VELS UNIVERSITY

VELS INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)

(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)

NAAC ACCREDITED

PALLAVARAM - CHENNAI - INDIA

SCHOOL OF BASIC SCIENCES

DEPARTMENT OF CHEMSITRY

Diploma
Green Chemistry

Program specific outcome:

PSO1: To equip the diploma students as a valuable citizen in protecting our environment

PSO2: To facilitate the student to be a good entrepreneur in energy resources

PSO3: To learn the various instrumental techniques and the technology behind them

PSO4: To understand the importance of minimised utility of agrochemicals

PSO5: To understand the overall background of green chemistry in agricultural

PSO6: To make the students to knowing various techniques in green chemistry based on Current needs

SCHOOL OF BASIC SCIENCES

DEPARTMENT OF CHEMSITRY

Diploma in Green Chemistry

BOS MEMBERS LIST

Sl.No.	Name & Address	Designation
1.	**Mr. Ganesh Babu,** Associate Professor & Head Department of Chemistry, RKM Vivekananda College, Mylapore, Chennai 600 004.	External Expert
2.	**Dr.P. Rajakumar** Professor & HOD Department of Organic Chemistry University of Madras Guindy	External Expert
3.	**Ms.Sukhanya.V** Fourts India Pvt. Ltd., Kelambakkam Road Kandigai, Chennai -600 121	Alumni Member
4.	**Dr . V. Mahalingam** Professor Department of Chemistry, School of Basic Chemistry Vels University, Pallavaram,Chennai - 600 117	Member
5.	**Dr. R. A. Kalaivani**, Director HOD, Department of Chemistry, School of Basic Sciences, Vels University, Pallavaram,Chennai - 600 117	Convenor
6.	**Dr. A. Perumal** Professor Department of Chemistry, School of Basic Chemistry Vels University, Pallavaram,Chennai - 600 117	Member

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NAAC ACCREDITED

PALLAVARAM - CHENNAI - INDIA

Diploma
Green Chemistry

Curriculum and Syllabus
(Based on Choice based credit system)
2015 – 2016

Department of Chemistry
School of Basic Sciences

Diploma in Green chemistry

Total No. of Credits: 36

Category	Sub.Code	Title of the Paper	Hours/week			Credit
			Lecture	Tutorial	Practical	
Semester-I						
Core	15CDGC11	Introduction to Green Chemistry	4	0	0	4
Core	15CDGC12	Analytical Instrumentation & Its technological aspects	4	0	0	4
Core	15CDGC13	Environmental Pollution & Prevention	4	0	0	4
DSE		Elective-I	3	0	0	3
Core	15PDGC11	Practical I – Green Synthesis		0	4	2
			15	0	4	17
Semester-II						
Core	15CDGC21	Green Chemistry in Agriculture and environment	4	0	0	4
Core	15CDGC22	Agro chemical & Renewable Resources	4	0	0	4
DSE		Elective-II	3	0	0	3
Core	15PDGC21	Practical II – Green Chemistry & Environment	0	0	4	2
Core	15RDGC21	Project	0	0	14	6
			11		18	19
		Total	**26**	**0**	**22**	**36**

Syllabus
Core courses

		L	T	P	C
15 DGC001	**INTRODUCTION TO GREEN CHEMISTRY**	**4**	**0**	**0**	**4**

Objectives: To learn about the environmental status, public awareness in evolution, principles involved in green chemistry, bio-catalytic reactions, global warming and its control measures, availability of green analytical methods.

Unit I Introduction 12

Introduction-Current status of chemistry and the Environment-Evolution of the Environmental movement: Public awareness - Dilution is the solution to pollution-Pollution prevention

Unit II Principles 12

Green Chemistry – Definition – Principles of Green Chemistry - Why is this new area of Chemistry getting to much attention - Why should chemist pursue the Goals of Green Chemistry - The roots of innovation – Limitations

Unit III Bio Catalytic Reactions 12

Green Chemistry Using Bio Catalytic Reactions – Introduction - Fermentation and Bio transformations - Production of Bulk and fine chemicals by microbial fermentation-Antibiotics – Vitamins - Bio catalyses synthesis of industrial chemicals by bacterial constructs - Future Tends.

Unit IV Green House Effect 12

Green house effect and Global Warming – Introduction - How the green house effect is produced - Major sources of green house gases - Emissions of CO_2 - Impact of green house effect on global climate - Control and remedial measures of green house effect - Global warming a serious threat - Important points.

