pollution of natural resources soil, water and air.



**SS 5113. Environmental Microbiology (2)**

Microbial bioenergetics. Microbiology of biogeochemical cycles. Microorganisms as a sink and source of environmental pollutants in terrestrial and aquatic ecosystems. Biotransformation of environmental pollutants. Use of microorganisms as bio-indicator and biosensor. Principles of biological treatments. Enzymes in the soil environment; interactions with colloids, inhibition and kinetics.

**SS 5114. Digital Soil Mapping (2)**

Theory, Introduction to digital Soil Mapping, Fundamentals of Digital Soil Mapping, GIS tools for Digital Soil Mapping, Basic GIS functions, Soil Sampling using spatial statistical methods, Statistical spatial data analysis techniques, Sources of Ancillary information for digital soil mapping Following laboratory sessions will be conducted; dereferencing and navigation, GIS functions, Construction of DEM, Construction of apparent electrical conductivity data base

**SS 5151. Management of Soil Organic Matter (2)**

Organic and inorganic phases of soil: Chemical composition and characterization of soil organic matter. Role of soil organic matter in improving soil fertility. Composting techniques. Use of organic materials in agriculture; compost, green manure, crop residues, farm yard manure etc. Concepts of organic and biodynamic farming systems.

**SS 5152. Techniques in Soil, Plant, Water and Fertilizer analysis (3)**

Principles of volumetry, gravimetry, colorimetry, turbidimetry, nephelometry, fluorimetry, flamephotometry, atomic absorption spectrometry and potentiometry analytical techniques. Sampling and sample preparation for analysis. Errors in analysis. Quality assurance and quality control. Determination of basic soil properties. Extraction of soil nutrients. Analysis of soil, plant, water and fertilizers for elements.

**SS 5153. Soil Morphology and Classification (2)**

Soil forming processes. Soil morphology. Soil profile description. Soil survey. Historical background of soil classification. Systems of soil classification; FAO classification and soil taxonomy. Soils of Sri Lanka and their classification. Classification of rice growing soils.

**SS 5154. Plant-Microbe Interactions (2)*****(Offered only under Soil and Environmental Microbiology Program)***

Nature of phyllosphere and rhizosphere. Diversity of phyllosphere and rhizosphere microorganisms. Signal transduction and host specificity. Di-nitrogen fixation. Mycorrhizae. Plant Growth Promoting Rhizobacteria. Plant growth regulators, phytotoxins and allelochemicals. Plant-microbe interactions and ecosystem stability.

**SS 5155. Management of Tropical Soils (3)**

Soils of the tropical belt, their formation, characteristics and classification; Differences between tropical and temperate-zone soils; Soil development and land use in the tropics; Sustainability and productivity of tropical soils; Management of tropical soils; Problem soils

of the tropics, their properties and management; Soil degradation under tropical conditions; Soil conservation and rehabilitation of degraded soils in the tropics.

**SS 5156. Water Quality and Environment (2)**

Significance of water for global sustainability, Properties of water and forms in nature, Global water availability in qualitative and quantitative terms, Water cycle, Uses (common and specific) and quality requirements, Measurements and monitoring water quality parameters, Sources and causes of water pollution, Ground water quality, Influence of land management on water quality, Social and economic dimensions of water pollution, Mitigation of water pollution, Purification methods, Responsibilities and ignorance of water users.

**SS 5198. Directed Study (5)**

Candidate should carry out an independent research project on a topic related to degree program as recommended by the advisor.

**SS 5199. Seminar (1)**

Communication of science. Assessment of research articles, Preparation of extended abstracts, Techniques to effectively present data, handling of audio visuals.

**SS 6101. Tracer Techniques in Soil and Plant Studies (2)**

Basic principles of radioactivity, its detection and measurement. Hazards of radioactivity and safety measures. Radioactive waste management. Atomic energy regulations. Tracer methodology; mass spectrometry, photo spectrometry and auto radiography. Use of traces in ion uptake, root activity, root distribution and soil organic matter dynamics, fertilizer use efficiency, C and N dynamics in soils, microbial growth and activity measurements, soil erosion and fate of nutrients and pesticides in soils.

