DEPARTMENT OF BOTANY

THE AMERICAN COLLEGE, MADURAI

COURSES FOR THE

POST GRADUATE CURRICULUM

2019 ONWARDS

PG DEPARTMENT OF BOTANY (2019 ONWARDS)

S.no	COURSE TITLE	HOURS	CREDIT
SEMESTER I			
PGB4441	Plant Diversity	6	4
PGB4443	Principles of Microbiology	6	4
PGB4445	Plant Diversity and Microbiology LAB	6(L)	4
PGB4447	Plant Cell Chemistry	5	4
PGB4249	Biochemistry LAB	3(L)	2
PGB4331/ PGB 4333	CBCS(**Campus Ecology/ Pl. based enterprises)**	4	3
	Total	**30**	**21**
SEMESTER II			
PGB4542	Plant Systematics	7	5
PGB4544	Plant Physiology	7	5
PGB4446	Plant Systematics &Physiology LAB	6(L)	4
PGB4448	Mycology and Pathology	6	4
PGB4330/PGB 4332	CBCS(**Trends in Agriculture/ Plants and people)**	4	3
	Total	**30**	**21**
SEMESTER III			
PGB5641	Morphogenesis	7	6
PGB5643	Genetics and Molecular Biology	7	6
PGB5445	Gen., Mol biol. and Morpho. LAB	6 L	4
PGB5547	Environment and Bio-Resource Management	6	5
PGB5349	Analytical and Research Methodology	4	3
	Total	**30**	**24**
SEMESTER IV			
PGB5742	Biotechnology	8	7
PGB5444	Biotechnology and Plant Tissue Culture Lab	6(L)	4
PGB5346	Nanobiology	4	3
PGB5348	Systems Biology	4	3
PGB5750	Projects	8	7
	Total	**30**	**24**

Programme Specific Outcomes (PSOs) for PG Department of Botany

1. Identify the indicators of biological diversity and conduct ecosystem health assessment to create career opportunities in healing the mother earth

2. Document, monitor, sustainably manage and share biological resources without bias and exploitative profiteering motives

3. Acquire technological and analytical skills needed for industrial support services

4. Take back biotechnological innovations to strengthen nutritional and food security

5. Forecast the forthcoming climate risks and develop combating strategies for survival

6. Handle large data using computational biology to became a partner of artificial intelligence revolution

7. Decode international governance, policies, treaties and participate in politics that protect environment and forest to become the stewards of global commons

8. Develop skills to pursue carrier in the arena related to plant sciences namely farming, forestry and floristic pursuits

9. Find scope for effective use of technology to develop new concepts and ideas to replace the old constructs that comes from myths and misjudgement of facts

10. Learn from the study of plants to continuously innovate the change according to the need and ceaselessly struggle to find a personal and collective meaning for life.

Course outcome (CO) vs Program specific outcome (PSO) – PG Botany

Course code	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10
PGB4441	√	√	√		√		√		√	√
PGB4443	√	√	√					√		√
PGB4445	√	√	√	√				√		
PGB4447	√		√		√					
PGB4249		√	√							
PGB4331/ PGB 4333	√	√		√	√	√	√	√	√	√
PGB4542	√	√				√	√			√
PGB4544		√	√		√					
PGB4446	√	√	√	√	√				√	
PGB4448	√	√	√	√	√				√	√
PGB4330/ PGB 4332	√	√		√	√	√	√	√	√	√
PGB5641	√	√	√							√
PGB5643		√	√						√	
PGB5445		√	√					√	√	
PGB5547	√	√		√	√	√	√	√	√	√
PGB5349		√	√	√						
PGB5742			√	√			√	√	√	
PGB5444	√	√	√	√	√		√	√	√	
PGB5346		√	√		√			√	√	
PGB5348		√				√		√		√
PGB5750	√		√	√				√	√	√
PGB 421V	√	√	√					√		
PGB 422V		√						√		√
PGB 521V			√	√	√			√	√	
PGB 522V		√	√	√	√					

Mapping of PSO with PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10
PSO1	X	x	x	x	x	x	x	x	x	x
PSO2	X	x	x	x	x	x	x	x	x	x
PSO3	X	x	x	x	x	x	x	x	x	X
PSO4	X	x	x	x	x	x	x	x	x	x
PSO5	X	x	x	x	x	x	x	x	x	X
PSO6	X	x	x	x	x	x	x		x	x
PSO7	X		x	x	x	x	x	x	x	x
PSO 8	X	x	x	x	x				x	x
PSO9	X	x	x	x	x	x	x	x		x
PSO10	X	x	x	x	x	x	x	x	x	x

PGB 4441 PLANT DIVERSITY 6Hr./4Cr.

PREAMBLE: Students will explore the stupendous variation in the organization of internal and external morphology encountered in cryptogamic plants. The complexity of these features they will unravel in the light of lines of evolution. They will appreciate the interrelationship among them. Students will learn the lessons from the past fossil history to relate it to the present.

COURSE OUTCOME

At the end of the course, the students will be able to

i. understand and realize the paleontological history of the living earth by way of studying the evolution of green plants, classification and characterization of major plant groups.
ii. comprehend the General features, classifications, biology and distribution and evolution of different algal farms with their ecology and ecological importance with their counterpart lichens.
iii. connect the link between algae with their terrestrial counterpart bryophytes through studying the features, ecology and variations of gametophytes and sporophytes and their evolutionary significance
iv. correlate the link between non vascular plants and vascular plants through analyzing the features, distribution and the significance of stele and seeds in land plants and also through the knowledge of various Indian pteridologists.
v. comprehend the importance of seed plants in terrestrial habitat while learning the origin, general features and evolution of seed plants which will pave way to understand the origin of angiosperms.

UNIT I: Paleontological History: Earth as a living planet – origin of life – evolution of green plants through ages – geological timescale – continental drift – kingdom classification – mega extinction and speciation – classification and characterisation of major plant groups – fossils and fossilization.

UNIT II: Algae: General features – criteria for various classifications – thallus organization – biology and distribution – evolution of life cycle patterns – fossil algae – ecology and economic importance – algal research in India and key contributors – algae as symbiont – biology of lichens.

Unit III: Bryophytes: General features, distribution and ecology – variations of gametophytes and sporophytes – classification and inter-relationships – trends in bryology (Sphagnales and Takkakiales) – progressive and retrogressive evolution.

Unit IV: Pteridophytes: General features and distribution – origin of land plants – evolution of stele – alternation of generations, heterospory and seed habit – structural variations in gametophytes and sporophytes – apogamy and apospory – aquatic ferns – contributions of Indian pteridologists.

Unit V: Gymnosperms: Origin and evolution of seed bearing plants – general features of Cycads, Conifers, and Gnetopsids – morphology, anatomy and reproductive biology – evolution of seed – fossil gymnosperms – origin of angiosperms.

TEXT BOOKS

1. Cavers, F.1971. The interrelationship of bryophytes. Dawsons Pallwall. ISBN -0-521-66794-1
2. Chopra, R.N.2001. Biology of Bryophytes. Narosa publishers. ISBN: 81-224-343- 9
3. Lee,R. E. 2009. Phycology. Cambridge University Press. ISBN: 978-0521-14144-42.
4. Rashid, A. 1982. An introduction to Pteridophyta. Vikas publishing Co. (repr.ed). ISBN: 81- 259-0709-2
5. Sporne, K. R. 1962. The morphology of Pteridophytes. Hutchinson University Library. California. ISBN 978009123861
6. Sporne, K.R. 1965. The morphology of gymnosperms: The structure and evolution of primitive seed plants. B. I. Publications Pvt. Ltd. ISBN 81 7225 0398. 10.
7. Stewart, W.N and Rothwell G.W. 2010 Paleobotany and the Evolution of Plants. Cambridge University Press (2nd Edn). ISBN – 10:0521126088

REFERENCE BOOKS

1. Bell, P.R. and A.R. Hemsley. 2000. Green plants, their origin and diversity. Cambridge University Press, U.K. (2nd Edn). ISBN: 0-521-64109-8
2. *Bold,* H.C. and W*ynne,* M.J. 1985. *Introduction* to the *Algae*: Structure and Reproduction. 2nd Edn. Prentice Hall. Englewood Cliffs, New Jersey. ISBN: 978-0134777467
3. Fritsch, F.E. 1945. The structure and reproduction of the algae. Vikas publishing Co. ISBN: 0-521-77051-3.
4. Ingrouille M and Eddie B 2006., Plant diversity and evolution. Cambridge Univ. Press. ISBN 0 521 79433 1.
5. Johri.R. M., Latha.S and Sharma.S. 2009. Text book of Pteridophyta. Wisdorn Press. ISBN 978 81 9086 35 82.
6. Kumar, H.D. 1988. Introductory Phycology. East West press. ISBN: 81- 859- 3896-2.
7. Morris, I. 1971. An introduction to Algae. Hutchinson University Librarary. ISBN: 0-090-80713-8
8. Smith, G.M. 1966. Cryptogamic botany vol. 1. Algae and Fungi. Tata McGraw-Hill Book Company. (2nd ed.).ISBN : 0-070-99576-1.

9. Vanterpoorten, A. and Goffinet,B. 2009. Introduction to Bryophytes. Cambridge Press. ISBN: 978-0-521-70073-3.

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)
CO 1				**4**		
CO 2				**4**		
CO 3					**5**	
CO 4					**5**	
CO 5				**4**		

PGB4443 **PRINCIPLES OF MICROBIOLOGY** **6Hrs. /Cr 4**

PREAMBLE:

This course enables students to understand the basic concepts in microbiology and microscope as a tool to explore the microbial life. The emphasis will be given to their cosmopolitan distribution, diversity and ability to adapt in different environments. Microbes in different environmental conditions will be discussed with practical examples. Applied microbiology section will provide a glimpse on the industrially important microbes.

COURSE OUTCOME

At the end of the Semester, the Students will be able to

i. knowledge about Microbiology starting from history and basic knowledge about the microorganisms. Understand microbial diversity, ultra-structure of eukaryotic and prokaryotic cells. Assess the characters and classification of microbes through modern approach. knowledge about Microbiology starting from history and basic knowledge about the micro organisms

ii. know the techniques of microscopy, quantitative measurement of bacterial growth sterilization and disinfection, methods of isolation, and get sufficient knowledge in measurement of bacterial growth and basic pure culture techniques, maintenance and preservation of cultures.

iii. recognize the biology of bacteria and viruses, energy production, classification and reproduction. sufficient knowledge in biology of bacteria and viruses. relationship between food and microbes, techniques used in food processing. Enable the student to get sufficient knowledge in relationship between food and microbes, techniques used in food processing.

iv. sound knowledge on the air, soil and aquatic microflora, role of microbes in organic matter decomposition and bioremediation. Understand solid waste management and waste water treatment.

v. inculcate knowledge in role of micro organisms in eco system and impact created by microbes in agricultural development. gain experience in different aspects used in industrial microbiology. Understand food processing, nutrition,& food processing technology. And also study methods of refrigeration, material handling and food preservation

UNIT I: General Microbiology: History – scope – microbial diversity – extremophiles – ultra-structure of eukaryotic and prokaryotic cells – human microbiome – natural classification,

phylogenetic approach – numerical taxonomy (simple match coefficient and Jaccard coefficient), modern approach – base composition – nucleic acid sequencing (RNA fingerprint – 5S rRNA and 16S rRNA) – Bergey's classification.

UNIT II: Tools and techniques: Microscopy (brightfield, darkfield, phase-contrast, fluorescence and electron microscopy) – microbial nutrition – quantitative measurement of bacterial growth – sterilization and disinfection – physical and chemical agents – methods of isolation – axenic cultures – maintenance and preservation.

UNIT III: Biology of bacteria and viruses: Energy production (anaerobic fermentation – aerobic respiration) – bacterial recombination (conjugation – transduction – transformation.) Viruses (general characteristics, structure, composition and classification of viral genomes.) bacteriophages (morphology and structure of T4 and λ phage.) – classification of viral vaccines – rabies and HIV.

UNIT IV: Environmental Microbiology: Air microflora (indoor and outdoor), soil microflora (diversity and abundance) – organic matter decomposition – biological nitrogen fixers (symbiotic and asymbiotic) – aquatic microflora (fresh and marine) – microbes in biodegradation, biodeterioration and bioremediation – potability, microbial assessment and purification of water – waste water treatment – solid waste treatment – source of food and energy.

UNIT V: Applied Microbiology: Scope – intrinsic and extrinsic factors affecting the growth of microbes – food microbiology (microbes in food, and spoilage, prevention and preservation methods – functional foods (probiotics, prebiotics, synbiotics and nutraceuticals) – dairy microbiology (microflora of raw milk, processed milk, spoilage and defects, fermented milk and microbiological standards of milk, milk products) – clinical microbiology (common pathogens, protocol for specimen collection, handling, transportation, processing, laboratory safety and infection control.) – applications of microbes in agriculture – bioinoculants – biofertilizer (types, mass production and quality control).

