Course No. H/BIOT-231 Course Title: Elementary Plant Biotechnology
Credits: (1+1) 2 Semester: III

Theory

Concepts of Plant Biotechnology: History of Plant Tissue Culture and Plant Genetic Engineering; Scope and importance in Crop Improvement: Totipotency and Morphogenesis, Nutritional requirements of in-vitro cultures; Techniques of In-vitro cultures, Micropropagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture, Factors affecting above in-vitro culture; Applications and Achievements; Somaclonal variation, Types, Reasons: Somatic embryogenesis and synthetic seed production technology; Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and cybrids, Applications in crop improvement. Genetic engineering; Restriction enzymes; Vectors for gene transfer – Gene cloning – Direct and indirect method of gene transfer – Transgenic plants and their applications. Blotting techniques – DNA finger printing – DNA based markers – RFLP, AFLP, RAPD, SSR and DNA Probes – Mapping QTL – Future prospects. MAS, and its application in crop improvement. Nanotechnology: Definition and scope, types of nano material and their synthesis, green synthesis. Tools and techniques to characterize the nano particles.Nano-biotechnological applications with examples, Nano toxicology and safety.

Practical

Requirements for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture; Media components and preparations; Sterilization techniques and Inoculation of various explants; Aseptic manipulation of various explants; Callus induction and Plant Regeneration; Micro propagation of important crops; Anther, Embryo and Endosperm culture; Hardening / Acclimatization of regenerated plants; Somatic embryogenesis and synthetic seed production; Isolation of protoplast; Demonstration of Culturing of protoplast; Demonstration of Isolation of DNA; Demonstration of Gene transfer techniques, direct methods; Demonstration of Gene transfer techniques, indirect methods; Demonstration of Confirmation of Genetic transformation; Demonstration of gel-electrophoricsis techniques. Green synthesis of nano particles and their size characterization.

Lesson plan - Theory

No.	Topic	Sub Topics	Marks
1.	History, scope and importance of Biotechnology in Crop Improvement	History of Plant Tissue Culture and Plant Genetic Engineering, scope and importance in Crop Improvement:	10
2.	Totipotency and Morphogenesis,	Definition, Importance of totipotency and morphogenesis.	8
3.	Nutritional requirements of in-vitro cultures.	General techniques of tissue and cell culture, Different composition of culture medium, components of tissue culture medium, importance of growth regulator in culture medium	8
4.	Techniques of In-vitro cultures	Types of culture, Micro-propagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture Factors affecting above in-vitro culture; Factors affecting above in-vitro culture; Applications and	7

		Achievements;	
5.	Somaclonal variation,	Introduction, causes, procedure and application in crop improvement. Manipulation and Fusion; Products of somatic hybrids and cybrids, Applications in crop improvement.	10
6.	somatic embryogenesis	Types, direct and indirect embryogenesis, factors influencing somatic embryogenesis and synthetic seed production technology	8
7.	Protoplast Culture,	Introduction, method of protoplast fusion, selection of somatic hybrids and application of somatic hybridization.	7
8.	Genetic engineering;	Concept, vector and its types Restriction enzymes, Recombinant DNA techniques – Gene cloning, Direct and indirect method of gene 6transfer – Transgenic plants and their applications.	6
9.	Blotting techniques –	Types, procedure, Application, advantages and disadvantages.	10
10.	DNA finger printing	Introduction, Methodology, DNA based markers – RFLP, AFLP, RAPD, SSR and DNA Probes –	10
11.	Mapping QTL –	Introduction, concept, types,Mapping QTL – Future prospects. MAS (Marker Assisted Selection), and its application in crop improvement.	8
12.	Nanotechnology:	Definition and scope, types of nano material and their synthesis, green synthesis. Tools and techniques to characterize the nano particles. Nano-biotechnological applications with examples, Nano toxicology and safety.	8
		Total	**100**

Lesson Plan- Practical

Ex. No.	Title
1.	General instruction and laboratory methods.
2.	Plant tissue culture laboratory organization.
3.	Plant tissue culture laboratory equipments and their uses.
4.	Dry, Heat and Wet Heat sterilization methods
5.	Chemical sterilization, Filtration and UV irradiation.
6.	Preparation of solutions
7.	Preparation of tissue culture media and their composition

8.	Establishment and maintenance of callus culture from different explants, sub culture of callus.
9.	Production of embryogenic callus
10.	Indiect organogenesis: Production of shoots and roots from callus
11.	Acclimatization and Hardening
12.	Micropropagation with shoot apex culture in different plants (Banana)
13.	Demonstration of Gene transfer techniques, direct methods and indirect methods;
14.	Demonstration of Confirmation of Genetic transformation;
15.	Demonstration of gel-electrophoresis techniques.
16.	Green synthesis of nano particles and their size characterization.

