M.Sc BOTANY SYLLABUS STRUCTURE FOR III & IV SEMESTER

PG Syllabus Structure			Program : Science (Botany)					
Sl. No	**Subject**	**Semester**	**Type of Paper**	**Teaching Hours**	**Credits**	**IA**	**SEE**	**Total**
1	**Botany**	**3rd Semester**	**Hard Core Theory**					
			HCT 3.1	4	4	20	80	100
			HCT 3.2	4	4	20	80	100
			HCT 3.3	4	4	20	80	100
			Soft core Theory (Chose any One)					
			SCT 3.1	4	4	20	80	100
			SCT 3.2	4	4	20	80	100
			Hard core Practical					
			HCP 3.1	4	2	10	40	50
			HCP 3.2	4	2	10	40	50
			HCP 3.3	4	2	10	40	50
			Soft core Practicals					
			SCP 3.1	4	2	10	40	50
			SCP 3.2	4	2	10	40	50
			Open Elective					
			OET 3.1	2	2	10	40	50
			Total credits for III sem		**26**	**130**	**520**	**650**

2	**Botany**	**4thSemester**	**Hard Core Theory**					
			HCT 4.1	4	4	20	80	100
			HCT 4.2	4	4	20	80	100
			Soft core Theory (Chose any One)					
			SCT 4.1	4	4	20	80	100
			SCT 4.2	4	4	20	80	100
			Hard core Practical					
			HCP4.1	4	2	10	40	50
			HCP4.2	4	2	10	40	50
			Soft core Practical					
			SCP 4.1	4	2	10	40	50
			SCP 4.2	4	2	10	40	50
			Hard Core Project					
			HCMP 4.1	6	6	30	120	150
			Total credits for IV sem		**24**	**120**	**480**	**600**

M.Sc BOTANY III- SEMESTER- THEORY SYLLABUS

BOT: HCT 3.1 CELL BIOLOGY AND GENETICS

64 HOURS

1.	**Cell Theory:** Historical perspective and contemporary status. **Cytoskeleton:** Structural organization and functions of prokaryotic and eukaryotic cell and detailed account of Cell wall - plant cell wall and fungal cell wall, plasma membrane, Nucleus, Nuclear pore complex, Endoplasmic reticulum, Golgi complex, Lysosomes, Plant cell vacuoles, peroxisomes and glyoxysomes. **Chromosomes:** Structure of eukaryotic chromosome, Centromere, Kinetochore complex, Centromere Proteins (CENPs), Telomeres and their role in chromosome segregation, Heterochromatin, Euchromatin structures, Nucleosome complex, Giant chromosomes: Polytene and lampbrush chromosomes, Karyotype and Ideogram.	**18h**
2.	**Cell Cycle:** Cell division and significance of Mitosis and Meiosis, molecular events during Cell Cycle, checkpoints, role of Cyclins and cell signalling in plants. **Chromosomal aberrations:** Numerical: Euploidy (Monoploidy, Haploidy and Polyploidy) Polyploidy Autopolyploidy and Allopolyploidy. Aneuploidy - Monosomy, Nullisomy and Trisomy. Structural- Deletions, Duplication (Tandem, Reverse tandem and Displaced), Translocation (Simple, Isochrome, Reciprocal, Displaced) and Inversions (Pericentric and Paracentric). Significance of chromosomal aberrations.	**12h**
3.	Introduction and history of genetics, trait, genotype and phenotype **Mendelian genetics:** Mendelian laws of inheritance: Law of dominance, Law of segregation and Law of independent assortment. **Extensions of Mendelian principles:** Incomplete dominance, codominance, multiple alleles, lethal alleles and interaction of genes - Epistasis, complementary, supplementary and collaborator genes.**Quantitative genetics:** Quantitative inheritance- Multiple gene interaction, Linkage and Crossing over - Tetrad analysis, Construction of linkage maps and chromosomal mapping and sex determination and sex influenced characters in plants. **Extra chromosomal Inheritance:** Inheritance of Mitochondrial and chloroplast Genes, Inheritance in Chlamydomonas, male sterility in maize, Leaf variegation in Mirabilis jalapa.	**18h**
4.	**Population genetics:** Populations, concept of gene pool, gene frequency, genotype frequency, Hardy-Weinberg law of equilibrium; migration and random genetic drift. **Evolutionary genetics:** Biological species concept, Mechanisms of reproductive isolation, modes of speciation, Evolution of genes concept, Factor, allele, pseudoallele (cistron, recon, muton) fine structure of gene: rII locus of gene, split genes, over lapping genes, jumping genes. **Mutation:** Types of mutations: Spontaneous, induced, somatic, germline, Physical and chemical mutagens.	**16h**

