

Controller of Examinations
SAMBALPUR UNIVERSITY
JYOTI VIHAR, BURLA
Sambalpur (Odisha), PIN- 768 019



PHONE and Fax:0663-2430806
e-mail: coesuniv@gmail.com

Urgent

(Both by post and by e- mail)

No. 8420 / Acd.-I

Dated: 04.11.16

To

The Principals,

(All the Affiliated Colleges under Sambalpur University having
Three Year Degree Courses excluding Autonomous Colleges.)

Sub: Syllabus & Implementation of CBCS pattern Arts/Science/Commerce (Pass and
Hons.) from the Academic Session 2016-17.

Ref :- This office letter No 5314/ Acd.-I dated 21.7.16 and letter No. 5970/Acd.-I
dated 8.8.16.

Sir,

In continuation to the letters and the subject cited above, I am directed to intimate you that the Vice- Chancellor has been pleased to approve the syllabus for Courses / papers related to **Botany** for CBCS + 3 courses degree B.Sc. (Both Pass & Hons.) examinations under 6 (15) of O.U. Act -1989 giving it effect from the Academic Session, 2016-17. The detail Courses of Studies is enclosed herewith for your reference and necessary action.

This may kindly be noted that it is the final syllabus for Botany subject/ papers under CBCS pattern. It may be made available to teachers and students concerned. Further you are requested to ensure teaching of the courses in your colleges accordingly.

Any error and omission etc. may kindly be intimated to this office.

. Any queries on the matter may be made through e-mail: coesuniv@gmail.com.

Thanking you,

Yours faithfully,

Encl: *As above*

S.K. Das
3/11/16
Controller of Examinations
S.K. Das

P.T.O.

Memo No. 8421 /Acad.-I(BOS),

dtd. 04-11-16

Copy forwarded with enclosure for information and necessary action to:

1. The Chairman, Post Graduate Council, Sambalpur University.
2. The H.O.D., P.G. Department of *Life Sciences*, Sambalpur University.
3. The Director, College Development Council, Sambalpur University.
4. The Director, Directorate of Distance and Continuing Education, Sambalpur University.
5. The Co-ordinator, Private Examination Cell, Sambalpur University.
6. Asst. Registrar (Examination), Sambalpur University.
7. Programmer, University Computer Unit, Sambalpur University.
8. Asst. Controller of Examinations, Sambalpur University.
9. Section Officer / Assistant –in- Charge, *e – Governance Cell*, Sambalpur University with request to provide all the materials in the official web- site accordingly. (as + 3 cbcs- syllabus – *Botany –Final*)
10. Section Officers, Computer Unit, E.G.-I, EG-II, E.C-I, EC-II, EC-VI Sections.
11. Five spare Copies for Academic-I Sections with enclosure.

Memo No. 8422 /Acad.-I(BOS),

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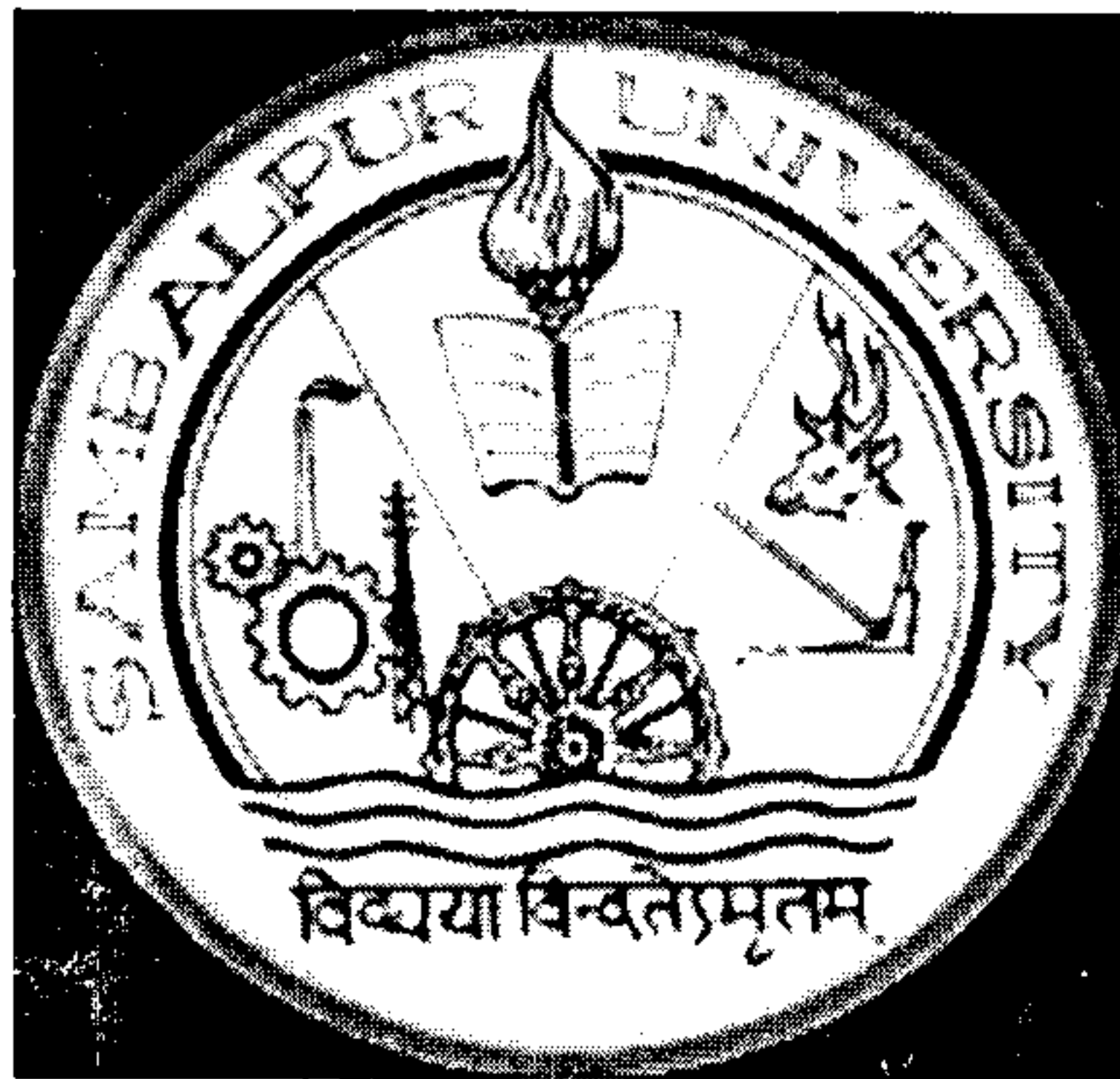
Copy forwarded without enclosure for information and necessary action to:

1. *The Dy. Director, e – Governance Cell*, Sambalpur University with request for needful to provide all the materials in the official web- site accordingly .
2. P.A. to the Vice- Chancellor, Sambalpur University.
3. P.A. to the Registrar, Sambalpur University.
4. P.A. to the Controller of Examinations, Sambalpur University.

