

Bachelor of Science in Green Technology (B.Sc in G.Tech)

1. Introduction

The University of Ruhuna, Faculty of Agriculture comprises of seven departments. The B.Sc. (Agric) degree has been offered from the inception of the faculty in 1978. The students' intake of the faculty at the beginning was about 20 per year and now, it was increased up to 150 per year. The most of staff members has completed the postgraduate studies in various disciplines related to natural sciences and their capabilities with respect to modern knowledge and technologies are quite expanded. Apart from the bachelor degree courses, the regular Master degree programs have already been initiated in the recent past related to agriculture and natural resources management, basically, due to higher demand in the southern province of Sri Lanka. The faculty has decided to offer several parallel bachelor degree programs for the expanding of student intake of the faculty as well as providing the opportunity for the student to study in various disciplines according to their wish and country demand while utilizing the human resources in the faculty efficiently. The B.Sc in GT degree program was basically formulated to produce graduates who can contribute the national development using modern technologies while minimizing the environmental degradation occurred due to the development activities.

With the development, the natural resources are being heavily utilized, reduced and polluted creating numeric problems for all living beings in the world. Therefore, for the sake of all living being, it is essential to utilize natural resources for the betterment of the human needs and development by minimizing the environmental burdens associated with them. Officers in government, non-government and private organizations who work in the development projects, especially in rural areas where more priorities have been identified for the future development, should arm with the knowledge and technology which can be used for the sustainable development through production and services by minimizing the environmental burdens. At present, officers of the government, private and non-government organization who work in development projects is not much consider about environment which vital for the sustainable development. This degree program produces graduates who are capable of working in development projects including service based organizations with considering the environmental aspects also. The course will cover environment management, renewable energy production, energy efficiency, crop production for bio-based products, sustainable land use, waste management and recycling, traditional/indigenous technology, production technologies for bio-products, environmental improvement, efficient management of water and quality management.

A graduate in B.Sc. Green Technology should be a professional for rural development, small-scale renewable power generation, sustainable production of crops for energy, raw materials for industry, and infra structure development with the integration of

sustainable concepts in a multidisciplinary approach to the environmentally sensitive production with resource optimization by maintaining environmental quality standards.

2. Objectives

The objective of this degree program is to produce B.Sc graduates combining technical and scientific skills with an understanding of the environment, renewable energy management, waste utilization, resource management and land based industries who can contribute to the national and global development.

3. General course description

The course will cover environment management, renewable energy production, energy efficiency, crop production for bio-based products, sustainable land use, waste management and recycling, traditional/indigenous technology, production technologies for bio-products, environmental improvement, efficient management of water and quality management.

4. Graduate Profile

A graduate in B.Sc. Green Technology should be a professional for rural development, small-scale renewable power generation, sustainable production of crops for energy, raw materials for industry, and infra structure development with the integration of sustainable concepts in a multidisciplinary approach to the environmentally sensitive production with resource optimization by maintaining environmental quality standards.

5. Job Profile

Based on the outcome of the seminars, discussions and workshops conducted and participated, it was identified that there is a great opportunity for B.Sc Green Technology graduates employ in government, non-government and private organizations as consultants, development officers, managers, environmental officers, technical officers, extension officers, and similar positions in wide variety of fields

6. Entry Requirement

Candidates should meet the following requirements

- They should be qualified for entry requirements set by University Grant Commission in Sri Lanka to admit students to Universities in biological stream. (Biology, Chemistry, Physics/Agriculture/Soft technologies)
- Candidates should have at least grade “C” pass for English in GCE (O/L) examination.

7. Number of students per Year

Maximum number of candidate admitted to this course in a year will be limited to fifty (50).

8. Duration of the course

The academic program leading to the Degree of B.Sc. in Green Technology shall be a full time course organized on a two semester system, over a period of four academic years. Thus the degree program shall consist of 8 semesters. Each course will be taught and evaluated within the semester. And end semester examinations will be held at the end of each semester. One semester (except last two semesters) consists of 15 weeks of academic work. Courses will be evaluated under the credit scheme. Fourth year first semester will be allocated for an industrial training. Fourth year second semester will be a research project extending a maximum of six month duration.