TEXT BOOKS

1. Dubey, R. C. and Maheswari, D. K. 2013. A Textbook of Microbiology, S. Chand & Comp. ISBN 81-219-2620-3
2. Pelczar, H.J. E.C.S. Chan and N.R. Kreig. 1996. Microbiology concepts and applications. McGraw Hill Inc. ISBN 0-07-049234-4

REFERENCE BOOKS

1. Atlas, M R. 1997. Principles of Microbiology. Wm. C. Brown Publishers. ISBN 0-8151-0889-3

2. Hull, R. 2004. Plant Virology.4th Edn. Academic Press., ISBN 0-12-361160-1
3. Madigan M.T. and Martinko, J. M. 2006. Biology of Microorganisms, 11th ed., Pearson Prentice. 9780132017848 and 0132017849
4. Perry, J. J. and Stanley, J. T. 1997. Microbiology Dynamics and Diversity. Saunders College Publishing. ISBN 0-03-053893-9
5. Prescott, M. J., Harley, J. P. and Klein, D. A. 2008. Microbiology, 7th ed. WCB McGraw Hill. ISBN 978 007-126 727 4
6. Stanier, R.Y. 1987. General Microbiology. 5th Ed. McMillan Education Ltd. ISBN 0-333-41768-2
7. Talaro, K. P. and Talaro, A. 2002. Foundations in Microbiology. McGraw Hill Publ. ISBN 0-07-232042-7

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	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)
CO1			3			
CO2				4		
CO3					5	
CO4				4		
CO5			3			

PGB 4445 PLANT DIVERSITY & MICROBIOLOGY LAB 6Hr /4Cr

COURSE OUTCOME

At the end of the course the students will be able to

i. explore the variations in the organization of internal and external morphology and the interrelationship observed among the non flowering plants right from the unicellular to multicellular organisms in the light of evolution.

ii. perform the basic microbial culture techniques, standard methods of microbial load analysis in environmental samples, staining techniques and growth studies. Can demonstrate experiments and for antagonistic studies to screen chemicals and microbes to be used in microbial control strategies.

PLANT DIVERSITY

I. ALGAE: Taxonomy, thallus organization and reproductive structures of the following taxa:

1. **Chlorophyta** – *Chlamydomonas, Volvox, Ulothrix, Oedogonium, Cladophora, Spirogyra, Fritchiella, Coleochaete, Chaetomorpha, Caulerpa, Chara.*

2. **Phaeophyta** – *Dictyota, Padina* and *Sargassum*

3. **Rhodophyta** – *Batrochospermum, Gracilaria, Polysiphonia*

4. Sea weeds- Collection and the identification of macro algae and agarophytes from coastal lines

II. BRYOPHYTES: Study and the evolution of the thallus organization of the sporophytic and gametophytic structures of following taxa:

5. Marchantiales – *Riccia, Targionia, Marchantia* **Jungermanniales**

6..**Anthoceratales** – *Porella, Anthoceros* **Bryopsida** – *Sphagnum, Funaria* and *Polytrichum*

III. Pteridophytes: Study and the evaluation of the following taxa:

7. **Psilopsida** – *Psilotum,* **Lycopsida and Sphenopsida** – *Lycopodium, Selaginella, Isoetes, Equisetum*

8. Pteropsida and Leptosporangiate ferns - *Marsilea, Salvinia,Azolla,Adiantum***,** *Gleichenia and Pteridium.*

IV. Gymnosperms: Morphology and anatomy of vegetative and reproductive structures of the following types

9. Cycadopsida : *Cycas, Zamia*

10. Coniferopsida : *Pinus, Cupressus, Podocarpus, Araucaria*.**Gentopsida:** *Gnetum*

11. Fossil Pteridophytes and Gymnosperms - Fossil cycads (*Lyginopteris oldhamia* Stem TS (*Lyginodendron*), *Lyginopteris* male (*Crassotheca*); *Lyginopteris* rachis (*Rachiopteris aspera*); *Lyginopteris* pinnae (*Sphenopteris*), *Botryopteris* root, sporangia; petiole (*Botryopteris ramosa*), TS of stem (*Botryopteris cylindrica*). *Lepidodendron* - Stem (leaf base), periderm (*Stigmaria*); Medullosa.

V. Field Visit: Field trips to the Eastern and Western Ghats to study plants in their natural habitats.

REFERENCE BOOKS

1. *Bold*, H. C. & W*ynne*, M. J. 1985. *Introduction* to the *Algae*: Structure and Reproduction. 2nd Edition. Prentice Hall. Englewood Cliffs, New Jersey. ISBN : 9780134777467
2. Cavers, F. 1971. The interrelationship of bryophytes. Dawsons Pallwall. ISBN -0-521-66794-1
3. Fristch, F. E. 1945. The structure and reproduction of the algae. Vikas publishing Co. ISBN: 0-521-77051-3.
4. Kumar, H.D. 1988. Introductory Phycology. East West press. ISBN: 81- 859- 3896-2.
5. Morris, I. 1971. An introduction to Algae. Hutchinson University Library. ISBN: 0-090-80713-8
6. Rashid, A. 1998. An introduction to Bryophyta. Vikas publishing Co ISBN: 81-259-0569-
7. Rashid, A. 1982. An introduction to Pteridophyta. Vikas publishing Co. (repr.ed). ISBN: 81-259-0709-2
8. Sporne, K. R. 1965. The morphology of gymnosperms: The structure and evolution of primitive seed plants. B.I.publications Pvt.Ltd. ISBN 81 7225 0398.

MICROBIOLOGY LAB

1. Principles of Microscopy – microbial photographs.
2. Preparation of culture media, sterilization - moist heat – dry heat- radiation- filtration.
3. Pour plate- spread plate, streak plate-serial dilution – hanging drop.
4. Microbial examination of different habitats – CFU, MPN, colony characterization.
5. Staining techniques - Smear preparation, Gram staining, endospore staining, capsular staining and fungal staining.
6. Microbial enzyme screening: amylase, protease, lipase, cellulase.
7. Growth studies: Growth curve – heamocytometry and turbidometry
8. Actinomycetes – isolation and characterization
9. Fungal endophyte study – isolation technique.

10. Type study - *Mucor*, *Rhizopus*, *Pilobolus* and *Aspergillus*
11. Macrofungal fruiting bodies - diversity
12. Disease symptoms and assessment methods - Paddy blast scale.
13. Evaluation of fungicide: Slide germination technique and inhibition zone technique
14. Biological control – Antagonistic property.
15. Visit to microbiological lab/ microbe based industry.

REFERENCE BOOKS

1. Cappuccino, J. G. and N. Sherman. 2003. Microbiology – A Laboratory Manual. Pierson Education. ISBN 81-2970265
2. Gunasekaran, P. 2000. Laboratory Manual in microbiology. ISBN 81-224- 0783-8
3. Anonymous 1983. Field problems of tropical rice. International Rice Research Institute, Philippines. ISBN 971-194-080-8

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1				4			
CO2					5		

PGB 4447 PLANT CELL CHEMISTRY 5Hr./ 4Cr.

PREAMBLE:

This course unravels the basic construct of how organisms are hierarchically assembled from free atoms and molecules to bioorganic chemicals and cells that cell as the basic structural and functional unit of life is able provide the material as well as strategy for survival as rooted entity.

COURSE OUTCOME

At the end of the semester, students will be able to

i. look at cells as a composite organic entity made of simple atoms and molecules that can congramulate to form supra molecular complexes and macro molecules that can provide a basis for functioning of life.

ii. comprehend plant cells as a finely Owen network of continuous and discreet membranous pockets to enable a cell to live as a fundamental and structural entity.

iii. understand the basic framework of cells contributed by homo and hetero polymers of carbohydrates, amino acids and proteins that provides for the organization of the cell wall, plasma membrane, cytoskeleton and cytocavitory network.

iv. unravel the structural and functional intricacies of nucleic acids and proteins whose sequence information's prove vital to store the genetic scripts that control and regulate the expressions of hereditary traits.

v. comprehend cell as a thermodynamically competent and energy sufficient component of the plant system which by its various carbon breakdown pathways and electron transfer reactions meet out the energy requirements.

UNIT I: Molecules of life : Atoms, molecules, bonds, functional groups, periodic table, nomenclature, units of measurement – physical constants – concepts of pH and buffers – simple inorganic molecules to macromolecules, reducing power, energy rich molecules – basic design of metabolism.

UNIT 2: Cell Architecture: Concept of Cell – ultrastructure and organization of plasma membrane – cell wall – cytoskeleton nucleus – nucleolus – chromosome – chloroplasts, mitochondria – lysosome – peroxisomes – glyoxysomes – centriole – flagellum – cilium and vacuoles – cell cycle and cell division- cell as a building block

UNIT 3: Structural and Skeletal Compounds in Plant Cells: Configurational and conformational aspects of carbohydrates and lipids – structure, properties and importance of

structural (cellulose and chitin) and storage polysaccharides (starch and glycogen) and Chemical nature of lipids (fatty acids, triacylglycerol, phospholipids, waxes, spingolipids) – topology of biological membrane – fluid mosaic model – biosynthesis of membrane lipids

UNIT 4: Memory Chemicals and Cell's Makeover: Candidacy of protein, RNA and DNA as genetic material, Structure and classification, physical, chemical and optical properties of amino acid – peptides – Ramachandran Plot – porphyrin biosynthesis – amino acids metabolism (synthesis and deamination)- chemical structure and base composition – biosynthesis and break down of nucleotides – Smaller compounds and Secondary metabolites (terpenoids, alkaloids and flavonoids, vitamins).

UNIT 5: Substrates of Energy Transactions and Cell Dynamics: Carbohydrate and lipid reserves- glycolysis – pentose phosphate pathway – Krebs cycle- lipid metabolism (biosynthesis, oxidation and energy budget) β oxidation – electrochemical potential and redox reactions- – Role for enzymes - enzyme catalysis – substrate specificity – kinetics and allostearism – coenzymes- metabolic regulation.

TEXT BOOKS

1. Gerald Karp. 2013. Cell Biology. 7th edition. John Wiley & Sons. ISBN:1118318749
2. Voet, D, J. G. Voet and Pratt, C. W. 2008, Principles of Biochemistry, John Willey and Sons, Publ. ISBN 13-978-0470-23396-2
3. Devlin, T.M. 2002, Biochemistry, 5th Edn. Wiley-Liss Publ. ISBN 0-471-411361.

REFERENCE BOOKS

1. Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walter P., 2002. Molecular Biology of the Cell, 4th Edn. Garland Science Publ. ISBN 0-8153-4072-9.
2. Berg, J. M., Tymocozko, J. L. and Stryer L. 2007. Biochemistry, 6th Edn, W.H. Freeman and Company, ISBN 0-7167-8724-4
3. Dey, P. M. and Harborne, J. B. 2000. Plant Biochemistry. Harcourt Asia, Pvt. Ltd. Singapore. ISBN 0-12-214674-3 (HB)
4. Gurr, M.I., Harwood, J. L. and Frayn, K. N. 2002 Lipid Biochemistry 5th Edn. Freeman Publ. ISBN 1-4039-4876-3
5. Mathews, C.K., Van Holde, K. E. and Ahern, K. G., 2005, Biochemistry, Pearson Ed. Publ. ISBN 81-297-0215-0
6. Nelson, D. L. and Cox, M. M. 2008. Principles of Biochemistry 5th Ed., CBS Publ. ISBN 1 4292 1241 1.
7. Murray, R. K., D. K. Granner, P. A. Mayes, and V.W. Rodwell, 2000. Harpers Biochemistry, 25th Ed., McGraw Hills Pub. ISBN 0 8385 3684 0.

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	**K2 (Understand)**	**K3 (Apply)**	**K4 (Analyze)**	**K5 (Evaluate)**	**K6 (Create)**
CO1			3			
CO2		2				
CO3		2				
CO4				4		
CO5		2				

PGB4249 BIOCHEMISTRY LAB 3Hr./ 2Cr.

COURSE OUTCOME

At the end of the course, the students will be able to

i. perform qualitative tests for all major macro molecules and file a report of chemical profile of a plant cell.

ii. extract bimolecule of diverse nature from different sources that they will be able to assess the metabolic profile of their source material

1. Carbohydrates – Qualitative and Quantitative tests.
2. Protein – Qualitative and Quantitative tests.
3. Estimation of free fatty acids and saponificaiton value.
4. Lipids – Separation of chloroplast lipids
5. Estimation of cholesterol.
6. Amino acids – Estimation of amino acids in biological samples.
7. Separation of amino acids by paper chromatography and Thin Layer Chromatography.
8. Protein separation by Polyacrylamide Gel–Electrophoresis.
9. Extraction and quantification of pigment (Lycopene & Curcumin).
10. Extraction and estimation of vitamins and phenolics.

