



त्रिभुवन विश्वविद्यालय

विज्ञान तथा प्रविधि अध्ययन संस्थान

वनस्पति शास्त्र केन्द्रीय विभाग

पत्र संख्या:- ५-जी. २२/०६५/५/१०

कीर्तिपुर, काठमाडौं
नेपाल



श्रीमान् डीन् ज्यू,
विज्ञान तथा प्रविधि अध्ययन संस्थान
क्रि. वि. कीर्तिपुर।

मिति: २०७५/०५/१०

क्र. २२९/०२/०६
०५/२१२

विषय : B.Sc तेस्रो वर्षको वनस्पतिशास्त्रको पाठ्यक्रम बारे

महोदय,

उपरोक्त सम्बन्धमा B.Sc. तेस्रो वर्षको वनस्पतिशास्त्र विषय BOT 301 (Plant Biochemistry and Biotechnology) मा केही प्राविधिक गल्तीहरु देखिन गएकोले सो को सुधार गरि पेश गरेको छु। अतः सुधारिएको पाठ्यक्रम त्यस कार्यालयको (Website) मा राखिदिनु हुन समेत अनुरोध गर्दछु।

संलग्न:

(१) BOT 301 को पाठ्यक्रम

मोहन सिवाकोटी

प्रा.डा.मोहन सिवाकोटी
विभागीय प्रमुख

मोहन सिवाकोटी
क्रि. वि.
(सिवाकोटी)
०५/२१२

Plant Biochemistry and Biotechnology

Course No: Bot 301

Nature of the Course: Theory

Year: B.Sc. III year

Full Marks: 100

Pass Marks: 35

Lectures: 150

Objectives: The general aim of this course is to provide fundamental knowledge of plant biochemistry and biotechnology.

Unit A: Plant Biochemistry

75

1. **Introduction:** a) Plant biochemistry as a science (b) Relationship between plant biochemistry and plant sciences (genetics, cell biology, molecular biology, plant physiology and other branches of bio sciences) 2 hrs

2. **Bio-molecules** 37 hrs
 - (a) **Water:** molecular structure, properties, water as a solvent; Ionization of water, pH scale, buffer. 6 hrs
 - (b) **Functional groups** found in bio-molecules: general concept 3 hrs
 - (c) **Carbohydrates:** Definition, classification
Monosaccharides: classification (based on functional group; based on no of C atoms), Properties (Esterification, oxidation, reduction, osazone formation, cyanohydrin reaction, furfural formation, enolization); derivatives of monosaccharides (de-oxy derivatives, acids, alcohols, amino sugars, sialic acid); Biological importance; Disaccharides, Polysaccharides and their biological importance (1+6+3 hrs)
 - (d) **Lipids:** Definition, structure of glycerol and fatty acids
Properties of fatty acids, kinds of lipids (Glycero lipids; lipids without glycerol; complex lipids), properties of lipids, Biological roles of lipids (1+ 4 hrs)
 - (e) **Proteins:** Definition, Amino acids and their classification (essential, semi essential and non-essential; polar and non-polar; acidic, basic or neutral)
Properties of Amino Acids: Amino acids as zwitterions, Amino acids as electrolytes, Reactions of amino acids (ninhydrin reaction; Sanger's reaction; Edman's reaction, Dansyl Chloride reaction; Phosgene reaction; decarboxylation; Esterification; Acylation); Peptide bonds and Polypeptide; Structure of polypeptides- primary/secondary/tertiary and quaternary structures; Classification of proteins, Functions of proteins. (2+5+3+3 hrs)

3. Nucleic acids:

(3+2+1+1+3+2+3hrs) = 15 hrs

Building components of nucleic acids: N₂ bases and their derivatives, sugars, phosphates, modified bases.