Unit V Green Analytical Methods 12

Future trends in Green Chemistry - Green analytical methods, Redox reagents, Green catalysts; Green nano-synthesis, Green polymer chemistry, Exploring nature, Biomimetic, Proliferation of solvent-less reactions; Non-covalent derivatization, Biomass conversion, emission control

Total-60hours

Outcomes:

- To understand the environmental status and evolution
- To know about the Pollution and its prevention measures

- To familiarise the green chemistry
- To learn about the bio-catalytic reactions
- To understand about the vitamins and antiobiotics
- To expertise the global warming and its effects
- To learn about the control and remedial measures of green house effect
- To know about the various analytical green methods

Text Books

1. V. Kumar, "An Introduction to Green Chemistry" Vishal publishing Co. Reprint Edition 2010
2. Rashmi Sanghi, M.M Srivastava "Green Chemistry" Fourth Reprint - 2009

References Book

1. Anastas & Warner, Green Chemistry: Theory & Practice ,Oxford Univ. Press,New York,1998

		L T P C
15DGC002	**ANALYTICAL INSTRUMENTATION & ITS TECHNOLOGICAL ASPECTS**	**4 0 0 4**

Objectives: To learn about the various instrumentations, chromatographic techniques, sampling and handling of equipments, statistical methods, chemical grades, labelling and manipulation, storage and safety disposal of chemicals.

Unit I Instrumentation 12

Instrumentation – Types Principles Maintenance operations working of pH meter, Colourometer, Conductometer, Potentiometer, Flame Photometer, Nephlometer, Atomic Absorbtion spectro photometer.

Unit II Chromatographic Techniques 12

Chromatographic Techniques–Introduction-General Principles, Classifications of chromatography - Paper, Column, Thin layer, Gas, H.P.L.C. Instrumentation and applications of chromatography.

Unit III Laboratory Practices 12

Good laboratory Practices - sampling Preparation for analysis - Before, during and after the analysis, Equipments & Glass wares - Selection, Suitability, Equipments qualification, Cleaning, Drying.

Unit IV Statistical methods 12

Data Presentation and statistical methods- Statistical methods, Probabilities, Degree of Freedom, Average, Mean Deviation, Variance, Standard Deviation, Standard Error, Confidence limit, Significance test, Regression, Correlation, Non linear Relationships.

Unit V Chemicals 12

Chemicals and Consumables- Grade, Labelling , Preparation , Manipulation, Containers Storage, Safety, Disposal- Laboratories Accidents and first aid- Safety Legislations in India.

Total-60hours

Outcomes:

- To know about the basic concept of various instruments
- To study about the different chromatographic techniques
- To expertise about the applications in instrumentation
- To study about the sampling way of compounds
- To learn how to handle equipments and glasswares
- To familiarise about the statistical methods
- To learn about the chemical grade, labelling and manipulation
- To study about the storage, safety and disposal of chemicals

Text Books

1. Douglas A. Skoog et al "Instrumental Analysis" Cengage Learning, edition 2007

References

1. Spectroscopy by Chatwal Anand Himalaya Publishing House
2. Analytical & Industrial Chemistry by Naik, Vithalkar, Bajaga, Bidkan, Ghatage, Mulik

L T P C

15DGC003 ENVIRONMENTAL POLLUTION & PREVENTION 4 0 0 4

Objectives: To learn the air pollution, biological activity of carbohydrates, proteins, fats and oil, toxic effects of various pollutants. To study about the water, soil , thermal and solid waste management and their control measures.

UNIT I Chemistry and the environment 12

Chemistry and the environment - environmental pollution - causes - pollutants – air pollution - effects of air pollution: Environmental fate of pollutants – transformation Process - bio concentration - fate of air, water and soil pollutants.

UNIT II Biological activity 12

Biological activity - biodegradation of carbohydrates, proteins, fats and oil, detergents, pesticides; Metabolic fate of pollutants - adsorption – distribution - metabolism - excretion.

UNIT III Toxic effects of pollutants 12

Toxic effects of pollutants - toxicity - carcinogenicity - mutagenecity- teratogenicity - biochemical effects of arsenic, cadmium, lead, mercury, carbon monoxide, nitrogen oxides, sulphur dioxide, ozone and pan, cyanide, pesticides, asbestos.

