M.Sc. in Green Technology

Department of Agricultural Engineering
Faculty of Agriculture
University of Ruhuna
Mapalana, Kamburupitiya
Sri Lanka

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INTRODUCTION

Green technology is the application of the environmental sciences to conserve the natural environment and resources, and by curbing the negative impacts of human involvement through environmental friendly appropriate technologies.

Today's issues of climate change and exhausting fossil fuel reserves are driving the expansion of renewable energy technologies and the production of bio fuels and industrial raw materials from agricultural and forest resources.

Sri Lanka being endowed with natural resources along with a rich biodiversity has the potential advance to be frontiers in Green technologies to live closer to the nature while exploiter the resources in sustainable manner. The program intends to focus on Buddhist way of ethics and philosophical thinking on nature to address to day's burning issues on Environmental management for the benefit and survival of the mankind.

RATIONALE

Green Technology as an emerging sector offers a wide range of exciting employment opportunities in almost all the sectors including agriculture and applied sciences, energy and power, agro-tourism, environmental studies, forestry etc. The course will open the wide range of employment for the followers to be the researchers or professionals, in vast areas of Science, Industry and Technology areas. They will be fit to work as resource person and consultants who could be able to act on sustainable manner to unify the living world with non-living world with adopted green technologies.

OBJECTIVES

This degree course aims to produce competent professionals with postgraduate qualification combining technical and scientific skills with an understanding of the environment, land-based industries and

LEARNING OUTCOMES

At the end of the course, the post graduates should have;

- ❖ An ability to apply their gained knowledge and experiences in the fields of technologies of natural resource systems, climate change and global environment, pollution waste management and recycling, Renewable energy, Energy management, Business Management and Entrepreneurship Development.
- ❖ An ability to identify, formulate, and solve problems related to Green technology involving physical, human, and economic parameters.
- ❖ An ability to design and conduct experiments involving Green Technology
- ❖ An ability to design environmental friendly energy systems, components, or process to meet desired needs.
- ❖ An ability to understand the impact of engineering solutions to Green Technology in a global and societal context.
- ❖ An ability to recognize needs and requirements to maintain the sustainability of the ecological systems
- ❖ An ability to use the techniques, processes, and modern engineering tools necessary for

ELIGIBILITY REQUIREMENT

This M.Sc. course is suitable for the graduates with numerate science-based degrees such as engineering, agriculture, agricultural engineering, physics, biological science, environmental science, etc. However, the subject area is interdisciplinary, and motivated applicants with other degree

ADMISSION REQUIREMENT

Master's Degree program

To be eligible for admission to the master's program, an applicant must:

> ➢ Hold a Bachelor degree (normally from a four-year program), or its equivalent, in an appropriate field of study from an institution of good standing acceptable in Sri Lanka.
> ➢ Have undergraduate grades significantly above average; the minimum GPA requirement for admission to the master's program is 2.75 or equivalent at the Bachelor degree level.
> ➢ Be in satisfactory physical and mental health, and have a record of good conduct.

Diploma Program

The eligibility requirements for the Diploma program are the same as those entering the master's degree program.

APPLICATION PROCEDURE

- Applicants should apply by the application forms from the University of Ruhuna.
- To apply for admission, applicants must complete and submit the following documents:

  - A completed Application for Admission
  - Two letters of recommendation from named referees
  - Official attested Transcript
  - Copy of degree Certificate
  - Evidence of Proficiency in English
- Application Processing Fee
  A nonrefundable application processing fee Rs. 500 is required to process an application. The application fee may be paid by bank draft, valid credit card or cash and should be made payable to the "University of Ruhuna".
- Applications for admission must be received by the normal closing date. If study seats are still available, late applications may be considered.

COURSE SYLLABUS- MAJOR AREAS

1. Environmental Impacts Assessment

2. Renewable energy

   a. Bio Energy

   b. Non bio energy

3. Energy management

4. Agro Entrepreneurship Development

Teaching on most modules involves lectures, tutorials, laboratory practical, field studies, seminars and case studies.

