

#### Shivaji University, Kolhapur

New Syllabus For

#### P.G. Diploma (one year) in Green Chemistry & Crop Protection

1. TITLE : Subject : Botany, Chemistry & Zoology

#### **IDS under the Faculty of Science**

2. **YEAR OF IMPLEMENTATION:**- New Syllabus will be implemented from June 2010 onwards.

#### 3. PREAMBLE:-

**B**]

- 1) To develop Specialization course at Post Graduate level in emerging areas.
- 2) To accommodate new ideas and Innovative proposals to influence teaching, promote scientific and technological applications for the benefit of society.
- 3) So Programme emphsizes Innovative Ideas with field orientation & interdisciplinary in nature

#### 4. GENERAL OBJECTIVES OF THE COURSE : (as applicable to the Degree /Subject- Paper concerned)

- 1)To create awareness among students, teachers & farmers about green Chemistry in crop protection
- 2)To train the students to use eco-friendly approaches in synthesizing agro-based chemicals viz.insecticides,fungicides,herbicides,bactericides, acaricides,weedicides.
- 3)To train the students to identify the crop diseases, insects pests in the local area.
- 4)To guide the students to undertake survey on insecticides, pesticides, weedicides, which are being used by farmers to control diseases & pests.
- 5)To emphasize green chemistry approach in crop protection which helps to reduce global warming.
- 6)Green chemistry approach in the crop protection is an emerging field having tremendous opportunities in research field. This also certainly offer versatile benefits to the teachers, students & society especially farmers.

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#### 5. **DURATION**

- The course shall be a full time course of one year.
- The duration of course shall be of one year .

#### 6. PATTERN:-

Pattern of Examination will be Annual.

- 7. **FEE STRUCTURE:** (as applicable to regular/self supporting course)
- i) Entrance Examination Fee (If applicable)- Rs. 50 (Not refundable)

#### 8. IMPLEMENTATION OF FEE STRUCTURE:-

In case of revision of fee structure, this revision will be implemented in phase wise manner as mentioned below:-

N.A

#### 9. ELIGIBILITY FOR ADMISSION :-

Candidates for admission to the PG Diploma (one year)shall be required to have passed an appropriate Bachelor Degree in Science Agriculture with minimum 50% marks & optional subjects Chemistry, Botany, Zoology, Microbiology, Plant protection, Biochemistry, Geology, Biotechnology, Horticulture as one of the subject of study .P.G students in either of above subjects are highly preferred.

#### **10. MEDIUM OF INSTRUCTION :**

The medium of instruction shall be in English.

#### 11. STRUCTURE OF COURSE-

(Note – The structure & title of papers of the degree as a whole should be submitted at the time of submission/revision of first year syllabus.

Sr.No.	Subjects – Title of Paper	Marks
1.	Paper I - Crop Pathology & Entomology	100
2.	Paper II – Agrochemicals & Pest	100
	Management.	
3.	Paper III - Green Chemistry &	100
	Environment	
4.	Paper IV - Analytical Instrumentation &	100
	It's technological aspects	
5.	Practical I based on Paper I	50
6.	Practical II based on Paper II	50
7.	Practical III based on Paper III	50
8.	Practical IV based on Paper IV	50
	Total	600

12. SCHEME OF TEACHING AND EXAMINATION:-[The scheme of teaching and examination should be given as applicable to the course/paper concerned.]

anor I	L	Т	Р	Total	Theory	Pract.	Tatal
non I					, v	Work	Total
aper 1	4	-	5	9	100	50	150
aper II	4	-	5	9	100	50	150
aper III	4	-	5	9	100	50	150
aper IV	4	-	5	9	100	50	150
tal	16		20	36	400	200	600
	aper II aper III aper IV tal HEME OF EXAMI	aper II 4 aper III 4 aper IV 4 tal 16	aper II 4 - aper III 4 - aper IV 4 - tal 16 HEME OF EXAMINATION	aper II       4       -       5         aper III       4       -       5         aper IV       4       -       5         tal       16       20         HEME OF EXAMINATION :-       -       -	aper II       4       -       5       9         aper III       4       -       5       9         aper IV       4       -       5       9         aper IV       4       -       5       9         tal       16       20       36         HEME OF EXAMINATION :-       -       -	aper II       4       -       5       9       100         aper III       4       -       5       9       100         aper IV       4       -       5       9       100         aper IV       4       -       5       9       100         tal       16       20       36       400         HEME OF EXAMINATION :-       -       -       -	aper II       4       -       5       9       100       50         aper III       4       -       5       9       100       50         aper IV       4       -       5       9       100       50         aper IV       4       -       5       9       100       50         tal       16       20       36       400       200         HEME OF EXAMINATION :-       -       -       -