9. Degree Offered

B.Sc (Hons) Green Technology will be offered to candidates who have successfully completed the required courses, industrial training and the research component.

10. Structure and Design of curriculum

10.1 Major Thematic Areas of the Degree Course

Sustainable Resource Management (SRM)

- Natural Resources of Sri Lanka
- Efficient Use of Natural Resources
- Conservation Principles
- Environmental Pollution
- Environmental Sociology
- Laws and Regulations with respect to Natural Resources and Pollution Prevention
- Human Resources Management

Sustainable Environmental Design (SED)

- Land Use Planning
- Environmental tools
- Environmental Economics
- Wildlife and Biodiversity
- Project Planning
- Climate Change
- Carbon Crediting

Sustainable Environmental Technology (SET)

- Wastewater Management
- Solid Waste Management
- Emission Control
- Cleaner production
- product Processing
- Quality Management
- Indigenous Technology

Sustainable Energy (SE)

- Energy and Development
- Renewable Energy Sources
- Energy Analysis and Management

10.2 Course Structure

Year	Semester	Compulsory	Optional	Total
1	I	15		15
	II	15		15
2	I	15	2	17
	II	15	2	17
3	I	16	2	18
	II	16	2	18
4	I	Industrial Training (06) Course Modules (06)		08
	II	Research (08)		12
Total		112	08	120

10.3 Credit Criteria

One credit is equal to 15 hours of lectures or 30 hours of practical. Numbers of Compulsory credits are 112 and number of optional credits would be 8 – 20 for the degree.

10.4 Courses Offered and Course Notations

Year	Semester	Compulsory	Thematic Area (compulsory)	Optional	Thematic Area (Optional)
1	I	CC1101 Basic Mathematics (2) CC1102 Information and Communication Techn. (2) ID1101 Environment and Pollution(2) EC 1101 Economic principles (2) EN 1101 Applied Hydrology and Climatology (3) ID1102 Atmospheric Pollution and Prevention (2) ID1103 Natural Resources of Sri Lanka (2) [15]	- - SRM SRM SRM SRM SRM		
	II	CC1201 Basic Statistics (2) BL1201 Environmental Biotechnology (2) SS1201 Introductory Soil Science (2) EN 1201 Virtual Water and Water Foot Print (2) EN 1202 Renewable Energy I (2) BL 1202 Biodiversity and Wildlife (2) EN 1203 Climate Change and Carbon Balancing (3) [15]	- SET SRM SRM SE SED SED		
2	I	EN2101 Machinery Principles and power units (2) EN2102 Renewable Energy II (3) EN2103 Biomass Energy Technology (2) EC2101 Environmental Economics (2) ID2101 Introductory Green Chemistry (2) ID2102 Basic concepts of Quality and Productivity (2) EN2104 Energy analysis and budgeting (2) [15]	SET SE SE SED SED SRM SE	ID2103 Electronics and Instrumentation (2) CS2101 Urban Agriculture (2) BL2101 Introductory Plant Protection (2) CC 2101 Data Base Management (2) [2]	SED SET SET -
	II	EN2201 Water Resource Management (2) AS2201 Sustainable Livestock Production Systems (2)	SRM SRM	ID2202 Cleaner Production (2) EN2205 Phytoremediation (2)	SET SET