REFERENCES

1. Cooper, T.G.1991. The tools of biochemistry, John Willey and Sons, Publ. ISBN 0 4711 7116 6.
2. Harborne, 1998. Phytochemical methods, Chapman and Hall, Publ. ISBN 0 4125 7270 2.
3. Jeyaraman, J. 1988. Laboratory Manual in Biochemistry, New Age International Pub., Ltd. ISBN 0–85226–428–3
4. Plummer, DT., 2003. An Introduction to Practical Biochemistry, 3rd Edn. Tata McGraw Hills Pub Company, ISBN 0–07–0994870
5. Sadasivam. S and A. Manickam. 2008. Biochemical methods for Agricultural Sciences, 2nd edn., New Age International Pub. Ltd., ISBN 978–81–224–2140–8
6. Willson, K. and J. Walker. 1994. Practical Biochemistry, Cambridge University Press, ISBN 0 5217 9965 1.

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1					5		
CO2					5		

PGB 4331 **CAMPUS ECOLOGY** **4Hrs./ 3Cr.**

PREAMBLE: This course stresses the importance of ecological knowledge to preserve and protect the nature and its elements *per se* in the campus. Awareness of our own ecosystem alone can give an insight towards the conservation of our own environment. The present course aimed at giving quality education on the basics of ecosystem, in order to give a clean atmosphere within the campus. Uniqueness of the flora and fauna in the campus will tickle the young mind to broaden their vision towards the biodiversity of the campus. After the completion of the course the students will be able to understand, appreciate and conserve the nature.

COURSE OUTCOME

At the end of the Semester, the Students will be able to

i. know about the ancient history and establishment of the campus which is an important heritage marvel and the origin and history of the satellite campus and their immediate beneficiaries.
ii. understand the biodiversity abode in the campus especially the flora and fauna with their seasonal variations and the abundant exotic plants and weeds including the horticultural varieties and appreciate the reasons behind it.
iii. realize the ecoclimatic conditions prevailing in the campus which is responsible for the serenity of the campus, and efforts taken by the administration related to maintain the ecological harmony of the campus especially during the water crisis and conservation.
iv. comprehend the reason behind the cleanliness of the campus by way of solid waste disposal and also to ensure the serene atmosphere related to air, water and environment following ecological ethics.
v. conduct anywhere the quantitative experiments such as the tree cover using – quadrat analysis, tree identification, bird watching and aerobiology on their own.

UNIT I: Understanding the campus: Origin and history – departments – etymology – building designs – architecture – various facilities – organizational set up – satellite campus – origin and history – beneficiaries.

UNIT II: Biodiversity: flora and fauna – seasonal variations – exotic plants and weeds – horticultural species – arboretum – species of birds and animals – importance of flora and fauna

UNIT III: Ecoclimate: Serenity of the campus – ecological factors – rainfall – temperature – altitude – impact of plants – campus as an ecosystem – litter fall – rain water harvesting – water crisis and conservation.

UNIT IV: Waste regulation: waste disposal – litter *vs* solid waste – basics of solid waste management – pollution (air, water and environment) – ecological ethics – importance of diversity – atmospheric cleanliness – future scope.

UNIT V: Eco-watching: Tree cover – quadrat analysis (density, abundance and frequency) – basics of bird watching – tree identification – unique trees and animals – litter drop method – basics of aerobiology.

TEXT BOOKS

1. Anonymous, 2016. Green Audit Report. The American College, Madurai.
2. Odum, E. & Barrett G.W. 2005. Fundamentals of ecology. Cenage Learning India Private Limited ISBN 8131500209, 9788131500200
3. Sharma, P. D. 2017. Ecology and Environment. Rastogi Publications *ISBN*: 9789350781227.

REFERENCE BOOKS

1. Anonymous 2005. The American college Commemoratory publication SCILET
2. Bor N. L. & Raizada M.B. 2000 Some Beautiful Indian Climbers and Shrubs, Bombay Natural History Society. Bombay
3. Mc Cann, C. 1966. 100 Beautiful trees of India – A descriptive and pictorial handbook. D.B.Taraporevala Sons & Co Private Ltd, Bombay.
4. Sahni K C. 1998. The Book of Indian Trees. Bombay Natural History Society. Bombay. ISBN – 13: 978 – 0195645897
5. Santapau, H. 1966. Common trees, India land and the people, National book Trust India New Delhi. ISBN: 81 – 237 – 0288 – 4

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)
CO 1		**2**				
CO 2				**4**		
CO 3						**6**
CO 4					**5**	
CO 5				**4**		

PGB 4333 PLANT BASED ENTERPRISES 4Hr./3Cr.

PREAMBLE:

This course will survey the overall business potentiality of plants and practical aspects of food fermentation in regard to beer, wine, and cheese/dairy. Focus will be on the processes of converting source material to finished products. Students will gain a fundamental understanding of theory and technology involved in it.

COURSE OUTCOME

At the end of the Semester, the Students will be able to

i. identify trade opportunities and funding agency , build business plan, acquire talent and awareness on food certification
ii. Categorize food and practice the preparation of commercial products, cultivate and trade of medicinal plants.
iii. Use biotechnological approach to produce processed food, know the strategies to develop bakery industry.
iv. List the types of biofertilizers, learn the process of composting and design backyard composting.
v. Distinguish between edible and poisonous mushroom, develop cultivation method- evaluate the economics of marketing –practice the mushroom recipe preparation.

UNIT I: Plant trade: Trade opportunities – Becoming an Entreprenuer –guidance from MSME - Finance from banks -SME –MSMED act - plan and proposal – training in concerned field - trade license and registration marks – marketing strategies -Food safety –Food certification (FAO, EFSA) - organic shops – food centres.

UNIT II: Fresh and Dry Plant market: Fresh plant products **: F**ood – health drink – juice - ~~herbs~~ herbal drink- salad) — cut flowers usage (garland, Bonsai & Bouquet)- Nursery(cultivating and sale of ornamental plants, medicinal plants) Dried plant products: (spices, leaf plates –leaf fan - plant articles –wood work) food supplements (health mix) – beverages (tea/coffee) - raw drugs – natural dyes – Cosmetic products – awareness on narcotic plants.

Unit III: Processed food Products: Fermentation -milk and milk products –alcoholic products- Bakery products –preparation of Batter - jam – jelly – squash - pickles –pounded masala products - starting bakery unit – factors affecting the products -natural preservatives.

Unit IV: Farm Supplements: Bio-fertilizer types– microbial biofertilizer production – green manures – mass cultivation of *Azolla, BGA* – composting processes (vermi, backyard compost)

UNIT V: Mushroom Technology: Identification – characterization – collection – edible and poisonous – nutritional, medicinal and economical value –substrates, spawning and pure culture techniques – protocols for cultivation (indoor and outdoor cultivation) – harvesting, storing, packing – marketing strategies – mushroom recipes.

TEXT BOOKS

1. Bahl, N. 2000. Hand book on mushroom cultivation. 4th Ed. Oxford & IBH Publishing Co. New Delhi. ISBN: 8120413997

2. SubbaRao, N. S., 1995. Soil microorganisms and Plant Growth. Oxford & IBH Publishing Co., New Delhi. ISBN: 1886106185

3. Handbook on herbs cultivation and processing, 02004, Asia Pacific Business Press Inc. ISBN:9788178330747

REFERENCE BOOKS

1. Chang, T.S. and Hayes, W.A. 1978. The biology and cultivation of edible mushrooms. Academic Press, New York. ISBN: 9781483271149

2. Nair, M.C., Gokulapalan, C. and L. Das, 1997. Topics on mushroom cultivation. Scientific Publishers, Jodhpur, India.

3. Abu Mathur (2017) Fundamentals of Entrepreneurship, The tax and corporate laws of India publication. ISBN: 9789386882479

Mapping Cos with Bloom's taxonomy:

	K1(KNOW)	K2(UNDER)	K3(APPLY)	K4(ANALY)	K5(EVAL)	K6(SYN)
CO1				4		
CO2			3			
CO3					5	
CO4						6
CO5					5	

PGB 4542 **PLANT SYSTEMATICS** **7Hr./5Cr.**

PREAMBLE: The present course is aimed at giving a holistic account on the nuances of flowering plants such as history, classification and the relationship with non flowering plants. Nomenclature of higher plants is another wing of plant systematics which ought to be given importance. Teaching herbarium techniques on hand, might give the students an insight regarding the study of plant specimens and appreciate the morphology of plants better. Alternative methods of classification of plants will make the students see beyond microscope to the digital world.

COURSE OUTCOME

At the end of the Semester, the Students will be able to

i. comprehend the different flavours of evolution from the origin of species and its development in to a complex structure in its natural habitat and the ever changing physiognomy of the habitat based on their geological position with special reference to the diversity of Southern India and its conservation
ii. tread and appreciate the glimpses of botanical history right from the layman's classification to the phylogenetic classification through ages
iii. do research and also gets hands on training in herbarium taxonomy through the process of preserving the plant specimens for herbarium which is a biological tool and store house of plants for taxonomical research.
iv. understand the principles, articles and recommendations of International Code of Nomenclature and apply the rules and regulations formulated by the botanical congress while naming the plant species.
v. examine the recent developments in the field of plant systematics and reflect upon the e-learning programs related to net based applications which will make the students amused towards the subject.

UNIT I: Ascent of angiosperms: Origin of flowering plants – angiosperm phylogeny – co - evolution – basal angiosperms – ecological dominance of angiosperms – latitudinal and altitudinal zonation of floristic wealth, biomes – physiognomy and structures of forest in southern India – endemism and hotspots.

UNIT II: History of classification: Pre-Linnaean, Linnaean and post Linnaean period – contributions of Linnaeus, Bentham and Hooker, Engler and Prantle and Bessey – angiosperm phylogeny groups APG I, II, III, and IV – ethnobiological survey and classification of plants.

UNIT III: Herbarium taxonomy: Objectives and functions – herbarium preparation – collection – pressing – poisoning and drying – identification – mounting – labeling – incorporation – herbarium ethics – maintenance – important herbaria – BSI (Botanical Survey of India), and TBGRI (Tropical Botanical Garden and Research Institute) Rapinat herbarium (RAPINAT) – Kew Garden (KEW).

UNIT IV: International Code of Nomenclature: History of different codes – botanical congress – ICBN to ICN (Melbourne code 2010), IAAT (Taxon), IAPT (Rheedea) – principles of ICN – taxonomic hierarchy – active principles (priority of publication, typification, effective publication) valid names, rejection of names, author citation – botanical naming (polynomial, trinomial and binomial).

UNIT V: Trends in classification: Cladistics and biosystematics (chemo, sero and molecular taxonomy) **–** numerical taxonomy – Kubitzski system – use of computers – automated pattern recognizing systems – matrices, online data bases: IPNI (International Plant Names Index) – Index Kewensis and The Plant List.

TEXT BOOKS

1. Bhatacharyya, B. 2005. Systematic Botany, Narosa Pub. House Pvt. Ltd. ISBN 81-7319-542-0
2. Krishnamurthy, K.V. 2003. A text Book on Biodiversity (Principles and Practice), Science Publishers, USA. ISBN 1578083257.
3. Lawrence, G. H. M. 1964. Taxonomy of Vascular Plants. Oxford and IBH Publishers. ISBN 17-L5-5
4. Prathipalsingh, 2010. Introduction to biodiversity. Ane books Pvt. Ltd. New Delhi. ISBN 978-1-8052-185-0
5. Singh, G. 2007. Plant systematics theory and practices. Oxford and IBH Publishing Co. ISBN 81-204-1652-x
6. Sivarajan, V. V. 1999. Introduction to the principles of Plant Taxonomy. Oxford & IBH publishing co. ISBN: 81-204-0445-9.
7. Pandey, B.P. 2013. Taxonomy of Angiospherms, S. Chand Publishing, New Delhi. ISBN 9788121909327

REFERENCE BOOKS

1. Davis, P. H. & Heywood, V. H. 1972. Principles of Angiosperm taxonomy. Edinburgh, London, Publ. ISBN 0 8825 5129 8
2. Henry, A. N. and Chandrabose, M. 1979. An aid to the International Code of Botanical Nomenclature. Today and Tomorrow Publ. ISBN 8 1701 9094 0
3. Jain, S. K. and Rao R. R. 1993. A handbook of field and herbarium methods. Today and Tomorrow Publ. ISBN 8 1701 9130 0
4. Jones Jr. SB and Luchsinger AE 1987. Plant systematics. McGraw- Hill Book Company. ISBN 0-07-032796-3.
5. Stace, C.A. 1989. Plant taxonomy and biosystematics, 2nd Ed. Edward Arnold, ISBN 0-7131-2955-7
6. Simpson, M. G. 2010. Plant Systematics, 2nd Ed. Academic press ISBN 978-0-12-374380-0.

