UNIVERSITY OF KALYANI

COURSE STRUCTURE FOR 4 YEAR (8 SEMESTER) UNDERGRADUATE PROGRAM IN BOTANY UNDER NEP 2020

SEMESTER I (REVISED)

Course Code	Course Title	Name of the Course	Credit of Course	Class hours per week	Evaluation	Internal Assessment	Total
BOT-MJ-CC-T-01	Origin , Life Processes & Diversity of Plant groups	Major (Theory)	4	4	40	15	75
BOT-MJ-CC-P-01	Do	Major (Practical)	2	4	20		
BOT-MI-CC-T-01	Biodiversity of Microbes, Algae, Fungi and Bryophytes	Minor (Theory)	3	3	25	10	50
BOT-MI-CC-P-01	Do	Minor (Practical)	1	2	15		
BOT-MDC-T-01		Multidisciplinary course (Theory)	2	2	25	10	45
BOT-MDC-P-01		Multidisciplinary course (Practical)	1	1	10		
BOT-SEC-T-01		Skill Enhancement Course (Theory)	2	2	25	10	45
BOT-SEC-P-01		Skill Enhancement Course (Practical)	1	2	10		
	Environmental Education	Value Added Course	4	4	40	10	50
TOTAL			20	24			265

SEMESTER II

Course code	Course title	Name of the course	Credit of Course	Class hours per week	Evaluation	Internal assessment	Total
BOT-MJ-CC-T-02	Biomolecules and cell biology	Major (Theory)	**4**	**4**	**40**	**15**	**75**
BOT-MJ-CC-P-02	Do	Major (Practical**)**	**2**	**4**	**20**		
BOT-MI-CC-T-02	Plant ecology, morphology and Taxonomy	Minor (Theory)	**3**	**3**	**25**	**10**	**50**
BOT-MI-CC-P-02	Do	Minor (Practical)	**1**	**2**	**15**		
BOT-MDC-T-01		Multidisciplinary course (Theory)	**2**	**2**	**25**	**10**	**45**
BOT-MDC-P-01		Multidisciplinary course (Practical)	**1**	**1**	**10**		
	Communicative English	Ability Enhancement course	**4**	**4**	**40**	**10**	**50**
BOT-SEC-T-02		Skill enhancement course (Theory)	**2**	**2**	**25**	**10**	**45**
BOT-SEC-P-02		Skill enhancement course(Practical)	**1**	**2**	**10**		
		Summer internship course	**4**				
TOTAL			**24**	**24**			**265**

B.SC. BOTANY 4 YEAR SYLLABUS

SEMESTER I	Origin, Life Processes & Diversity of Plant groups.
SEMESTER II	Biomolecules and Cell Biology.
SEMESTER III	Phycology and Lichen.
SEMESTER IV	Bryophytes and Pteridophytes, Gymnosperm and Palaeobotany.
SEMESTER V	Plant Systematics, Morphology and Anatomy, Ecology, Phytogeography.
SEMESTER VI	Plant Physiology & Biochemistry, Plant Metabolism, Genetics, Biometry and Plant Breeding.
SEMESTER VII	Microbiology, Fungi and Plant Pathology, Plant Molecular Biology and Biotechnology.
SEMESTER VIII	Biodiversity and Conservation, Economic Botany and Pharmacognosy, Analytical Techniques in Plant Science. [Research Methodology, Stress Biology **(for Honours without research)**]

SEMESTER I - MAJOR

COURSE CODE: BOT-MJ--CC-T-01 (THEORY) & BOT-MJ-CC-P-01 (PRACTICAL)

COURSE TITLE: ORIGIN, LIFE PROCESSESS AND DIVERSITY OF PLANT GROUPS

CREDIT: 6 [4 (THEORY) + 2 (PRACTICAL)]

FULL POINTS: 75 [40 (THEORY) + 20 (PRACTICAL) + 15 (INTERNAL ASSESMENT)]

COURSE OBJECTIVES:

After completion of the course the learners will be able to:

- Describe general characteristics of viruses, bacteria, algae, fungi and archegoniate with special reference to their classification, morphology, reproduction and ecology.
- Explain their role in environment, human welfare and in industrial applications;
- Apply this knowledge in understanding the evolutionary significance of these organisms.

COURSE CONTENT (THEORY)
COURSE CODE: BOT-MJ--CC-T-01

Unit 1: Origin of Life (12)

What is life? Theories of origin of life; role of water in life process; origin of land plants.

Unit 2: Microbes (6)

Viruses- Discovery, general structure; economic importance;
Bacteria- Discovery, general characteristicsand cell structure; economic importance.

Unit 3: Algae (8)

General characteristics; salient features of Cyanophyceae, Chlorophyceae, Charophyceae, Phaeophyceae,Rhodophyceae and Bacillariophyceae; ecology and distribution of algae; economic importance of algae.