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SAMBALPUR UNIVERSITY



CHOICE BASED CREDIT SYSTEM B.Sc. BOTANY HONOURS

2016-2019

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Choice Based Credit System (CBCS), Sambalpur University


Syllabus for B.Sc. (Honours) in BOTANY-2016-2019

SEMESTER	COURSE OPTED	COURSE NAME	Credits	Marks*	Hours of instruction
Semester-I	Ability Enhancement Compulsory Course-I	Environmental Studies	2	50	30
	Core course-I (Theory)	Microbiology and Phycology	4	50	60
	Core Course-I (Practical)	Microbiology and Phycology	2	50	20
	Core course-II (Theory)	Biomolecules and Cell Biology	4	50	60
	Core course-II (Practical)	Biomolecules and Cell Biology	2	50	20
	Generic Elective -1 (Theory)	GE-1 - Biodiversity (Microbes, Algae, Fungi & Archegoniate)	4	50	60
	Generic Elective -1 (Practical)	GE-1 - Biodiversity (Microbes, Algae, Fungi & Archegoniate)	2	50	20
		Sub-Total of Semester-I		20	350
Semester-II	Ability Enhancement Compulsory Course-II	English/M.I.L	2	50	30
	Core course-III (Theory)	Mycology and Phytopathology	4	50	60
	Core course-III (Practical)	Mycology and Phytopathology	2	50	20
	Core course-IV (Theory)	Archegoniate	4	50	60
	Core course-IV (Practical)	Archegoniate	2	50	20
	Generic Elective -2 (Theory)	GE-2 - Plant Physiology & Metabolism	4	50	60
	Generic Elective -2 (Practical)	GE-2 - Plant Physiology & Metabolism	2	50	20
		Sub-Total of Semester-II		20	350
Semester-III	Core course-V (Theory)	Anatomy of Angiosperms	4	50	60
	Core course-V (Practical)	Anatomy of Angiosperms	2	50	20
	Core course-VI (Theory)	Economic Botany	4	50	60
	Core course-VI (Practical)	Economic Botany	2	50	20
	Core course-VII (Theory)	Genetics	4	50	60
	Core course-VII (Practical)	Genetics	2	50	20
	Skill Enhancement Course-1	(Herbal Technology)	2	50	30
	Generic Elective -3 (Theory),	GE-3A - Plant Ecology & Taxonomy,	4	50	60
	Generic Elective -3 (Practical),	GE-3A - Plant Ecology & Taxonomy,	2	50	20
		Sub-Total of Semester-III		26	450

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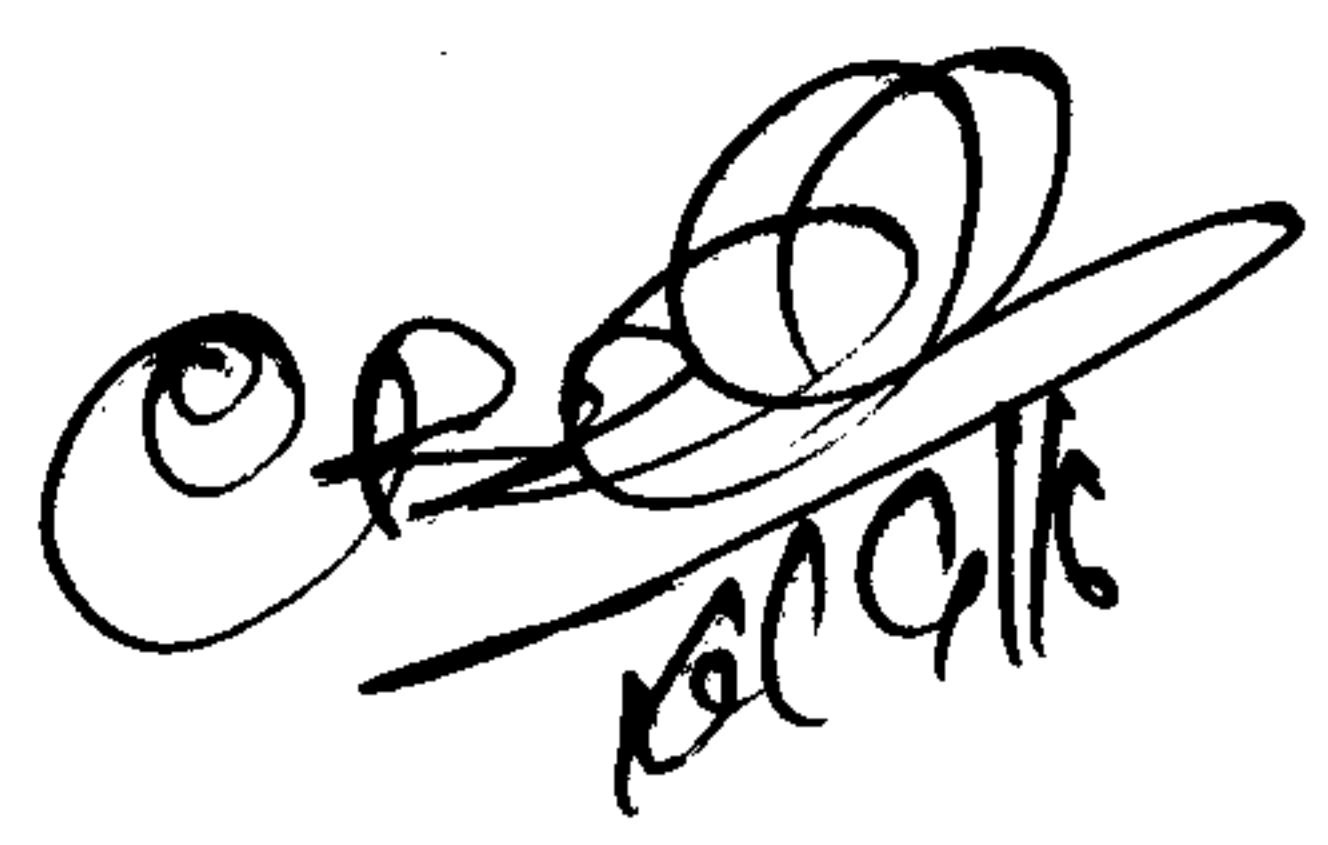
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Semester-IV	Core course-VIII (Theory)	Molecular Biology	4	50	60
	Core course-VIII (Practical)	Molecular Biology	2	50	20
	Core course-IX (Theory)	Ecology	4	50	60
	Core course-IX (Practical)	Ecology	2	50	20
	Core Course- X (Theory)	Plant Systematics	4	50	60
	Core Course- X (Practical)	Plant Systematics	2	50	20
	Skill Enhancement Course-2	(Mushroom Cultivation Technology)	2	50	30
	Generic Elective-4 (Theory) (Any one of GE-4A & GE4B)	GE-4A-Plant Anatomy and Embryology	4	50	60
	Generic Elective-4 (Practical) (As per Theory)	GE-4A-Plant Anatomy and Embryology	2	50	20
		Sub-Total of Semester-IV	26	450	350
Semester-V	Core-XI (Theory)	Reproductive Biology of Angiosperms	4	50	60
	Core course-XI (Practical)	Reproductive Biology of Angiosperms	2	50	20
	Core-XII (Theory)	Plant Physiology	4	50	60
	Core course-XII (Practical)	Plant Physiology	2	50	20
	Discipline Specific Elective - 1 (Theory)	Plant Breeding	4	50	60
	Discipline Specific Elective - 1 (Practical)	Plant Breeding	2	50	20
	Discipline Specific Elective - 2 (Theory)	Natural Resource Management	4	50	60
	Discipline Specific Elective - 2 (Practical) [As per theory]	Natural Resource Management	2	50	20
	Sub-Total of Semester-V	24	400	320	
Semester-VI	Core course-XIII (Theory)	Plant Metabolism	4	50	60
	Core course-XIII (Practical)	Plant Metabolism	2	50	20
	Core course-XIV (Theory)	Plant Biotechnology	4	50	60
	Core course-XIV (Practical)	Plant Biotechnology	2	50	20
	Discipline Specific Elective - 3 (Theory)	Horticulture Practices & Post Harvest Technology	4	50	60


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	Discipline Specific Elective - 3 (Practical)	Horticulture Practices & PostHarvest Technology	2	50	20
	Discipline Specific Elective-4 (Theory)	Biostatistics	4	50	60
	Discipline Specific Elective - 4 (Practical)	Biostatistics	2	50	20
		Sub-Total of Semester-V	24	400	320
		Total Semester I+II+III+IV+V+VI	140	2400	1880


