SYLLABUS BASED ON CHOICE BASED CREDIT SYSTEM

M.Phil. (Botany)

SEMESTER SYSTEM

(Effective from the Session 2012-2013)

UTKAL UNIVERSITY

VANI VIHAR, BHUBANESWAR-751004

ODISHA, INDIA

M. Phil. COURSE IN BOTANY

P.G. Department of Botany, Utkal University, Vani Vihar, Bhubaneswar

(SEMESTER SYSTEM)

To be effective from the session 2012-2013

Eligibility

Any student who has passed M.Sc. in Botany having minimum of 55% marks can take this course.

Admission

The candidates have to take admission after qualifying in an entrance test conducted by the department. The merit list will be prepared by taking 40% of marks in career plus 40% of marks secured by a candidate in the entrance test and 20% Viva-Voce. The admission will be strictly as per the merit list in each category.

Course and Regulation

1. The course is of one year duration with two semesters for theory, seminar and dissertation work.

2. First semester have two theory papers (core & elective). Second semester has two seminars and one dissertation. The candidate shall have to appear both mid-term (30 marks of each paper) and end semester examination (70 marks of each paper). of each semester.

3. Each theory paper carries 100 marks.

4. For passing a semester examination a candidate must secure a minimum of 40% marks in dissertation & seminar and 33% marks in aggregate of the theory papers in each semester. If the marks secured in a theory paper is less than 25% then the said mark will not be included in the aggregate.
5. If a candidate passes all the two semester examination he / she will be declared to have passed the M.Phil. examination in Botany.
6. Attendance in each semester shall be strictly adhered to University Rules.
7. A candidate may repeat only once in one or more papers of any semester examination within a period of one year of the said semester examination. However, if the candidate does not clear the 1^{st}& 2^{nd} semesters, he/she shall appear in the immediate next examination of the next batch for the same semester. A candidate failing on any semester examination will be allowed to appear once only in the examination for that semester conducted for the next batch of students and also be allowed to continue to the next semester. A candidate not appearing the 1^{st} and 2^{nd} semester examinations will be considered to have discontinued his/her study and will not be allowed to appear the remaining semesters.
8. Merit list will be prepared as per University Rules, from among the students those who have cleared all semester examinations in 1^{st} chance in one time without repeat of any paper.
9. The candidates who have failed in one semester may be allowed to appear the same in the immediate next chance, following the due provision. However, he/she will be not given another chance to appear.

Course of studies for M.Phil. Botany

(With effect from 2012-2013)

Semester-I	***Marks***	***Credit***
Paper-I (Core) : Techniques in Plant science	**100**	**6**

Microbial culture cell, tissue and organ culture

Instrumentation methods of analysis

Separation techniques

Techniques in Cell and Molecular Biology

Techniques in Environmental Monitoring

Paper-II (Elective) :	**100**	**6**

A. Plant Cell Tissue & Organ culture
B. Physiology & Biochemistry of Stress
C. Microbial Biotechnology
D. Environmental Physiology

Semester-II

Paper-III :	Seminar presentation pertaining to dissertation	**50**	**4**
	Seminar pertaining to Core & Elective paper	**50**	
Paper-IV (Dissertation Pertaining to elective paper)		**100**	**10**

Paper-I

Core Paper

Course Objectives: Students will be taught about various techniques used for plant science research such as microbial culture techniques, instrumentation techniques, separation techniques, techniques in cell and molecular biology, techniques in environmental monitoring.

Unit-I : Microbial culture, Cell, tissue and Organ culture

Microbial culture, methods of isolation, purification and preservation of microorganism, synchronous growth, batch and continuous culture, culture collections, techniques of organ, tissue, cell and protoplast culture.

Unit-II : Instrumentation

Centrifugation, UV-vis-spectrophotometry, Fluorescence spectrophotometry, PAM spectrophotometry, Luminescene, Atomic Absorption spectrophotometry, Flame photometry, potentiometry.

Unit-III : Separation Techniques

Chromatographic techniques : Paper chromatography, Thin-layer chromatography, Column chromatography; Gel chromatography, Adsorption chromatography, Ion-exchange chromatography, High performance liquid chromatography;

Unit-IV : Techniques in cell and molecular Biology

Extraction and purification of genomic DNA, plasmid DNA, NV-RNA, Restriction cleavage and ligation of DNA molecule for construction of recombinant DNA, Reverse transcription and cloning of cDNA, PCR amplification, cDNA libraries, genomic libraries ;
Identification of recombinant clones : Insertional inactivation, DNA sequencing, Hybridization with radioactive or non-radioactive probes (*In situ* hybridization (Colony hybridization & Plaque hybridization), Dot blot hybridization (Dot blotting), Southern, Northern and Western blotting).