Unit 4: Fungi (7)

Introduction – General characteristics, salient features of Myxomycota, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina; fungi- nutrition and reproduction; ecology and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza; Lichens- general account.

Unit 5: Introduction to Archegoniate (7)

Unifying features of archegoniates; transition to land habit; alternation of generations.

Unit 6: Bryophytes

(7)

General characteristics, salient features of Hepaticopsida, Anthocerotopsida and Bryopsida.

Adaptation to land habitat, adaptation to land habitat; Ecological and economic importance of Bryophytes.

Unit 7: Pteridophyres

(7)

General characteristics, salient features of Psilophyta, Lycophyta, Sphenophyta and Filicophyta; Ecological and economical importance.

Unit 8: Gymnosperms (7)

General characteristics; salient features of Cycadophyta, Coniferophyta and Gnetophyta.; Ecological and economic importance.

Unit 9: Angiosperms (10)

Floral characteristics, affinity with Gymnosperms; Herbarium; Botanical Garden.

COURSE CONTENT (PRACTICAL)
COURSE CODE: BOT-MJ--CC-P-01

Identification of the following from Preserved or Fresh Specimen/Permanent slides/Phptographs:

1. **Bacterial forms** : Coccus, Bacillus, Spirillum, Vibrio
2. **Algae** : *Nostoc, Lyngbya, Spirogyra, Oedogonium*
3. **Fungi** : *Rhizopus* (Vegetative structure with sporangium/ zygospore) , *Aspergillus*(vegetative structure with conidia), *Ascobolus* (Fruit body, L.S of *Ascobolus* fruit body), *Agaricus* (Fruit body, L.S of gills).
4. **Bryophytes**: *Riccia,* (Entire thallus, T.S of thallus showing sporophyte), *Marchantia* (V.S of archegoniophore & antheridiophore, sporophyte), *Funaria,* (Plant body, L.S of capsule).
5. **Pteridophytes***: Lycopodium* (Plant body, L.S of strobilus), *Pteris,*(T.S of leaflet).
6. **Gymnosperms:** Megasporophyll and microsporophyll of *Cycas,* external morphology of *Pinus* female cone; L.S of male and female cone of *Pinus.*
7. Angiosperms : *Polyanthes tuberosa, Crysopogon aciculatus, Tridax procumbens, Oldenlandia corymbosa, Solanum nigrum*

SUGGESTED READINGS/REFERENCES

1. Introductory Phycology by H. D. Kumar. East West Press Pvt. Ltd., New Delhi 1999.
2. General Microbiology by R.Y. Stanier. , J.L. Ingraham. , M.L. Wheelis. and P.R. Painter. International Edition(5th). 1999.
3. Introductory Mycology by C.J. Alexopoulos. , C.W. Mims. And M. Blackwell. John Wiley andSons (Asia), Singapore. Ed. 4th. 1996.
4. An Introduction to Embryophyta by N.S. Parihar. Central Book Depot, Allahabad. Vol. I. 1991.
5. Pteridophyta by P.C. Vashishta. , A.K. Sinha. And A. Kumar. S.Chand, Delhi. 2010.
6. Gymnosperms by S. P. Bhatnagar and A. Moitra. New Age international Pvt Ltd., New Delhi, 1996
7. Angiosperm: morphology, anatomy, taxonomy, evolution by S. K. Sachdeva, Kalyani Publishers,New Delhi, 1990

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COURSE CODE: BOT-SEC-T-01(THEORY) & BOT-SEC-P-01(PRACTICAL)
COURSE; CREDIT- 3 [2(THEORY)+1(PRACTICAL)]
FM=45[25(THEORY)+10(PRACTICAL) + 10 (INTERNAL ASSESMENT)]

COURSE TITLE: A. BIOFERTILIZERS

COURSE OBJECTIVES:
After completion of the course the learners will be able to:

- elucidate different types of fertilizers using biological organisms;
- apply the knowledge gained in utilization of biofertilizers in organic farming.

COURSE CONTENT (THEORY)
COURSE CODE: BOT-SEC-T-01-A

Unit 1: (4)

General account about the microbes used as biofertilizer - *Rhizobium* - isolation. identification, mass multiplication, carrier-based inoculants, Actinorhizal symbiosis.

Unit 2: (8)

Azospirillum: isolation and mass multiplication - carrier based inoculants, associative effect of different microorganisms. *Azotobacter*: classification, characteristics - crop response to *Azotobacter* inoculum, maintenance and mass multiplication.

Unit 3: (4)

Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.

Unit 4: (8)

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield - colonization of AM - isolation and inoculum production of AM, and its influence on growth and yield of crop plants.

Unit 5: (6)

Organic farming - Green manuring and organic fertilizers, recycling of biodegradable municipal, agricultural and industrial wastes - bio compost making methods, types and method of vermicomposting- field application.