- The examination shall be conducted at the end of each academic year.
- Theory paper shall carry 100 marks per paper & Practical shall carry 50 marks per paper.
- The evaluation of the performance of the students in theory papers shall be on the basis of Annual Examination of 400 marks & Practical exam of 200 marks.
- Question Paper will be set in the view of the /in accordance with the entire Syllabus and preferably covering each unit of syllabi.
- 14. STANDARD OF PASSING:-Minimum Standard of passing. Theory-40/100 marks Practicals 40/100 marks
  1) 40% to 49%- Pass Class
  2) 50% to 59%- Second Class
  3) 60% to 74%- First Class
  4) 75 and above First Class with Distinction For above grades, Aggregate marks should be considered.
- **15.** NATURE OF QUESTION PAPER AND SCHEME OF MARKING :- (Unitwise weightage of marks should also be mentioned)

Theory Que	stion Paper Skeleton	Total Marks	- 100 Per paper	•
Q.No. 1 :	Multiple Choice questio	ns -	[20 x 1]	20
Q.No. 2 :	Answer any Two Quest	ions out of Thre	ee [ 15 x 2 ]	30
Q.No. 3 :	Answer any Three out c	of Five	[10 x 3]	30
Q.No. 4 :	Short Notes any Four ou	ıt of Six	[4x5]	20

#### Practical Question Paper Skeleton for Practical I & II Total Marks – 50 Per paper

Q.No. 1	Long answer Question	[15]
Q.No. 2	Short answerQuestion (10 x 2)	[20]
Q.No. 3	Identification ( 5 x 1)	[05]
Q.No. 4	Tour Report / Project Report	[05]
Q.No. 5	Journal	[05]

### **Practical III**

Practical Q	Question Paper Skeleton	Total Marks - 50 Per paper		
Q.No. 1 :	Experiment of Long durat	ion	20	
Q.No. 2 :	Experiment of short durat	ion	15	
Q.No. 3 :	Tour Repot/ Project Repo	rt		10
Q.No. 4 :	Journal		05	
Prac	tical IV	Total Marks - 50 Per paper		

Q.No. 1	Experiment of Long duration	[20]
Q.No. 2	Experiment of short duration	[15]
Q.No. 3	Journal	[10]
Q.No. 4	Viva Voce	[05]

# 16. EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS- (FOR REVISED SYLLABUS)

N.A.

17. SPECIAL INSTRUCTIONS, IF ANY. N.A.

#### **18.** Teachers qualifications

M.Sc in Botany ,Chemistry ,Zoology ,Microbiology ,Physics, Mathematics &Statistics with minimum 55% marks. The higher desired qualification will be appreciated.

### NEW SYLLABUS FOR P.G. Diploma (one year) in Green Chemistry & Crop Protection (Introduced from June 2010 omwards)

#### **Paper I – Crop Pathology**

TT '4 1	1 aper 1 – Crop 1 athology	
Unit 1 1.1.	History, Aims, Scope & objectives of Crop pathology	(2)
1.2.	Contribution of scientists to the field of crop pathology.	(3)
1.3	Pests on crops – Invertebrates, Nematodes , Birds , Roden	ts,
	Weeds, Fungi, Viruses, Bacteria , Mycoplasma	(10)
Unit 2.	. Diseases on crops	(15)
	<ul> <li>2.1. Jowar - Rust, Bajra - Ergot/ Green ear</li> <li>2.2 Groundnut - Tikka, Sunflower - Rust.</li> <li>2.3 Gram - Wilt, Tur - Damping off</li> <li>2.4 Pomegranate - Dieback &amp; Bacterial Blight (Telya),</li> <li>2.5 Banana - Bunchy Top</li> <li>2.6 Onion - Blight,</li> <li>2.7 Potato - Early Blight &amp; Late Blight</li> </ul>	
Unit 3	Transgenic plants GMOS	(2)
Unit 4	Application of Information Technology in Crop Pathology:	(10)
	<ul> <li>4.1)Simulation &amp; epidemic programme for diagnosis.</li> <li>4.2)Remote sensing &amp; image analysis ecosystemlevel effect</li> <li>4.3) Predictions &amp; Disease control decisions.</li> <li>4.4) Information systems in disease management</li> <li>4.5). Legislation in crop Protection .</li> </ul>	ct.
	Entomology	
Unit 5	Introduction & Definition (05 Types of life cycles - complete incomplete, metamorphoses ametamorphosis.	5)
Unit 6	Mouth parts of insect-, chewing biting sucking baring	(5)
Unit 7	Study of insect pests with respect to following crops, stages in life, cycle & damaging stage	(20)