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Semester	CORE COURSE(14)	Ability Enhancement Compulsory Course(AEC)(2)	Skill Enhancement Course (SEC) (2)	Discipline Specific Elective (DSE) (4)	GENERIC ELECTIVE: (GE) (4)
I	Algae and Microbiology	Environmental Studies			GE-1
	Biomolecules and Cell Biology				
II	Mycology and Phytopathology	English/MIL			GE-2
	Archegoniate				
III	Morphology and Anatomy		SEC -1		GE-3
	Economic Botany				
	Basics of Genetics				
IV	Molecular Biology		SEC -2		GE-4
	Plant Ecology and Phytogeography				
	Plant Systematics				
V	Reproductive Biology of Angiosperms			DSE-1	
	Plant Physiology			DSE-2	
VI	Plant Metabolism			DSE -3	
	Plant Biotechnology			DSE-4	


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Structure of B.Sc Honours Course under CBCS

Core Courses:

1. Algae and Microbiology
2. Biomolecules and Cell Biology
3. Mycology and Phytopathology
4. Archegoniate
5. Morphology and Anatomy
6. Economic Botany
7. Genetics
8. Molecular Biology
9. Plant Ecology and Phytogeography
10. Plant Systematics
11. Reproductive Biology of Angiosperms
12. Plant Physiology
13. Plant Metabolism
14. Plant Biotechnology

Discipline Specific Electives


1. Analytical Techniques in Plant Sciences
2. Bioinformatics
3. Stress Biology
4. Plant Breeding
5. Natural Resource Management
6. Horticultural Practices and Post-Harvest Technology
7. Research Methodology
8. Industrial and Environmental Microbiology
9. Biostatistics

Generic Electives

1. Biodiversity (Microbes, Algae, Fungi and Archegoniate)
2. Plant Ecology and Taxonomy
3. Plant Anatomy and Embryology
4. Plant Physiology and Metabolism
5. Economic Botany and Biotechnology
6. Environmental Biotechnology

Ability Enhancement Course Compulsory

1. Environmental Science
2. English/MIL Communication


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Ability Enhancement Courses Elective

1. Biofertilizers
2. Herbal Technology Nursery and Gardening
3. Floriculture
4. Medicinal Botany
5. Plant Diversity and Human Welfare
6. Ethnobotany
7. Mushroom Culture Technology
8. Intellectual Property Rights

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Core Courses

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Semester-I

Core Course I: Phycology and Microbiology
(Credits: Theory-4, Practical-2)

THEORY
Lectures: 60

Unit 1: Introduction to microbial world

Microbial nutrition, growth and metabolism. Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine). **(7 lectures)**

Unit 2: Viruses

Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV). **(7 lectures)**

Unit 3: Bacteria

Discovery, general characteristics; Types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). **(7 lectures)**

Unit 4: Algae

General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; methods of reproduction; Classification; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups); Significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P. Iyengar). Role of algae in the environment, agriculture, biotechnology and industry. **(11 lectures)**


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Unit 5: Cyanophyta and Xanthophyta

Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of *Nostoc* and *Vaucheria*. (8 lectures)

Unit 6: Chlorophyta and Charophyta

General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Chlamydomonas*, *Volvox*, *Oedogonium*, *Coleochaete*, *Chara*. Evolutionary significance of *Prochloron*. (8 lectures)

Unit 7: Phaeophyta and Rhodophyta

Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Ectocarpus*, *Fucus* and *Polysiphonia*. (12 lectures)


Practical

Microbiology

1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.
3. Gram staining.
4. Endospore staining with malachite green using the (endospores taken from soil bacteria).

Phycology

Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas* (electron micrographs), *Volvox*, *Oedogonium*, *Coleochaete*, *Chara*, *Vaucheria*, *Ectocarpus*, *Fucus* and *Polysiphonia*, *Prochloron* through electron micrographs, temporary preparations and permanent slides.


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Suggested Readings

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
4. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
5. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
6. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.


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Core Course II: Biomolecules and Cell Biology (Credits: Theory-4, Practical-2)

THEORY

Lectures: 60

Unit 1: Biomolecules (20 lectures)

Types and significance of chemical bonds; Structure and properties of water; pH and buffers. **Carbohydrates:** Nomenclature and classification; Monosaccharides ; Disaccharides; Oligosaccharides and Polysaccharides.

Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacyl glycerols structure, functions and properties; Phosphoglycerides.

Proteins: Structure of amino acids; Levels of protein structure(-primary, secondary, tertiary and quaternary); Protein denaturation and biological roles of proteins.

Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

Unit 2: Bioenergetics (4 lectures)

Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.

Unit 3: Enzymes (6 lectures)

Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.

Unit 4: The cell (4 lectures)

Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).

Unit 5: Cell wall and plasma membrane (4 lectures)

Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

Unit 6: Cell organelles (16 lectures)

Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.

Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament.

Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast.


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Endomembrane system: Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing; Smooth ER and lipid synthesis, export of proteins and lipids; Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Lysosomes

Unit 7: Cell division

(6 lectures)

Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases.

Practical

1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
2. Study of plant cell structure with the help of epidermal peel mount of Onion/*Rhoeo*/*Crinum*.
3. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.
4. Measurement of cell size by the technique of micrometry.
5. Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains).
6. Study of cell and its organelles with the help of electron micrographs.
7. Cytochemical staining of : DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.
8. Study the phenomenon of plasmolysis and deplasmolysis.
9. Study the effect of organic solvent and temperature on membrane permeability.
10. Study different stages of mitosis and meiosis.

Suggested Readings

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
6. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
7. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
8. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
9. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco

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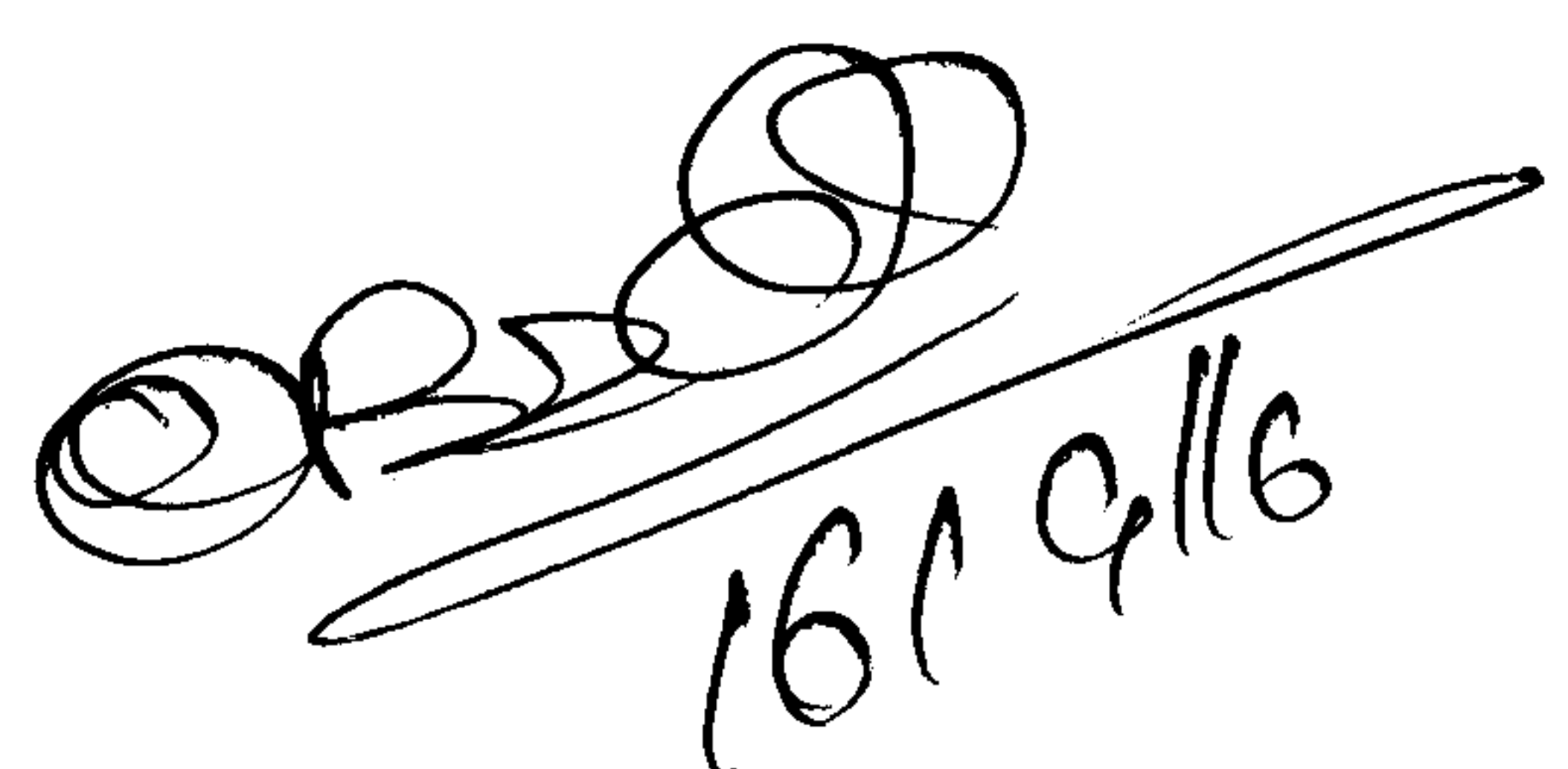
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Semester-II