		CS2201 Sustainable Crop Production Technology (3) EN2202 Biogas technology (2) EN2203 Sustainable Solid Waste Management (2) ID2201 Green Buildings Designing (2) EN2204 Ergonomics (2) [15]	SET SE SET SED SED	EN 2206 Composting technology (2) EN2207 Water Quality and Purification (2) [2]	SET SET
3	I	EN 3101 GIS and RS (2) CS 3101 Landscape Architecture (2) ID 3101 Waste Water Treatment (2) EC 3101 Business Management and Entrepreneurship (2) EC 3102 Eco-tourism (2) EN 3102 Post Harvest Technology (2) FS3101 Organic Food Production and Preservation (2) CS 3102 Forest Ecology (2) [16]	SRM SED SET SRM SRM SET SET SRM	CC3101 Rapid Application Development (2) EC3103 Human Resources Management (2) EN3103 Integrated Water Resource Management (2) EN3104 Precision Agricultural Technology (2) [2]	- SRM SRM SED
	II	CC 3201 Applied Statistics (2) CC 3202 Research methodology Scientific Writing (2) ID 3201 Quality management tools and problem solving (2) ID 3202 Life Cycle Assessment (2) EC 3201 Project Planning and Management (2) CC 3203 Carrier Development (2) ID 3203 Indigenous Knowledge Systems (2) ID 3204 Green Productivity (2) [16]	- - - SED SRM - SRM SED	ID3205 Building Wiring and Air Condition (2) SS3201 Sustainable Land Use Management (2) EN3201 Ecological Sanitation (2) ID3206 Environmental Evaluation (2) [2]	SET SRM SET SED
4	I	Industrial Training (6) (3 months) ID4101 Disasters and Green Solutions (2) ID4102 Innovation and Technology Transfer (2) EN4101 Non destructive measurements (2) [12]			
	II	Research (6 Months) [8]			
Total		112		08	

Course notation consists of two letters at the beginning representing the relevant department as follows,

AS – Department of Animal Science
BL – Department of Agricultural Biology
CS – Department of Crop Science
EC – Department of Agricultural Economics and Extension
EN – Department of Agricultural Engineering
FS – Department of Food Science and Technology
SS – Department of Soil Science
CC – Common Courses
ID – Inter Department

The first digit of number after two letters represents the year that particular course is offered and the second number represents the semester that particular course is offered in the year. Last two digits indicate the course number of the department for the semester.

• **CC1101 Basic Mathematics (2:15T+30P):**

Numbers, Inequalities, Intervals, Quadratic and cubic functions, Coordinate geometry, Limits and derivatives, Differentiation, Maxima and Minima, Integration of functions, Applications of Differentiation and Integration, Basic Mathematical Models.

• **CC1102 Information and Communication Technology (2:15T+30P):**

Introduction to operating systems, Word processing, Spread sheet application, Data base management, Presentation applications, Introduction to computer programming (Visual Basic).

• **ID1101 Environment and Pollution(2:15T+30P):**

Introduction to GT, Definition, principles background and scope of environmental science, Understanding of environment and measurements, Environmental Science and technology, Media and people, decision making and applications of Environmental Science. Environmental ethics, Global and national environmental issues, Human impact on environment and its consequences

• **EC1101 Economic principles (2:15T+30P):**

Nature, definitions, scope and importance of economics, Economics as a science, Basic micro-economic concepts, theories of consumption, production and markets, Pricing of products and factors of production, Profit maximization and cost minimization, Introduction to welfare economics, Mathematical approach of economic analysis

• **EN1101 Applied Hydrology and Climatology (3:30T+30P):**

Hydrological cycle, components in hydrological cycle, Soil water relationships, Plant water relationships, Water movement in the soil, Water requirements of crops.

• **ID1102 Atmospheric Pollution and Prevention (2:15T+30P):**

Air Quality standards, Emission standards, Criteria pollutants, Air pollution and meteorology, Atmospheric stability, Atmospheric dispersion, A line-source dispersion model, Area-source models, Indoor air quality, Indoor air quality model, Emission control, Emission controls for vehicles.

- **ID1103 Natural Resources of Sri Lanka (2:15T+30P):**

Population, Economic development and trends, land resources, Water resources, Energy resources, Mineral resources, Forest resources, Coastal and marine resources, Inland aquatic resources, Biological diversity, Towards sustainable development.

- **CC1201 Basic Statistics (2:15T+30P):**

Introduction to data analysis, Probability, Probability distribution, Sampling distribution, Hypothesis testing, one sample tests of hypothesis, Test of hypothesis involving two samples

- **AB1201 Environmental Biotechnology (2:15T+30P):**

History of biotechnology; Microbes and metabolism, Fundamentals of biological interventions, Biotechnology for environmental monitoring, remediation, reduction or removal of wastes, and pollution prevention; Improvement of biota for energy generation, environmental friendly products, Future prospects.