in life cycle & damaging stage 7.1) Polyphagous pests - white grub, Termites & Aphids.

(5)

7.2) Pests on millets -

- a) Jowar stem borer, shoot fly, midge fly.
- b) Bajara Red spider.
- c) Cotton Mealy Bugs, Scale Insects.
- d) Onion Thrips, Jassids
- e) Vegetables Looper on cauliflower

Weevils, Rice Moth, Khapra Beetel.

- f) Gram Pod Borer
- g) Potato Tuber Moth
- h) Groundnut- Aphids
- i) Brinjal Lacebug
- j) Mango-Thrips

Unit -8 ) Stored Grain Pests -

(3)

## Paper II

## Agrochemicals & pest Management

Unit 1) Agrochemicals –	
Introduction , Biocides : types and applications	(6)
Unit 2) Fungicides- i) Copper fungicides- BM (Bordeaux Mixture ) COC / coppe	(15) r
hydroxide	-
ii) Dithiocarbamic Acid derivatives Dithane – M -45, Z -78	
iii) Organo Chlorinated fungicides - carbamates.	
iv) Systemic fungicides - Broad spectrum fungicides Ex- v) Organo Mercurial fungicides (Seed treatment )	
.) - 8	
Unit 3) Insecticides – Types	(7)
i) Plant origin Insecticides – Neem, Nicotine , Pyrethrum & rotenene	
ii) Inorganic Insecticides - Arcinic	
iii) Organic Insecticides – Carbamates , Chlorinated hydrocar cypermithrin, fenvalverate phosphorus, other synthetic	bons ,
phsethroids	
Unit 4) Growth Hormones	(7)
1. Auxins IAA, IBA, NAA	
2. Gibberellins – GA3	
3. Cytokines - GBA	
4. ABA	
5. Ethylene (Etherel )	
6. C C C	
7. MH (malic hydrazide )	

Discovery, site of synthesis Structure, properties and practical applications.

### Pest Management

<ul> <li>Unit 5). Cultural methods <ul> <li>i) Field sanitation</li> <li>ii) Crops rotation</li> <li>iii) Trap crops /catch crops / secondary Crops</li> <li>iv) Sowing time</li> <li>v) Tillage practices</li> </ul> </li> </ul>	(12)
<ul> <li>Unit 6). Biological Methods <ol> <li>Trichoderma viridae</li> <li>Fusarium spp.</li> <li>Verticillium spp</li> <li>Verticillium spp</li> <li>Polyhydral Virus</li> <li>Polyhydral Virus</li> <li>Bacillus thurigensis BT</li> <li>Trichograma Spp.</li> </ol> </li> <li>Biological control using Bacteria fungi or viruses (Diseases and Merits, Demerits.Limitations</li> </ul>	(15) Insets)
<ul> <li>Unit 7). Other methods of pest management <ol> <li>Attractants</li> <li>Repellents</li> <li>Chimo sterilants METEPD TEPA etc</li> <li>Antifeedents</li> <li>Pheromones</li> <li>Autocidal rays</li> </ol> </li> </ul>	(12)
Unit 8). Integrated pest management (IPM)	(6)

Use of cultural, Biological, Chemical, Physical and other methods of pest control with suitable examples

### Paper III Green Chemistry & Environment,

Unit 1) Introduction	(5)
1.1. Current status of chemistry and the Environment.	(0)
1.2. Evolution of the Environmental movement	
Public awareness	
Dilution is the solution to pollution	
Waste treatment and abatement through command and	control.
Pollution prevention	
Green Chemistry	
1.3 The role of Chemistry	
Unit2) Green Chemistry	(5)
i) What is Green Chemistry	(-)
ii) Definition	
iii)Why is this new area of Chemistry getting to much atter	ntion
iv)Why should chemist pursue the Goals of Green Chemis	try
v) The roots of innovation	5
vi)Limitations / obstacles	
Unit3) Tools of Green Chemistry	(10)
i) Alternative feed stocks starting material	
ii) Alternative Reagents	
iii) Alternative Solvents	
iv) Alternative products / Target molecules	
v) Process Analytical Chemistry	
vi) Alternative Catalysts	
vii) Principles of Green Chemistry	
Unit 4). Green Chemistry Using Bio Catalytic Reactions	(10)
Introduction	
Fermentation and Bio transformations	
Production of Bulk and find chemicals by microbial	
fermentation	
Bulk & fine Chemicals	
Antibiotics	

Antibiotics
 Vitamins

1.