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)
CO 1				**4**		
CO 2				**4**		
CO 3			**3**			
CO 4						**5**
CO 5						**5**

PGB 4544 **PLANT PHYSIOLOGY** **7Hrs/5Cr**

PREAMBLE:

Students would be able to understand water as an elixir for plant life. They will scientifically explore the plumbing and pipe line system along with the ventilating system for gas exchange. The molecular mechanism of synthesis of food and its usage to derive energy are explored. The physiology of deriving nourishment from soil and its conversion to usable form too are unravelled. Plant's management of physical, chemical and edaphic factors are studied.

COURSE OUTCOME

At the end of the Semester, the Students will be able to

i. to locate water as a resource and analyze the movement of water and other substances across membranes which gets integrated with cellular chemistry and functions that the soil water-plant –atmospheric continuum provides the vibrancy needed for plants despite its sedentary habit.

ii. discover photosynthesis as a mandatory mechanism to input energy into the living world and analyze the ultra structural and biochemical variations of the photosynthetic machinery among plants and estimate the

iii. photosynthetic productivity at specific types of ecosystems

iv. understand the inside story of molecular physiology of mineral nutrient acquisition, transport and utilization involving a select list of elements with which the land plant is able to show case the dynamism of life with only a fewer macromolecules and specific secondary chemicals.

v. analyze the energy utilization pathways of photosynthetic products harnessing energy into ATP through a proton circuit mechanism and electrophysiology of membranes that the life forms are thermodynamically equipped to be self sufficient structures at normal and stressed conditions.

vi. Correlate how plants respond to environmental conditions that limits the distribution of plants and understand the challenges encountered by plants to defend themselves from these stresses.

UNIT I: Plant, water and ionic relations: Soil and atmospheric water-Physiological role of water – water potential –uptake and transport mechanisms – stomatal mechanics – gas transfer equation – malate metabolism in guard cells – potassium ions – organization of conducting tissues, Source sink relations- phloem loading and unloading-theories of translocation.

UNIT II: Carbon metabolism: Fine structure of photosynthetic machinery-light harvesting protein complex– Einstein's law of photochemical equivalent – light absorption and photosynthetic electron transfer – Emerson's enhancement effect and synergetic functions of LHCP 1 and LHCP 2– cyclic, non–cyclic, pseudo cyclic photophosphorylation – significance of OEC and D2 proteins – C-3 cycle — C-4 and CAM metabolism – factors affecting photosynthesis- photorespiration (C-2 cycle)

UNIT III: Mineral nutrition and nitrogen metabolism: Macro, micro nutrients of plants-deficiency and toxicity symptoms – integration of nitrogen, phosphorus, Sulphur- nitrogen assimilation - GS - GOGAT path way, Hup genes nitratereductase,–leghaemoglobin, carbon economy –biological role of carotenoids and flavonoids - *nod*- hsn, gsn genes – ammonia assimilation-uride synthesis – ammonia assimilation.

UNIT IV: Respiration: respiratory substrates- Carbon break down pathways-Respiratory Quotie:Int -Electron transport and respiratory chain. Energy budget – chemi-osmotic proton circuit, ATPase complex, mechanism of ATP synthesis–cyanide resistant respiration-pentose phosphate pathway-factors affecting respiration.

UNIT V: Stress physiology: Concepts – water-drought,flooding and salt-radiation-UV-temperature-heat,frost- acidic soil, osmotic, oxygen deficit and oxidative stress – mechanism of plant responses-stress proteins – mineral and metal toxicity – stress management.

TEXT BOOKS

1. Francis.H.Witham,Robert M.Devlin 1986 Plant physiology 4 edition W.Grant press ISBN-13 978-0871507655
2. William G.Hopkins ,Norman Introduction to Plant Physiology John Wiley& Sons ISBN-13 978-0470247662
3. Irwin P.Ting Plant Physiology Addison Wesley longman Publishing Company 1982 ISBN 0 19850180 3
4. Raman, K. 1996.Transport phenomenon in plants. Narosa Publications.ISBN 978 81 319 128 2.
5. Frank B.Salisbury,CleonW. Ross and Plant physiology edition 4 wadsworth publishing company. ISBN 0534983901
6. Voet, D., J. G. Voet and Pratt, C. W. 2008. Principles of Biochemistry. John Willey and Sons, Publ. ISBN 13-978-0470-23396-2
7. Malcolm B.Wilkins, M.B. Advanced Plant Physiology. Pitman press. ISBN 0-273-01853-1

REFERENCE BOOKS

1. Alberts B., Johnson A., Lewis, J. Raff, M, Roberts, K. and Walter, P. 2002. Molecular Biology of the Cell, 4thEd. Garland Science Publ. ISBN 0-8153-4072-9.
2. Baker, R. D. J., Cartledge, T. G, Dewhurst, F. and Jenkins, R. O., 1992, Principles of Cell Energetics, Butterwoth-Heinemann Publ. ISBN 0-7506-15044
3. Berg, J. M., J. L. Tymocozko and Stryer L. 2007. Biochemistry, 6th e ed, W.H. Freeman and Company, ISBN 0- 7167-8724-4
4. Licoln Taiz,Eduardo Zeigner, Plant Physiology 5 thEd.Sinauer Inc ISBN-13 978-0878938667.
5. Gurr, M. I., Harwood, J. L. and Frayn, K. N., 2002 Lipid Biochemistry. Freeman Publ. ISBN 1-4039-4876-3
6. Lehninger, A. L., D. L. Nelson and M. M. Cox. 2008. Principles of Biochemistry. 5th Ed. CBS Publishers and Distributors. ISBN 1 4292 1241 1
7. Matthews, C. K., Van Holde, K. E. and Ahern, K. G., 2005, Biochemistry, Pearson Pub. ISBN 81-297-0215-0
8. Voet, D., J. G. Voet and Pratt, C. W. 2008. Principles of Biochemistry. John Willey and Sons, Publ. ISBN 13-978-0470-23396-2
9. Willard, H. H., L. L. Merritt, J. D. Dean, F. A. Settle. 1986. Instrumental methods of analysis. CBS Publ. ISBN 0 5340 8142 8

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)
CO 1				4		
CO 2		2				
CO 3				4		
CO 4		2				
CO 5				4		

PGB 4446 PLANT SYSTEMATICS & PHYSIOLOGY (LAB) 6H/4C

COURSE OUTCOME

At the end of the course the students will be able to

i. comprehend and analyze the salient features of different families in the world of flowering plants through hands on experience and field trips to different botanically rich areas from the sea shore to the altitude sholas which will ensure further conservation of green plants locally and globally.

ii. Critically evaluate the primary metabolic activities of plant and get hands on experiences and training on instrumental skills.

PLANT SYSTEMATICS

OBJECTIVES:

1. to explore the diversity of angiosperms
2. to understand and appreciate the evolutionary trend in the plant world.
3. Hands on experience to study plant morphology and vegetative parts
4. To botanically describe and identify the species with the help of available local floras
5. to study the plants in their natural habitat through field trips

1. Morphology of flowering plants: General description and traits of taxonomic interest
2. Herbarium preparation (Traditional methods).
3. Phytography (describing plants with technical terms).
4. Construction of dichotomous keys (indented and bracketed key)
5. Identification of local plants using local floras
6. Phenological study on select tree species in the campus.
7. Characterisation of different forests in Southern India
8. Analysis of plant characters - Polypetalae
9. Analysis of plant characters - Gamopetalae
10. Analysis of plant characters - Monochlamydae
11. Analysis of plant characters - Monocots
12. Computer databases in plant identification
13. Field visit to at least three of the listed destinations -Alagar Hills, Kuttupatti, Karungalakudi, Kodaikanal, Coimbatore and Udagamandalam.

REFERENCES

1. Gamble.J. S. 1954. The Flora of Presidency of Madras. Botanical Survey of India Calcutta. ISBN 8 1211 0452 1.
2. Jain, S. K. and Rao R. R. 1993. A handbook of field and herbarium methods. Today and Tomorrow Publ. ISBN 8 1701 9130 0
3. Lawrence, G.H.M. 1964. Taxonomy of vascular plants. Oxford and IBH publ. ISBN 0 0236 8190 X.
4. Matthew,K. M. 1995. An excursion flora of central Tamilnadu. Rapinat Herbarium. ISBN 8 1204 0940 X.

PLANT PHYSIOLOGY

1. Measurement of water potential
2. Osmosis
3. Measurement of phosphate ion absorption by plant tissues
4. Extraction and estimation of chlorophylls a,b, and carotenoids in C 3 and C4 plants.
5. Isolation of chloroplast and measurement of Hill reaction
6. Estimation of Photosystem II activityC3,and C4 anatomy,C 4 subtypes.
7. Permeability changes of biomembranes (using beet root discs and RBC)
8. Measurement of enzyme activity (Nitrate reductase)
9. Factors affecting enzyme activity-substrate concentration, pH and Temperature
10. Calculation of activation energy of enzymes (NR as a model)
11. Isolation of mitochondria from potato
12. Mineral nutrition – hydroponics
13. Estimation of proline
14. Estimation phenols in plant tissues under different environmental and physiological conditions.

REFERENCES

1. Cooper, T. G. 1991. The tools of biochemistry, John Wiley & Sons Publ.ISBN 047117116 6
2. Jayaraman, J. 1988. Lboraory manual in biochemistry, New Age interna tional Publishers, Ltd., New Delhi. ISBN 0852264283
3. Mannar Mannan, R. 1988. Experiments in Photosyntheses: a loboratory manual. Macmillan India Ltd., Madras.
4. Plummer, D. T. 2003. An Introduction to practical biochemistry, 3rd Ed. Tata McGraw Hill Publ. ISBN 0-07-0994870.
5. Sadasivam. S and A. Manickam. 2008. Biochemical methods for agricultural sciences, 2nd ed., New age international Pub. Ltd., 978-81-224-2140-8

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1				4			
CO2					5		

PGB4448 MYCOLOGY AND PATHOLOGY 6Hrs/4Cr.

PREAMBLE:

The course has been designed to give basic knowledge of fungi and plant pathology. The history and development in the field of plant pathology will be traced. The uniqueness of the fifth kingdom – fungi in terms of characteristics, growth pattern and reproduction will be discussed. Host pathogen interactions and stages in disease development will help to understand the pathogen, which in turn will facilitate the strategies of disease management. Etiology and management of important fungal, bacterial, viral diseases and angiosperm parasites will be dealt.

COURSE OUTCOME

At the end of the Semester, the Students will be able to

i. comprehend the milestones in field of Plant pathology, diagnostic methods and pattern of disease development.
ii. recognize characteristic features, classification and commercial importance of fungi and their interactions.
iii. interpret the stages in disease development and various defense mechanisms in plants and suggest suitable combat measures.
iv. identify the incidence and symptoms of disease caused by: fungi, bacteria, virus, mycoplasma, nematodes and angiosperm parasites to closely monitor and control the spread of pathogens.
v. apply knowledge on epidemiology and disease forecasting tools and disease management strategies to minimize the crop loss thereby increasing productivity.

UNIT I: Fundamentals of Plant Diseases: History – classification – diagnosis and identification – Koch's postulates – gene for gene hypothesis – disease tetrahedron – pathogenesis (disease initiation, development and establishment) – parasitism (role of enzymes, toxins and growth regulators.)

UNIT II: Elements of mycology: General characters – habitat – growth pattern – nutrition types – cell wall (structure, composition) – fungal classification upto class level (Alexopolous and Mims) – modes of reproduction – parasexual cycle – fruiting bodies – fungal interactions (parasitic and symbiotic) – importance of VAM fungi – primary and secondary metabolites – commercial fungal enzymes.

UNIT III: Disease development and defense mechanisms: Disease development and influence of factors – inoculum and inoculum potential – hypersensitivity – pathogenic impacts on host physiology – host defense mechanisms - innate and induced – morphological and anatomical defenses – biochemical (phenols, phenolic glycosides, phytoalexins) – Pathogenesis Related Proteins (PR) – Systemic acquired and Induced systemic resistance (SAR and ISR).

UNIT IV: Diseases and Disease Cycle: Study of the following diseases with reference to their incidents – symptom manifestation and control measures – fungal (rust of wheat, blast of rice, Tikka of groundnut, Red rot of Sugar cane) – bacterial (Bacterial blight, Citrus canker) – mycoplasmal (Little leaf of brinjal, *phyllody of* sesamum – viral (Yellow vein mosaic disease) – nematode (Root knot of potato) – non- parasitic diseases (*Cuscuta, Striga).*

UNIT V: Disease management: Epidemiology – disease forecasting – concepts on prophylaxis, exclusion and legislation – plant quarantine principles – eradication (crop rotation, field sanitation, elimination of alternate hosts, soil treatment and seed treatments.) –management strategies (chemical and biological) – microbial antagonists [(bacterial, fungal and viral) mode of action, mass production and field application)] – engineered resistance against fungal, viral and bacterial pathogens – Integrated disease management (IDM).