**Second Semester**

**SS 5201. Soil Fertility and Fertilizers (3)**

Factors affecting plant growth. Historical background of fertility management. Soil fertility parameters and interpretations. Assessment of soil fertility. Sustainable management of soil fertility. Fertility based crop selection. Basic aspects of fertilizers, manure and amendments. Manufacture and standards of chemical fertilizers. Types of fertilizers. Formulation of fertilizer mixtures. Composting. Biofertilisers. Amendments to improve soil fertility. Efficient use of fertilizers. Organic farming. Fertilizer recommendations.

**SS 5202. Advanced Plant Nutrition (2)**

Status of nutrients in plant tissues. Plant water relationship. Physiological pathways of nutrients. Nutrient interactions in plant and soil. Relationships between nutrients and pest and diseases. Nutrition and yield responses and yield quality. Nutrient stressed conditions in plants and adaptations.

**SS 5203. Degradation and Conservation of Tropical Soils (2)**

Types and nature of soil degradation. Soil degradation under tropical conditions. Soil erosion. Mystification, Salinization, nutrient depletion and imbalance in agricultural soils. Soil subsidence, compaction, desertification etc. Rehabilitation of degraded soils. Mechanical and agronomic conservation measures with special reference to Sri Lanka. Legal aspects of soil conservation.

**SS 5204. Management of Tropical Uplands (1)**

Land classification. Land suitability evaluation for upland agriculture. Land development. Productivity management of soils under rainfed agriculture, grasslands and forests. Tillage, moisture and organic matter conservation in the uplands. Some aspects of irrigation. Fertility management of upland agricultural soils in the tropics.

**SS 5205. Management of Tropical Wetlands (1)**

Characteristics and processes in wetland environment. Role of wetlands in global nutrient cycles. Fertility and water management in lowland rice. Problem rice soils with special reference to Sri Lanka. Environmental issues associated with wetlands, including swamp and marshy lands. Legal aspects on conservation of wetlands.

**SS 5206. Social and Legal Aspects of Land Management (2)**

Population pressure on land. Resource poor land users in developing countries. Land tenure. International conventions and environment laws. World soil charters. Global and local investment on soil conservation. Past and present Sri Lankan legislation, their success and failures. Law enforcement and policies for the future.

**SS 5207. Reclamation and Management of Problem soils in Sri Lanka (2)**

Types, distributions and description of problem soils in Sri Lanka. Natural and anthropic causes leading to problems. Impact on the productivity and environment. Socioeconomic issues, reclamation challenges. Law and policy requirements. Integrated approaches for rehabilitation and better management. Importance of on-farm solutions.

**SS 5208. Field Characterization of Soils (2)**

Site / location description. Identification and relevance of soil horizons / layers,. Estimation of mottles, stones, organic matter, particle size classes, soil water. Determination of carbonates, soil reaction, salinity and nutrient status. Sampling equipment, commercial and self prepared field soil kits, indicator plants. Overall fertility assessment.

**SS 5209. Land Use Planning (2)**

Basic concepts of land use planning. Land suitability evaluation. Land classification. Present and past land use planning in Sri Lanka. Present land use and land cover mapping. Remote sensing and GIS. Economic and social aspects related to land use. Crop requirements. Watershed approach in land use planning. Land suitability for different crops, pasture and forestry sector. Implementing land use plans.

**SS 5211. Soil Enzymology (1)**

***(Offered only under Soil and Environmental Microbiology Program)***

Fundamental properties of enzymes. Characterization and quantification of enzymes in soil. Interactions of enzymes with organic and inorganic colloids. Inhibition of enzymes in soils. Kinetics of enzymes and their applications. Enzymes as an indicator of soil quality.

**SS 5212. Soils of Sri Lanka (1)**

Agro-ecological regions, Soil and their distribution, Potentials and limitations for agriculture, Environmental concerns.

**SS 5251. Organic Pollutants and Environment (2)**

Nature of organic pollutants. Fate of organic pollutants in soil and water: retention, transformation, catabolic pathways: metabolites, enzymes and genes, leaching and volatilization. Fate of hydrocarbons in soil and water. Toxicity of organic pollutants with an emphasis on pesticides. Impact of organic pollutants on ecosystem. Risk Assessment.