Core Course III: Mycology and Phytopathology
(Credits: Theory-4, Practical-2)

THEORY
Lectures: 60

- Unit 1: Introduction to true fungi** (6 lectures)
General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification.
- Unit 2: Chytridiomycota and Zygomycota** (5 lecture)
Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to *Synchytrium*, *Rhizopus*.
- Unit 4: Ascomycota** (10 lectures)
General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; Life cycle and classification with reference to *Saccharomyces*, *Aspergillus*, *Penicillium*, *Alternaria*, *Neurospora* and *Peziza*.
- Unit 5: Basidiomycota** (8 lectures)
General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat *Puccinia* (Physiological Specialization), loose and covered smut (symptoms only), *Agaricus*; Bioluminescence, Fairy Rings and Mushroom Cultivation.
- Unit 6: Allied Fungi** (3 lectures)
General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.
- Unit 7: Oomycota** (4 lectures)
General characteristics; Ecology; Life cycle and classification with reference to *Phytophthora*, *Albugo*.
- Unit 8: Symbiotic associations** (4 lectures)
Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza-Ectomycorrhiza,


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Endomycorrhiza and their significance.

Unit 8: Applied Mycology

(10 Lectures)

Role of fungi in biotechnology; Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.

Unit 9: Phytopathology

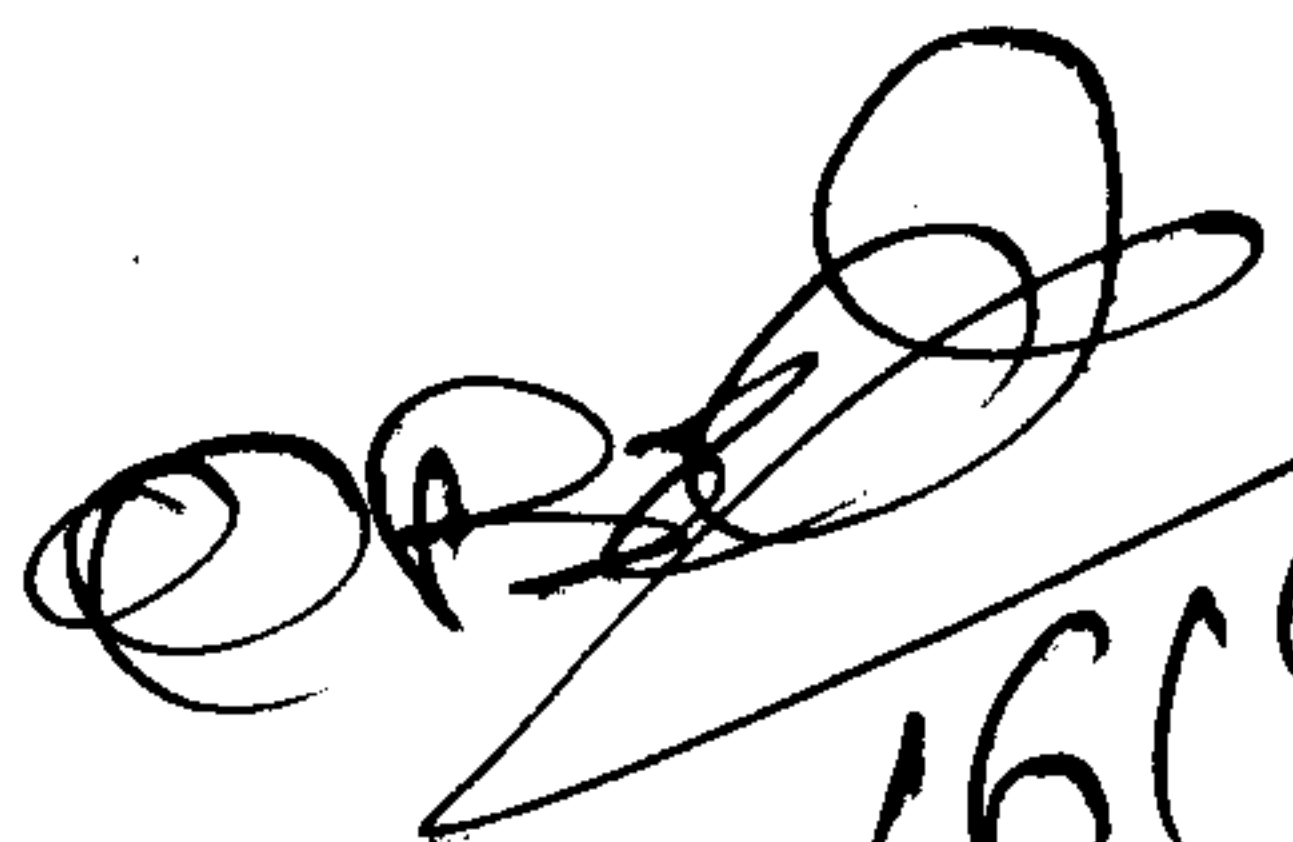
(10 lectures)

Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine.

Bacterial diseases – Citrus canker and angular leaf spot of cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers.

Practical

1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps).
2. *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides.
3. *Aspergillus* and *Penicillium*: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.
4. *Peziza*: sectioning through ascocarp.
5. *Alternaria*: Specimens/photographs and temporary mounts.
6. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
7. *Agaricus*: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*, fairy rings and bioluminescent mushrooms to be shown.
8. Study of phaneroplasmodium from actual specimens and /or photograph. Study of *Stemonitis* sporangia.
9. *Albugo*: Study of symptoms of plants infected with *Albugo*; asexual phase study through section/