COURSE MODULES- Compulsory

Major Subject streams: Environmental Impacts for Green Technology Development (No. of Credits 8)

EN5301 **Technical Engineering : Evolution and Practices for   Natural Resource Protection (3 Credits)**

Introduction to Technical Engineering, Evolution of Technical engineering systems, Waves of technology development, technology spike and global toxic emergency. Crisis of Natural Resources degradation, Green Technology solutions. Creativity in mechanical, electrical and electronic instrumentation, practical designs strategies for productivity improvement of limited natural resources (brainstorming, group discussions and presentations for creative design ideas)

EN5302 **Climate change and Clean Development Mechanism   (3 credits)**

Climate as dynamic system, Past, recent and future climate change, Green house gas emission, Adaptation, Eco-system and Biodiversity, energy production and use, climate change assessment tools, reclamation of lands, Environmental Management. Risk assessment methodology

EN5201 **Pollution, Waste Management and Recycling (2 credits)**

Philosophy of resource management, Reasons for pollutions, major categories in pollution, issues and practice in Waste Management, environmental legislation, policy and leadership, waste treatment technologies, waste as a resource municipal solid waste management scenarios (incineration, landfill, gasification, gasification with recycling), System with zero waste.

Major Subject streams: Renewable energy (No of credits 7)

EN5303 **Bio Energy Production technology (3 credits)**

The role of bio-energy, incentive programs and future plans, raw-material sources of bio-energy as bio diesel, ethanol, biomass (municipal solid waste gasification and hydrogen fuel cell produced from gasified municipal solid waste) and bio gas, resources and current use. biomass supply systems and bio-fuel refining technologies, quality control and standards, biogas and liquid bio-fuels, combustion technologies in heat and power generation. environmental considerations, constraints and sustainability, invention and innovation related to bio energy

EN5202 **Non-bio energy Production Technology (2 credits)**

Basic principles of solar electricity, solar water heating, wind power, micro hydro-power, heat pumps and their applications for homes, businesses and farms. hybrid energy system, invention and innovation related to non-bio energy.

EN5203 **Energy Management Principles and Practice (2 credits)**

The role of energy in society, energy policies, exponential growth, Energy conservation, trends in energy consumption, energy economics, energy costs and appliance usage, environmental impacts of energy production and consumption, energy systems, energy efficiencies, energy management and energy auditing and agricultural system analysis.

Major Subject streams: Agro Entrepreneurship Development (No of credits 2)

EC5204 **Agro Entrepreneurship Development (2 credits)**

Management policy, elements of financial accounting, agro-business environment, agro-business ethics & entrepreneurship, organizational management , human resource management.

Other Courses (No. of credits 5)

Following courses offered for the degree will be required as tools to perform the study area of the Green Technology.

CC5201 **Statistic for research (2 credits)**

Descriptive statistics, introduction to estimation and confidence intervals, the normal distribution, confidence intervals for means and proportions, introduction to hypothesis testing, t-test, F-test, multiple comparisons, analysis of variance, design of experiments, correlation and straight line regression, multiple regression, analysis of categorical data;

CC5205 **GIS and Remote Sensing (2 credits)**

Principles of GIS, image Analysis, GIS Applications, advanced GIS applications and modeling, integrated remote sensing and GIS, current Issues in GIS, cartography and data visualization

EN5206 **Innovation led sustainable growth (2 credits)) (2T) (30 hrs)**

Definition of innovation, Systems of innovation approaches, Entrepreneurship, Integration of policy maker, Society, Industry and Institute, Small and medium size companies, Intellectual Property Rights (IPR), Genetic resources, Research for innovation, Commercialization of research, International practices and experience of creative process for foresights, strategic changes

CC5103   **Computer programming (2 credits))**

Introduction to programming languages, microsoft.NET, framework, basic language concepts, control flow and error handling, object oriented programming, visual studio 2005, visual basic.NET, debugging visual basic applications, database handling.

COURSE MODULES- Optional

CC5207   **Soft skill Development (2 credits)**

English, ICT,

EN5205   **Precision Agricultural Technology (2 credits)**

Guidelines for adopting precision Agricultural practices, Site specific management strategies used in precision agriculture and tools, Potential application of remote sensing, Collection of crop, field data, Yield data, Mapping of land and crop information using GIS techniques, Variable Rate Technology (VRT) in precision Agriculture, Techniques for conducting field scale research with precision agriculture tools.