Biological roles of nucleotides

Types of nucleic acids (DNA, RNA and their types) and their role

DNA: Structure

Properties of Nucleic acids: Denaturation/ renaturation, hydrolysis, non-enzymatic transformation of nucleotides and nucleic acids (deamination, depurination, alkylation, formation of pyrimidine dimers and photoproduct); Enzymatic transformation of nucleic acids (concept of DNase/RNase, endo- and exonuclease, DNA polymerases, their types and functions)

DNA sequencing (Determination of base sequences in DNA molecule): Maxam Gilbert sequencing, Sanger sequencing.

4. **Enzymes:** Properties and chemical structure, Mechanism of action, Denaturation, Factors affecting enzyme action, Allosteric protein and feedback inhibition. Classification and nomenclature 7 hrs

5. **Plant pigments:** Structure and functions of chlorophylls, carotenoids, anthocyanins, phycobillins 4 hrs

6. **Vitamins and their role in plants:** Fat soluble vitamins (A, E and K); Water soluble vitamins (Coenzyme A, Vitamins B1, B2, B6, C, and H) 5 hrs

7. **Introduction to Bioinformatics** 5 hrs
Definition, role of computer in bioinformatics, Branches of bioinformatics, Aim of bioinformatics, Scope and research areas in bioinformatics, Biological data-DNA sequence, protein sequence, macromolecular structure. Databases in bioinformatics, basic bioinformatics tools- Databases search (Entrez, SRS), Blast, Fasta.

Unit B: Plant Biotechnology

75

1. Overview of Biotechnology

(1+3+10 hrs) = 14 hrs

Introduction : A) Origin and History of biotechnology. B) Scope and importance of biotechnology: a) Biotechnology in Medicine, b) Biotechnology in food industry, c) Biotechnology in agriculture, d) Biotechnology in Fermentation technology e) Biotechnology in environmental engineering; C) Achievements of biotechnology: a) Gene cloning, b) Recombinant DNA technology, c) *In vitro* culture technology, d) Genetically engineered drugs, e) Diagnosis of diseases f) Biosensors g) Biofertilizers h) Mutation Breeding, i) Enzyme technology, j) DNA finger printing, h) Monoclonal antibody

2. Plant tissue culture technique and application

(2+5+25+3) =35 hrs

A. Introduction to plant tissue culture.

B. Basic principles and techniques of *In vitro* culture: Totipotency, Basic requirements for growing plants in vitro: Laboratory organization, composition and selection of nutrient media, sterilization, culture room

C. Types of plant tissue culture and their applications: a. Seed culture, b. organ culture (Meristem culture, root culture, shoot culture), c. Embryo culture, d. Anther Culture. Ovule culture, f. Endosperm culture, g. Callus culture h. Protoplast culture, i. Cell suspension culture, j Shortening of breeding cycle.

D. Cryopreservation : a. Principles, **Method of cryopreservation**-i) Preparation of material for deep freezing, ii) Cryoprotectors, iii) Freezing programmes, iv) Storage strategies, v) Assessment of successful cryopreservation. b. **Uses of cryopreservation** – i) Cryopreservation of Semen, ii) Cryopreservation of ova and embryo, iii) Maintenance of plant germplasm for long duration, iv) Organ explants, v) Zygotic and immature embryos, vi) Shoot tips, vii) Callus, viii) Cell suspensions x) Protoplasts, c. **Significance of cryopreservation**

3. Plant- Microbe Interaction

(2+3+7) 12 hrs

A. Biological Nitrogen fixation: mechanism and its importance

B. Symbiotic and asymbiotic organisms for soil fertility and crop improvement.

C. Biofertilizers (Symbiotic associations): i) Rhizobium- Formation of nodule, Nitrogen fixing organism found in nodules, Structure and function of nodule, Mechanism of Nitrogen fixation by Nodules, Rhizobial biofertilizers, Rhizobium biofertilizers in forest trees. ii) Blue Green Algae (BGA)-Mass production and application of Blue Green Algae, Azolla – anabaena symbiosis, Asymbiotic associations, Non symbiotic nitrogen fixing bacteria, Non symbiotic bacterial biofertilizer- a) Azotobactor, b) Azospirillum, c) Carrier formulation, iii). Frankia biofertilizer, iv) Mycorrhiza-Types of mycorrhiza, benefits from Mycorrhizas to plants, establishment of Mycorrhiza associations in vitro