- **SS1201 Introductory Soil Science (2:15T+30P):**

Soil as a live body; physical, chemical and Biological properties of soil; Soil formation, Soil Taxonomy, Soils of Sri Lanka.

- **EN1201 Virtual Water and Water foot print (2:15T+30P):**

Issues on virtual water; virtual water footprints, virtual water cycle and calculator, virtual water in food production and trade, virtual food consumption; food storage as reservoirs of virtual water, passage from real to virtual water, Virtual water value, Concept of marginal virtual production site, principles in assessing virtual water, applications and features of virtual water, computing virtual water trade at global level, applying the principle of marginal gain in estimating virtual water, virtual water imports generates real water savings, virtual water trade generates global real water savings, food storage generates real water savings, high value of virtual water of sea products, impacts of diet changes on water requirements, historical decline of water needs for food.

- **EN1202 Renewable Energy I (2:15T+30P):**

Concept of Energy, Units and Measurement, Types of energy, Energy and Power, Energy demand, History of fossil fuels, Sources of Energy, Solar, wind, biomass, animal, human.

- **AB1202 Biodiversity and Wildlife (2:15T+30P):**

Biodiversity Management, Pollinator Management. Biodiversity Management Master Plan these two topics, Pollinator Utilization and Conservation & Soil Fauna Conservation and Utilization, Sensitive ecosystem inventories. Wildlife ecology and management.

- **EN1203 Climate Change and Carbon Balancing (3:15T+60P):**

Weather, climate, factors affecting for climate change, greenhouse gases, greenhouse effect, Impact of climate change on natural resources. Ecological footprint, Life Cycle Assessment (LCA), carbon footprint of products, persons, feature of carbon offsets, carbon credits, carbon trading.

- **EN2101 Machinery Principles and Power Units (2:15T+30P):**

Different types of engines and their working principles, Systems in engines; Power transmission by gears, belts, fluids, etc.

- **EN2102 Renewable Energy II (3:30T:30P):**

Energy in water, Power contained in Static and flowing water, Components in a hydropower system, Energy assessment, Site assessment; configuration, sizing, installation and maintenance issues of a micro hydropower system, economic evaluation. Tidal waves Energy, Nuclear energy, Fuel cells and Hybrid technologies.

- **EN2103 Biomass Energy Technology (2:15T+30P):**

Biomass classification, Biomass characteristics, Biomass production techniques, Harvesting of biomass, Biomass processing for rural use, Energy efficiency biomass burner, Gasifier and its process, Producer gas, Bio-ethanol production, bio-diesel production, Electricity generation from biomass.

- **EC2101 Environmental Economics (2:30T):**

Natural resource economics, the fundamental balance, terminologies, Cost-benefit analysis. Biological valuation, Environmental economic analysis- impact, cost-effectiveness, benefit-cost, risk. Case studies. Environmental policy, modeling Pollution,

- **ID2101 Introductory Green Chemistry (2:15T+30P):**

Introduction to chemistry, Organic chemistry, Biological molecules (Isomerism, proteins, polysaccharides, nucleic acid, etc.), Microbial metabolism, Water quality chemistry (Oxygen demand, BOD, COD, Acidity, Alkalinity, Hardness, Chemical characteristics of freshwater, Chemistry and Environmental remediation.

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- **ID2102 Basic concepts of Quality and Productivity (2:30T):**

Total quality management productivity indicators, cooperate culture for quality and productivity improvement, KAIZAN and continuous improvement.

- **EN2104 Energy analysis and budgeting (2:15T+30P):**

Energy flows and suppliers, Energy basics (Units , measurements, etc), Global and Domestic energy demand, Energy inputs and Outputs in Agricultural Products, Energy sources, Energy flow in production process, Energy auditing, Energy conservation

- **EN2201 Water Resource Management (2:15T+30P):**

Surface and ground water resources, Wetland conservation, Runoff routing, Design and construction of a minor irrigation tank, Dam construction, Spillways and spillway design, Hydrology of a farm reservoir, Ground water estimation, Different wells and construction.