- 4. Bio catalyses synthesis of industrial chemicals by bacterial constructs .
- 5. Future Tends

Unit 5) Evaluation of Methods to destine paper Chemicals	(10)
6.1 Mechanism of actions Analysis	
6.2 Structure Reactivity & Relationship	
6.3 Avoidance of toxic functional Group	
6.4 Minimizing Bio availability	
6.5Minimizing Auxiliary substances	
Unit 6) Controlled Environmental Agriculture	(10)
i) Green house Technology	<b>、</b>
ii) Effect of Various Parameters	
iii) Types of Green house based on	
iv) Shape	
v) Quality	
vi) Construction	
vii) Covering Material	
viii) Climate	
ix) Advantages and disadvantages of protected cultivation	
x) Cultivation practices in regional various crops	
Unit 7) Green house effect and Global Warming	(15)
Introduction-	
1. How the green house effect is produced .	
2. Major sources of green house gases.	
3. Emissions of CO <sub>2</sub>	
4. CO relation of initial rise in temperature with the increasing	5
atmospheric Co2 concentration	
5. Impact of green house effect on global climate	
6. Cause of fluctuations occurring in global temperature	
7. Consequences of green house effects	
8. Control and remedial measures of green house effect.	
9. Solar green houses and their future potential	
10. Global warming a serious threat	
11. Gasbagging the north	
12. Hidden sink uncovered	
13. The march of the spruce tree	
14. Ironing can reduce global warming	
15. Cutting off Co <sub>2</sub>	
16. Methane on decline	
17. Penguins may cause global warming	
18. Global consumption patterns	
19. Important points	
Unit 8 ) Properties and contribution of soil to plant Growth (15)	
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Properties Physical Water holding capacity of soil

Physical Chemical Properties PH, Electrical Conductivity

Chemical Properties – Major elements Carbon , Hydrogen, Oxygen Macro nutrients – Nitrogen, Phosphorous , Potassium , Magnesium , Sodium , Calcium , Sulphur Micro nutrients – Boron, Chlorides , Copper , Iron, Manganese , Molybdenum , Zinc Others- Bicarbonates , Micro Organisms , Bacterial Fungi , Actinomycetes , Algae , Protozoa .

Effects due to its deficiency and excess quantity .

Paper IV	
Instrumental Methods & its Technological Aspect	<b>S.</b>
Unit 1. Instrumentation – (10)	
Types Principles Maintenance operations working of –	
PH meter, Colourometer, Conductometer, Potentiometer,	Flame
Photometer,	
Nephlometer	
Atomic Absorbtion spectro photometer	
Unit 2. Chromatographic Techniques -	(10)
Introduction	
General Principles	
Classifications of chromatography	
Paper , Column , Thin layer , Gas, H.P.L C.	
Unit 3. Good laboratory Practices - sampling Preparation for analys	sis - (15)
Before, during and after the analysis	
Unit4 Data Presentation and statistical methods-	(15)
Statistical methods	(10)
Probabilities	
Degree of Freedom	
Average	
Mean Deviation	
Variance	
Standard Deviation	
Standard Error	
Confidence limit	
Significance test	
Regression	
Correlation	
Non linear Relationships	
Unit 5. Equipments & Glass wares - Selection, Suitability,	(10)
Equipments qualification, Cleaning	( - )
Drying	
Unit 6. Chemicals and Consumables-	(10)
Grade, Labelling, Preparation, Manipulation, Containers	5
Storage, Safety, Disposal	
Unit 7. Laboratories Accidents and first aid-	(5)
Unit & Safaty Logislations in India	(5)
Unit of Jarcey Legislations in mula	$(\mathbf{J})$