COURSE CONTENT (PRACTICAL)
COURSE CODE: BOT-SEC-P-01-A

1. Isolation of *Rhizobium* from leguminous root nodule
2. Isolation of *Azotobacter, Azospirillum*

3. Isolation of BGA from water and soil samples
4. Production of *Azolla* in trays
5. Study of different types of mycorrhizal association from permanent slides/photographs
6. Visit to areas where organic farming, bio composting, vermicomposting is practiced.

SUGGESTED READINGS/ REFERENCES:

1. Dubey, R.C. (2005). A Text book of Biotechnology. S.Chand and Co, New Delhi.
2. Kumaresan, V. (2005). Biotechnology, Saras Publications, New Delh.
3. John Jothi Prakash, E. (2004). Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Sathe, T.V. 5. Subha Rao, (2004). N.S. Vermiculture and Organic Farming. Daya Publishers.
5. Subha Rao, N.S.. (2000). Soil Microbiology, Oxford and IBH Publishers, New Delhi.
6. Vayas, S.C, Vayas, S. and Modi, H.A. (1998). Bio-fertilizers and organic farming. Akta , Prakashan, Nadiad.

COURSE TITLE: B. PLANT DIVERSITY AND HUMAN WELFARE

COURSE OBJECTIVES:

After completion of the course the learners will be able to:

- explain the concept and value of biodiversity, threats to biodiversity, need for conservation and environmental stewardship;
- apply and implement conservation strategies for biodiversity management.

COURSE CONTENT (THEORY)
COURSE CODE: BOT-SEC-T-01-B

Unit 1: Plant diversity and its scope. (8)

Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.

Unit 2: Loss and Management of Biodiversity: (8)

Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss, Management of Plant Biodiversity: Organizations associated with biodiversity management- Methodology for IUCN, UNEP, UNESCO, WWE, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.

Unit 3: Conservation of Biodiversity (8)

Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ*, conservation, Social approaches to conservation, Biodiversity awareness programmes Sustainable development.

Unit 4: Role of plants in relation to Human Welfare (6)

a) Importance of forestry their utilization and commercial aspects, b) Avenue trees, C) Ornamental plants of India, d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.

COURSE CONTENT (PRACTICAL)
COURSE CODE: BOT-SEC-P-01-B

1. Study plant diversity in urban, rural and in a different phytogeographic region.
2. Visit to botanical garden, herbarium (*ex situ* conservation); national park/sanctuaries/biosphere reserve (*in situ* conservation).
3. Identification of some important microbes (*Aspergillus niger*, *Penicillium notatum*, *Lactobacillus*, Yeast, *Chlorella*, *Spirulina*) and their uses.

SUGGESTED READINGS/ REFERENCES:

1.Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.

SEMESTER I/II- MINOR

INSTRUCTION: Candidate may opt either in Sem I & III or Sem II & IV

COURSE CODE: BOT-MI-CC-T-01(THEORY) & BOT-MI-CC-P-01(PRACTICAL)

COURSE TITLE: BIODIVERSITY OF MICROBES, ALGAE, FUNGI AND BRYOPHYTES

CREDIT:4 [3(THEORY) + 1(PRACTICAL)]

FULL POINTS:50 [25 (THEORY) + 15 (PRACTICAL) + 10 (INTERNAL ASSESSMENT)]

COURSE OBJECTIVES:

After completion of the course the learners will be able to:

- Describe general characteristics of viruses, bacteria, algae, fungi and bryophytes with special reference to their classification, morphology, reproduction.
- Explain their role in environment, human welfare and industrial applications.
- Apply this knowledge in understanding the evolutionary significance of these organisms.

CO URSE CONTENT (TH EORY)
CO URSE CODE (TH EORY): BOT-MI-CC-T-01

Unit 1: Microbes **(10)**

Virus- General structure, replication (general account), DNA virus (T-phage); Lytic and Lysogenic cycle, RNA virus (TMV); Economic importance;

Bacteria- General characteristics and cell structure; Reproduction- conjugation, transformation and transduction; Economic importance.

Unit 2: Algae **(12)**

General characteristics: reproduction; Classification of algae by Fritsch (1935); Economic importance of algae.

Unit 3: Fungi **(12)**

Introduction: General characteristics, cell wall composition, reproduction and classification (Alexopoulos, Mims and Blackwell 1996); Symbiotic associations- Lichens: General account; Mycorrhiza: ectomycorrhiza and endomycorrhiza.

Unit 4: Bryophytes **(10)**

General characteristics; adaptations to land habit; classification following Smith G.M. (1955); Economic importance of bryophytes with special mention of *Sphagnum*.