Suggested

Reading:

Reference books:

Singh, B D, 2004. *Biotechnology Expanding Horizons* 2nd Edn.Kalyani Publishers, New Delhi.

Gupta, P.K., 2015. *Elements of Biotechnology* 2nd Edn. Rastogi and Co., Meerut.

Razdan M K, 2014. *Introduction to plant Tissue Culture* 2nd Edn. Science Publishers, inc. USA.

Gautam V K, 2005. *Agricultural Biotechnology*. Sublime Publications

Thomar, R.S., Parakhia, M.V., Patel, S.V. and Golakia, B.A., 2010. *Molecular markers and Plant biotechnology*, New Publishers, New Delhi.

Purohit, S.S., 2004. *A Laboratory Manual of Plant Biotechnology* 2nd Edn. Agribios, India. Singh, B.D. 2012. *Plant biotechnology*. Kalyani publishers, Ludhiana

Bilgrami, K.S. and Pandey, A.K.1992. *Introduction to biotechnology*. CBS Pub. New Delhi Gupta, P.K. 1994. *Elements of biotechnology*. Rastogi Pub. Meerut.

Chahal, G.S. and Gosal, S.S.2003. *Principles and procedures of plant approaches breeding Biotechnological and conventional*. Narosa Publishing House, New Delhi.

e-reading: http://ecourses.iasri.res.in/

Course No: H/BOT-111 **Course Title : Introductory Crop Physiology**

Credits : 1+1=2 **Semester: I**

Theory

Introduction to plant physiology. Water Relations in Plants: Role of water in plant metabolism, diffusion and osmosis. Water potential and its components, measurement of water potential in plants. Absorption of water, mechanism of absorption and absorption of water in plant. Ascent of sap and theories of ascent of sap. Transpiration Stomata: Structure, distribution, classification, mechanism of opening and closing of stomata. Factors affecting transpiration, Osmotic pressure, guttation, stem bleeding. Drought: Different types of stresses; water, heat, cold and salinity tolerance; mechanism of tolerance. Drought: Different types of stresses; water, heat, cold and salinity tolerance; mechanism of tolerance. Plant Nutrition: criteria of essentiality, classification of mineral elemements and its role in plant metabolism and absorption of mineral elemements. Photosynthesis: definition, structure and function of chloroplast, Pigment involved in Photosynthesis, nature of light. Light reaction; photolysis, water emersion effect, cyclic and non-cyclic electron transfer.

TEACHING SCHEDULE (THEORY)

Lecture No	Topics	Weightage (%)
1	Introduction to plant physiology	5
2	Water Relations in Plants: Role of water in plant metabolism, diffusion and osmosis	5
3	Water potential and its components, measurement of water potential in plants	5
4	Absorption of water, mechanism of absorption and absorption of water in plant	5
5	Ascent of sap and theories of ascent of sap	10
6	Transpiration Stomata: Structure, distribution, classification, mechanism of opening and closing of stomata.	10
7	Factors affecting transpiration, Osmotic pressure, guttation, stem bleeding.	5

8	Drought: Different types of stresses; water, heat, cold and salinity tolerance; mechanism of tolerance.	10
9	Plant Nutrition: criteria of essentiality, classification of mineral elemements and its role in plant metabolism and absorption of mineral elemements	5
10	Photosynthesis: definition, structure and function of chloroplast,	10
	Pigment involved in Photosynthesis, nature of light.	
11	Light reaction; photolysis, water emersion effect, cyclic and non-cyclic electron transfer	5
12	Dark reactions, CO_2 fixation , C_3, C_4 and CAM cycle, advantages of C_4 pathway and factors affecting photosynthesis.	5
13	Photorespiration : mechanism and its implications	5
14	Biological nitrogen fixation- mechanism and nodulation and its importance	5
15	Secondary metabolites, types and its importance in plant defense.	5
16	Herbicide : physiology and mode of action and mechanism of herbicide resistance	5
	Total	**100**