- **AS2201 Sustainable Livestock Production Systems (2:15T+30P):**
 History and evolution of livestock production; present situation of the livestock industry, Animal husbandry Vs Animal Industry; Nutrient, water and energy cycles through livestock systems; Utilization efficiencies of nutrient, water, and energy in livestock systems; Environmental burdens of livestock industries; Feeding strategies for sustainable livestock production, crop and livestock breeding strategies for sustainable livestock production; Concepts and practices of organic livestock production systems; Livestock as components of integrated farming systems.
- **CS2201 Sustainable Crop Production Technology (3:30T+30P):**
 Crop and environment, Basic crop requirements, Inputs in crop production, Land preparation, Land management, Harvesting technologies.
- **EN2202 Biogas technology (2:15T+30P):**
 Importance of biogas production, Biological process involved in Anaerobic digestion, Suitable raw materials, factors affecting for biogas production, Uses of biogas, uses of digested material, Designing of small biogas digesters, Construction of a digester, Industrial level biogas plants for electricity generation.
- **EN2203 Sustainable Solid Waste Management (2:15T+30P):**
 Wastes, Classification, Waste generation and composition, Properties of wastes, Basic requirements of waste management, 3R concept, Waste management techniques, Waste collection, Sorting, Concepts of sustainable waste management, Development of Integrated Sustainable Waste Management System.
- **ID2201 Green Buildings Designing (2:15T+30P):**
 What is green building?, architecture of green building, planning and management of green building,
- **EN2204 Ergonomics (2:15T+30P):**
 Definition, The application of ergonomic principles, Development in Ergonomics, Ergonomic Model, The Nature of Basic Human Factors involve in performing the task, Anthropometry, Application of Anthropometric Data Design Consideration, Main body types, Body measurement categories, Use of Anthropometric Data, Body motions, Terms used in Body movement, Body Movement Classification, Energy Expenditure in Physical Activities, Working posture, Work-Space Layout, Operator Exposure to Environmental Factors, Thermal Comfort in Operator Enclosures.
- **EN3101 GIS and RS (2:15T+30P):**
 Introduction to GIS, Maps and Spatial Data Management, Spatial data, characteristics and models, Spatial data analyses in GIS, Concepts of Remote sensing, Sensors and Platforms, Interpretation of Satellite Images and Air Photos, Applications of Remote Sensing.
- **CS3101 Landscape Architecture (2:15T+30P):**
 Landscape drafting, Plant design, Landscape technology, Open space design, Urban design, History of architecture, Landscape construction, Lawn Sprinkler System and Drainage, Water

Gardening, Annual and Perennial Culture, Home Landscape Construction, Habitat Gardening, Home Landscape Design, Horticulture Internship

- **ID3101 Wastewater treatment (2:15T+30P):**

Problem of wastewater, Sources, Properties of wastewater (physical, chemical, biological, etc), different treatment technologies (Physical, Chemical, Biological including Phytoremediation), Wastewater sampling and analysis.

- **EC3101 Business Management and Entrepreneurship (2:30T):**

Introduction to Management, Manager as Leader, Management Functions and Decision Making, Planning and Organizing, Implementing and Controlling, Human Resource Planning, Employee and Organizational Development, Organizational Communication, Definition of entrepreneurship, business plan outline, business model, attracting stakeholders.

- **EC3102 Eco-tourism (2:15T+30P):**

What is eco tourism, Current issues in eco tourism, Global environmental travel, ecotourism travel plan development, agro tourism.

- **EN3102 Post Harvest Technology (2:15T+30P):**

Post harvest systems, Methodology of loss assessment and estimation, Village level practices, Preservation and processing of selected crops (drying and dehydration, refrigeration and freezing), Psychometry, Storage, Packaging, Post harvest systems for grains, Post harvest systems for fruit and vegetables, Post harvest engineering and Processing of Spices: Cinnamon, Citronella, Distillation technologies for Essential oils. Mathematical principles and application in food processing, Material and Energy balances, Heat transfer, Thermal process calculation, Emerging technologies in food processing, Process control in food processing, Separation, Mixing emulsification and size reduction in food processing.