#### Practical I Crop pathology List of Practicals /Experiments.

- 1. Study of plant diseases as per theory syllabus with respect to host symptoms causal organisms.
  - i) Grain smut of Jowar
  - ii) Green ear disease of Bajara
  - iii) Tikka disease of groundnut /leaf spot
  - iv) Rust of sunflower
  - v) Fusarium wilt of gram
  - vi) Damping of Pigeon pea
  - vii) Bunchy top of Banana
  - viii) Bacterial Blight (Telya) of pomegranate
  - ix) Blight of onion
  - x) Late blight of potato, Early blight of potato
- 2. Study of insects pest as per theory syllabus with respect to mark of identification, life cycle stages, nature of damage and management
  - i) Jowar -stem borer, shoot fly, midge fly
  - ii) Bajara -Red spider, mealy bugs, scale insects
  - iii) Onion Thrips, Jussids
  - iv) Potato Tuber moth
  - v) Stored grain pests Rice weevils, lacer grain borer, pulse beetle worm.

List of Practicals / Experiments

#### Practical II

#### **Agrochemicals & Pest Management**

1. Study of fungicides as per theory syllabus with respect to active Ingredients, formulations, colour code, methods of application mode of action and uses.

I. Sulphur – sulphur dust

II. Copper fungicides - Bordeaux mixture (BM)

COC/ Copper hydroxide

Copper oxychloride

III. Mercurial fungicides – Hg Cl  $_2\,$  , Hg Cl  $_2\,$ 

Ceresan/Agrosan

IV) Benzene Compounds – Benzimidazole (Benlet)

V) Antibiotics - Streptomycin sulphate

Griseofulvin

Agromycin / Phytomycin

VI) Systemic fungicides - Bavistin

Curzate, Ridomyl, Benlet,

Acrohat , Polyram

(any two)

VII) Study of the insecticides as per theory by colour code, formulation, mode of application .

- 1) Endosulfon
- 2) Diethoate (Rogor)
- 3) Chloropyriphos (tricel)
- 4) Synthetic pyrethroids (any two)
  - Fenvalverate
  - Cypermethrin
  - Decamethrin
  - Permenthrin

#### Alphamethrin

VIII) Culture of Trichoderma spp. in lab.

- IX) Effect of fungicides on soil mycoflora
- X) Study of growth regulators on seed germination and growth parameters (root / shoot length )
- XI) Biological methods -Entomogenous fungi: (any two) Aspergillus, Cladosporium Trichoderma spp, Bauveria spp. Vertcillium, Fusarium.
- XII) Study Tour / Field tour / Industrial visits
- XIII) Crop Protection equipments
- XIV) Project report / collection / submission

### Practical - III Green Chemistry & Environment

List of Practicals / 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. Nitration of nitrobenzene
- 5. Acetylatation/ Propionelation of aniline using water as eco friendly solvent
- 6. Preparation of Schiff base by microwave technique
- 7. Determination of water holding capacity of soil
- 8. To determine Acidity of water trimetrically
- 9. Preparation of Eco friendly pesticides .

10. Project work.

11. Study Tour / Field tour / Industrial visits

## Practical IV

### Instrumental Methods & its Technological Aspects.

List of Practicals / Experiments

- 6. Determination of PH of Water
- 7. Determination of PH of soil
- 8. Determination of electrical conductivity of water
- 9. Determination of electrical conductivity of soil
- 10. Determination of Nitrogen by Kjedahl's Method
- 11. Determination of total Alkalinity of water by Potentiometer
- 12. Determination of Nickel, cobalt, Copper by Flame Photometer.
- 13. To estimate Fe, Zn, Mn by colorimetery.
- 14. Spectrophotometeric determination of Copper
- 15. Determination of by ultra Violet Spectroscopy
- 16. Nephlometric estimation of sulphate and Phosphate
- 17. Detection of Pesticide residual in plants by electrophoresis method
- 18. Chromatographic separation of Cd,Zn, Mg, Cu,Ni,Co,by Ion exchange chromatography.

#### (NOTE :

- i) The details of field work, seminar, Group Discussion and Oral examination be given wherever necessary.
- ii) General/Specific instructions for Laboratory safety should be given wherever necessary)

#### C] OTHER FEATURES :

#### 1. INTAKE CAPACITY / NUMBER OF STUDENTS:-(Wherever applicable)

- 2. TEACHERS QUALIFICATIONS:-
  - The As prescribed by norms.
  - However required number of core faculty should be given for particular course along with paper wise and Specialization wise work load allocation.
  - Work load details should be as per Apex body/UGC/State Govt./University norms.
- 3. Board of studies should clearly mention the required Books, Journals and specific Equipment's necessary for the Course.