TEACHING SCHEDULE (PRACTICAL)

Lecture No	Topics
1	Study of osmosis
2	Study of water potential by different methods-I
3	Study of water potential by different methods-II
4	Study of root pressure
5	Study of Structure of stomata
6	Study of distribution of stomata
7	Study of opening and closing of stomata
8	Measurement of rate of transpiration different methods- photometer method
9	Measurement of rate of transpiration different methods- bell jar method
10	Study of transpiration pull by Darwings photometer
11	Study of importance of light in photosynthesis.
12	Study of importance of chlorophyll in photosynthesis.
13	Separation of chloroplast- a pigment in horticultural crops by solvent extraction method.
14	Measurement of Relative water content.
15	Study of plant movements- positive tropism, negative tropism
16	Study of plant movements- photo tropism,

Test books &Reference book:

SR	Name of Book	Author	Publisher
Text books			
1.	A Text Book Plant Physiology*	Dr. V. Verma	Emkay Publisher, Delhi-110 051
2.	A Text Book Plant Physiology* 2005	c. P. Malik & A. K. Srivastava	Kalyani publisher, Ludhiyana
3.	Introductory Plant physiology* 2013	G. Roy Noggle & George friz	PHI learning pvt ltd, N. Delhi
4.	Plant Physiology*	S. N. Pandey & B. K. Sinha	Vikas Publishing House, New Delhi-110 014
5.	Experiment in Plant Physiology –A Lab. Manual * 1998	Dayanand Bajracharya	Narosa publishing house, panchshil park, N. Delhi
6.	Practical Plant Physiology*1967	Amar Singh	Kalyani Publisher, Ludhiana
7.	Plant Physiology*2005	C. P. Malik	Kalyani Publisher, Ludhiana
8.	Crop Physiology*	C. N. Chore, S. R. Ghadekar & R. K. Patil	Agromet Publisher, Nagpur- 440 010
9.	Plant physiology*2010	Taiz & Zeiger, E	Sinaur asso.Inc,USA
Reference books:			
10.	Plant Physiology@	K. N. Dhumal, T. N. More and M. R. Munnali	Nirali prakashan, Pune
11.	Plant Physiology	Robert M. Devlin & Francis H. Witham	CBS Publisher & Distributors, Delhi-110 032
12.	Plant Physiology@	H. S. Shrivastava	Rustogi Publications, Meerut-250 002
13.	Plant physiology 2005@	S. Mukharji and A. K. Ghosh	New central book agency, Kolkatta
14.	Plant Physiology@1993	S. Chandra Datta	Wiley Eastern ltd, Daryaganj, N. Delhi
15.	Plant Physiology – fundamentals & applications @2005	Arvind kumar & S. S. Purohit	Agrobios (India), Jodhpur
16.	Modern Plant physiology 2007@	R. K. Sinha	Narosa publishing house, panchshil park, N. Delhi
17.	**e-reading: http://ecourses.iasri.res.in/**		

Course No:-H/EVS-121 **Course Title:-Environmental Studies and Disaster Management**

Credit hours: (2+1) 3 **Semester:-II**

Theory

Environmental studies:- Nature, Definition, scope and importance. Natural Resources:- Renewable and non-renewable resources, Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of non-conventional energy sources. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. Ecosystems: -Concept of an ecosystem, Structure and function. Study of Producers, Consumers and Decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids. Types of Ecosystem Introduction, characteristic features, structure and function of Forest,Grassland, Desert and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) Biodiversity: -Introduction, definition, genetic, species & ecosystem diversity and bio-geographical classification of India, Value of biodiversity. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity: -habitat loss, poaching of wildlife, Endangered and endemic species of India., Conservation of biodiversity. Environmental Pollution:- Types of pollution, definition, cause, effects and control measures of Air, Water, Soil, Marine, Noise, Thermal pollutions and Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes.Role of an individual in prevention of pollution. Carbon Credit: Concept, Exchange of carbon credits. Carbon Sequestration, Importance, Meaning and ways. Environmental ethics- issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products. Environment (Protection) Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act and Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Human Population and the Environment: Population growth, variation among nations, population explosion. Environment and human health: Human Rights, Value Education. Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves. Climatic change: global warming, Sea level rise, ozone depletion. Man Made Disasters:- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management:- Concept, Effect to migrate natural disaster at national and global levels. International

strategy for disaster reduction. National disaster management framework; financial arrangements. Role of NGOs, community –based organizations and media.Central, state, district and local administration; Armed forces in disaster response; Police and other organizations