TEXT BOOKS

1. Alexopoulos CG, Mims CW and Blackwell M. 1996. Introductory Mycology, John Wiley. ISBN 9814-12-612-8
2. Singh RS 2005. Plant Diseases. Oxford and IBH publishing. ISBN 8120416589
3. Mehrotra RS and Aggarwal.A. 2003. Plant Pathology. Tata McGraw Hill Pub. ISBN 0070473994

REFERENCE BOOKS

1. Agrios G. N. 2006. Plant Pathology. Elsevier Publication, Academic Press. ISBN-13: 9788131206393
2. Biswas S. B. and Biswas A. 1996. An Introduction to Viruses.4th Edn. Vikas Publishing House. ISBN 0706982207
3. Chaube H. S. and Pundhir V. S. 2005. Crop diseases and their management. Prentice Hall of India. ISBN 8120326741
4. Deacon J. W. 2006. Fungal Biology. Blackwell Scientific Publ. Oxford. ISBN 14051 6953 0
5. Dickinson, M. 2003. Molecular Plant Pathology. BIOS scientific Publishers, ISBN 0-203503309
6. Mukerji, K. G. and Bhasin, J. 1972. Plant diseases of India – A source book. Tata McGraw Hill, New Delhi.

7. Vidhyasekaran, P. 2008. Fungal Pathogenesis in Plants and Crops: Molecular biology and host defense mechanisms. CRC Press. ISBN 13: 9780849398674.

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)
CO1				4		
CO2					5	
CO3				4		
CO4				4		
CO5			3			

PGB 4330 TRENDS IN AGRICULTURE 4Hr./ Cr.

PREAMBLE: This course is designed for the non major students and stress would be given on the history, traditional agricultural practices and the cropping pattern practiced for generations. The period in which the production of food materials was surplus and extensive cultivation was practiced in order to cope up with the famine in india. Modern agricultural techniques have also been discussed to have a better understanding about the agricultural practices in India.

COURSE OUTCOME

At the end of the Semester, the Students will be able to

i. appreciate and get amazed in listening to the various civilization of the yesteryears along the riverbanks, primitive agricultural practices along the ganges delta and in Southern India especially the agricultural details in sangam literature.
ii. comprehend the traditional agricultural practices in India which includes the irrigation system and methods and the crop and land use patterns practiced by the early agriculturalists in India. .
iii. recognize and realize the cropping pattern which is mainly based on the soil and climatic conditions in Southern India and its conservation
iv. evaluate the history of agriculture with special reference to famines and also the governing policies for the construction of dams and application of fertilizers and development of gene and seed banks for the betterment of mankind
v. understand and develop the modern agricultural practices in order to save water and also to promote waterless agriculture, development of hybrids, and high yielding varieties.

UNIT I History of agriculture: Early civilization (Indus valley, Harappa, Mayan Inca, Egyptian, Chinese) – nomads, pastoralism, sedentism – river banks as cradle of civilization – domestication of plants – monoculture – Ganges delta farming – farming in southern India – Sangam literature – ancient crops.

UNIT II Traditional practices: Agronomy in India – irrigation methods (dam, kanmai/ oorani, ayakattu, anicut, ponds, lakes, channel, well, check dams) – irrigation systems – catchment area – reservoirs – manuring (farm, cattle, green manure) – multicropping – crop rotation.

UNIT III Cropping pattern: Weather based cropping (Kharif, rabi and zadi) **–** Basic soil types – soil map of southern India – soil and crop selection – top soil – soil erosion and conservation (types and methods)

UNIT IV Green revolution: History (famines in India) – government policies – construction of reservoirs – extensive cultivation – introduction of exotic varieties – fertilizers and pesticide industries – high yielding varieties – rural banks and road – seed banks – wild relatives of

cultivars – contributions of Indian Scientists – IRRI, IARI, ICAR and TNAU – ecological backlash.

UNIT V Modern practices in agriculture: Mechanization (seeding, weeding, manuring, harvesting) – intensive cultivation – hybrids – water saving devices – rain water harvesting – biofertilizers – underutilized crops for food security – organic and vertical farming – hydroponics and aquaponics – scope for agriculture in space.

TEXT BOOKS

1. Anonymous, 2011. Hand book of Agriculture, 6th ed. ICAR, New Delhi**.** ISBN 81-7164-050-8
2. Chandrasekaran, B., K. Annadurai, and E. Somasundaram, 2010. A textbook of agronomy, New Age International (P) Limited, Publishers, ISBN (13) : 978-81-224-2859-9

REFERENCE BOOKS

1. Carson, R. 1962. Silent spring, Mariner Books. ISBN 0-618-24906-0
2. Toffler, A. 1980. The Third Wave, Bantam books, United States ISBN 0-517-32719-8 (hardcover), ISBN 0-553-24698-4 (paperback)
3. Raychaudhuri, S.P. and Roy, M., 1993. Agriculture in Ancient India: A Report, ICAR Publication, New Delhi.

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	**K2 (Understand)**	**K3 (Apply)**	**K4 (Analyze)**	**K5 (Evaluate)**	**K6 (Create)**
CO1			3			
CO2				4		
CO3			3			
CO4				4	5	
CO5						6

PGB4332 **PLANTS AND PEOPLE** **4Hrs./3Cr.**

PREAMBLE:

The objective of the course is to highlight the importance of plants in our different facets of life. Plants have been part of human civilization from the pre historic period. The contents are divided to give an overview of plants in different aspects of human being. References of plants in scriptures and Sangam literature will be cited and relevance at the context will be discussed. Cultures are identified based on their food and dressing habits, an overview of history of Indian cuisine will be traced specially with references to south India. Plants always served us as food and medicine the important plants used in the Indian system of medical practioners also included.

COURSE OUTCOME

At the end of the semester, the students will be able to

i. spot the major events that shaped up the modern society by taking into consideration the changes adopted in terms of vocation life styles.

ii. get a glimpse of major religions and faith component of India with a special mention about the significance of plants in each system.

iii. develop a wholistic appreciation of plant references made in tamil and western literature that the learner would develop a sense of tolerance and mutual respect all faiths.

iv. food as basic necessity and composite and complementary amalgamations of inputs that are geographically relevant to health, culture and practices.

v. accept and adopt the Indian and indigenous systems of medicines (AYUSH) as a viable better alternative to allopathic practices.

Unit 1. Prehistorical evidences: Unraveling ancient civilization using plant based prehistoric evidences – cotton fabrics and dyes of prehistoric period – plants in ancient funerary rituals – pollen and paleoclimates

Unit 2. Scriptures: Forest and trees associated with Lord Buddha – plants in Bible and Quran – temple trees and sacred plants of India – sacred oil and fragrances used across the religious barriers.

Unit 3. Plants in literature: Cultural and biological diversity – Sangam landscape – Thinai concept – early livelihood strategies in Sangam literature – western literature.

Unit 4. History of Indian cuisine: Social history of food – dietary beliefs and cooking patterns of Indians – minor millets, spices and sweeteners of Indian origin.

Unit 5. Indian System of Medicine: Indian system of medicine – Siddha, Ayurveda and Unani – revitalization of indigenous medicinal practices and knowledge in south India.

TEXT BOOKS

1. Haberman, D. L. 2013. People Trees – Worship of trees in North India Oxford University Press. *ISBN*-13: 978-0199929160
2. Ahluwalia, S. 2017. Holy Herbs : Modern Connections to Ancient Plants, Fingerprint Publishers. ISBN 9788175994461

REFERENCE BOOKS

1. Achaya, K. T. 1998. Indian food: A Historical Companion, Oxford University Press, ISBN 0195644166, 9780195644166
2. Albala, K. 2013. Food: A cultural culinary history the great courses ISBN 10: 1598039474 ISBN 13: 9781598039474
3. **Schmithausen, L. 2009.** Plants in Early Buddhism and the Far Eastern idea of the Buddha-Nature of Grasses and Trees Published by Lumbini International Research Institute. ISBN 10: 9937217164, ISBN 13: 9789937217163
4. Nanditha, K. and Amirthalingam., 2014. Sacred plants of India, Penguin Books Limited ISBN 10: 0143066269
5. சீனிவாசன், . கு.,. .சங்க இலக்கிய தாவரங்கள், தமிழ் பல்கலைகழகம்

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)
CO1		2				
CO2				4		
CO3		2				
CO4				4		
CO5		2				

PGB 5641 MORPHOGENESIS 7 Hr / 6 Cr

PREAMBLE: This course is to inculcate in students the appreciation of architectural marvel of plants and to explore the various developmental stages involved in it. The types of building blocks and the engineering mechanisms involved in tissue assembly and organ development would be unraveled. The innate message and its communication at the cellular level is explored. The vegetative growth and the reproductive ability of the immobile entity as plants would be studied at the experimental level.

COURSE OUTCOME

At the end of the semester, students will be able to

i. understand plant as a composite life form made of genetically identical and functionally different distinctive cells and cell types derived from a simple process of cell division which through a coordinated design is able to provide attributes to an autotrophic mode of life.

ii. comprehend shoot apical meristem (SAM) as a transient entity derived from zygote which with its developmental potential is able to sensitively respond to the cues of space and time to offer a regulated contribution to plant development in consonance with environmental stimuli

iii. gain insights on the dynamics of growth, mechanics of cell expansion, cytoskeletal controls, vacuolization, cell maturation and cytodifferentiation with a an intent of suitably tinkering these microporocesses of development with a utility value

iv. resolve the most fascinating process of flower development in plants with a modularized approach of analyzing floral induction, development of the various floral organs and anthesis the processes of post pollination-fertilization changes can be suitably intervened and interceded to suit market interest

v. get reinforced with the biophysical principles in understanding the growth dynamics that on elucidation of pattern formation students will be carrying out practical and applied experiments in plant morphogenesis.

UNIT I Organization of land plants: Exomorphic design – internal morphology and histological diversity – unique and general attributes of plant growth – plant structure viewed in terms of functions – cell as a building block – developmental potential of zygote, shoot and root meristem – embryogenic, somatic and reproductive phases of plant development.

Unit II Developmental anatomy: Uniqueness of meristematic cell – Shoot Apical Meristem (SAM)– theories and contemporary views– parenchyma as a filler and feeder – wall thickening and cytological variations in collenchyma and sclerenchyma – axial and appendicular structures – shoots – leaf differentiation and leaf expansion – plastochron – phyllotaxy – mechanism of axial and radial growth – polarity – histogenesis – lateral meristem (vascular and cork cambium)

– xylem – phloem – secondary growth and anomaly – environmental control – special structures (velamen, hydathodes and laticifers).

Unit –III Growth and Development: Mechanics of cell cycle and cell division – Growth curve and relative growth rate (RGR) – growth pattern – Plant Growth Regulators: bioassay and biosynthesis – mode of action of classical hormones, Brasinosteriods, Jasmonic Acid – Phytochromes and Photoperiodism – Biological Clock – Plant Movements – Biochemical and Hormonal Integration – Signal Transduction – Genetic Control – Growth Measurement – Aging – Senescence, Abscission – Dormancy – Programmed Cell Death (PCD).

Unit IV R**eproductive Biology:** Organization of floral meristem – protective and generative organs of a flower – floral evocation – Control of florogenesis: ABC model – microsporogenesis and pollen development – megasporogenesis and female gametophytes – genic and cytoplasmic male sterility – Floral and extrafloral nectories – Protection and pollination behavior – pollen – pistil interactions and sexual incompatibility– syngamy, post-fertilization changes (embryo, seed, fruit development).

Unit V Experimental morphogenesis: Plant growing structures – controlled and precision farming. Nursery practices – propagation through cutting, layering, grafting – Seed science – traditional and hybrid seed production – grain filling – parthenocarpy and applications (seedless, shelf - life) – commercial dimensions of flower, seed, fruit and grain production – Case studies on rubber, tea 'banji' removal and Jasmine production.

TEXT BOOKS

Burgess, J. 1985. An Introduction to plant cell development. Cambridge University Press. ISBN 0 5213 0273 0.

1. Esau, K. 1977. Anatomy of seed plants. Wiley Eastern, Publ. ISBN 0 4712 4520 8.
2. Esau, K. 2002. Plant anatomy, John Wiley and Sons. ISBN 9 8141 2649 7.
3. Fahn A 1989. Plant anatomy. Pergamone Press, ISBN 0-02-946201-0
4. Johri. B. M. 1982. Experimental Embryology of Vascular Plants – Springer – Verlag, ISBN 3 5401 0334 1

REFERENCE BOOKS

1. Lyndon, R. F. 1990 Plant development: The cellular basis Unwin Hyman Publ. ISBN 00458 1032 X.
2. Maheshwari, P. 1985. An introduction to the embryology of angiosperms, Tata McGraw Hill,.ISBN 0 0709 9434 X.