#### (A) $\underline{LIBRARY}$ :

#### Reference Books for Paper I & II

- 1. Principles and procedures of plant protection S.B. Chattopadhyay
- 2. Diseases of Crop plants in India G Rangaswami
- 3. Plant Pathology Mehrothra
- 4. Principals of Plant protection Thaphial and Nene
- 5. Plant Pathology R . S. Singh
- 6. Entomology Rastogi Publication Shivaji Road Meerut 2 UP
- 7. Insect pest Prashan Natn Book Trust.
- 8. Crop Protection in tropics J. P. Singh
- 9. Biotechnology & Plant Pathology Current trends Vinodkumar Jain
- 10. Fundamentals of Entomology, 1978, Elzinga R.J. Prentice Hall, India
- 11. Imms General Textbook of Entomology, Vol. I & II, 1993, Richards O.W. & Davis R.G. B.I Publications (Indian Edition), Delhi
- 12. Entomology & Pest Management, 1996, Pedigo I.P. Prentice Hall, India
- 13. An Introduction to Entomolgy 1997, Srivastava P.D. & Singh R.P, Concept Publishing Co. Delhi.
- 14. General Entomology, 1998 (Reprint), Mani M.S., Oxford IBH, India
- 15. The Science of Entomology, 1981 Romover W.S. Mac Millan Co, New York.
- 16. Principles of Insect Morphology, 1935, Indian Reprint 1994, Snodgrass R.E. CBS Publishers, New Delhi.
- 17. Structure & Functions of Insects, R.F. Chapman, ELBS London
- General & Applied Entomology 1983, K.K. Nayar. T.N. Anantkrishnan
   & B. V Davic, Tata Mc Graw Hill Publishing Company, Delhi.

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#### Reference Books for Paper III& IV

- 1. Textbook of Soil Science
  - T.D. Biswas and S.K. Mukharji
  - Tata McGraw Hill Publication New Delhi
- 2. The Nature and Properties of Soil N.C. Braddy and R.R.Well Pearson Education
- 3. Spectroscopy by Chatwal Anand Himalaya Publishing House
- 4. The Fundamentals of Analytical Chemistry Sookg West and Holler Hercort College Publisher
- 5. Environmental Chemistry
  - A.K. Deew Age International
- 6. Environmental Chemistry
  - G.W.Valoom and S.J.Duffy
- 7. Text Book of Analytical and Indistrial Chemistry for B.Sc Part III
- 8. Chemical & Biological methods for water pollution studies. R.K.Trivedi & P.K. Goel
  - Environmental Publication
- 9. A Text Book of quantitative inorganic Chemical analysis - A.I. Vogel
- 10. Water & Water analysis Remtebe of Mhaghe (NEERI publication)
- 11. Quality Assurance in Analytical Chemistry by Elizabeth Prichard and Vicki Barwick
- 12. Senior Practical Physical Chemistry by B.D. Khosla, V.C. Gg.rg.
- 13. Environmental Chemisry by B.K. Sharma, H.Kaur
- 14. Analytical & Industrial Chemistry by Naik, Vithalkar, Bajaga, Bidkan, Ghatage, Mulik
- 15. Green Chemistry Theory & Practices by Paul T. Anastas
- 16. Notes in Chemistry for Biologists by J. Fisher & J.R.P. Arnold
- 17. Insects Lipids ( Chemistry, Biochemistry & Biology ) Edited by Dennis R. Nelson.
- 18. "Green Chemistry : theory and Practice " Oxford University Press Oxford, 1998.
- 19. J. Chem Tech Biotechnol.
- 20. Green Chemistry for Sustanable future in "Fundamentals of Environmental Chemistry" Stanley F. Manahan (Ed). Lewis Publishers.
- 21. http://www.Cpa.gov/greenchemistry/aspagg.html

#### Journals and Periodicals :-

- 1) Biology Today
- 2) Environment Science
- 3) Bio Science
- 4) Current Science
- 5) Jr. of Environment Biology
- 6) Pollution
- 7) Agro-Bios
- 8) ICFAI Uni Jr.of Life Sciences.
- 9) ICFAI Science & Technology
- 10) ICFAI Biotechnology
- 11) ICFAI Environment Science
- 12) University News
- 13) Talenta
- 14) Advances in Plant Sciences
- 15) Indian Journal of Environment & Ecoplanning
- 16) Indian Journal of Heterocyclic Chemistry
- 17) Pollution Research
- 18) Ecology & environmental Conservation.
- 19) Journal of Entomology.