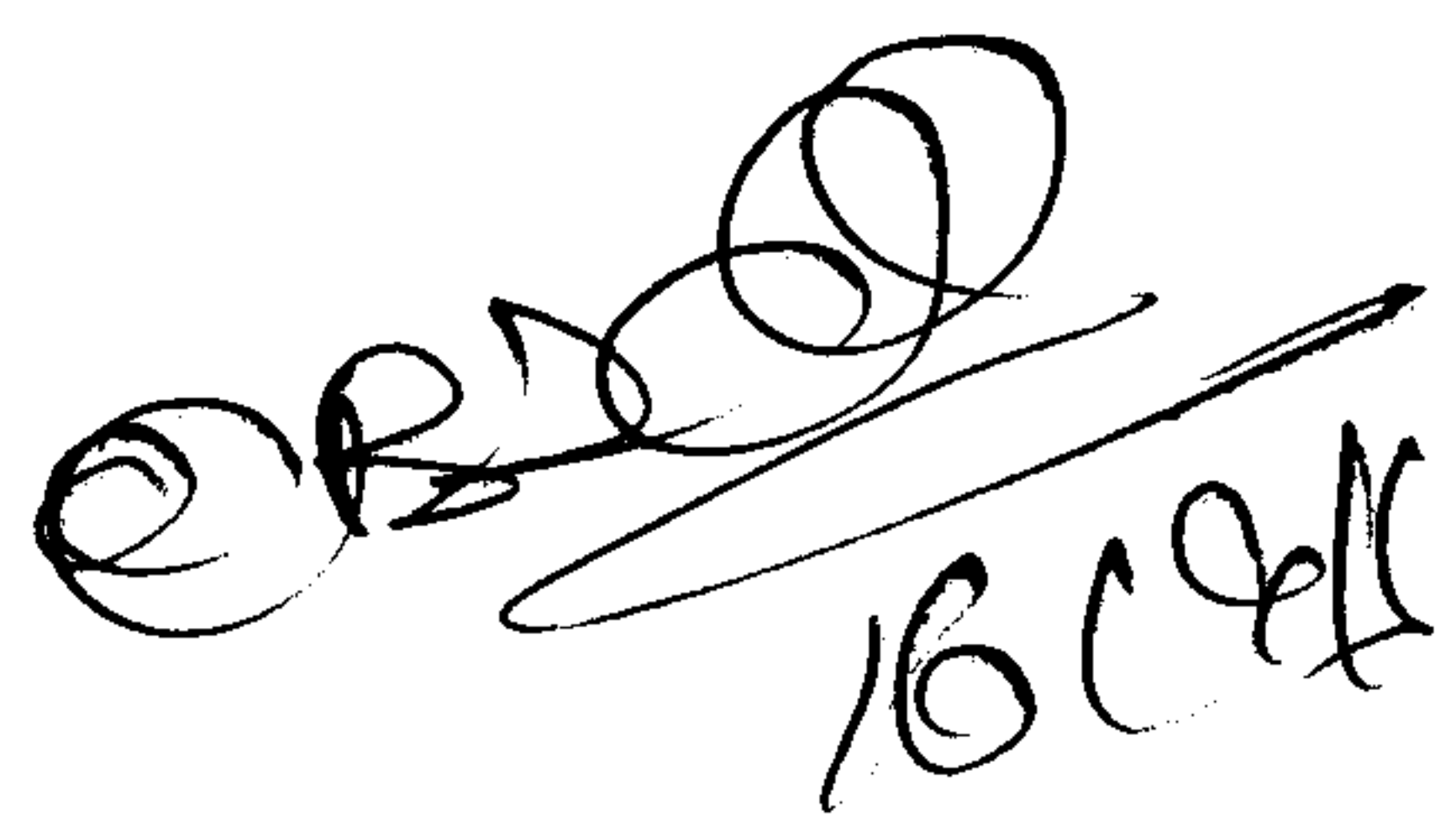

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temporary mounts and sexual structures through permanent slides.

10. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs)
11. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers.

Suggested Readings

1. Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
3. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
4. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
5. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.


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Core Course IV: Archegoniate
(Credits: Theory-4, Practical-2)

THEORY
Lectures: 60

Unit 1: Introduction (4 lectures)
Unifying features of archegoniates; Transition to land habit; Alternation of generations.

Unit 2: Bryophytes (6 lectures)
General characteristics; Adaptations to land habit; Classification; Range of thallus organization.

Unit 3: Type Studies- Bryophytes (12 lectures)
Classification (up to family), morphology, anatomy and reproduction of *Riccia*, *Marchantia*, *Pellia*, *Porella*, *Anthoceros*, *Sphagnum* and *Funaria*; Reproduction and evolutionary trends in *Riccia*, *Marchantia*, *Anthoceros* and *Funaria* (developmental stages not included). Ecological and economic importance of bryophytes with special reference to *Sphagnum*.

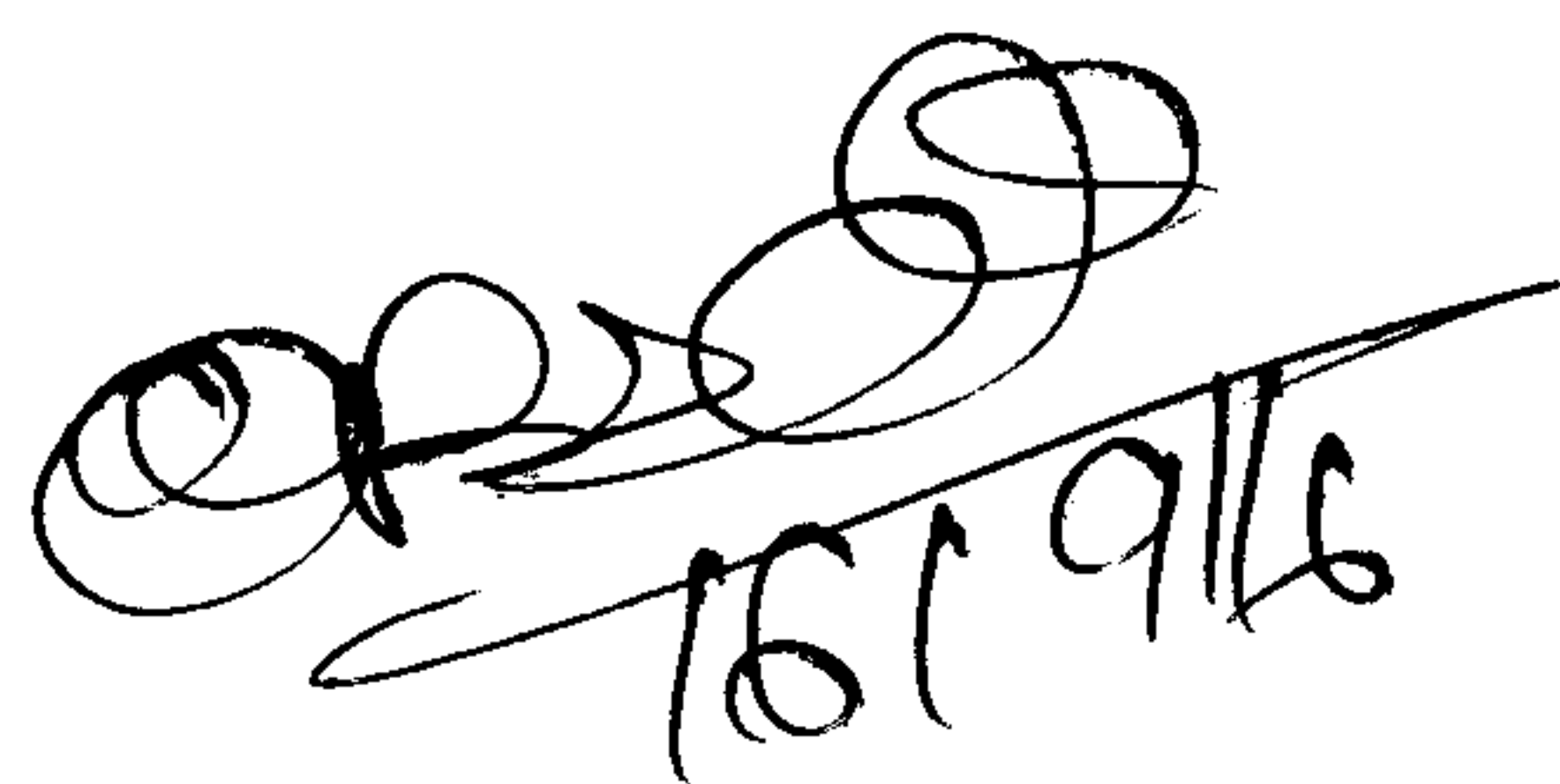
Unit 4: Pteridophytes (6 lectures)
General characteristics; Classification; Early land plants (*Cooksonia* and *Rhynia*).