EN5106   **Environnent and Cinéma (2 credits)**

CC5106   **Literature Survey and virtual referencing (2 credits)**

EN5107   **Farm Buildings and Controlled Environments (2 credits)**

EN5102   **Analytical Techniques & Green Experimental Tools (2 credits)**

Introduction to instrumentation and measurements, Common methods of analytical techniques, Direct and indirect measurements, Green analytical techniques, Non-destructive measurements, visual, acoustic, capacitance, Ultrasonic, CT, radiometric etc. Benefits of non-destructive techniques, working principles of common nondestructive analytical techniques, NIR spectroscopic methodology as a typical non-destructive tool. Applications of NIR spectroscopy in agriculture, precision agriculture, dairy industry, fruit and vegetable, flour milling, traceability studies. Reference methods and evaluation, instrument calibration, reference analysis.

EC5201   **Project management (2 credits) (T1:P1)**

CC5202   **Environmental Modeling (2 credits)**

Course code	Course	Credits No	
		T	P
EN5301	Natural Resource Systems	2	1
EN5302	Climate change and Clean Development Mechanism	2	1
EN5201	Pollution, Waste Management and Recycling	1	1
EN5303	Bio Energy Production technology	2	1
EN5202	Non-bio energy Production Technology	1	1
EN5203	Energy Management Principles and Practice	1	1

EC5201	Agro Entrepreneurship Development	1	1
CC5201	Statistic for research	1	1
CC5202	GIS and Remote Sensing	1	1
EN5204	Instrumentation and Measurement techniques	1	1
EN5206	Innovation Lead Sustainable Growth	1	1
CC5203	Computer Programming	1	1
EN5207	Precision Agricultural Technology	1	1
EN5208	Environment and Cinema	1	1
CC5205	Literature Survey and virtual referencing	2	
EN5209	Farm Buildings and Controlled Environments	1	1
CC5204	Soft Skill Development	1	1
CC5206	Experimental and Analytical technique	1	1
EC5202	Project Management	1	1
CC5207	Environmental Modelling	1	1

TEACHING /LEARNING METHODS

- ❖ Lectures
- ❖ Tutorials and seminars
- ❖ Laboratory and practical classes
- ❖ Fieldwork and Field trips
- ❖ Computer-based methods –Using '*Moodle'* Software
- ❖ Independent learning tasks- Group assignments and student centered activities
- ❖ Essays, dissertations and project
- ❖ Library searches and internet browsing
- ❖ Videos and posters

STRUCTURE OF THE PROGRAM

One credit unit is defined as 15 hours of teaching, 30 hours of practical work or 45 hours of field studies subjected to the approval of faculty board of the Faculty of Agriculture and the Senate of the University of Ruhuna.

	Maximum	Minimum
Number of course credit hours per semester	18	09
Total number of credits for course work		30
Total number of research credits		20
Total number of credits from core courses		22
Total number of credits from Optional courses		08

A minimum of two academic years (4 Semesters) shall ordinarily be required for the completion of course work, research, thesis / project preparation and examinations leading to the award of the M.Sc. degree.

The two-year Master of Science Degree is 30 credits of coursework and 30 credits research thesis. First year (2 semesters) are allocated for the course works which are comprised of compulsory and optional courses.

Not more than 3 credits earned from special studies may be counted towards the credit requirement of the Master program. It is possible to substitute some credits from other approved modules taken at B.Sc. degree courses.

The course will be 2 years. The course is fully taught in the first year with 30 credits and 30 credits research will be conducted during the second year. Candidates who will not perform sufficiently well in the first part of the course (at least 2.5 GPA) may be allowed to have Post Graduate Diploma with minimum GPA of 2.0. All the requirements for the degree must be completed within four years of first registration for the degree of Master.

EVALUATION PROCEDURE

Courses shall be evaluated on the basis of assignments, seminars, mid semester exam and end-semester examination.

Limitations of the marks for each component;

Criterion	Maximum	Minimum
End Semester Examination	80%	50%
Mid Semester Examination	25%	-
Practical / field Work/ Case study	25%	-
Assignments / Seminars	25%	-
Oral Examinations (End Semester)	10%	-

Assessed coursework includes computer and internet-based assignments, as well as laboratory and written reports. Some modules include formal examinations. All participants make at least two seminar presentations. Many participants come with considerable relevant experience, and are encouraged to share and develop these both informally and in assessed work. Most work is assessed on an individual basis, but some small-group assignments are also included.

