

Four-year Undergraduate Programme**Subject: Botany****Semester: Third****Major 3****Course Name: *Laboratory and Field Techniques in Plant Science***
Course Level: 200-299, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45			
Unit no.	Unit content	No. of classes	Marks
Unit 1	Laboratory safety and good practices: General laboratory safety: dos and don'ts, lab safety measures, code of conduct in laboratory, safe handling of chemicals, glass apparatus, instruments, electrical appliances; First aid practices (acid spills, burns and other injuries), safety symbols, classes/ grades of chemicals, Laboratory waste management: radioactive, hazardous chemicals and biological wastes.	8	8
Unit 2	Handling and maintenance of instruments: Weighing balance, pipettes and micropipettes, magnetic stirrer, autoclave, laminar airflow, pH and conductivity meter (calibration and use), Incubator (static and shaker), Lux meter, hemocytometer, micrometer, spectrophotometer, Agarose gel electrophoresis unit, SDS PAGE unit, centrifuge, distillation unit.	8	12
Unit 3	Measurements and calculations: Units of measurements, conversion from one unit to another, Weighing, calculations: scientific notations, powers, logarithm and fractions; measurement of volumes of liquids.	4	8
Unit 4	Solutions and Buffers: Preparation of solutions: stock solution, standard solution. Types of solutions: Normal, Molar, Molal, Percentage, ppm, ppb. Dilution and dilution factors, Acids, Bases, adjustment of pH, Buffers - phosphate, Tris- HCl and Citrate buffer.	6	8
Unit 5	Microscopy and Culture Techniques: Microscopes: working principles and types (Light and Electron microscopes), sample and slide preparation: fixation, staining, mounting, preservation (for light and electron microscopy). Basic culture media (NA, NB, PDA, MS),	8	12

	selective and differential media, Culture techniques: plating (streak, spread & pour), serial dilution.		
Unit 6	Biostatistics, computing and field skills: Data types - primary and secondary, methods of data collection, sample and sampling methods - merits and demerits; technical and biological replicates; Tabulation and presentation of data, Descriptive statistics - Mean, Median, Mode, Variance, Standard Deviation, Standard error, Coefficient of Variation, MS-Word, PowerPoint, Excel, concept on biological databases. Collection, Identification, Preparation and Preservation of Herbarium and Museum specimens.	11	12
PRACTICAL [Credit: 01]			
	1. Preparation of solutions- molar, molal, normal, percentage, stock solution and dilution 2. Measurement of pH of solutions using pH meter/ pH strip and preparation of buffers (Phosphate /citrate buffer) 3. Working with instruments - Centrifuge, autoclave, laminar air flow, hot air oven, incubator, light microscope, spectrophotometer/colorimeter, 4. Slide preparation and staining of plant materials. 5. Determination of cell/spore size using micrometer. 6. Preparation of PDA/NA medium for growth and maintenance of fungal/bacterial cultures. 7. Calculation of mean, mode, median, standard deviation using data set. 8. Drawing of tables, graphs and to carry out statistical calculation using Microsoft Excel. 9. Preparation of herbarium specimen: Collection, processing, mounting, and labelling of plant specimen.	30	40

Reading list:

1. Bisen PS (2014) Laboratory Protocols in Applied Life Sciences, 1st Edition. CRC Press.
2. Danniel WW (1987) Biostatistics. New York, NY: John Wiley Sons.
3. Evert RF, Eichhorn SE, Perry JB (2012) Laboratory Topics in Botany. W.H. Freeman and Company.
4. Jones AM, Reed R, Weyers J (2016) Practical Skills in Biology, 6th Edition, Pearson
5. Mann SP (2016) Introductory Statistics, 9th edition. Hoboken NJ, John Wiley and Sons Inc.
6. Mesh MS, Kebede-Westhead E (2012) Essential Laboratory Skills for Biosciences. John Wiley & Sons, Ltd.
7. Mu P, Plummer DT (2001) Introduction to practical biochemistry. Tata McGraw- Hill

Education.

8. Zar ZH (2010) Biostatistical Analysis, 5th Edition, Pearson Prentice Hall, New Jersey, USA.

Graduate Attributes

Course Objective:

This paper will provide basic knowledge and understanding of good laboratory practices, laboratory waste management, understanding hazards and risks to ensure a safe laboratory environment, measurements, units, and common mathematical calculations, sampling and data collection, and instrument operation and maintenance.

Course outcomes:

On successful completion of the course, students will be:

1. Able to learn fundamental skills important for performing laboratory and field experiments.
2. Able to prepare, analysis of data and interpretation of results.