Unit 5: Type Studies- Pteridophytes (14 lectures)
Classification (up to family), morphology, anatomy and reproduction of *Psilotum*, *Selaginella*, *Equisetum* and *Pteris* (Developmental details not to be included). Apogamy, and apospory, heterospory and seed habit, telome theory, stelar evolution; Ecological and economic importance.

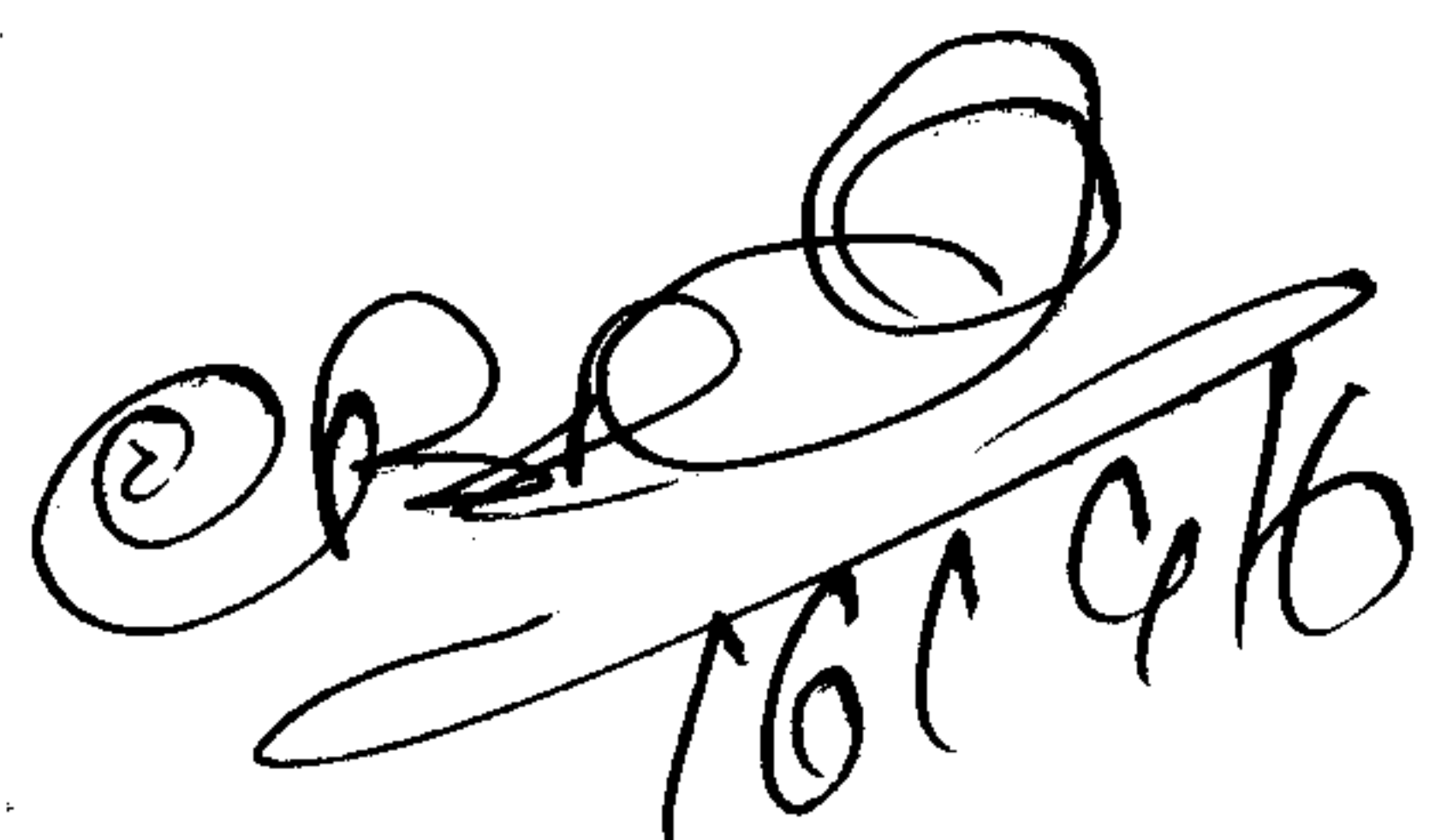
Unit 6: Gymnosperms (18 lectures)
General characteristics, classification (up to family), morphology, anatomy and reproduction of *Cycas*, *Pinus* and *Gnetum* (Developmental details not to be included); Ecological and economic importance.

Practical

1. *Riccia* – Morphology of thallus.
2. *Marchantia*- Morphology of thallus, whole mount of rhizoids & Scales, vertical section of thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides).
3. *Anthoceros*- Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).
4. *Pellia*, *Porella*- Permanent slides.


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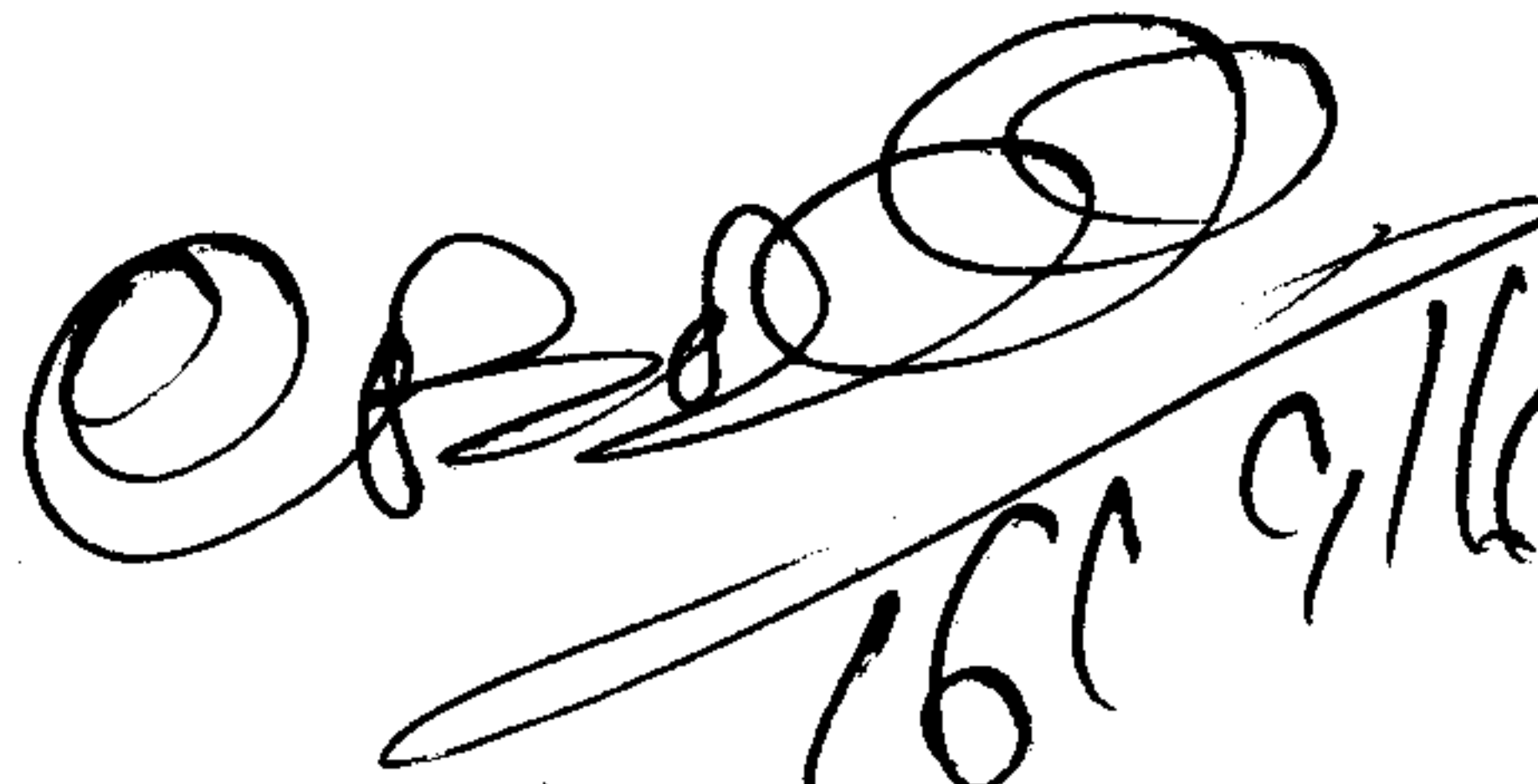
5. *Sphagnum*- Morphology of plant, whole mount of leaf (permanent slide only).
6. *Funaria*- Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal section of capsule and protonema.
7. *Psilotum*- Study of specimen, transverse section of synangium (permanent slide).
8. *Selaginella*- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide).
9. *Equisetum*- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).
10. *Pteris*- Morphology, transverse section of rachis, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).
11. *Cycas*- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide).
12. *Pinus*- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of Needle, transverse section of stem, longitudinal section of / transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), longitudinal section of female cone, tangential longitudinal & radial longitudinal sections stem (permanent slide).
13. *Gnetum*- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide)
14. **Botanical excursion.**