REFERENCES:

1. Snustad P and Simmons MJ. 2002. Principles of Genetics. John Wiley & Son, USA.
2. Russell PJ. 2009. Genetics A Molecular Approach. Pearson Ltd. USA.
3· Hartl DL and Jones EW. 1997. Genetics: Principles and Analysis. Jones and Bartlett Publishers Inc. USA.
4. Singh BD. 2015. Plant Breeding principles and Methods. Kalyani Publishers. India
5. Tamarin RH. 2004. Principles of Genetics. McGraw-Hill Higher Education. USA
6. Singh P. 2010. Essentials of Plant Breeding. Kalyani Publishers, New Delhi.
7. Hartwell L and Goldberg M. 2004. Genetics: From Genes to Genomes. McGraw-Hill Higher Education. USA
8. Pierce BA.2012. Genetics: A conceptual approach. WH Freeman. USA.
9. Acquaah G. 2012. Plant Genetics and Breeding. Wiley-Blackwell. USA.
10. Ahluwalia KB. 1985. Genetics. Wiley Eastern Limited. India.
11. Gupta P. K.2010. Genetics. Rastogi Publications. India.
12.Verma PS and Agarwal VK. 2010. Genetics. S. Chand Publishing. India.
13. Khanna VK. 2017. Fundamentals of Genetics Laboratory Manual. Kalyani Publishers. India.
14. Gardner and Snustad S. 2005. Principles of Genetics, John Wiley and Sons, Singapore.
15. Singh BD. 2003. Genetics. Kalyani Publishers, New Delhi.
16. Smith JM. 1998. Evolutionary Genetics, Oxford Univ. Press, Oxford.
17. Snustad DP, Simmons MJ and Jenkins JP. 1997. Principles of Genetics. John Wiley and Sons, INC
18. Verma RS. 1988. Heterochromatin: Molecular and Structural aspects. Cambridge University Press, Cambridge.
19. Snustad DP and Simmons MJ. 2010. Principles of genetics (V Edn). John Wiley and Sons.
20.Hartl DL and Jones EW. 2009. Genetics: Analysis of genes and genomes (VII Edn). Jones and Bartlett publishers.