- **FS3101 Organic Food Production and Preservation (2:15T+30P):**

Introduction to Food Science and Preservation, Food losses, Organic Food Production Techniques, Consumer demands for organic foods, Food Preservation by removal of Heat, Food Preservation by application of heat, Postharvest Technology, Organic Food Preservatives, Green Food Packaging, Green techniques used in Food Preservation and Processing.

- **CS3102 Forest Ecology (2:15T+30P):**

Ecosystem concepts, The physical and biotic environment, Ecological energetic, Transfer and storage of energy in ecosystem, 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 forest, Disturbance in ecosystems and regeneration of soil and vegetation, Gap theory.

- **CC3201 Applied Statistics (2:15T+30P):**

Analysis of variance, Two factor analysis, Linear regression and correlation, Goodness of fit tests for categorical data.

- **CC3202 Research methodology Scientific Writing (2:15T+30P):**
Research and World Economy, What is research, Concepts, basic requirements, literature survey (Definitions, Information literacy, Sources of information, Search techniques, Search strategy, Evaluate information and judge its quality, Evaluation criteria, Web databases, How to select a proper database, Manual search tools, Interpretation of researched results (Scientific writing).
- **ID3201 Quality management tools and problem solving (2: 15T+30P):**
Process Decision program charts, Matrix data analysis and problem solving processes
- **ID3202 Life Cycle Assessment (2:15T+30P):**
What is life cycle assessment? Benefit of Life cycle approach, Limitations, Structure of Life cycle assessment, Life cycle inventory, Life cycle inventory models, A case study.
- **EC3201 Project Planning and Management (2:30T):**
Introduction to the project planning and management cycle, Project management process and strategic context of projects, Project planning and management cycle, Feasibility analysis and Appraisal of projects, Organizational design for project management, Project planning and management information system, Project monitoring, Evaluation and control, Interpersonal dynamics in the management of projects and the cultural elements, New prospects of projects planning and management.
- **CC3203 Carrier Development (2:15T+30P):**
Development of communication, assertiveness, presentation skills, leadership development.
- **ID3203 Indigenous Knowledge Systems (2:30T):**
Indigenous technology and knowledge on environment and natural resource management and conservation.
- **ID3204 Green Productivity (2:15T+30P):**
Sustainable development, tools and techniques of GP methodology, Green Productivity Strategic plan, Green supply chain and productivity.
- **ID2103 Electronics and Instrumentation (2:15T+30P):**
Introduction to General Electronic Instruments and Devices, Static and Dynamic Performance of Instruments, Diodes Applications and Power Supply, Potentiometer Circuit and the Whetstone Bridge, Transistors and Amplifiers, Applications of OP AMP, Digital Techniques in Instrumentation, Measurement Displacement, Velocity and Acceleration, Measurement Temperature, Moisture, Humidity and Radiation, Measurement of Force and Torque, Measurement of Flow and Pressure, Measurement of Vibration and Noise, Recording Instruments, Data Acquisition and Processing.