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Suggested Readings

1. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
2. Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
3. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. And Vol. II Pteridophyta: Central Book Depot. Allahabad.
4. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
5. Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.


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Semester-III

Core Course V: Anatomy of Angiosperms
(Credits: Theory-4, Practical-2)

THEORY

Lectures: 60

Unit 1: Introduction and scope of Plant Anatomy

(4 Lectures)

Applications in systematics, forensics and pharmacognosy.

Unit 2: Structure and Development of Plant Body

(6 Lectures)

Internal organization of plant body: The three tissue systems, types of cells and tissues. Development of plant body: Polarity, Cytodifferentiation and organogenesis during embryogenic development.

Unit 2: Tissues

(12 Lectures)

Classification of tissues; Simple and complex tissues (no phylogeny); cytodifferentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances. Hydathodes, cavities, lithocysts and laticifers.

Unit 3: Apical meristems

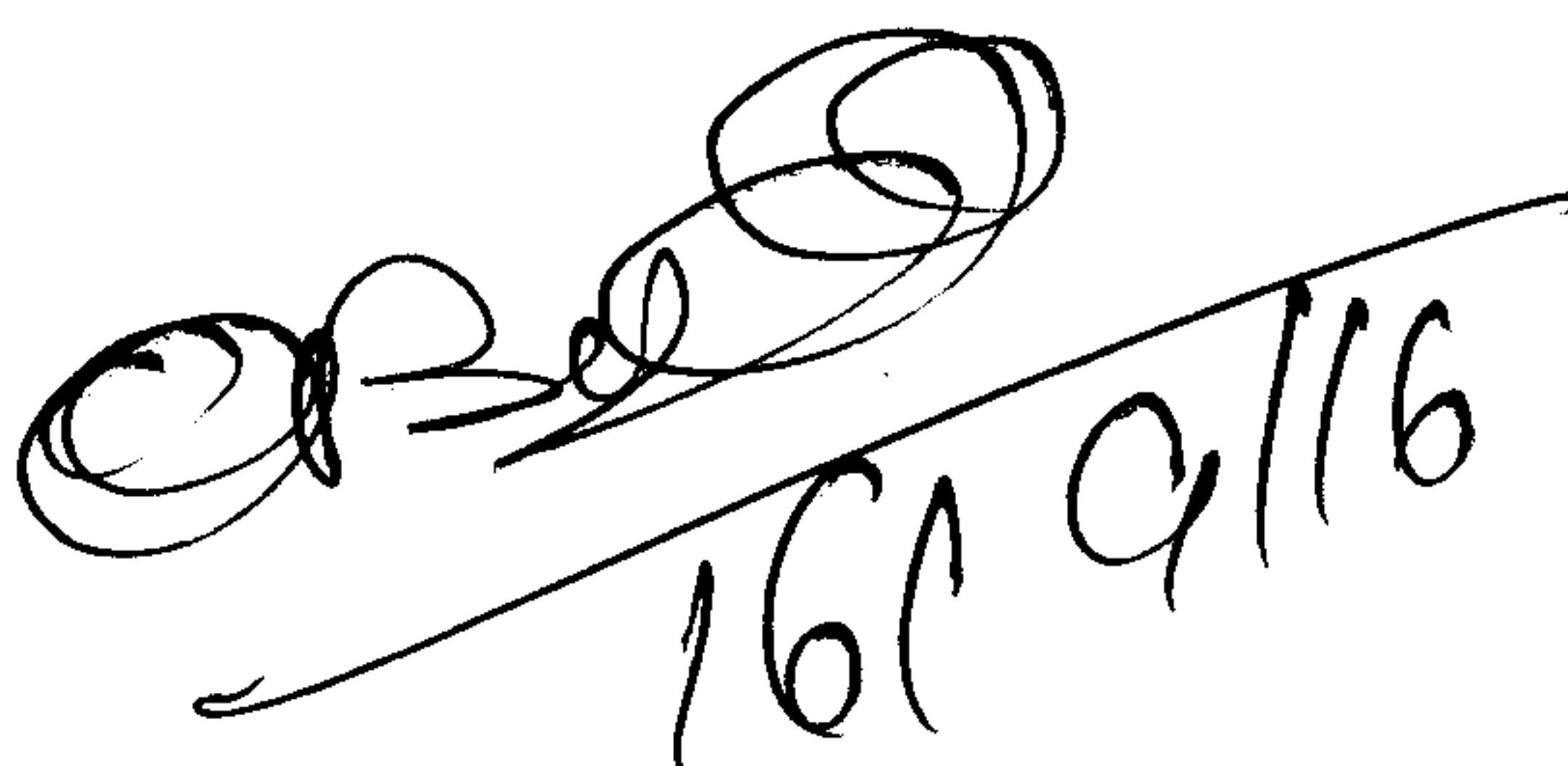
(15 Lectures)

Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cytohistological zonation); Types of vascular bundles; Structure of dicot and monocot stem. Origin, development, arrangement and diversity in size and shape of leaves; Structure of dicot and monocot leaf, Kranz anatomy. Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap; Structure of dicot and monocot root; Endodermis, exodermis and origin of lateral root.

Unit 4: Vascular Cambium and Wood

(15 Lectures)

Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm, rhytidome and lenticels.


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Unit 5: Adaptive and Protective Systems**(8 Lectures)**