3. Raghavan, V. 1986. Embryogenesis in Angiosperms, Cambridge University Press, ISBN 0 5212 6771 4
4. Raghavan, V. 1997. Molecular Basis for Plant Development, Cambridge University Press. ISBN 0 5215 5246 X.
5. Wardlaw, C. W. 1952. Plant Morphogenesis. Mac Millan & Co Ltd. London.

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1				4			
CO2					5		
CO3				4			
CO4						6	
CO5					5		

PGB5643 GENETICS AND MOLECULAR BIOLOGY 7Hr./ 6Cr.

PREAMBLE: This important course on modern biology provides the basic knowledge on genes genomes and genotype as the basis of heredity and goes on to provide an explanation as to how biological systems which vulnerable and dynamic are able to offer firm foundations in dealing with plants as biotic entities with endless opportunities to evolve bio based experiments and enterprises. Besides offering a broad based understanding on the functioning of plant genetic systems it seeks to provide useful insights on how breeding will have bearing on agronomy and crop improvement

COURSE OUTCOME

At the end of the semester, students will be able to

i. gain a comprehensive exposure on the foundations and application of classical genetics that they would realize the implications of their study with live examples
ii. understand the chromosomal basis of heredity and evaluate the phenotypic expressions of the autosomes and sex chromosomes with real time case studies that the ramifications of mutations can be understood in comparison with wild type as showcased in select organisms
iii. undisputedly affirm the DNA as the genetic material in life forms and elucidate its functions and replication to the extent that the centrality and the significance of this form polynucleotide in the study of molecular biology is comprehended
iv. elucidate the molecular frame work of the process of transcription and translation that a reference is created for understanding the controls of selective and sequential expression of genes
v. infer from the host of argonomically significant case studies that the value of organelle genome and advantages of classical and contemporary techniques hired by plant breeders is studied and evaluated

UNIT I: **Concepts of Heredity:** Pre-Mendelian and Mendelian genetics – classical experiments in plants – phenotype and genotype variations - laws of Mendel – Genes and Alleles– application of statistics in genetics — Mendel-Fisher Controversy- Extensions of Mendelian Genetics - Penetrance – expressivity –pleiotrophy –phenocopies- Lethality – genetic heterogeneity – Gene interaction

UNIT II: **Genetics in everyday life:** Sex determination – linkage and crossing over – gene Maps (*Neurospora, Yeast, Caenorhabditis elegans, Drosophila melanogaster and Homo sapiens*— Sex linkage – Sex Limited and Sex influenced inheritance - Polygenic Inheritance. Gene Mapping - Structural and numerical alterations of chromosomes- types, causes and detection of mutations – Gene Mutation: biochemical loss and gain of function

UNIT III: Organization of nuclear genome: DNA as genetic material – prokaryotic and eukaryotic DNA- chromatin – chromosomes - gene, C value paradox – *Arabidopsis* and *Oryza* as genome models – transposons – evolution of DNA - Replication of DNA (Structure – types – melting curve – types of replication – enzymes in replication – formation of replication fork – synthesis of daughter strands – repair mechanisms).

UNIT IV: Genes in Action: Transcription in prokaryotes and eukaryotes (RNA synthesis – enzymology – signaling) – mechanics of initiation, elongation, termination – post–transcriptional modification and RNA splicing - regulation of gene expression (operon concept, physical and chemical factors) – RNA interference (TGS and PTGS)- Translation (genetic code – redundancy and elucidation of base composition – tRNA charging – initiation, elongation and termination) – post-translational modification – coupled transcription and translation.

UNIT V: Organelle Genome and Plant Breeding Techniques: Endosymbiotic theory – organization in chloroplast and mitochondria – synthesis and assembly of RUBPcase – interaction with nuclear genome – cytoplasmic male sterility, Plant breeding: selection (types , methods) – Hybridization techniques – heterosis – clonal selection – Types of breeding (mutation, ploidy) – introduction and acclimatization – Pros and Cons of GM crops.

TEXT BOOKS

1. Freifielder, D. 1995. Microbial Genetics. Narosa Publication. ISBN 0 8672 0248 3
2. Grierson, D. and Covey, S.N. 1984. Plant Molecular Biology. Blackie and sons ISBN 0 2169 1632 1
3. Ignacimuthu, S.J. 1997. Plant Biotechnology, Oxford & IBH Pub ISBN 81-204-0992-2

REFERENCE BOOKS

1. Alberts, B., Dennis Bay, Lewis, R. Raft, M.R. Roberts and Watson, J. F. 1994. Molecular Biology of cell. Garland Publ. ISBN 0 8153 4072 9.
2. Karp. G. 2008. Cell and Molecular Biology.5th edn. John Wiley & sons.ISBN 978 0470 169 61 2
3. Lewin 2007. Gene IX. Jones and Barlett Pub. ISBN. O 7637 5222 3

4. Old, R.N. and Primrose, S.B. 1989. Principle of gene manipulation – An Introduction to Genetic Engineering. Blackwell Scientific Publication, Oxford. ISBN 0-632-03712-1
5. Watson, J.D. et al. 2004 Molecular Biology of Gene 5th Edn. Pearson Edu. ISBN 0-321-22368-3.

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1				4			
CO2					5		
CO3				4			
CO4					5		
CO5					5		

PGB 5445 GENETICS & MOLECULAR BIOLOGY AND

MORPHOGENESIS LAB. 6hr./$Cr.

PREAMBLE

This back to back laboratory sessions that comes in two splits will provide an hands on experience to the students to test and verify the laws and concepts in classical and modern genetics that the learner will be confident in handling issues that crop up in these domains and in addition provide a know-how to interpret the plant structure and its growth from the developmental point of view. ON effective completion of the lab exercises prescribed here the students gain and gather immense confidence to perform horticultural and plant breeding experiments and take jobs in plant based vocations.

COURSE OUTCOME

At the end of the semester, students will be able to

i. test and verify the basic laws of inheritance as proposed by mendalian and post mendalian era and entrain themselves to handle experiments in molecular biology that they would be inspired to take up advanced studies in gene manipulation

ii. to gain a comprehensive understanding on the organization of plant structure that they will draw insights to effectively manipulate them for commercial gains

Genetics

1. Verification of Mendel's laws
2. Gene interactions
4. Study of Mendelian traits in human
5. Barr bodies & Giant chromosome - Chironema
6. Blood grouping- multiple alleles
7. Probability test – beads/coin/dice
8. Chromosome mapping

Molecular Biology

1. Isolation of genomic DNA from plant tissue.
2. Estimation of Nucleic acid
3. Preparation of genomic DNA from Bacteria.
4. Isolation of plasmid DNA
5. Identification of DNA by Agarose Gel Electrophoresis.
6. Extraction of total RNA (hot phenol method).
7. PCR.

References

1. Gardner,E.J.,Simmon,M.J and Snustad .D.P. (1991) . Principles of Genetics. John Willey and Son (Asian) Ltd. Singapore. ISBN:0-471-50487-4 .
2. Stansfield,W.D. (1991). Theory and problems of Genetics. 3rd ed. McGraw Hill Inc. ISBN 0-07-060877-6
3. Palanivelu, P. (2001). Analytical Biochemistry and Separation Techniques – A laboratory manual for B.Sc. and M.Sc. Students Kalaimani Printers, Madurai.
4. Sambrook J and Russel DW, 2001. Molecular Cloning- A laboratory Manual., Cold Spring Harbour Publ. ISBN 0 8796 9577 3.
5.Theil T. Bissen S. and Lysons E.M. (2002). Biotechnology DNA to protein. A laboratory project in molecular biology, Tata McGraw Hill publishing company, Publ. ISBN 0 0711 2279 6.

MORPHOGENESIS-LAB

The morphogenesis component throws light on the exomorphic variations, anatomy of root, stem and leaf and lends insights on the pattern of primary and secondary growth. Variations that occur during the development of plant organs shall be presented through suitable examples. The technique of maceration, micrometry and the staining will be taught along with method of micro slide preparation. Due importance is also given to the embryological aspects. Histological analysis of ovular complex, different types of ovules, ovary and placentation shall be presented. Some experiments are included on experimental manipulation of plant growth.

1. Morphology and adaptations of flowering plant.
2. Growth pattern
3. Internal morphology of the monocot and dicot root and shoot (using camera lucida).
4. Investigation of secondary growth and wood anatomy.
5. Anomalous secondary growth in selected plants.
6. Study on leaf: Anatomy, Trichomes, Phyllotaxy and Stomatal apparatus.
7. Plant organs of special purpose – Floral, extra floral nectaries, laticifers.
8. Observation on primary, secondary meristems and nodal anatomy.
9. Maceration techniques and study of plant tissues.
10. Types and variations in inflorescences and flowers, floral modification.
11. Organization of anther and pollen(pollen wall patterns, pollen germination)
12. Study on ovary, ovules and their modification.
13. Isolation of plant embryos and embryonal tissues.
14. Group projects:
    1. Vegetative propagation techniques: Budding, Layering, Cuttage and graftage.
    2. Microtomy and permanent slide preparations.

Submission:

A minimum of 10 double stained permanent sections
Record and observation note book.
Wax blocks and slides mounted with wax ribbons.
Group report on a ontogenetic change in selected plant.

REFERENCES

1. Esau, K. 1977. Anatomy of seed plants. Wiley Eastern, Publ. ISBN 0 4712 4520 8.
2. Esau, K. 2002. Plant anatomy, John Wiley and Sons. ISBN 9 8141 2649 7.
3. Fahn, A. 1989. Plant Anatomy. Mac Millan Pub. New York. ISBN 008 028030 7
4. Johri. B.M. 1982. Experimental Embryology of Vascular Plants – Springer – Verlag, Nerlin. ISBN 3 5401 0334 1.
5. Maheshwari, P. 1985. An introduction to the embryology of angiosperms, Tata McGraw Hill, ISBN 0 0709 9434 X.
6. Raghavan V., 1986 Embryogenesis in angiosperms, Cambridge University Press. ISBN 0 5212 6771 4

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1					5		
CO2						6	

ENVIRONMENT AND BIORESOURCE MANAGEMENT

PGB 5547 **6Hr/ 5 Cr**

Preamble: The course presents an overview on the components of environment. Students will learn about the fragility and delicate balance between the interactive variables of habitat. Various causes of pollution and will have an opportunity to get sensitized about local and global environmental issues. The course reveals various resources available in the environment and suggest management strategies and conservation techniques to prevent loss of environment.

COURSE OUTCOME

The student will be able to

i. Understand the elements of nature governing life, categorize the ecosystem, analyze the interaction among living organism
ii. assess the effects of disasters, remind of the episodes of natural and man-made disasters, develop strategies to tackle the situation during disasters.
iii. know the resources available in land ,water and air, utilize the bioresources sustainably, assess the microbial products, produce animal food product.
iv. plan for his land, manage water and wildlife, render ecoservices, restore the environement, create integrated crop management system
v. differentiate in-situ and ex-situ conservation, identify ecosensitive zone and heritage sites, create community reserves

Unit 1. Living Earth:

Elements of Nature – Biotic, abiotic and climatic factors –seasonal variations- lithosphere – atmosphere –hydrosphere – biosphere –land forms – forest - ecosystem (Structure, component and Types) –food chain &food web –ecological pyramid –energy flow – Succession – biogeochemical cycle – living organism interactions.

Unit 2. Disasters affecting Environment:

Natural disasters: earthquake – volcanic eruption – floods –cyclones – tsunami – forest fire.
Man made disasters: pollution of air (green house effect, ozone depletion, acid rain, photochemical smog) land (solid waste, chemical waste, nuclear waste) water (pacific gyre, oil spillage, thermal) -episodes (Bhopal gas tragedy, Fukushima nuclear plant disaster, Gulf war oil spill)

Unit 3. Natural resources:

Renewable resources: Land (nutrient rich soil, mineral, constructing materials, precious stones) water (hydro power, tidel power, salt, minerals) air (wind energy, oxygen source, breeze). Non renewable resources: Fossil fuel (Natural gas – Coal- Crude oil).

Bioresources: Plants (Food, fodder, fuel, timber, Paper,fibre, NTFPs, seaweed)Animals(meat, dairy products, wool, biogas, seafood, corals) Microorganisms (antibiotics, enzymes, detritus, Nitrogen fixer)

Unit 4 .Natural resource management:

Land use planning – Land reclamation – Water management – biodiversity conservation – sustainability of (agriculture – mining – fisheries –forestry) – reintroduction of species – mimic environment afforestation and reforestation – Integrated crop management –wildlife management –ecosystem services – ecobalance –ecotourism.