**SS 5252. Environmental Impact of Inorganic Pollutants and Radio-nuclides (3)**

Soil and air pollution by fertilizers. Sources of toxic metals and metalloids. Contamination of water sources use for domestic purposes and irrigation. Eutrophication. Speciation of metals in soil and water. Biogeochemical behaviour of inorganic pollutants. Impact of toxic metals and metalloids on plants, microorganisms and animals. Decontamination of groundwater. Radionuclides; Sources of radionuclides: Fallout radionuclides deposited on soils. Transfer to crops and migration to groundwater.

**SS 5253. Solid Waste and Environment (2)**

Common types and composition of solid wastes. Contamination of soil and water with waste. Immediate impacts on physical, biological and chemical properties of soils. Transformation of wastes. Accumulation and residual effects on soils. Risks of translocation. Capacity of soils to buffer adverse impacts. Overall effects on soil health. Appropriate application methods, rates and environmental law. Social responsibility and attitudes.

**SS 5254. Environmental Biotechnology (2)**

Trends in the development of soil biotechnology, Technology and ecology of genetically engineered soil microorganisms for environmental processes. Ecological concerns of introducing genetically engineered organisms as biofertilizers, biopesticides and agents of waste decomposition and bioremediation. Commercialization of genetically engineered organisms and relevant legal aspects. Case Studies.

**SS 5255. Special Topics Related to Microbiology (2)**

***(Offered only under Soil and Environmental Microbiology Program)***

Use of stable radio-active isotopes in mineralogical studies, Statistical methods for microbiological data analysis, Modeling of microbial growth and activity, Environmental policies and laws with special reference to Sri Lanka. Current issues related to environmental microbiology.

**SS 6201. Techniques for Efficient Plant Nutrient Management (2)**

Land preparation, Fertilizer/amendments application techniques including fertigation. Integrated plant nutrient management in agriculture. Crop specific nutrient supply with special emphasis on horticulture and floriculture crops. Media preparation and nutrient management in protected agriculture; soil less cultures/ hydroponics.

#### **SS 6202. Environmental Soil Mineralogy (2)**

Minerals in soil environments, Geochemical-biological cycle of toxic elements, Bedrock geochemistry and stability of secondary phases, Soil-solution-mineral and organo-mineral interactions, Properties of soil mineral surfaces.

#### **SS 6203. Land Use and Environment (1)**

Land use. Land use systems in Sri Lanka. Impact of urbanization on land use. Assessment of land use. Measures to control misuse of lands.

#### **SS 6204. Remediation of Contaminated Soil and Water (2)**

Sources and environmental consequences of hazardous inorganic and organic toxicants. Remediation of soil and water. In-situ, and ex-situ methods of remediation of contaminated soils. Physical, chemical and biological remediation techniques; their potentials and limitations. Some case studies describing use of these different techniques to solve real world, soil/water pollution problems, and their success and failures. Application of different remediation techniques under Sri Lankan conditions.

#### **SS 6205. Advanced Instrumentation in Environmental Research (2)**

Electron microprobe analysis, Infrared spectrometry, X-ray diffraction techniques, X-ray fluorescence spectrometry, Chromatography, GC-MS, Isotopic analytical techniques, Electro-chemical techniques, Techniques used for solid- and solution-phase chemical speciations with sample studies, ICP-AFS / MS.

#### **SS 6206. Soil Environmental Modeling (2)**

Concepts of modeling, soil water interactions, formulation of models and solution techniques, verification and calibration, chemical speciation models, redox and adsorption models, application of water flow and solute transport models, simulation models for biochemical processes and bacterial growth, Graphic programs for chemical and mineral structure plotting.

#### **SS 6207 Applications of Digital Soil Mapping (2)**

Theory, Upgrading and Updating soil maps, Digital Terrain Analysis, Field measurements and analysis of apparent electrical conductivity data, Spatial prediction techniques, Geostatistical predictions, Data reduction techniques, Unsupervised classification, Spatial modeling of soil variation, Laboratory sessions: Exploratory analysis of exhaustive data sets, Geostatistical analysis Univariate and Multivariate, Proximal sensing and data analysis,

## Key Staff at the PGIA

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