UNIT IV Water pollution 12

Water pollution - water quality parameters - turbidity, colour, pH, acidity, alkalinity, solids, hardness, chlorides, residual chlorine, sulphates, fluorides, phosphates, iron and manganese, DO, BOD, COD, nitrogen, grease, volatile acids, gas analysis.

UNIT V Soil pollution 12

Soil pollution - noise pollution - thermal pollution; Wastewater treatment – volume reduction - strength reduction - neutralisation - equalisation - proportioning – primary and secondary treatment - solid waste disposal.

Total -60hours

Outcomes:

- To know the chemistry and the environment
- To study about the air pollution

- To learn the biodegradation activity of carbohydrates, protein and fats
- To understand the toxic effect of various pollutants
- To familiarise the biological effects of various chemical compounds
- To study the water pollution
- The understand the biological methods of determining the water pollution
- To know the soil and thermal pollution
- To learn about the wastewater treatment and solid waste disposal

Text Books

1. Environmental Nanotechnology : Applications and Impacts of Nanomaterials, Edited by Mark R. Weisner and Jean-Yves Bottero, Mc Graw Hill (2007).
2. "Nanotechnology for Environmental Remediation", Sung Hee Joo and I. Francis Cheng, Springer (2006).

Reference Book

1. Nanotechnology: Health and Environmental Risks, Jo Anne Shatkin, CRC Press (2008).

L T P C

NANOTECHNOLOGY IN GREEN CHEMISTRY 4 0 0 4

Objectives: To learn about the basic concept of nanoscience, physical and chemical methods of nanomaterial preparation, biologically synthesis of nanomaterials, Nanocomposites, risk and safety of nanotechnology

Unit I Basic concepts of Nanoscience and Nanotechnology 9

Basic concepts of Nanoscience and Nanotechnology – Bottom-up approach and Top-down approaches with examples – Synthesis of Nanomaterials – Classification of Nanomaterials – Properties and Application of Nanomaterials.

Unit II Green Chemical and Physical of Nanoparticles 9

Green Chemical and Physical of Nanoparticles – Physical synthesis of nanoparticles – Inert gas condensation - aerosol method - Arc discharge - laser ablation - Gas-phase synthesis – Chemical Synthesis of nanoparticles – precipitation and co-precipitation method, sol-gel method, solvothermal and hydrothermal method, chemical vapour synthesis.

Unit III Bio-inspired Green Nanomaterials 9

Bio-inspired Green Nanomaterials – microbial synthesis of nanoparticles – Biosynthesis of Nanoparticles by bacteria and Fungi – Biosynthesis of nanoparticles using plant extracts – Advantage of biosynthesis.

Unit IV Nanocomposites 9

Nanocomposites - Biologically inspired nanocomposites – protein based nanostructure formation – DNA templated nanostructure formation – Naturally Occurring Food Nanosubstances and Nanostructures – Carbohydrates – Protein assembly.

Unit V Risks and safe nanotechnology 9

Risks and safe nanotechnology: Nano-objects – exposure routes to nano-objects – effects seen in animal studies – observations from epidemiological studies – hypothesis from animal and epidemiological studies – fire and explosion risk – risk of catalytic reactions – workplace exposures – sampling strategy.

Total -45hours

Outcomes:

- To study the basic concept of nanomaterials
- To know about the classification of nanomaterials
- To familiarise about the physical method of nanomaterial preparation
- To learn about the chemical method of nanomaterial synthesis
- To understand the biosynthesis of nanomaterial
- To know about the nanocomposite materials
- To study about the risk of nanotechnology
- To understand the safety of nanotechnology

Text Books

1. Nanotechnology: Health and Environmental Risks, Jo Anne Shatkin, CRC Press (2008).

References

2. Green Processes for Nanotechnology: From Inorganic to Bioinspired Nanomaterials, Vladimir A. Basiuk, Elena V. Basiuk Springer (2015)
3.

L T P C

15PDGC004 PRACTICAL I – GREEN SYNTHESIS 0 0 4 2

Objectives:
To learn about the synthesis of zinc oxide from plant extract, nitration from nitrobenzene, acetylation of aniline, silver nanoparticles, eco-friendly pesticides, activated carbon from agricultural wastes and Schiff base using microwave techniques.

List of Practicals /Experiments (Any Five Experiments)

1. Synthesis of zinc oxide by solution combustion method using plant exact.
2. Nitration of nitrobenzene
3. Acetylatation/ Propionelation of aniline using water as eco friendly solvent.
4. To determine silver nanoparticles by green synthesis
5. Preparation of Eco friendly pesticides.
6. Synthesis of activated carbon from agriculture waste.
7. Preparation of Schiff base by microwave technique.