M.Sc BOTANY III- SEMESTER- THEORY SYLLABUS

BOT: HCT 3.2 MOLECULAR BIOLOGY

64 HOURS

1.	**Nature of genetic material:** Nucleic acid as genetic material; the primary and secondary structure of DNA and RNA; Organization of the Genetic material in prokaryotes and eukaryotes; mitochondrial and chloroplast DNA organization; **Replication of DNA:** Patterns of replication-experiments of Messelson's and Stahl, Cairns, Tailor, enzymes and proteins of DNA, replicating machinery, mechanism of replication-initiation, elongation and termination in prokaryotes and eukaryotes, fidelity of replication, proof reading mechanism, RNA directed DNA synthesis (reverse transcription).	**18h**
2.	**Expression of Genome: Transcription** - RNA polymerase-types, structure and function mechanism of transcription-initiation, elongation and termination in prokaryotes and eukaryotes. Post transcriptional modifications-RNA processing, capping, polyadenylation, splicing, alternate splicing, exon, shuffling, structural organization of m-RNA, t-RNA and r-RNA, m-RNA transport; Translation: t-RNA identity, amino acylation of t-RNA, amino acyl synthetase, the genetic code, deciphering of genetic code, degeneracy and Wobble hypothesis, enzymes, mechanism of translation-initiation, elongation and termination, proof reading, translational inhibitors, post translational modifications of proteins;	**12h**
3.	**Gene regulation in prokaryotes:** Cis regulatory factors, promoters, enhancers, operators, silencers-trans regulatory factors, transcription factors, regulation at transcription initiation operon concept-Lac operon-positive and negative control, tryp-operon, attenuation, ribosomal proteins as translational repressors, ribo switches, regulation in lytic and lysogenic cycle, induction and maintainance; **Gene regulation in eukaryotes:** Transcription activators, transcriptional repression, gene silencing by modification of histone and DNA (Deacylation and methylation), regulation after initiation of transcription, translational controls, RNA interference, m-RNA localization during development.	**18h**
4.	**Transposable elements:** Prokaryotic transposons, discovery, structure of IS elements, composite transposons, phage μ eukaryotic transposable elements-transposons discovery, AC-DS elements in maize, cpm/en elements in snapdragon, P elements in Drosophila, retro transposons -retroviruses and retro transposons, copia and Ty elements, mechanism of transpositions, uses of transposons-as genetic markers, mutagens, transposon tagging for gene isolation and vectors for transformation;	**16h**

REFERENCES:

1) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Rafi, Keith Roberts, and Peter Walter. 2008. Molecular biology of the cell, 5th ed., Garland science, Taylor & Francis Group, LLC, 270 Madison Avenue, NewYork NY f 0016, USA.
2) 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
3) Kleinsmith, L.J. and Kish, V.M. 1995 .Principles of Cell and Molecular Biology 2nd Edition Harper Collins College Publishers, New York, USA.
4) Lodish, H. Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell,J. 2000. Molecular Cell Biology 4th Edition. W.H. Freeman and Co. New York, USA
5) Malaciniski, G.M. and Freidfelder, D. 1998. Essentials of Molecular Biology 3rd Edition. Jones and Bartlet Publishers, Inc., London.
6) Gunning.B.E.S. and Steer, M.W.1996. Plant Cell Biology; Structure and Function. Jones and Bartlett Publishers, Boston, Massachusetts.
7) Harris,Nand Oparka, K.J. 1994. Plant Cell Biology A Practical Approach. IRL Press, Oxford University Press, U.K.
8) F.M. Ausubel, R.Brent, R.E. Kingston, D.D. Moore, J.G. Seidman, J.A. Smith, K. Struhl, (Current Edition) (2005). Current Protocols in Molecular Biology.
9) B.B. Buchanan, W.Gruissem and R.L. Jones . USA (2000).Biochemistry and Molecular Biology of Plants. Ed. ASPP Press.
10) T.A. Brown, 2000. Essential of Molecular Biology, Vol-I & 2 Oxford University Press.
11) James D. Watson, Tania,. A. Baker, Stephen, P. Bell, Alexander ,Gannm, Michael Levine.2004. Molecular Biology of the gene. 5th Edition, Pearson Education.
12) Philip M Gilmartin and Chris Bowle.2002. Molecular Biology of Plants. Vol 1 & 2 Oxford University Press.

M.Sc BOTANY III- SEMESTER- THEORY SYLLABUS

BOT: HCT 3.3 PLANT PHYSIOLOGY AND METABOLISM

64 HOURS

1.	Structure of Amino acids, Proteins and Enzymes; Extraction and purification of enzymes; Carbohydrates: Classification and functions; Synthesis and degradation of sucrose; Lipids and fatty acids; Conversion of lipids to carbohydrates in germinating seeds. Membranes: Structure and organization; Transport across membranes- passive and active transport processes.	**16h**
2.	**Photosynthesis:** Mechanisms of electron and proton transport processes. Photophosporylation and ATP synthesis. Kelvin and Hatch-Slack cycles; Crassulacean acid metabolism in plants; Respiration- Overview of plant respiration. Glycolysis, Kreb's cycle, Electron transport chain; Oxidative phosphorylation and ATP synthesis; Photorespiration.	**16h**
3.	**Plant growth hormones:** Biosynthesis, metabolism, transport and physiological effects of ethylene and abscisic acid; A brief account of commercial applications of the growth hormones; Nitrogen metabolism and fixation: Assimilation of Nitrate and Ammonium ions. Molecular mechanism of nitrogen fixation- Role of *Leg* hemoglobin, *nif* and *hup* genes.	**16h**
4.	**Temporal organization:** Characteristics of biological rhythms-biological clocks, Phytochrome-cellular location and action. Stress physiology: Biotic and abiotic stress, Mechanism of plant responses to drought and cold stresses.	**16h**