- **CS2101 Urban Agriculture (2:15T+30P):**
Hydroponic, Aeroponics, Roof Gardening, Protected houses, Poly-tunnel Techniques
- **AB2101 Introductory Plant Protection (2:15T+30P):**
The biological basis of agricultural biology, crop production and protection, and ecosystem management, Abundance, diversity and distribution of invertebrates, non-insect arthropods, insects in agro-ecosystems; functional relationships among different groups. Biology, importance and management of, Termites, Wasps, Ants and Bees, Indicators of sustainability; diversity of natural systems, conservation areas, Industrial plant pathology and entomology, Forensic Plant Pathology and forensic entomology. Use of bio control agents and other techniques in modern agriculture, Modern techniques in identification and diagnosis of plant pathogens and pests, diseases and weeds diagnosis. Practical aspects of pest, disease and weed management - Preventive methods, monitoring systems, intervention methods for pest and disease management Identification of common pests and diseases and weed flora, Molecular biological applications and genetic engineering in plant protection, Computer modeling and pests and disease forecasting, Use of modern telecommunications in pests,
- **CC2101 Data Base Management (2:15T+30P):**
Introduction to Database Systems, Databases and Database Users, Database System Concepts and Architecture, Data Modeling Using the Entity-Relationship (ER) Model, The Relational Data Model and Relational Database Constraints, Relational Database Design by ER to Relational Mapping, Introduction to Structured Query Language (Oracle/My SQL); SQL: Schema Definition, Constraints, and Queries; Restricting and Sorting Data, Displaying Data from Multiple Tables, Aggregating Data Using Group Functions, Manipulating Data.
- **ID2202 Cleaner Production (2:15T+30P):**
What is cleaner production, Importance of cleaner production, Steps of cleaner production, Flow chart, Material balances, Energy balances, Cost assignments, Review process, Generating cleaner production opportunities, Selection of Workable opportunities, Implementing cleaner production, Monitoring and evaluation, Sustain cleaner production, Limitations and opportunities, A case study.
- **EN2205 Phytoremediation (2:15T+30P):**
Introduction, Overview of Phytoremediation, Technical Considerations, Economic Considerations, Regulatory Considerations, Ecosystem Restoration, Evaluation of Phytoremediation Technologies (Phytoextraction, Rhizofiltration, Phytostabilization, Rhizodegradation, Phytodegradation, Phytovolatilization, Hydraulic Control, Vegetative Cover Systems, Riparian Corridors/Buffer Strips), Phytoremediation System Selection and Design Considerations; Remedial Objectives, Treatability, and Evaluation; Introduction to onsite wastewater treatment systems.
- **EN2206 Composting technology (2:15T+30P):**
What is composting?, Advantages and limitations, Raw materials, Essential requirements, Different technologies, Selection criteria, Quality of compost, How to use compost.
- **EN2207 Water Quality and Purification (2:15T+30P):**

What is water quality?, Water quality for agriculture, Water quality for industry, Water quality for drinking, Water purification technologies for drinking and other purposes

- **CC3101 Rapid Application Development (2:15T+30P):**

Introduction to programming languages, Concepts of RAD, Visual Basic – Foundation Level, Develop reusable modules, Database handling using Visual Basic.

- **EC3103 Human Resources Management (2:30T):**

Introduction to HRM (HRM function in Organization, Leadership, Management style and team work, Decision making) Strategic HRM (Role of HRM function for strategic formulation, Competence of HR Manger, Acquiring Human Resources (HR planning recruitment and placing), Developing Human Resources (Motivation, Training, Employee development and career management), Performance Management (Job Evaluation, Assessing work, performances appraisal, managing employee Benefit), Managing Internal and External Environment (Legal Environment and employee Relation, working condition, Health and safety), Counseling.

- **EN3103 Integrated Water Resource Management (2:15T+30P):**

Introduction to IWRM, Important of IWRM, Water management principles, Water users, Process of implementing IWRM, Policy and legal frame work, Institutions frame work, Practical management instruments, Water supply and sanitation.

- **EN3104 Precision Agricultural Technology (2:15T+30P):**

Guidelines for adopting precision Agricultural practices, Management of information relevant to Precision Agriculture: Basic, strategies and tools, Potential application of remote sensing, Collection of crop, field data and mapping, Procedure for accurate yield mapping, Yield map interpretation, Data layer smoothing and interpolation in yield mapping and interpretation, Mapping of land and crop information using GIS techniques, Variable Rate Technology (VRT) in precision Agriculture, Site specific management strategies used in precision agriculture, Adoption and economics of precision agriculture technologies, Site specific management of crop and land parameters , Techniques for conducting field scale research with precision agriculture tools.

- **ID3204 Building Wiring and Air Condition (2:15T+30P):**

Basics of electricity, conductors, safety devices, insulators, two phase and three phase wiring, Principles of air condition, criteria for air condition, layout.

- **SS3201 Sustainable Land Use Management (2:15T+30P):**

Land degradation causes, Impacts, Need of land improvement, Land improving technologies.