Unit-V : Techniques in Environmental Monitoring :

Methods of air sampling and analysis, Waste water sampling and analysis, Types of Noise and their measurement; Techniques in soil sampling and analysis, Methods of analysis of plant communities and evaluation of ecological dominance of plant species.

Learning outcomes: Students will learn microbial cell culture, plant cell, tissue and organ culture, centrifugation, spectrophotometry, chromatographic techniques, extraction and purification of DNA, recombinant DNA technology, *In situ* hybridization and blotting technique, methods of air, water, soil sampling and analysis.

Paper-II
(Elective)

A. Plant Cell, Tissue and Organ culture

Course Objectives: Students will be taught about *ex situ* conservation of germplasm, in vitro modifications, somatic embryogenesis, protoplast technology, genetic transformation in plants.

Unit-I

***Ex situ conservation of Germplasm* :** Overview on Plant Tissue Culture, Culture media, Aseptic techniques, Micropropagation and its application in horticulture, pharmaceuticals and forestry, Cryopreservation.

Unit-II

***In Vitro Modifications* :** Dedifferentiation, Induction of morphogenesis in callus and cell suspension culture, Production of secondary metabolites in culture, Somatoclonal & gametoclonal variation, Isolation of variants & mutants. Haploid production by anther & ovule culture, Embryo rescue in wide hybridization.

Unit-III

***Somatic Embryogenesis* :** Somatic & zygotic embryos, The process of *in vitro* embryogenesis : induction, maturation & germination of somatic embryos, Recurrent embryogenesis, Application of somatic embryogenesis-Synchronous mass propagation, Scale-up potential using bioreactors, Synthetic seed.

Unit-IV

***Protoplast Technology* :** Isolation of protoplasts, Protoplast culture and realization of totipotency, Electro-stimulation of protoplast division and plant regeneration, Induction of fusion-Chemical fusion & electrofusion, Mechanism & techniques of protoplast fusion, Post-fusion selection schemes biochemical & physical methods (micromanipulation & fluorescence activated cell sorting). Analysis & application of somatic hybrids. Application of somatic hybrids & cybrids in crop improvement.

Unit-V

***Genetic Transformation* :** Gene transfer to plants, *Agrobacterium*-mediated genetic transformation of plants, Methods for direct DNA delivery, gene tagging, Molecular analysis of transformed lines to detect foreign gene & gene products, Chloroplast transformation, Transgenic plants for crop improvement, Right, risks & ethics.

Learning outcomes: Students will learn about plant tissue culture for *ex situ* conservation of germplasm, callus and cell culture, somatic & zygotic embryogenesis, plant protoplast isolation, culture and fusion, gene transfer to plants for crop improvement, risks & ethics of genetic transformation.

B. Physiology & Biochemistry of Stress

Course Objectives: Students will be taught water and salinity stress, chilling freezing and heat stress, light stress, oxygen deficiency and oxidative stress, stress induced gene expression

Unit-I

Water and Salinity Stress. Drought resistant and tolerant plants, adaptive response to water deficit, Leaf abscission, root growth stomatal operation, photosynthesis, osmotic adjustments, Energy dissipation, wax deposition, crassulacean acid metabolism, Growth and photosynthesis in saline condition, salt resistance strategies.

Unit-II

Chilling Freezing and Heat Stress : Membrance properties, synthesis and function of ABA, gene regulation expression and protein synthesis in freezing stress, Frost damage, photosynthesis and respiration in heat stress, thermal stability of membranes and proteins at high temperature, Synthesis and function of Heat shock proteins.

Unit-III

***Light Stress*:** Light induced production of reactive oxygen species in plants. Damage to photosystem, photoprotective, strategies in plants, operation of xanthophylls cycle. Molecular Biological approach to study plant adoption to photo-oxidative stress.

Air pollutants : inhibition of photosystem and growth in plants, effect of acid rain on plant growth.

Unit-IV

***Oxygen deficiency and Oxidative Stress* :** Effect of oxygen deficiency in root and shoot growth, synthesis of anacrobic stress proteins acclimation under hypoxia and anoxia, mechanism of oxygen activation during plant stress.

Unit-V

Stress Induced Gene Expression : Regulation of gene expression in stress, promoter sequences involved in gene expression, Role of calcium and protein kinases in stress tolerance, transgenic plants for stress tolerance.