Total -30hours

Outcomes:

- To understand the green synthesis methods
- To study the synthesis of zinc oxide by solution combustion method using plant exact.
- To understand the Nitration of nitrobenzene
- To know about the Acetylatation/ Propionelation of aniline using water as eco friendly solvent.
- To familiarise about the silver nanoparticles by green synthesis
- To learn about the preparation of Eco friendly pesticides.
- Synthesis of activated carbon from agriculture waste.
- Preparation of Schiff base by microwave technique.

15DGC005 GREEN CHEMISTRY IN AGRICULTURE AND ENVIRONMENT L T P C **4 0 0 4**

Objectives: To learn about the alternative feedstock, evaluation methods, green house technology, advantages and disadvantages of cultivation, fermentation process and physical and chemical growth of the plants in agriculture

Unit I Alternative feed stocks **12**

Alternative feed stocks starting material, Alternative Reagents, Alternative Solvents, Alternative products /Target molecules, Process Analytical Chemistry, Alternative Catalysts, and Advantages of alternative catalyst.

Unit II Evaluation of Methods **12**

Evaluation of Methods to destine paper Chemicals, Mechanism of actions Analysis, Structure Reactivity & Relationship, Avoidance of toxic functional Group, Minimizing Bio availability. Reduce the toxicity of chemicals.

Unit III Green house Technology **12**

Controlled Environmental Agriculture, Green house Technology, Effect of Various Parameters, Quality, Construction, Advantages and disadvantages of protected cultivation, Cultivation practices in regional various crops.

Unit IV Fermentation **12**

Green Chemistry Using Bio Catalytic Reactions, Fermentation and Bio transformations, Production of Bulk and fine chemicals by microbial fermentation, Antibiotics, Vitamins, Bio catalyses synthesis of industrial chemicals by bacterial constructs.

Unit V Properties **12**

Properties and contribution of soil to plant Growth; Properties Physical Water holding capacity of soil, Chemical Properties – Major elements Carbon, Hydrogen, Oxygen, Macro nutrients – Nitrogen, Phosphorous, Effects due to its deficiency and excess quantity.

Total -60hours

Outcomes:

- To know about the alternative feedstock
- To study about the process and advantages of alternative materials

- To know about the toxicity of functional group
- To learn how to reduce the toxicity of chemicals
- To get familiarise about the green house technology
- To understand the advantage and disadvantages o protecting the cultivation
- To study about the biocatalytic reactions and fermentation
- To learn about the physical and chemical properties of plant growth

Text Books

1. Environmental Chemistry A.K. Deew Age International.
2. ‘‘Green Chemistry: theory and Practice ’’ Oxford University Press Oxford, 1998.

References

1. Green Chemistry for Sustanable future in ‘‘Fundamentals of Environmental Chemistry ’’ Stanley F. Manahan (Ed). Lewis Publishers.

L T P C

15DGC006 AGRO CHEMICAL & RENEWABLE RESOURSCES 4 0 0 4

Objectives: To study about the agrochemicals, fungicides, pest management and their biological control measures, renewable resources of biomass, fossil fuels and biorefinery chemicals

Unit I Agrochemicals 12

Agrochemicals – Introduction, Biocides: types and applications, Organic Insecticides – Carbamates, Chlorinated hydrocarbons, cypermithrin, fenvalverate phosphorus, other synthetic phsethroids. Growth Hormones, Discovery, site of synthesis Structure, properties and practical applications.

Unit II Fungicides 12

Fungicides- Copper fungicides- BM (Bordeaux Mixture) COC /copper Hydroxide, Dithiocarbamic Acid derivatives Dithane – M -45, Z -78, Insecticides – Types Plant origin Insecticides – Neem, Nicotine , Pyrethrum & rotenone Inorganic Insecticides – Arcinic.

Unit III Pest Management 12

Pest Management, Cultural methods, Field sanitation, Crops rotation, Trap crops, secondary Crops, Sowing time, Tillage practices, Biological Methods,

Trichoderma viridae, Fusarium spp., Verticillium spp, Biological control using Bacteria fungi or viruses (Diseases and Insets) Merits, Demerits. Limitations.

Unit IV Renewable resources 12

Renewable resources Biomass –Renewable energy – Fossil fuels-Energy from Biomass-Solar Power- Other forms of renewable energy-Fuel Cells-Alternative economics-Syngas economy-hydrogen economy.