Theory Credit: 03

Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany
Gauhati University, Guwahati-14

Four-year Undergraduate Programme
Subject: Botany
Semester: Third
Major 4
Course Name: *Plant Physiology*
Course Level: 300-399, and subsequent level as per NEP structure

THEORY [Total marks: 60] Credit: 03; Total No. of classes: 45			
Unit no.	Unit content	No. of classes	Marks
Unit 1	Plant-water relations: Water Potential and its components; Water absorption by roots: aquaporins; Pathway of water movement: symplast, apoplast, transmembrane pathways; Ascent of sap: Mechanisms, cohesion-tension theory, root pressure, guttation; Transpiration: Factors affecting transpiration, anti-transpirants, mechanism of stomatal movement.	5	8
Unit 2	Mineral nutrition and nutrient uptake: Criteria for essentiality of mineral elements, macro and micronutrients, nutrient solutions for plant growth experiments, roles of essential elements, mineral deficiency symptoms, chelating agents, Ion antagonism and toxicity. Soil as a nutrient reservoir; Transport of ions across cell membrane: Passive and active absorption, electrochemical gradient, facilitated diffusion, carrier systems, proton ATPase pump and ion flux, uniport, symport, antiport, co-transport.	10	10
Unit 3	Translocation of organic solutes: Phloem as the path of organic solute translocation: Experimental evidences, Mechanisms of solute transport, Pressure-Flow Model and Munch's hypothesis, Phloem loading and unloading, Source - sink relationship.	4	8
Unit 4	Plant growth regulators (PGRs): Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxins, Gibberellins, Cytokinins, Absciscic acid, Ethylene, Brassinosteroids and Jasmonic acid; Synthetic PGRs; Application of PGRs in agriculture and horticulture.	10	14
Unit 5	Physiology of flowering and seed dormancy: Photoperiodism: SDPs and LDPs, flowering	8	12

	stimulus, florigen concept; Vernalization; Photoreceptors: Phytochrome, cryptochrome and phototropin; Discovery, chemical nature, mechanism of action, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR); Seed dormancy: Significances, causes of dormancy, mechanisms to break dormancy.		
Unit 6	Plant stress physiology: Abiotic and biotic stress: Plants' responses to drought, water logging, salinity, heavy metals, freezing, heat stress and pathogen attack. Oxidative stress: Generation of reactive oxygen species (ROS); Effect of ROS on metabolism; ROS detoxification mechanisms in plants; Stress mitigation strategies (Enzymatic and non-enzymatic).	8	8
PRACTICAL [Credit: 01]			
	1. Determination of osmotic potential of plant cell sap by the method of plasmolysis. 2. Determination of water potential of given tissue (e.g., potato tuber) by weight method. 3. Study of the effect of sunlight on the rate of transpiration in excised twig/leaf. 4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of mesophyte/ xerophyte. 5. Effect of carbon dioxide concentration on the rate of photosynthesis. 6. To study the effect of different concentrations of IAA on Gram/Pea/Moong root (IAA Bioassay). 7. Determination of seed germination percentage in different physical conditions (Demonstration) 8. To demonstrate water stress by application of PEG/ water withdrawal in germinating seeds /growing plants (Demonstration) 9. Fruit ripening/Rooting from cuttings (Demonstration).	30	40

Reading list:

1. Bajracharya D (1999) Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.
2. Bhatla SC, Lal MA (2018) Plant Physiology, Development and Metabolism. Springer Nature Singapore Pte Ltd.
3. Devlin RM (2017) Outline of Plant Physiology. Medtech: Scientific International Pvt. Ltd.
4. Devlin RM, Witham FH, Blaydes DF (2017) Devlin's Exercises in Plant Physiology. Medtech: Scientific international Pvt. Ltd.

5. Hopkins WG, Huner A (2008) Introduction to Plant Physiology (4th edition). John Wiley and Sons. U.S.A.
6. Kochhar SL, Gujral SK (2021) Plant Physiology: Theory and Applications (2nd edition). Cambridge University Press.
7. Malik CP, Srivastava (2015) Text Book of Plant Physiology. Kalyani Publishers, New Delhi.
8. Salisbury FB, Ross CW (2004) Plant Physiology (4th edition). Cengage Learning India Pvt. Ltd., New Delhi, India.
9. Taiz L, Zeiger E, Møller IM, Murphy A (2015) Plant Physiology and Development (6th edition). Sinauer Associates Inc. USA.

Graduate Attributes

Course Objective:

Students will be able to learn the plant and water relation and thus will be able to elucidate the crucial role of water in diverse physiological functions of plants, by studying this paper. The paper will also highlight the importance of mineral elements in plant physiology and various mechanisms applied to uptake mineral elements by plants. It will provide the basic idea of pathways and mechanisms of translocation of organic solutes synthesised in plant. Furthermore, this paper will explain the role and mechanisms of action of various plant growth regulators as well as physiology of flowering and dormancy of seeds. Additionally, the paper will also focus on the different abiotic and biotic stresses encountered by the plants in their environment as well as various stress mitigation strategies employed by plants to overcome the effects of stress.

Course outcomes:

1. Knowledge on mechanisms of water, minerals, and nutrient absorption of plants
2. Knowledge on roles of plant hormones and mechanism of flowering in plants
3. Practical knowledge on effects of growth regulators on plant parts
4. Practical knowledge on determination of osmotic and water potential

Theory Credit: 03

Practical Credit: 01

No. of Required Classes: 75 (Theory: 45; Practical: 30)

No. of Contact Classes: 75 (Theory: 45; Practical: 30)

No. of Non-Contact Classes: Nil

Particulars of Course Designer (Name, Institution, email id):

CCS, Department of Botany
Gauhati University, Guwahati-14