Learning outcomes: Students will learn about drought resistant mechanism in plants, salt resistance strategies in plants, chilling, freezing and heat stress tolerance mechanism in plants, photoprotective mechanism in plants, oxidative stress management in plants and regulation of gene expression in stress.

C. Microbial biotechnology :

Course Objectives: Students will be taught biotechnological application of microorganisms for industry, microbial fermentation, Optimization of microbial products, Microbes in recombinant DNA technology and genetic engineering and basics immunology.

Unit-I

Biotechnological application of microorganisms for industry : Characteristics of Industrial microorganisms, biosynthetic pathways of secondary metabolites in industrial microorganisms, genetics of microbes in relation to industrial requirements, pure culture methods and sources of industrial microbes, selection criteria of industrial microbes.

Unit-II

Fermentation : Media, sterilization, development of mocula, assay of fermentation products, types of fermentation, batch, continuous feed back process. Bioreactor : Modes of operation, designing of bioreactors, down stream processing, product separation, concentration, purification and finishing of products.

Unit-III

***Optimization of microbial products* :** Parameters for scale up carbon substrate as energy source, macro and micronutrients, pH and temperature, control of toxic material, bioavailability of desired microbes, germplasm collection and maintenance.

Unit-IV

***Microbes in recombinant DNA technology and genetic engineering* :** Isolation and purification of DNA restriction endonucleases, enzyme digestion, electrophoretic separation of DNA fragments, SDF-PAGE for protein separation northern, Southern and western blotting, microbial bioinformatics.

Unit-V

Principles of immunology, immunoglobins, antigens, antigen, antibody, intraction, immunoresponse, vaccines, agglutination, serological tests.

Learning outcomes: Students will learn about industrial use of microbes, fermentation technology, bioreactors, Parameters for optimization of microbial products, recombinant DNA technology and genetic engineering using microbes and principles of immunology.

D. Environmental Physiology

Course Objectives: Students will be taught physical and chemical environments of plants, solar radiation and utilization of solar radiation by the plants, the temperature relation of plants, water stress, salts and ion stresses.

Unit-I

Physical and chemical environments of plants : The atmosphere, the hydrosphere and the lithosphere. Concepts of environmental stresses. Stress and strain terminology. Biotic and biotic stresses. Environmental stress injury and resistance in plants.

Unit-II

Solar radiation and utilization of solar radiation by the plants : Plurality of carbon fixation pathways and its ecological significance. Photorespiration, role of light on stomatal movement, phytochrome regulation, dormancy germination and flowering in plants.

Unit-III

The temperature relation of plants : The low and high temperature stresses. Heat shock protein. The nature of stress injuries due to low and high temperature stresses. Heat resistance in plants.

Unit-IV

Water stress : Water deficit and drought stress, water deficit stress injury and resistance, physiological implications of water deficit stress, Oxygen deficit stress (flooding) and its impact on plant growth and metabolism, Oxidative stress.

Unit-V

Salts and ion stresses : salt stress injuries and resistance in plants physiological aspects of heavy metal toxicity in plants, sources and type of an pollutants, Ozone and green house effects, Effects of atmospheric pollutants on plants. Role of plants in monitoring atmospheric pollutants.

Learning outcomes: Students will learn about environmental stress and resistance in plants, role of solar radiation in plant physiology, low and high temperature stresses, heat resistance in plants, water deficit stress and its impact on plant growth and metabolism, oxidative stress, salt, heavy metal stress and resistance in plants, effects of atmospheric pollutants on plants.

Suggested Readings

Krishnamurthy, K.V. 2000, Methods in Cell Wall cytochemistry, CRC Press, Boca Raton, Florida.

Buchanan, B., B., Gruissem, W. and Jones, R.L. 2000 Biochemistry and Molecular Biology of Plants, American society of Plant Physioligists, Maryland, USA.

De. N.N. 2000, Plant cell Vacuoles : An Introduction CSIRO Publication, Collingwood, Austriala.

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Dennis, D.T., Turpin. H.H., Lefebvre, D.D. and Lyzell, D.B. (eds) 1997, Plant Metabolism (2nd Edition) Longman, Essex, England.

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Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & sons, inc., New Yorkl, USA

Moore, T.C. 1989. Biochemistry and Physiology and plant Hormones (2nd edition), Springer-Vertag, New York, USA

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Satisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4th edition) Wadsworth Publishing Co., California, USA.