4. Gene transfer in plants:

(10+4 hrs)=14 hrs

A) Concept of gene cloning: Basic requirements for gene cloning in plants; gene isolation and cloning; Concept of vectors; marker and reporter genes and their roles in plant

transformation; identification and analysis of cloned genes (colony hybridization, immunological detection, PCR, blotting)

B. Gene transfer techniques in plants: i) gene transfer methods: (Direct/vectorless and indirect/ vector mediated); transformation of mitochondria and chloroplasts iii) GM crops: applications and limitations iv) General concept of molecular farming from transgenic plants, v) ethical issues in plant genetic engineering

Text and Reference books

Plant Biochemistry

1. Bhattarai, T. 2005. Experiments on Plant Biochemistry and Plant Biotechnology. Bhundipuran Prakashan, Kathmandu
2. Bhattarai, T. 2007. Plant Physiology. Bhundipuran Prakashan, Kathmandu.
3. Jain, J.L. 2004. Fundamentals of Biochemistry. S Chand and Company Ltd. New Delhi
4. Lehninger, A.L., Nelson, D.L. and Cox, M. 2004. Principles of Biochemistry. 4th edition. McMillan Limited, USA (Indian Reprint)
5. Rastogi, S.C. 1993. Biochemistry. Tata McGraw-Hill Publishing Company Ltd. Delhi

Bioinformatics

1. Attwood, T.K. and Parry-Smith, D. J. 2001. Introduction to Bioinformatics. Prentice Hall Inc.
2. Ghosh, Z. and Mallick, B. 2008. Bioinformatics –principle and applications. Oxford University Press, India.
3. Mount, D. W. 2001. Bioinformatics Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press, New York.

Plant Biotechnology

1. Altman, A. and Hasegawa, P. 2012. Agricultural Biotechnology. Academic Press.
2. Bhojwani S. S. 1990. *Plant Tissue Culture: Applications and Limitations*, Elsevier Science Publishers.
3. Bhojwani S.S. and Razdan, M. K. 1996. *Plant Tissue Culture: Theory and Practice*. Elsevier Science Publishers.
4. Chawala H.S. 2009. *Introduction to Plant Tissue Culture*. Third Edition. Oxford and IBH
5. Crispeels, M.J. and Sadava, D.E. 2006. Plants, Genes and Crop Improvement. American Society of Plant Biologists. USA.
6. Debergh, P.C. and Zimmerman, R.H. 1990. Micropropagation. Kluwer Academic Publ. Dordrecht.

7. Dodds, j.H. and Roberts, L.W. 1995. *Experiments in Plant Tissue Culture* (3rd Edition). Cambridge University Press. Cambridge, UK.
8. Dubey R.C. 2009. A text Book of Biotechnology S Chand and company Limited.
9. Gamborg O.L. and Phillips G.C. 1995. *Plant Cell, Tissue and Organ Culture – Fundamental Methods* (Lab. Manual). Springer-Verlag.
10. Greene J.J. and Rao V.B. 1998. *Recombinant DNA Principles and Methodologies*. Marcel Dekker.
11. Lal R. and Lal S. 1995. *Genetic Engineering of Plants for Crop Improvement*. CRC Press.
12. Pierik R.L.M. 1997. *In vitro Culture of Higher Plants*. Kluwer Academic Publisher, Netherlands.
13. Punia M.S. 1999. *Plant Biotechnology and Molecular Biology: A Laboratory Manual*. Scientific Publishers, India.
14. Razdan M. K. 2003. *Introduction to Plant Tissue Culture*. Agritech Publications.
15. Satyanarayan U. 2005. *Biotechnology*. 1st ed. Arunabha Sen books and Allied P. Ltd.

Mohan Swatan.