REFERENCES:

1. Plant physiology: Lincoln Taiz and Eduardo Zeiger (Sinaur, Massachusetts (1998).
2. Cell Physiology and Biochemistry: Me Elroy W D (Prentice Hall of India 1995).
3. Enzymatic reaction mechanisms: Walsh C T (Freeman, New York 1979)
4. Physiology of ion transport across the tonoplast of higher plants: Birkla B J and Pantanjo (Ann. Rev. Plant Physiol. 47, 159-184, 1996).
5. Plant membranes-Endo and plasma membranes of plant cells: Robinson D G (1985).
6. Transport in plants I. Phloem transport: Zimmermann M H and Milburn J A
7. Electrogenic ion pumps: Spanswick R M (Ann. Rev. Plant Physiol. 32, 267-289, 1981).
8. Photosynthesis- physical mechanisms and chemical patterns: Clayton R K (Cambridge Univ Press 1992)

M.Sc BOTANY III- SEMESTER- THEORY SYLLABUS

BOT: SCT 3.1 GENETIC ENGINEERING

64 HOURS

1.	**Genetic engineering** - Definition & meaning; R-DNA Technology- Enzymes: Nucleases, Restriction enzymes(RE), nomenclature of RE, Mode of Action of REs; DNA Ligase, Kinase, Reverse transcriptase; Cloning Vectors- nomenclature and classification, plasmids, bacteriophages and cosmids.	**16h**
2.	**Blotting techniques:** Southern, Northern and Western blotting; **DNA Libraries:** Construction of genomic library and c-DNA library; **Transposable elements:** Prokaryotic transposons- Insertion and composite sequences; Applications of transposons in research and health care system. Mutation: Molecular basis of spontaneous and induced mutations and their role in evolution.	**16h**
3.	**Polymerase Chain Reaction:** Principle and components of PCR; Types of PCR- Inverse PCR, Anchored PCR, RT-PCR; Applications of PCR; **Molecular Markers-** Restriction Fragment Length Polymorphism(RFLP), Amplified Fragment Length Polymorphism (AFLP), Random Amplified Polymorphic DNA (RAPD).	**16h**
4.	**Gene Transfer Methods:** *Agrobacterium* mediated genetic transformation; Transfer of genes using physical delivery methods; Poly ethylene glycol mediated and Liposome mediated DNA uptake; Micro injection and Micro projectile bombardment. Trans genes and Transgenic plants: Marker genes; Reporter genes.	**16h**

REFERENCES:

1. Principles of gene manipulation- An introduction to genetic engineering: Bold R W and Primerose S B (Black Well, London)
2. Plant Cell Culture – A practical Approach: Dixan R A and Ganzales R A (1994).
3. Hand Book of Plant Cell Culture vol.-1: Evans et al.,(Macmillan, New York 1983)
4. Plant Cell, Tissue and Organ Culture Fundamental method: Gambarg O L and Phillips (Naraosa, New Delhi 1996).
5. Introduction to plant tissue culture 2nd edition: Razdhan M K (Oxford & IBH, New Delhi 2003).
6. Applied and Fundamental Aspects of Plant cell, tissue and organ culture: Reinert J and Bajaj Y P S (Narosa, New Delhi 1988).
7. Plant Secondary Metabolites: Shukla Y M, Dhruve J J, Patel N J, Bhatnagar R, Talati J G and Kathiria K B (New India, New Delhi 2009).
8. Cell culture and somatic cell genetics of plants vol.-II: Vasil I K (Academic, INC. New York 1985)
9. Introduction to plant biotechnology: Chawla, H. S. (IBH, New Delhi 2002)