Unit V Bio refinery chemicals 12

Bio refinery chemicals from fatty acids-Polymer from Renewable Resources –Some other natural chemical resources. Biodiesel from various feed stocks, controlled usage of nuclear energy, production of hydrogen fuel.

Total -60hours

Outcomes:

- To learn about the agrochemicals
- To know about the fungicides and Insecticides
- To understand about the pest management
- To study the biological control of bacteria, virus and fungi
- To study about the renewable resources of biomass
- To learn about fossil and fuel cells
- To understand about the bio refinery fuels
- To know the biodiesel from various feed stocks

Text Books

1. An Introduction to Entomolgy 1997, Srivastava P.D. & Singh R.P, Concept Publishing Co. Delhi.
2. General Entomology, 1998 (Reprint), Mani M.S., Oxford – IBH, India

Reference

1. The Science of Entomology, 1981 Romover W.S. Mac Millan Co, New York.

L T P C

WASTE MANAGEMENT & HAZARD ANALYSIS 4 0 0 4

Objectives: To learn about the treatment processes involved in waste water toxicity, electrical waste and electronic equipment, E-wasting and its recycling process, the context of technological risk and risk management

Unit I Treatment Processes 9

Waste water, toxicity, Treatment Processes – Sedimentation - Coagulation and Flocculation - Activated Sludge - Sand Filters - Membrane Separation, advanced oxidation process, adsorption, fenton oxidation.

Unit II Waste Electrical and Electronic Equipment 9

Waste Electrical and Electronic Equipment (WEEE), The scale of problem, restriction of hazardous substances, material composition of WEEE, anticipated hazards to ecosystems, WEEE health and safety implications.

Unit III E-Waste Recycling 9

integrated approach to E-Waste Recycling, recycling and recovery technologies, automated disassembly, thermal treatment, separation, comminution, capture technologies, design for recycling.

Unit IV Context for Technological Risk 9

Context for Technological Risk, Origins and Development of Risk Assessment, Societal Dimensions of Risk - Frameworks Addressing the Social Dimensions of Risk - How Risk Assessment Is Used in Environmental Decision Making

Unit V Risk Assessment 9

The Four Steps of Risk Assessment - Issues in Applying the Four Steps of Risk Assessment to Nanotechnology - Hazard Assessment - Exposure Assessment - Dose-Response Evaluation - Risk Characterization.

Total -45hours

Outcomes:

- To know about the waste water and its toxicity
- To study about the various treatments involved in waste water treatment

- To learn about the waste electrical and electronic equipment
- To understand the problem and restriction of hazardous substances
- To get familiarise about the E-waste and its recycling technology
- To know about the origin and development of risk assessment
- To learn about risk involved in environment decision making
- To study about the steps involved in risk assessment

Text Books

1. Nanotechnologies in Food, Edited by Qasim Chaudry, Laurence Castle and Richard Watkins, RSC Publications (2010).
2. Nanotechnology: Health and Environmental Risks, Jo Anne Shatkin, CRC Press (2008).

References

3. Nanotechnology and the Environment, Kathleen Sellers, Christopher Mackay, Lynn L. Bergeson, Stephen R. Clough, Marilyn Hoyt, Julie Chen, Kim Henry, Jane Hamblen, CRC Press (2009).

L T P C

15PDGC007 PRACTICAL II – GREEN CHEMISTRY & ENVIRONMENT 0 0 4 2

Objectives: To learn about the chemical oxygen Demand and Dissolved oxygen present in water. To determine the resin and organic content present in water sample, pesticides from plants, water holding capacity of soil and acidity of water

List of Practicals /Experiments (Any Five Experiments)

1. To determine the Chemical Oxygen Demand of the given water sample.
2. To estimate dissolved Oxygen (DO) in the waste water sample.
3. To determine breakthrough volume of per gram of the resin for the given water sample.
4. To determine the total organic content of the given water sample.
5. Preparation of pesticides from plants.
6. Determination of water holding capacity of soil
7. To determine Acidity of water trimetrically.

Total -30hrs

Outcomes:

- To study about the Chemical Oxygen Demand of water
- To learn about dissolved Oxygen (DO) in the waste water sample.
- To know the resin for the given water sample.
- To understand the total organic content of the given water sample.
- To study the preparation of pesticides from plants.
- To know the water holding capacity of soil
- To study the Acidity of water trimetrically.