Unit 5: Conservation of Bioresources:

In-situ conservation: National parks - wildlife sanctuaries – biosphere reserves – protected forests – ecosensitive zones – Unesco heritage sites – Man and Biosphere reserve – tiger reserve – conservation reserves – community reserves –Sacred groves.
Ex-situ conservation: Botanical gardens- germplasm centres – hot spots –agro forestry –seed gene bank –cryopreservation – Tissue culture bank – Long term captive breeding – zoological garden. Environment conservation organizations- ecological movements – Government policies – Ecosensitization.

TEXT BOOKS

1. Kumar H,D.,(1992), Modern concepts of Ecology, Vikas Pub. House Pvt. Ltd., New Delhi.
2. Sharma, P. D. 2017. Ecology and Environment. Rastogi Publications *ISBN*: 9789350781227.
3. Subramanyam, N.S., Sambamurty, A.V.S.S. 2000. Ecology , Narosa Pub. ISBN-817319289-8.
4. Tansley (2003) , An introduction to Plant Ecology, Discovery Pub. House , New Delhi. ISBN -81-7141-203-3
5. Verma, V. (2011) Plant Ecology, Ane Books Pvt. Ltd., New Delhi. ISBN- 978-93-8061-800-5

REFERENCE BOOKS

1. Kormondy,E.J. 2004. Concepts of Ecology , 4th Edi., Prentice –Hall of India Pvt. Ltd., New Delhi. ISBN- 81-203-1148-5

2. Odum, E P. 1970. Basic Ecology . Holts –Saunder Edition, CBS college Publizing, Japan . ISBN- 4-8337-0080-8

3. Sharma, P. D., 2015. Ecology and environment. Rastogi publications, New Delhi. ISBN: 978-93-5078-068-8.

4. Rana, S.V.S., 2012. Environmental studies. Rastogi publications, New Delhi. ISBN: 81-7133-728-7.

5. Sharma, P. D., 2013. Environmental biology and toxicology. Rastogi publications, New Delhi. ISBN: 978-81-7133-964-8.

6.Sharma, P. D., 2013. Ecology and utilization of plants. Rastogi publications, New Delhi. ISBN: 81-7133-861-5.

7.Bawa, K.S., Primack, R.B. and Oommen, M.A., 2012. Conservation biology. Universities press, New Delhi. ISBN: 9788173717246

Mapping Cos with Bloom's taxonomy:

	K1	K2	K3	K4	K5	K6
CO1		4				
CO2				4		
CO3			5			
CO4						5
CO5	4					

ANALYTICAL AND RESEARCH METHODOLOGY

PGB5349 **4Hr /3Cr**

PREAMBLE

In these days commoditization, marketization and globalization, education at tertiary level calls for personalized professional and skill development that can come only with a special emphasis on original research. This course has ingredients that would prepare the senior graduating students to get into the habit asking specific questions of exploration that would help in self-learning. The course content has emphasis on two components namely (1) ways and means to equip themselves with research methodology, and (2) to give a concise and comprehensive exposure for bioinstrumentation.

COURSE OUTCOME

The student will be able to

i. experiment using pH meter& centrifuge, know how to separate biomolecules and differentiate the various chromatography, construct the electrophoresis technique
ii. Use spectrophotometers, gain knowledge on advance techniques such as NMR & ESR, apply isotopes in various fields.
iii. Document the availability of plants in an area, monitor the weather condition prevailing in a locality, assess the topography, examine the characteristics of water.
iv. Effectively perform sampling techniques, retrieve data from web source-calculate using statistical formula and tabulate datas using computers, test the validation
v. review various types of research publication, develop their knowledge in writing thesis, summarize his work.

UNIT I: **Analytical and Separation techniques** : Concept and working principle of pH meter– principle and protocols of centrifugation (differential, density gradient and ultra); Chromatography (TLC, Column, GLC, HPLC) -Electrophoresis (PAGE, AGE).

UNIT II: Biophysical Methods: Spectroscopy (Visible/UV, IR, AAS) - Molecular structure analysis (mass spectrometry, X-ray diffraction, NMR) FTIR, MALDI-ToF, - detection using isotopes (measurement, radiolabelling, autoradiography).

UNIT III: Materials and methods in Field study : Qualitative and quantitative parameters: plant study – (Density, frequency, abundance, basal area, canopy cover, standing biomass,Quadrat, transect, point frame)- Meteorological studies (Rain gauge, anemometer, windpane, psychrometer barometer, altimeter, thermometer, Stoke's sunshine recorder)- Aquatic

studies(Secchi's disc, turbidometer)- field photography(DLR, Aerial)and remote sensing(GPS,GIS, toposheet)-Phytosociological studies

UNIT IV: Data Handling: Proposal of research- Hypothesis validation- Sampling (nature, design, size). Data sources (primary and secondary, electronic, library, database)- techniques in data collection (observation- interview- questionnaire- feed back- opinion poll) - quantification- classification- tabulation- diagrams(pictogram- cartogram- graphs- charts)- measures of central tendency (Mean, mode and Standard Deviation) - Percentages and Ratios – *f-test* & *t-tests* ANOVA)-Data interpretation.

UNIT V: Research design and Validation : Types of research publication (article, dissertation, research paper, peer- reviewed publication) - standards in publications- impact factor (SCOPUS and h-index)– plagiarism- thesis guidelines (Title of the paper, declaration, certificates, acknowledgement, contents, abbreviations, measurements, introduction, review of literature, rationale, plan of work, methodology, results, discussion, conclusion , summary, bibliography and appendices)– Presentation (oral and poster).

TEXT BOOKS

1. Datta, A. K. 2006. Basic Biostatistics & Its Applications. New Central Book Agency. ISBN 8173815038
2. Habib, M. M., Pathik, B. B., & Maryam, H. 2014. Research methodology-contemporary practices: guidelines for academic researchers. Cambridge Scholars Publishing. ISBN 1443864617
3. Jeyaraman. J. 1998. Laboratory Manual in Biochemistry, New Age International Publishers Ltd, ISBN 0852264283.
4. Kothari, C. R. 2004. Research methodology: Methods and techniques. New Age International. ISBN 8122436234.
5. Mahajan, B. K. 2002. Methods in biostatistics. Jaypee Brothers Publishers. ISBN: 9351529096
6. Nautiyal, S., Bhaskar, K., & Khan, Y. D. (2016). Biodiversity of Semiarid Landscape. Springer International Publishing. ISBN 331915463X
7. Palanivelu, P. 2009. Analytical biochemistry and separation techniques –A laboratory manual for B.Sc and M.Sc students, 21st Century Publications. Madurai.

Mapping Cos with Bloom's taxonomy:

	K1	K2	K3	K4	K5	K6
CO1			5			
CO2		4				
CO3					5	
CO4						5
CO5						5

PGB 5742 BIOTECHNOLOGY 8 Hr / 7 Cr

PREAMBLE: Students will apply the knowledge gained from molecular biology and microbiology in commercial explorations. They will learn the techniques for plant transformation and its confirmation. The students will appreciate the art of tissue culture not only in micropropagation but also in genetic transformation of plants.

COURSE OUTCOME

At the end of the Semester, the students will be able to

i. understand the theoretical approach to gene manipulation through enzymological study and vector mediated approaches that experiments on genetic manipulations can be pursed further

ii. Learn various wet lab molecular biological techniques and access the online bioinformatics tools and software to the extent that the in-silico resources are effectively tapped

iii. Acquire knowledge on in-vitro cultivation techniques to develop protocols targeted towards commercialization

iv. Appreciate the value of the traditional germplasm and get themselves trained in conserving and improving the crop variety to suit market interest and global legal policies

v. develop entrepreneurial skills by acquiring knowledge on lab and mass cultivation of beneficial microbes to suffice the demand of marketable product

UNIT I: Gene manipulation : Scope **-** cloning strategies – restriction endonucleases – modifying enzymes (ligases, phosphatases, kinases) – gene cloning vectors – DNA library – plasmid vectors – phage vectors – expression vectors – binary vectors – shuttle vectors – poly nucleotide probe – cDNA cloning – Ti plasmids – transformation (*Agrobacterium* mediated and biolistics method) –marker and reporter genes.

UNIT II: Molecular tools and techniques: Promoters – open reading frames – linkers and adaptors – fusion protein – DNA amplification (principle and applications) – RtPCR –blotting techniques (Southern, Northern and Western blotting) – nonradioactive probe – DNA diagnostics (RFLP, AFLP, RAPD, SNP) – gene chip – DNA sequencing – restriction mapping - online resources (NCBI and EBI) – softwares (Bioedit, ClustalW, NJplot).

UNIT III: Plant Tissue Culture: Founding Principles – rationale for *in vitro* culture – techniques of asepsis –patterns of regeneration– bud and meristem culture – genetic stability and variability (spontaneous variations and somaclones) – *in vitro* mutagenesis (physical and

chemical) – suspension culture – cell line selection – triploids, haploids – advantages of polyploidy – as an adjunct to plant breeding (embryo rescue and embryo culture) – limitations.

UNIT IV: Genetic improvement of crops : Importance of germplasm - crop improvement-nuances of cryoprotection – hybrid seeds – Seed certification – plant quarantine and international exchange of germplasm – gene transfer methods (direct DNA delivery, microinjection, biolisitic bombardment – electroporation) – Synthetic seeds – Case study on *glyphosate* and *Cry genes* – terminator Seed technology – gene pyramid and bioprospecting – lab to land transfer protocols – IPR – patenting – bioethics – ELSI.

UNIT 5 : Fermentation technology: Historical developments – fermentor (construction, components, types, basic functions) – media formulation – sterilization and culture methods (batch, continuous and fed–batch systems) – industrial microbes (isolation and strain improvement) – inoculum development – fermentation kinetics – fermentation scale–up , upstream and downstream processing – fermented products (milk products, alcoholic beverages, organic acids and amino acids) – single cell proteins (bacteria, algae and fungi).

TEXT BOOKS

1. Glick, B.R. & J.J. Pasternak. 2009. Molecular biotechnology, Panima Pub. Co. ISBN: 08 4933 4454.
2. Bhojwani, S.S. & Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India Pvt. Ltd. ISBN 81 8147 3256.
3. Islam, A.S. 1996. Plant tissue culture. Oxford & IBH Publ. ISBN 1 8861 0664 9.
4. Narayanaswamy, S. 1999. Plant cell and tissue culture. 8th edn.Tata McGraw Hill Publ. ISBN 0 0746 0277 2.
5. Prescott and Dunn's Industrial Microbiology., 2004 CBS Publ., ISBN: 81 2391 0010

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1. Casida Jr., L.E. 2001. Industrial Microbiology, New Age International Pub. ISBN 0-8822-6201-2
2. Chawla, H.S. 2009. Introduction to Biotechnology, 2nd edn. Oxford IBH, ISBN:978-81-204-1732-8
3. Glick, B.R. and J. J. Pasternak. 2009. Molecular biotechnology, Panima Pub. Co. ISBN: 08 4933 4454.
4. Hammond, J.C. McGarvey and V. Yusibov, 2009. Plant Biotechnology, Springer Verlag. ISBN: 81 8128 0886.
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7. Sathyanarayana, B. N. and Vergheese, D. B. 2007, Plant tissue culture- Practices and new experimental protocols, ILK Publ. ISBN 8 1898 8661 7.
8. Madigan, M.T., J. M. Martinko, J. Parker. 2003. Brook Biology of Microorganisms Prentice Hall. ISBN: 01 3123 2460 1.

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1						6	
CO2					5		
CO3						6	
CO4					5		
CO5						6	

BIOTECHNOLOGY AND TISSUE CULTURE (LAB)

PGB 5444 **6 Hrs / 4 Cr**

PREAMBLE: The objective of this lab course is to make the students understand the various techniques of genetic engineering, tissue culture and industrial microbiology. It deals with the procedures of extracting and estimating the nuclear material. Students will learn the techniques needed for cloning. Students will know the ways and means to use the *in vitro* procedures for crop improvement and plant propagation. The training in organ, callus, embryo, cell suspension and plant protoplast culture will help students to apply tissue culture in biotechnology. The stake holders will have the knowledge to make industrial products such as wine, alcohol, citric acid and single cell protein under lab conditions. They will have the expertise for mass production of cyanobacteria under improvised conditions. They will visit leading laboratories and institutes to get exposed to various developments that take place in biotechnology.