M.Sc BOTANY III- SEMESTER- THEORY SYLLABUS

BOT: SCT 3.2 BIOENERGY AND BIOFUELS

64 HOURS

1.	A brief history of various energy sources; Non-replenishable and replenishable energy sources; Present and future needs; Depletion of conventional energy sources-World energy crisis; Alternate systems based on non-conventional methods; Principles of energy conservation, utilization and prospects of bioenergy sources; Problems and viable solutions of energy utilization in ecological and sociological perspectives.	**16h**
2.	**Bioenergy-** An overview of major biofuels and routes to their production; Biomassdefinition and sources; Biomass systems, assessment, utilization and conservation; Types of conservation of biomass; Pre-treatment and compaction-drying, wood chips, briquette and pellet production; Modification of plants and biomass crops to enhance biomass production.	**16h**
3.	**Forestry as an energy source-** Forest biomass and residues; Energy and chemical characterization of forestry biomass; Agricultural energy crops and residues; Energy and chemical characterization of agricultural biomass and residues; Microalgae-cultivation methods, ponds, photobioreacters and biofuel extraction.	**16hh**
4.	**Biomass energy conversion technologies:** Thermochemical- Combustion, gasification, pyrolysis and torrefaction; Biological- anaerobic conversion and biogas generation, enzymatic conversion and liquid fuel production; Energy crops for biofuel production-Sunflower, Soybean, Castor, and Jathropa- cultivation and harvesting techniques; **Advanced biofuels-** Biobutenol, bioethenol and biodiesel; Sustainability criteria and the future of biofuels.	**16h**

REFERENCES:

1. Non-conventional energy sources: G. D. Rai
2. Renewable energy: Soreson
3. Principles of energy conversion: A Culp
4. Bio-renewable resources: Engineering new products from agriculture: Robert C Brown (Wiley-Blackwell)
5. Biomass for renewable energy, fuels and chemicals: Donald Klass (Academic press)
6. Gasoline, Diesel and Ethanol biofuels from gasses and plants: Ram B Gupta & Ayhan Demirbas (Cambridge Univ Press)
7. Biofuels engineering process technology: Cave Drapcho, John Nghiem and Terry Walker (McGraw Hill)
8. EPA Biofuels Educational module-I: D T Allen, R E Hebner and M E Webber (Univ Texas)

M.Sc BOTANY III- SEMESTER- THEORY SYLLABUS

BOT: OET 3.1 MEDICINAL PLANTS

30 HOURS

1.	**Introduction:** Medicinal plants-Basic concepts and their uses in Ayurveda, Tibetan,Unani, Siddha and Homoeopathic system of medicines; Classification of medicinal plants; Diseases of medicinal plants. Ethno-botany and ethno-medicine: Importance of ethno-botany and ethno-medicine in modern health care system; Methods of collecting traditional information and knowledge on medicinal plants.	**15h**
2.	**Medicinal value of food plants:** A few examples- cereals, pulses, spices, fruits, vegetables and wild food plants; Medicinal and nutritive values of mushrooms. Herbal remedies: Plants used for treatment of blood circulation, respiratory, urinary intestinal, nervous disorders, diabetics, cancer, jaundice, skin, and hair ailments. Plants in gynecological disorders and infertility. Plants used as general tonics.	**15h**

REFERENCES:

1. Indian Medicinal Plants: Kirtikar K R and Basu B D (1932)
2. Indian Materia Medica vol. I & II: Nadkarni A K (1954)
3. Ayurvedic drugs and their plant sources: (Oxford & IBH, New Delhi)
4. Pharmacognosy: G E and Evans W L (12th edn, Baillie Tindal, London 1983)
5. Some controversial drugs in Indian Medicine: Vaidya B Chaukamba (Oriental Varanasi 1982)
6. Natural Products: Mann J, Davidson R S, Hobbs J B, Benthorpe D V and Longman (Scientific, Essex).
7. The Chemotaxonomy of Plants: Smith P M, Edward Arnold (London 1976).
8. Hand Book of Medicinal Plants: Prajapati, Purohit, Sharma and Kumar. (Source Book, Agrobios, India 2007).
9. Phytochemical methods: Harborne J, Ed Chapman & Hall (London 1984)
10. Ethno-botany and Medicinal Plants of Indian Subcontinent: Maheshwari J K (Scientific, India 2000).
11. A Hand Book of Medicinal plants-A complete Source Book: Prajapati *et al.* (Agrobios, Jodhpur, India 2003).
12. Compendium of Medicinal Plants vol. I & II. CDIR (Lucknow Publication & Information Directorate, New Delhi 1991)

BOT: HCP 3.1 CELL BIOLOGY AND GENETICS
Practical Syllabus

Based on theory syllabus

1. Methods of fixing and staining (Acetocarmine, Aceto-orcein and Feulgen)

2. Study of mitosis *(Allium / Maize)*

3. Study of meiosis *(Tradescantia / Chlorophitium / Allium)*

4. Determination of chromosome number at mitotic metaphase and diakinesis /metaphase I of meiosis.

5. Study of mitotic index in root meristematic tissue of *Allium cepa*

6. Preparation of Karyotype analysis in *Allium cepa*

7. Polytene chromosome in Chironomous larvae *j* Fruit flies

8. Observation of mutant flies of *Drosophila*

9. Determination of mono, dihybrid and test cross ratios

10. Problems from Mendelian linkage, Quantitative genetics and population genetics

11. Linkage problems - 3 point test cross

12. Preparation of permanent slides

13. Models *j* Charts *j* Photographs related to cytologist and geneticist

BOT: HCP 3.2 MOLECULAR BIOLOGY

Practical Syllabus

Based on theory syllabus

1. Isolation of DNA from prokaryotes

2. Isolation of DNA from eukaryotes

3. Quantification of DNA

4. Electrophoretic Separation of DNA

5. Cultivation of E.coli

BOT: HCP 3.3 PLANT PHYSIOLOGY AND METABOLISM

Practical Syllabus

Based on theory syllabus

1. Estimation of proteins in seeds by Lowry's method.

2. Estimation of the activity of lipase in seeds,

3. Quantitative estimation of carbohydrates by Benedict's and DNS method.

4. Estimation of total fat content in seeds

5. Demonstration of experiments on growth hormones.

6. Determination of water potential of tissue by plasmolytic/gravimetric method.

7. Quantitative estimation of calcium by EDTA method.

8. Study of Kranz anatomy in C4 plant leaves.

9. Quantitative estimation of Chl a, Chl b and total chlorophyll in plant tissues.

10. Study of absorption spectrum of plant chlorophylls.

11. Determination of diurnal fluctuation in TAN of CAM plants.

12. Demonstration experiment on growth hormones/effect of red and far red light on seed germination.

BOT: SCP 3.1 GENETIC ENGINEERING

Practical Syllabus

Based on theory syllabus

1. Amplification of DNA using PCR technique

2. Isolation of genomic DNA from bacteria/plants

3. Quantification of DNA

4. Purification of DNA by agarose gel electrophoresis.

5. Genetic transformation using *Agrobacterium tumifaciens*.

6. Study of Vectors

7. Study of Plasmids

BOT: SCP 3.2 BIOENERGY AND BIOFUELS

Practical Syllabus

Based on theory syllabus

1. Assessment of rate of photosynthesis in plants

2. Estimation of chlorophyll pigments in algae

3. Identification of biomass plants

4. Extraction of oils from plant material

5. Viscosity tests on oils and fuels

6. Evaluation carbohydrates from biofuel feedstocks

7. Identification of biomass plants

8. Analysis of enzymatic breakdown of cellulosic material

9. Enzymatic hydrolysis of lignocellulosic substrates

10. Conversion of cellulosic biomass to ethanol

11. Conversion of vegetable oil to biodiesel.