Taiz, L and Zeiger, E., Plant physiology (4th edition), sinaurer associates., Inc., Publishers, Massachusetss., USA

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Westhoff. P. (1998). Molecular plant Development : from Gene to Plant. Oxford University Press, Oxford, UK

Alberts, B., Brary, D., Lewis. J.Raff., M., Roberts, K. and Watson. J.D. 1989. Molecular Biology of the Cell (4th edition). Garland publishing Inc., New York.

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Kard, D.L. and jones, E.W. 1998 Genetics : Principles and Analysis (4th Edition) jones & barnett Publisher, Massachusetts. USA.

Karp. G. 1999 Cells and Molecular Biology : Concepts and Experiments. Joh. Wiley & Sons Inc.USA.

Lewin, B. 2010. Gene X. Oxford University press, New York, USA

Lewis. R. 1997. Human Genetics Concepts and application (2nd edition) WCB McGraw Hill, USA

Malacinski, G.M. and Freigelder, D. 1998. Essentials of Molecular Biology (3rd Edition) Jones and bartler Publisher Inc. London

Russel, P.J. 1998 Genetics (5th Edition) the Benjamin/Cummings publishing Company inc. USA

Snustad, D.P. and Simmons, N.J. 2000. Principles of Genetics (2nd Edition) John Wiley & Sons Inc. USA
Bhojwani, S.S. and Razdan, M.K., 1996. Plant Tissue Culture : Theory and practical revised edition Elscwer Science publishers, new York, USA.
Brown, T.A. 1999, Genomes. Jhohn wiley & sons (Asia) Pvt. Ltd., Singapore
Callow, J.A. ford-Lloyd., B.V. and newbury, H.J. 1997. Biotechnology and plant Genetic resources. Conservator and use. CAB Internation ; Oxon. UK
Boston, USA Collins, H.A. and Edwards., S. 1998 Plant Cell Culture Bios Scienctic Publishers, Oxford UK
Glazer, A.N. and Nidaido. H. 1995. Microbial biotechnology. W.H. Feeemand & Company, New York, USA
Gustatson. HJ.P.2000./ Genomes. Kluwer Academic Plenum Publishers. New York, USA.
Henry, R.J. 1997. Practical Applications of Plant Molecular Biology. Chapmand & Hall. London. UK
S.M. Khepkar- Analytical Chemistry.
M.F. Hipkins and N.R. Bamer- Photosynthetic energy transduction, a practical approach, IRL Press, Oxford.
N. Mumata and K.Satoh. In. Light emission in plant and bacteria, Academic press.
Practical, Biochemistry- principles & techniques (5th edition) Wilson & Walker, Cambridge University Press.
Molecular cloning-2000-a laboratory manual. J.Sambrook; E.F. Fritsch and T. maniatis. Cold spring Harbor laboratory press, New York.
Prinches of Gene Manipulation, R.W.Old, S.B. Primrose, Blackwell Scientific publications.
Plant Molecular-Biology; A laboratory manual-M.S. Clark (ed) Springer 1997.
Fitter, A.H. & Hay, R.K.M. Environmental Physiology of plants, Academic press
Levitt, J.Physiological Ecology, Academic press
Larcher, W. Physiological Plant Ecology, Springer
Dc, A.K. Environmental Chemistry, Wiley Eastern Limited.
Moo-Young, M, Anderson, W.A. and Chakravorty, A.M. Edited. Environmental Biotechnology ; Principles & applications, Kluwer Academic Publishers.
Bonner, J. and Varner, J.Plant Biochemistry, Academic Press
Bidwel;I, R.G.S. Plant Physiology, Macmillan, London.
Taiz. L & Zeiger, E. Plant Physiology, Inc. Publishers.
Nobel, P.S. Physiochemical and Environmental Plant Physiology, Academic press.
Rao, C.S. Environmental Pollution Control Envineering Wiley Eastern Limited, New Delhi.
Soil and water testing method: A laboratory manual. IARI, New Delhi.
Misra, R. Ecology Work-Bool Oxford and IBH Publishing Co.New Delhi.
Standard methods for the estimation of water and waste water. APHA, Washington.
Chapman, S.B. (Eds) Methods in Plant Ecology, Black well scientific publications, Oxford.
Lewin. B. 2000 Genes VII, Oxford University Press, New York.
Alberts, B., Bray, D., Lewis, J., Raff. M.Roberts, K., and Watson. J.D. 1999. Molecular, Biology of the Cell Garland Publishing, Inc., New York.
Woffe, S.L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA
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