COURSE OUTCOME

At the end of the Semester, the students will be able to

i. perform experiments using DNA technology and skills acquired on fermentation methodology that they shall be able to make produce suiting industrial and community demands

ii. equip themselves to develop procedures and protocols to find employment oppurtunities in tissue culture industries and /or initiate project of entrepreneur dimensions

GENETIC ENGINEERING

1. Isolation of genomic DNA from plant tissue.
2. Estimation of Nucleic acid
3. Preparation of genomic DNA from Bacteria.
4. Identification of DNA by Agarose Gel Electrophoresis.
5. Restriction digestion
6. Polymerase Chain Reaction (PCR).

INDUSTRIAL MICROBIOLOGY

1. Production of citric acid using *Aspergillus niger* – Solid state fermentation and submerged fermentation.
2. Mass production of cyanobacteria – improvised method.
3. Fermentation and wine production.
4. Screening of microbes for antimicrobial products – Crowded plate method.

5. Immbolization of algal cells using calcium alginate.
6. Types of Fermentations- SSF and SMF

PLANT TISSUE CULTURE

1. Aseptic procedures.
2. Preparation of MS and B5 medium.
3. Callus culture techniques: model system – Carrot and Bean.
4. Maintenance of callus-subcultures and induction of regeneration responses.
5. Organ culture: Procedure for the *in-vitro* culture shoots bud and nodal buds.
6. Embryo rescue techniques and embryo cultures.
7. Culture of pollen, anther and ovary.
8. Delineating a protocol for organogenesis / embryogenesis.
9. Installation of cell suspension culture
10. Cell immobilization, Protoplast isolation and the production of new cell lines.
11. Feasibility of raising haploid and genetic variants.
12. Whole plant recovery, hardening and field plant.

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3. Jeyaraman, J. 1988. Laboratory manual in biochemistry. Wiley Eastern Ltd.. ISBN 0 8522 6428 3
4. Narayanaswamy, S. 1999. Plant cell and tissue culture. Tata McGraw Hill Publ. ISBN 0 0746 0277 2.
5. Palanivelu, P. 2001. Analytical Biochemistry and Separation Techniques – A laboratory manual for B.Sc. and M.Sc. Students Kalaimani Printers, Madurai.
6. Sambrook J and Russel DW, 2001. Molecular Cloning- A laboratory Manual., Cold Spring Harbour Publ. ISBN 0 8796 9577 3.
7. Sathyanarayana BN and Vargheese DB 2007, Plant tissue culture- Practices and new experimental protocols, ILK Publ. ISBN 8 1898 8661 7
8. Theil T. Bissen S. and Lysons E.M. 2002. Biotechnology DNA to protein. A laboratory project in molecular biology, Tata McGraw Hill publishing company, Publ. ISBN 0 0711 2279 6.

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1						6	
CO2						6	

NANOBIOLOGY

PGB 5346 **4 Hr / 3 Cr**

PREAMBLE: This course is designed for the students to identify the nanoparticles and their usage. Students will know the awe of the diverse application of DNA, protein and lipid in the fabrication of nanowires and nanomachines.

COURSE OUTCOME

At the end of the semester, students will be able to

i. trace the timeline of events in this new discipline, look at nature for drawing inspirations from the idea spontaneous self assembly to salvage pathways to locate plenty of room available at the bottom
ii. arrive at the classification of nano materials and finds ways and means of using them for novel applications in various spheres of research and utility
iii. evaluate the different types of synthesis of nano molecules and find the scope for developing innovative technology and products that their utility is consciously and continuously explored
iv. assess the feasibility of using this technology in dealing with issues pertaining to health and environment
v. discuss in detail the prospects and perils of hiring nanotechnology in the context of assessing ethical, legal, social implications cropping up in the liberalization, privatization & globalization (LPG) scenario

UNIT I: Basic concepts : Social background, definition – bio-nanotechnology and nanobiotechnology- timeline of nanotechnology - types, magnitude of particles, shape and phase of molecules – Moore's law - top down and bottom up approaches, delivery systems – liposome, Blood Brain Barrier.

UNIT II: Diversity in nanosystems – Carbon based nanaostructures - fullerences, nanotubes, nanoshells, buckyballs – biomolecules and nanoparticles, nanosensors, nanomaterials - Classification based on dimensionality- quantum dots, wells and wires – metal based nano materials (gold, silver and oxides) - Nanocomposites- Nanopolymers – Nanoglasses –Nano ceramics.

UNIT III: Fabrication of Nanostructures: Photolithography and its limitation-Electron beam lithography (EBL)- Nanoimprint – Soft lithography patterning, optical lithography – characterization – Bionanostructures and their properties - DNA nanowires Peptide nanowires and nanotubes - Protein nanoparticles - Bioinspired nanomaterials – DNA as a nano structure – silk protein - biomineralisation (diatoms) - lotus effect – nanomotors (ATPase, flagella).

UNIT IV : Nanobiotechnology : Nanodevices and nanomachines based on biological nanostructures - Protein and DNA nanoarrays, tissue engineering - medical applications - nanotechnology for reducing energy consumption and pollution.

UNIT V: Biophysical Applications: Solar energy conversion and catalysis, biosensors – Nanomedicine - Nanoparticles in bone substitutes and dentistry. Nanotoxicology - challenges. Nanotechnology in agriculture (fertilizer, pesticides and food), cosmetics (gels, sun-screen, shampoos and hair conditioners) – dispersions for UV protection using titanium oxide – color cosmetics - commercial exploration. Biosafety and bioethics.

TEXTBOOKS

1. Niemeyer, C. M. and Mirkin, C. A. 2004. Nanobiotechnology: Concepts, Applications, and Perspectives, Wiley-VCH, Weinheim, Germany.
2. Ratner, M. A. and Ratner, D. 2003. Nanotechnology: A gentle introduction to the next big idea, Prentice Hall Professional, New York.
3. Pradeep, T. 2012. A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Education Pvt. Ltd.
4. Nalwa, H. S. 2002. Nanostructured Materials and Nanotechnology, Academic Press.

REFERENCE BOOKS

1. Nicolini, C. 2008. Nanobiotechnology and Nanobiosciences, Pan Stanford Publishing, Singapore.
2. Boisseau, P. and Lahmani, M. 2009. Nanoscience: Nanobiotechnology and Nanobiology, Springer, UK.
3. Nabok A. 2005. Organic and Inorganic Nanostructures, Artech House.
4. Dupas C., Houdy P., Lahmani M. 2007. Nanoscience: Nanotechnologies and Nanophysics, Springer-Verlag Berlin Heidelberg.

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1					5		
CO2						6	
CO3						6	
CO4				4			
CO5					5		

PGB5348 SYSTEMS BIOLOGY 4Hrs. / 3Cr.

PREAMBLE:

Systems biology had emerged as a field of biology in the post-genomic era due to availability of omics data. This fundamental course in system biology will introduce the concepts pertaining to the systems biology. System approach helps to understand the structure, dynamics and functional attributes from molecules, cell, tissue and organism level. The course will provide insights into holistic approach in the biological system, contrary to the reductionist approach which dominates now. High throughput techniques employed in the biological research, data collection and processing will be dealt. Expose students to system level thinking and understanding the functions at different hierarchy by integrating different databases and working with existing models. This will help the students to work parallel with the experimental, computational and theoretical research in different aspects of biology.

COURSE OUTCOME

At the end of the semester, students will be able to

i. comprehend the complexity of processes in the biological system and construe the interactions from a holistic view harping on the theories over which this emerging discipline is built.

ii. understand the nuances of systems approach in biology in the aftermath of post genomic era, and employ high throughput techniques to collect and analyze biological data with a focus on its future perspectives.

iii. demonstrate the structure and dynamics of biological network and their interactions at various levels encompassing gene regulatory, biochemical and signal transduction network and apply the knowledge to analyze disorders in the system.

iv. apply system based modeling approaches in biology (microbial, plant based and ecological models) as template to collect and analyze perturbations to test hypothesis and draw holistic inferences.

v. evaluate the plant databases and software packages used in systems biology to secure desired details that innovations can be made in contemporary collaborative research

Unit I. Trends in biological research: Cell – a basic unit of life – molecules involved in cellular processes - cell to organism level process in biological system – paradigm in biological research – reductionism and holistic approach–Systems biology theories and time line – challenges and future perspectives.

Unit II. Facets of Systems approach: Hierarchies in biological system: gene, molecular, cellular and organ levels and interactions. High throughput experimental techniques - post-genomic era - omics technologies – whole genome sequences - big data - interactome. Properties of biological system – system dynamics and control - experimental and computational biology - emergent properties.

Unit III. Network biology and their applications*:* Cell as an integrated device – molecular interactions – network analytic methods – Gene, transcription and regulatory network – Biochemical reactions and metabolic pathway systems – disease pathway analysis - Signal transduction network.

Unit IV. System biology models and approaches: Genome to life – data integration and modeling process – hypothesis testing - flux balance analysis and applications. Cell cycle models – Microbial models (Bacterial chemotaxis and Yeast) – Plant based models (plant development and plant defense system) - Ecological models (energy flow and population dynamics).

Unit V: Databases and Software for Systems Biology Omics databases in plants - Software packages – Cytoscape, Celldesigner,Virtual cell. MetaCyc, BioCyc, KEGG pathway, Pathguide. Features of System Biology Markup Language and PYTHON.

TEXT BOOKS

Choi,S.2007. Introduction to Systems Biology. Humana Press Inc., New Jersey. ISBN 978159745531

Klipp E, Liebermeister W, Wierling C and Kowald A. 2016.Systems Biology - A Textbook (2^{nd}Edn.). Wiley-VCH, Germany. ISBN 9783527336364

Voit E O. 2013. A first course in Systems Biology. Garland Science, New York and London. ISBN 9780815344674

REFERENCE BOOKS

Alon U. 2006. An Introduction To Systems Biology: Design Principles of Biological Circuits. Chapman and Hall /CRC, London,UK. ISBN 1584886420

Baginsky S and FernieA R. 2007. Plant Systems Biology. BirkhäuserVerlag, Berlin ISBN 13: 978-3-7643-7261-3

Coruzzi G M and Gutierrez R A. 2009. Plant Systems Biology. Annual Plant Reviews. Vol.35. Wiley-Blackwell Publishing Ltd. UK. ISSN 14601494

Kitano H. 2001. Foundations of System Biology. MIT Press, Cambridge.ISBN 0262112663

Voit E O. 2016. The Inner Workings of Life. Vignettes in Systems Biology.Cambridge University Press. 9781316604427

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1				4			
CO2					5		
CO3					5		
CO4					5		
CO5						6	

PROJECT

PGB 5750 **8H/7Cr**

PREAMBLE: Project is a component of the active learning module that teaches approach and research techniques. Students would have hands on experience in investigating a selected research problem where he/she shall be trained in framing and testing hypothesis through suitable research design. The primary intent of the project experience is to build in interest, confidence and credentials in students to make them turn independent researchers, scientists, technocrats or a biological entrepreneur.

COURSE OUTCOME

At the end of the semester, students will be able to

i. make fair and unbiased judgment with data that they generate and draw meaningful inferences to contribute first hand information to the existing body of knowledge

ii. eventually emerge as an independent researcher who can make correct judgments for recommending policies for pursuing innovation

BROAD RESEARCH AREAS

- Plant diversity and Systematics
- Plant physiology and Biochemistry
- Plant Molecular Biology and Biotechnology
- Microbiology and Plant pathology
- Environmental Biology
- Computational Biology
- Nanobiotechnology

Allocation

- Student may select their broad research area during the end of the second semester and will be guided by a suitable research supervisor in the area allotted by the HOD.
- Each research supervisor may be allotted a single student or a group (2-3 students).
- Summer vacation may be used by the students to initiate their project work.
- Staff workload will be equally shared among the guides.

Objective of the study

- Topic investigated will have defined area of study.
- Project students would have hands on experience in all the instruments and techniques to conduct his/her original research.

- Minimum of 5-10 yrs of literature will be added in the review with recent year of publication.
- Standard of the project work should be high enough to be presented in conferences or to communicate as a paper and be subjected to a peer review.

Evaluation

- Term paper (summer and third semester) and Oral presentation (work plan in outline) in the beginning of the fourth semester. Guide and HOD will evaluate.
- At the middle of fourth semester (after the first test), Interim reports shall be submitted by the students. This interim report should form the basis for the final project report and which will be evaluated by UG HOD, PG HOD and guide.
- Even at instances where research is carried out as a group, individual students will be evaluated.
- Evaluation will be based on prescribed format approved by the faculty. The format may be revisited and updated as and when needed.
- Attendance of the student for presentation and viva-voce is a must.

Final Evaluation

A department level open viva-voce will be conducted. PG &UG Head, Guide and senior most faculty functioning as project coordinator will form a panel to evaluate the dissertation work.

PG HOD will chair all the evaluation components connected to the project work.

Dissertation format

- Introduction
- Review of literature
- Materials and methods
- Result
- Discussion
- Summary
- Bibliography

Mapping Cos with Bloom's taxonomy:

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1						6	
						6	