- **EN3201 Ecological Sanitation (2:15T+30P):**

What is ecological sanitation?, Sanitizing human excreta, Design and management features, recycling the nutrients, Grey water and management; Planning, promotion and support; Future development.

- **ID3205 Environmental Evaluation (2:15T+30P):** Environmental tools, Initial environmental evaluation, Concept of Environmental impact assessment.

- **ID4101 Disasters and Green Solutions (2:15T+30P):** Introduction to disasters (natural, manmade, water related), impact of disasters on community/culture, Economics of disasters, Pre disaster preparedness and vulnerability reductions, Post disaster response relief and rehabilitation, disaster mitigation and long term developments, Information technology in disaster planning.
- **ID4102 Innovation and Technology Transfer (2:15T+30P):** Importance of innovations, sources of innovations and networks, commercial exploitation of science and technology, new trends in technology management, importance of bridging network for technology transfer, importance of intellectual properties and patenting.
- **EN4101 Rapid Non Destructive and Chemical free Detection (2:15T+30P):** Fundamentals of non destructive detection, Non invasive detectors and transducers, Basic Principles of Near Infrared Spectroscopy, NIRS and its early history, The Advantages and Disadvantages of NIRS, NIR instruments, Instrument durability, Spectral quality, Useful Statistics for Evaluating NIRS Calibrations, Discriminate Analysis, Distribution of differences between NIRS and reference data, Data handling, Mathematical pretreatment, Scatter correction, Calibration model development and evaluation, Outlier detection, Special graphics, Basic Steps in Calibration, Reference methods and their error, Assembly of samples, Preparation of samples for scanning, Scanning of samples, Reference analysis, Calibration development, Verifying accuracy and reproducibility, Calibration transferability, How to Improve a Calibration. NIRS in Feed Industry, Flour Milling, Forage Analysis, Grain Handling, Manure Analysis, Plant Breeding, Precision Agriculture fruit and vegetable quality grading.

11. Teaching Method

The courses will be conducted through lectures, tutorials, assignments, field visits, and practical in the laboratory as well as in field sites where necessary. Each course would comprise 15 hrs lectures and 30 hrs laboratory works, field works or self study activities. Students centered learning activities such as cooperative learning, problem based learning will be practiced to give them more opportunity to actively participate their learning activities. The computer based (Moodle) system will also be used for the teaching activities where possible.

12. Evaluation Procedure

Each course will be evaluated during the course period and end semester examinations. The continuous evaluation will be performed by assignments, reports, self study modules, computer

based exams (Moodle), presentations, etc. Examination and grading will be performed according to the examination bylaws set by the Faculty of Agriculture, University of Ruhuna. Minimum 50 % of the marks will be allocated for the end semester examination.

Industrial Training and Evaluation

Fourth year first semester will be allocated for industrial training. The Faculty of Agriculture, University of Ruhuna shall arrange the places where students should get trained. The training period shall be 3-6 months depending on the availability of training opportunities. The students should make presentation after completing of the training for the evaluation. In addition they should submit a comprehensive report also. It is compulsory to submit progress reports each and every month during industrial training. Final marks allocation for the industrial training will be given based on the performance of the progress and final reports submitted at the end of the industrial training.

Research Project and Evaluation

After the successful completion of the industrial training, students should undertake the research study in the Faculty of Agriculture, University of Ruhuna or any other institute recommended by the Faculty of Agriculture for 6 month period during Fourth Year Second Semester. The student may have the opportunity to choose their research area for the project. During midway of the industrial training students should apply for the research project indicating their research interest. It will make utmost effort to direct the students to their interested research filed. However, faculty board will take the final decision for the directing of students for research project based on the available resources/research opportunities.

Research students will be supervised by the senior academics in the Faculty of Agriculture, University of Ruhuna. The research student will continuously be evaluated during research study. The outcome of the research study should be presented by the research student for the final evaluation at the end of fourth year (fourth year) second semester. The final grade for the research study will be decided according to the performance of research proposal, progress reports and the final presentation and the thesis