Lecture No.	Topic	Weightage (%)
1.	Environmental studies:- Nature, Definition, scope and importance	3
2	Natural Resources:-Renewable and non-renewable resources, Natural resources and associated problems.	16
3-6	a) Forest resources: Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.	

	d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of non-conventional energy sources. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.	
7	Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.	
8	Ecosystems: -Concept of an ecosystem, Structure and function.	14
9	Study of Producers, Consumers and Decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids.	
10	Types of Ecosystem Introduction, characteristic features, structure and function of Forest,Grassland, Desert and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	
11-12	Biodiversity: - Introduction, definition, genetic, species & ecosystem diversity and bio-geographical classification of India, Value of biodiversity.	
13-14	Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity: -habitat loss, poaching of wildlife, man – wildlife Endangered and endemic species of India., Conservation of biodiversity.	12
15-17	Environmental Pollution:- Types of pollution, definition, cause, effects and control measures of Air, Water, Soil, Marine, Noise, Thermal pollutions and Nuclear hazards.	14
18	Solid Waste Management: causes, effects and control measures of urban and industrial wastes.Role of an individual in prevention of pollution.	
19-20	Carbon Credit: Concept, Exchange of carbon credits. Carbon Sequestration, Importance, Meaning and ways.	08
21-22	Environmental ethics- issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products.	
23-24	Environment (Protection) Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act and Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.	08
25	Human Population and the Environment: Population growth, variation among nations, population explosion. Environment and human health: Human Rights, Value Education.	04
26-27	Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves.	10
28	Climatic change: global warming, Sea level rise, ozone depletion.	
29-30	Man Made Disasters:- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.	08

31-32	Disaster Management:-Concept, Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. National disaster management framework; financial arrangements. Role of NGOs, community –based organizations and media.Central, state, district and local administration; Armed forces in disaster response; Police and other organizations.	03
	Total Weightage (%)	100

Practical

Study of collection, processing and storage of effluent samples. To estimates solids in water samples. To measure the dissolved O_2 content in pond water by Winkler's method. Estimation of respirable and non respirable dust in the air by using portable dust sampler. Determination of sound level by using sound level meter. Study of community structure. Study of pond / River/ hill slopes ecosystem-abiotic and biotic components. Study of grass land and agro-ecosystem and measurement of their productivity. Crop adaptation to different ecosystems. A. Hydrophytes, B. Mesophytes, C. Xerophytes, D. Halophytes. Study and Visit of flora and Fauna. Visit to local polluted site - Urban / Rural/ Industrial: observations and remedial control measures. Collection, identification, herbarium, maintenance and study of plants grown in various ecosystems.

Exercise	Experiment Title
1	Study of collection, processing and storage of effluent samples.
2	To estimates solids in water samples.
3	To measure the dissolved O_2 content in pond water by Winkler's method.
4	Estimation of respirable and non respirable dust in the air by using portable dust sampler.
5	Determination of sound level by using sound level meter.
6	Study of community structure.
7	Study of pond / River/ hill slopes ecosystem-abiotic and biotic components.
8	Study of grass land and agro-ecosystem and measurement of their productivity.
9	Crop adaptation to different ecosystems. A. Hydrophytes
10	Crop adaptation to different ecosystems. B. Mesophytes
11	Crop adaptation to different ecosystems. C. Xerophytes
12	Crop adaptation to different ecosystems. D. Halophytes
13	Study and Visit of flora and Fauna.
14	Visit to local polluted site - Urban / Rural: observations and remedial control measures.

15	Visit to local polluted site - Industrial: observations and remedial control measures.
16	Collection, identification, herbarium, maintenance and study of plants grown in various ecosystems.

Text books:

1 Text book of Environmental Studies for undergraduate courses by Erach Bharucha University Grants Commission, New Delhi.