COURSE CONTENT (PRACTICAL)
COURSE CODE- BOT–MI-CC-P-01

1. **EMs/Models of viruses** -T-Phage and TMV.
2. **Types of Bacteria -**from temporary/permanent slides/photographs.
3. **Gram staining.**
4. **Algae- (Study from permanent slides/ permanent slide/preserved specimen)** -*Nostoc, Oedogonium, Chlamydomonas* and *Fucus*
5. **Fungi- (Study from permanent slides/ permanent slide/preserved specimen)-** *Rhizopus* and *Penicillium, Agaricus* (Section of gills).
6. **Lichens:** Study of growth forms of Lichens (crustose, foliose and fruticose).
7. **Mycorrhiza**: ectomycorrhiza and endomycorrhiza (Photographs).
8. **Bryophyte-(Study from permanent slides/ permanent slide/preserved specimen)-** *Marchantia* (morphology of thallus, VS of antheridiophore, archegoniophore), *Funaria (*morphology, LS of capsule).

SEMESTER-II MAJOR

COURSE CODE: BOT-MJ-CC-T-02 (THEORY) & BOT-MJ-CC-P-02 (PRACTICAL)

COURSE TITLE: BIOMOLECULES AND CELL BIOLOGY

CREDIT – 6 [4 (THEORY) + 2 (PRACTICAL)]

FULL POINTS – 75 [40 (THEORY) +20 (PRACTICAL)+ 15 (INTERNAL ASSESSMENT)]

COURSE OBJECTIVES:

After completion of the course the learners will be able to:

- Describe the types, nomenclature and structures of biomolecules;
- Explain the function and structure of cells including their metabolic reactions that occur in cells;
- Elucidate the laws of thermodynamics and translate reaction mechanisms within cells into theirfinal expressions;
- Discuss the origin of eukaryotic cell;
- Explain the process of cell division and inheritance.

COURSE CONTENT (THEORY)
COURSE CODE: BOT-MJ--CC-T-02

Unit 1: Biomolecules (20)

A. Types and significance of chemical bonds; Structure and properties of water; pH and buffers.
B. Carbohydrates: Nomenclature and classification; Monosaccharides; Disaccharides; Oligosaccharides and Polysaccharides.
C. Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacyl glycerol structure, functions and properties; Phosphoglycerides.
D. Proteins: Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quaternary; Protein denaturation and biological roles of proteins.
E. Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A,B,Z types of DNA; Types of RNA; Structure of t RNA.

Unit 2: Bioenergetics (4)

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

Unit 3: Enzymes (6)

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

Unit 4: The cell **(4)**

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

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

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

Unit 6: Cell organelles

A. Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.
B. Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament.
C. Chloroplast, Mitochondrion, and Peroxisome: Structural organization; Function; Semiautonomous nature of mitochondrion and chloroplast.
D. Endomembrane system: Endoplasmic Reticulum (ER) – Structure, targeting and insertion of protiens in the ER, protien folding, processing; Smooth ER and lipid synthesis, export of protiens and lipids; Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Lysosome
E. Organelle without membranes: Ribosomes – structure and function

Unit 7: Cell division

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

COURSE CONTENT (PRACTICAL)
COURSE CODE: BOT-MJ--CC-P-02

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

SUGGESTED READINGS/ REFERENCES:

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

BOTANY (MULTIDISCIPLINARY)
(Candidates will opt only once either in Semester I, II or III)

COURSE TITLE: PLANT DIVERSITY AND MORPHOLOGY
COURSE CODE; BOT-MDC-T-01 (THEORY) & BOT-MDC-P-01 (PRACTICAL)
COURSE CREDIT= 3 [2(THEORY)+1(PRACTICAL)]
FULL POINTS = 45 [25(THEORY)+10(PRACTICAL) + 10 (INTERNAL ASSESSMENT)]

COURSE CONTENT (THEORY)
COURSE CODE: BOT-MDC-T-01

1. General characteristics of virus, bacteria, algae, fungi, bryophyte, pteridophyte, gymnosperm and angiosperm; economic and ecological importance of virus, bacteria, algae, fungi, bryophyte, pteridophyte & gymnosperm.
2. Morphology of leaves (Types, phyllotaxy, modification of leaves, stipules).
3. Morphology of inflorescence (Types and examples).
4. Morphology of flower (Parts of flower, types of flowers, modification of calyx, aestivation, floral formula and diagram, adhesion & cohesion of floral parts, types of placentation.
5. Morphology of fruits & seeds (Types and dispersal).

COURSE CONTENT (PRACTICAL)
COURSE CODE: BOT-MDC-P-01

1. Identification from preserved/fresh specimen or permanent slides. [Coccus, Bacillus, *Nostoc*, *Agaricus*, *Funaria*, female cone of *Pinus*, any five angiosperms (at least one from monocot)].
2. Identification with reasons: stipules, inflorescence, flower & fruits.