End semester examination should be conducted within last two weeks of the semester. Normally the semester shall be 15 weeks.

Grades and Grade points shall be assigned for each course according to the following table.

Marks (%) (Out of 100)	Grade	Points
≥85	A+	4.0
80 – 84	A	4.0
75 – 79	A-	3.7
70 – 74	B+	3.3
65 – 69	B	3.0
60 – 64	B-	2.7
55 – 59	C+	2.3
50 – 54	C	2.0
45 – 49	C-	1.7
40 – 44	D	1.3

40>		F	0

For passing a course the student should obtain a minimum of C grade. Overall Grade Point Average (GPA) is calculated using the formula;

$$GPA = \frac{\sum C_i G_i}{\sum C_i}$$

Where;
  C_i is the number of credits for the ith course
  G_i is the grade point obtain for the ith course

The students should maintain the GPA at the level of 2.5 or above. The student should repeat the courses which he/she got less than D grade at the next earliest opportunity and the students can obtain a maximum of B- grade. When the student has obtain C- or D grades for a course, he/she has alternatives either to repeat the course and /or to keep the grade as it is if the student can maintain the minimum GPA requirement.

Comprehensive Examination

After completion of the required number of course credits subjected to requirements of core courses and optional courses the student can apply for comprehensive exam. Board of the study will arrange examination panel with three members out of the teaching panel for the comprehensive oral examination. Student should obtain a Satisfactory "S" grade to be eligible to award the Post Graduate Diploma in Green Technology.

Thesis Examination

For the thesis examination of the Master's degree program shall consist of a Committee. The examination shall include an oral presentation and defense by the candidate of his/her thesis and questions to test the candidate's knowledge of related areas. An announcement of the thesis examination must be made not less than seven working days prior to the examination. A copy of the thesis should be given by the candidate to each member of the Committee at least seven working days prior to the examination. If a thesis is judged to be satisfactory, the Program Committee will grade it: Excellent, Very Good, Good or Fair.
If there are minor modifications recommended by the external examiner, the student can submit the corrected thesis within a period of three months. If External examiner / board of examiners recommend to resubmit or to rewrite the thesis, the student should resubmit the thesis after six months period and should be registered for another semester.

Releasing Results of the End Semester Examinations

Course instructors will send the results of each course within four weeks after conducting end semester examinations to the course coordinator. After receiving all end semester examination marks of the specific semester, course coordinator will send the calculated marks to the Senior Assistant Registrar of Examination with necessary calculations and assigned GPA and grades with the approval of the Head of the Department of Agricultural Engineering.

Result boards of the end semester examinations consist of following members;

- Vice Chancellor (Chairman)
- Dean of the Faculty of Agriculture
- Director (Postgraduate studies)
- SAR (Examination)
- Head of the Department of Agricultural Engineering
- Course coordinator
- Professors of the Department of Agricultural Engineering
- All examiners of the courses

COURSE FEE & METHOD OF PAYMENT

As the program is designed to be a self financed project following fee structure is designed to cover the expenditure of the postgraduate program.

Application fee –SL Rs. 500 .00
Registration fee - SL Rs. 1000.00/semester
Library fee – SL Rs. 2000.00 refundable +1000/year
Internet/Computer fee- SL Rs.2000 per program
Examination fee - SL Rs. 500.00/course
Tuition fee- SL Rs.70,000
Tuition fee (PGDip students) SL Rs. 50,000
Research Project fee (MSc students) SL Rs. 30,000
Thesis submission fee for Post Graduate students - SL Rs. 5000.00
Comprehensive examination fee (PGDip students) -SL Rs. 1000

Non–refundable application fee should be paid at the time of obtaining the application form. Admission fee and refundable library fee should be paid at the time of registration. Tuition Fee for each semester should be paid at the beginning of the each semester.

Financial matters will be handled according to the financial regulations of the university.

Examinations, Records, Certificates, Transcripts and other administrative procedures shall be according to the examination and administrative procedures of University of Ruhuna.