#### (B) <u>SPECIFIC EQUIPMENTS</u>:

Necessary to run the Course.

Most Essential and Critical Equipment Required

#### 1. Equipments

- 1. Electrophoresis Kit
- 2. Sprayers
- 3. Dusters
- 4. pH- Meter
- 5. High Vacuum Pump
- 6. Deepfreeze
- 7. Rotary solvent evaporator
- 8. L.C.D. Projector
- 9. Electric Oven
- 10. Stirrers with hot plate
- 11. Centrifuge (10000 RPM)
- 12. All glass Distillation assembly
- 13. Porometer
- 14. Photographic camera microscope
- 15. Digital Balance (up to 3 digits)
- 16. Chromatography Kit
- 17. UV Spectrophotomer
- 18. IR Spectrophotomete
- 19. Spectronic 20 (Bosch & Lomb)(For chlophyll estimation & protein estimation )
- 20. Heating Mantles (250ml),(500ml)& (11it)
- 21. Sonicators
- 22. Microwave ovens
- 23. Television

#### **(C) LABORATORY SAFETY EQUIPMENTS :**

- First Aid Box 1
- Eye Wash Bottle 2.
- 3.
- Fire extinguisher two sets in 600 sq. ft. Area Sugar /Glucose 500 gm pack. in hypoglycemic conditions 4.

### GENERAL SAFETY RULES FOR LABORATORY WORK

1) List of equipments needed for Laboratory Safety:-

- 1. Fire extinguisher
- 2. First Aid Kit
- 3. Good earthing and insulated wirings for electrical supply.
- 4. Emergency exit
- 5. Apron and goggles wherever necessary
- 6. Fuming Chambers
- 7. Masks flows and shoes while handling hazardous chemicals & gases ( Good valves, manometers and regulators for gas supply)
- 8. Operational manuals for instruments (handling to be made as suggested.)
- 9. Rules of animals and blanks ethics.
- 10. Leakage of gases to be avoided.
- 11. Cylinders or flow pipes to handle Acids.
- 12. No weighings for NaoH and hygroscopic substances.
- 13. Stabilized supply in the laboratory.

#### 2) There Is No Substitute For Safety

- 1. Any injury no matter how small, it must be reported to teacher immediately.
- 2. a) In case any chemical enters your eyes go immediately to eye- wash facility and flush your eyes and face with large amount of water.

b) For acid or phenol split, do not use water instead put some bicarbonate.

- 3. In case of fire, immediately switch of all gas connections in the laboratory and pour sand on the source of fire or cover it with asbestos or cement sheet.
- 4. While leaving laboratory, make sure that gas, water taps and electricity are switched off.
- 5. Remove your lab coat. Gloves and clean your hands before leaving laboratory.
- 6. Make your workplace clean before leaving the laboratory.
- 7. Keep your hands away from your face, while working in laboratory.
- 8. Each laboratory must have a first aid box.
- 9. Know what to do in case of emergency e.g.
- (a) Know the place of fire extinguisher and first aid box.
- 10. Don't use cell phones in the laboratory.
- (a) Remember important phone numbers

#### 3) DO's

- 1. Always wear lab coat, shoes in the laboratory. Every student must have their weight box, a napkin etc.
- 2. Maintain separate record book for each subject.
- 3. Keep your belongings at the place allotted for the same.
- 4. Maintain silence, order, cleanliness and discipline in the laboratory.
- 5. Work at the place allotted to you or specially used for certain operations.
- 6. Keep the working table clean.
- 7. Handle the laboratory equipments, glassware and chemical with great care.
- 8. Use only required quantities of material and apparatus of essential size.
- 9. Perform the test in their proper order.
- 10. Know the location of eye wash fountain and water shower.
- 11. Minimize your exposure to organic solvents.
- 12. The Metal like sodium should be kept under kerosene or liquid paraffin layer in a vessel with a cork stopper.
- 13. Sodium metal should be cut on dry filter paper. The cut off pieces of sodium should be immediately collected in a vessel containing kerosene or liquid paraffin.
- 14. Always pour acid into water when diluting and stir slightly.
- 15. All operations involving poisonous flammable gases and vapours should be carried out in the flame chamber (with exhaust facility)
- 16. Ladies should avoid wearing saree. If it is there, apron is essential.