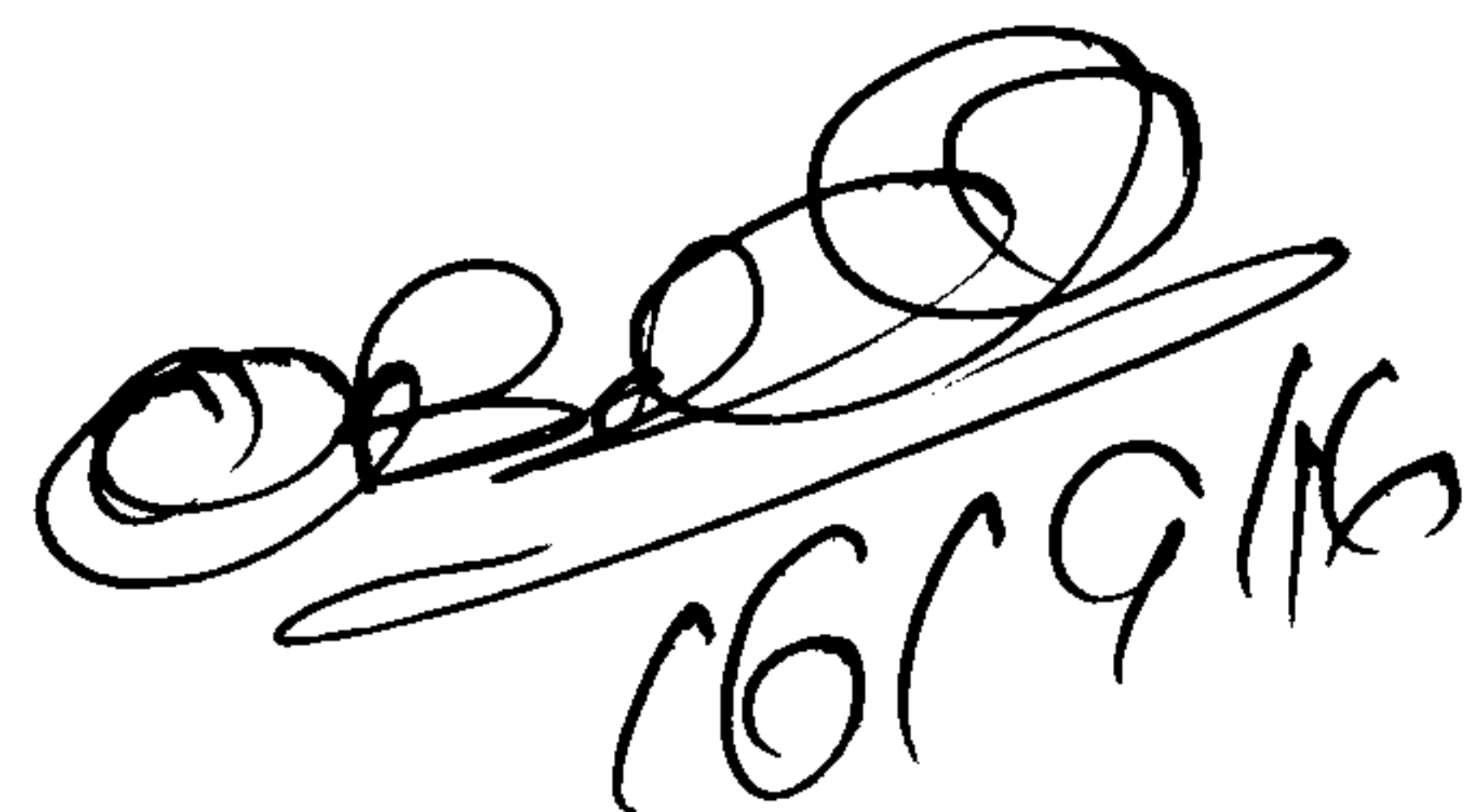
Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni- and multicellular, glandular and nonglandular, two examples of each), stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes.

Practical

1. Study of anatomical details through permanent slides/temporary stain mounts/ macerations/ museum specimens with the help of suitable examples.
2. Apical meristem of root, shoot and vascular cambium.
3. Distribution and types of parenchyma, collenchyma and sclerenchyma.
4. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres.
5. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
6. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
7. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
8. Root: monocot, dicot, secondary growth.
9. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
10. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).
11. Adaptive Anatomy: xerophytes, hydrophytes.
12. Secretory tissues: cavities, lithocysts and laticifers.

Suggested Readings

1. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
3. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
4. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

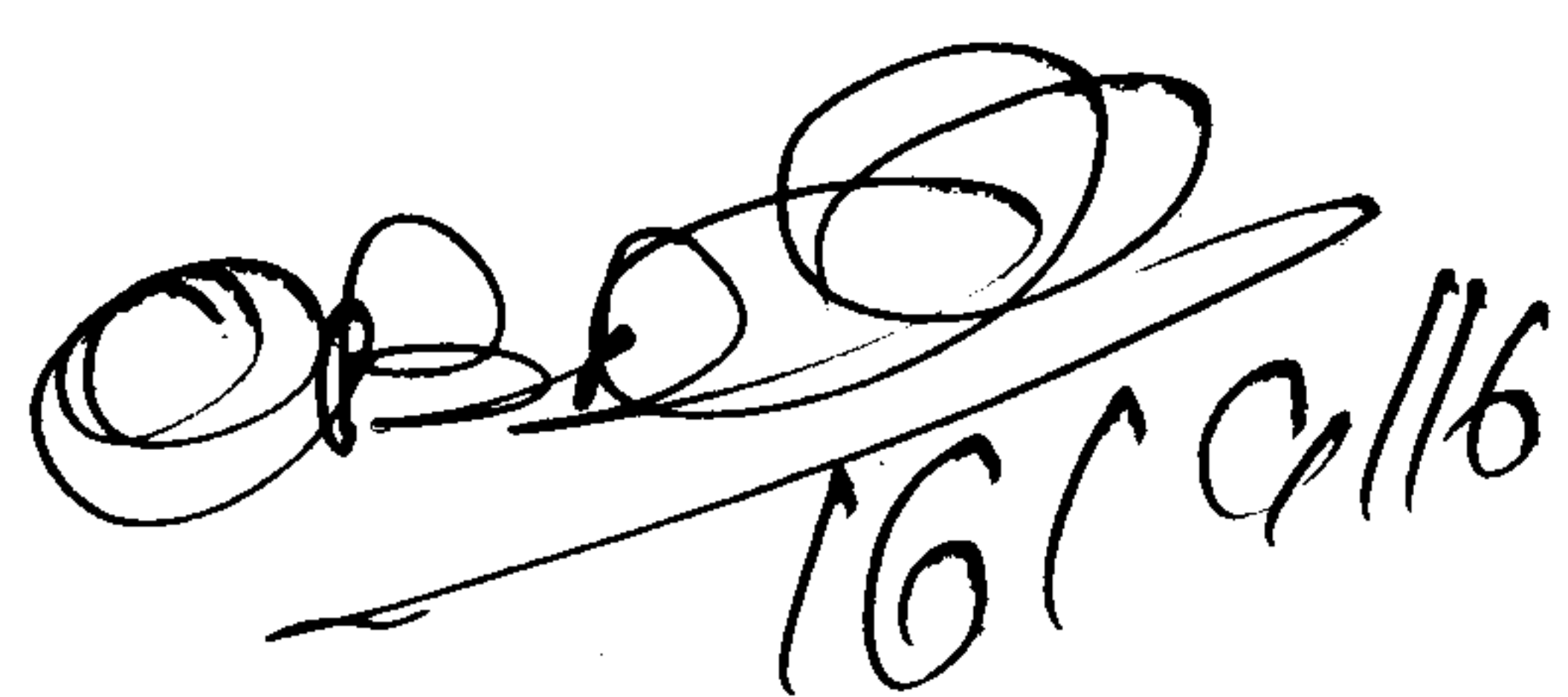


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Core Course VI: Economic Botany
(Credits: Theory-4, Practical-2)

THEORY
Lectures: 60

- Unit 1: Origin of Cultivated Plants** (6 lectures)
Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity.
- Unit 2: Cereals** (6 lectures)
Wheat and Rice (origin, morphology, processing & uses); Brief account of millets.
- Unit 3: Legumes** (6 lectures)
Origin, morphology and uses of Chick pea, Pigeon pea and fodder legumes. Importance to man and ecosystem.
- Unit 4: Sources of sugars and starches** (4 lectures)
Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.
- Unit 5: Spices** (6 lectures)
Listing of important spices, their family and part used. Economic importance with special reference to fennel, saffron, clove and black pepper
- Unit 6: Beverages** (4 lectures)
Tea, Coffee (morphology, processing & uses)
- Unit 7: Sources of oils and fats** (10 lectures)
General description, classification, extraction, their uses and health implications groundnut, coconut, linseed, soybean, mustard and coconut (Botanical name, family & uses). Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.
- Unit 8: Natural Rubber** (3 lectures)
Para-rubber: tapping, processing and uses.
- Unit 9: Drug-yielding plants** (8 lectures)
Therapeutic and habit-forming drugs with special reference to *Cinchona*, *Digitalis*, *Papaver* and *Cannabis*; Tobacco (Morphology, processing, uses and health hazards).


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