#### 4) DON'T

- 1. Don't work alone in the laboratory
- 2. Don't leave the glasswares unwashed.
- 3. Don't take apparatus, chemicals out of lab.
- 4. Don't leave any substance in a vessel or bottle without label.
- 5. Don't weigh the reagent directly on the balance pan.
- 6. Don't. throw the cut off pieces of sodium metal in sink or water. Transfer it immediately in it's container.
- 7. Don't take sodium metal with hands. Use forceps.
- 8. Don't panic and run in case of fire. Use the fire extinguishers or sand backets.
- 9. Don't breathe the vapours of organic solvents.
- 10. Don't. pour any unused reagent back in its stock bottle.
- 11. Don't eat or drink any food in laboratory.
- 12. Don't use inflammable solvents like benzene, either, chloroform, acetone and alcohol around flame.
- 13. Don't distill to dryness.
- 14. Don't exchange stoppers of flasks and bottles containing different reagents.
- 15. Don't leave reagent bottle lying on the table.
- 16. Don't disturb the order of reagent bottles in which they are placed.
- 17. Don't bring reagent on your working table from the general shelf.
- 18. Don't throw burning matchstick into dustbin.
- 19. Don't leave the laboratory without permission.

#### 5) LAB SAFETY PRECAUTIONS / MEASURES IN CHEMISTRY LABORATORY

Part I : Personal Precautions

- 1. All personnel must wear safety Goggles at all times
- 2. Must wear the Lab Aprons/Lab Jacket and proper shoes.
- 3. Except in emergency, over-hurried activities is forbidden.
- 4. Fume cupboard must be used whenever necessary.
- 5. Eating, Drinking and Smoking in the laboratories strictly forbidden.

#### Part II : Use of Safety and Emergency Equipments

- 1. First aid kits
- 2. Sand bucket
- 3. Fire exextinguishers (dry chemical and carbon dioxide extinguishers)
- 4. Chemical Storage cabinet with proper ventilation

- 5. Material Safety Date sheets.
- 6. Management of Local exhaust systems and Fume hoods.
- 7. Sign in register if using instruments.

#### 6) LABORATORY / FIELD WORK CARE AND SAFTY FOR BOTANY AND ZOOLOGY STUDENTS

- 1. Unnecessary wastage of plant material / animals during practicals should be avoided.
- 2. During study tour / personal collection, more emphasis be given on study of plants / animals in nature and collection of wild plants and animals should not be carried out.
- 3. If at all the collection of the plant material animals in needed, it should be carried out under supervision of concerned teacher. Collection of poisonous plants / poisonous mushrooms / harmful animals should be avoided.
- 4. Oral intake of unknown plant material / animal, out of curiosity, during practical or collection tour is strictly prohibited.
- 5. If there is any allergic reaction while handling the plants / plant parts / pollen grains / fungal specimens / animals it should be immediately brought to the notice of the concerned teacher and reported to the registered medical purloiner.
- 6. Wearing of handgloves (and mask) is essential while handling poisonous plants or animals / herbarium sheets / toxic and hazardous chemicals / reagents / stung acids / stung alkalis during the experiment should be made with vaccupipetle / autopipette / burette under the supervision of concerned teacher / lab assistant.
- 7. Highly inflammable organic solvents (alcohol, acetone etc.) should not be kept in vicinity of spirit lamp.
- 8. The laboratory safety measures adopted for handling of hazardous chemicals in chemistry practicals should be followed for conducting practicals in plant biochemistry / microbiology.
- 9. Operational manuals for equippnents such or centrifuge, autoclave, spectrophotometer should be followed.
- 10. In case of minor injuries, preliminary treatment should be undertaken with the help of first aid kit available in the laboratory. In case of serious injury, concerned teacher should be immediately contacted for consultation to the physician.
- 11. The instruction report for breeding, experimentation & dissection of animals will be submitted in a week period. (Which are laid down by Ministry of Social Justice & Empowerment and Ministry of Environment and Forests, Govt. of India)
- 12. Animal ethic committee should be constituted in the college where the subject Zoology is tought and the rules / norms laid down by the committee should be strictly followed while during experiment / performing dissection on animals.