2 A text book on Ecology and Environmental Science by M.Prasanthrajan and P.P. Mahendran., Agrotch Publishing Academy, Udaipur-313002.

Reference Book:

3 Ecology and Environment by P.D. Sharma, Rastogi Publication. Meerut.

4 Environmental Sciences by S.S. Purohit, Q.J. Shammi and A.K. Agrawal, Student Edition, Jodhpur.

5 Disaster Management by Sarthak Singh. Oxford Book Company.

6 Disaster – Strengthening community Mitigation and Preparedness by Dr. B.K. Khannna and Nina Khanna. New India Publication Agency.

7 Laboratory Manual of Ecology and Environmental Studies by Amrit Kaur, Paragon International Publisher, New Delhi.

e-reading: **http://ecourses.iasri.res.in/**

Course No. H/BOT-123 **Course title- Principles of Plant Breeding**

Credits- (2+1) 3 **Semester-II**

Theroy- Plant breeding as a dynamic science, genetic basis of Plant Breeding – classical, quantitative and molecular, Plant Breeding in India–limitations, major achievements, goal setting for future.Sexual reproduction (cross and self-pollination), asexual reproduction, pollination control mechanism (incompatibility and sterility and implications of reproductive systems on population structure). Genetic components of polygenic variation and breeding strategies, selection as a basis of crop breeding and marker assisted selection Hybridization and selection – goals of hybridization, selection of plants; population developed by hybridization – simple crosses, bulk crosses and complex crosses. General and special breeding techniques. Heterosis – concepts, estimation and its genetic basis. Calculation of heterosis, heterobeltosis, GCA, SCA, inbreeding depression, heritability and genetic advance.Emasculation, pollination techniques in important horticultural crops. Breeding for resistance of biotic and abiotic stresses. Polyploidy breeding.Mutation breeding.

Practical- Breeding objectives and techniques in important horticultural crops.Floral biology – its measurement, emasculation, crossing and selfing techniques in major crops. Determination of mode of reproduction in crop plants, handling of breeding material, segregating generations (pedigree, bulk and back cross methods), Field layout, and maintenance of experimental records in self and cross pollinated crops. Demonstration of hybrid variation and production techniques.Hardy Weinberg Law and calculation, male sterility and incompatibility studies in horticultural crops calculation of inbreeding depression, heterosis, heterobeltioses, GCA, SCA, GA, heritability.

Lesson/Course plan - Theory

Lecture No.	Topic	Weightage (%)
1,2	Plant Breeding - a dynamic science	5
3,4	Genetic basis for Plant Breeding classical, quantitative and molecular.	5
5-7	Plant Breeding in India- limitations, major achievement and goal setting for future.	5
8-10	Mode of reproduction-sexual reproduction.	10
11-13	Mode of pollination- self and cross pollination.	10
14-16	Mechanism of pollination control.	10
17-19	Genetic components of polygenic variation and Breeding strategies.	10
20	Selection of basis of crop breeding	5
21-22	Hybridization and goals of hybridization	05
23	Hybridization and selection of plants	05
24	Population developed by hybridization- Simple crosses	5
25	Population developed by hybridization- Bulk crosses	5
26-27	Population developed by hybridization- Complex crosses	5
28-29	General and special Breeding techniques.	5
30-31	Heterosis- Concept and types	05
32	Heterosis- Estimation and genetic basis.	05
	Total	**100**

Practical programme

Practical No.	Title
1	Field equipments for plant breeders
2	Selfing methods
3	Floral biology and hybridization technique
4	Floral biology – its measurement, emasculation,
5	Crossing techniques in major crops.
6	Selfingtechniques in major crops.
7	Determination of mode of reproduction in crop plants, handling of breeding material, segregating generations (pedigree, bulk and back cross methods),
8	Field layout, and maintenance of experimental records in self and cross pollinated crops.
9	Demonstration of hybrid variation and production techniques.
10	Hardy Weinberg Law and calculation,
11	Male sterility studies in horticultural crops
12	Incompatibility studies in horticultural crops
13	Calculation of inbreeding depression
14	Calculation of heterosis, heterobeltioses
15	Computation of GCA, SCA,.
16	Computation of GA, heritability

Suggested Reading:

Reference books:

B D Singh. *Fundamental of Plant breeding*. Kalyani. India.

B.D. Singh. *Plant breeding : principles and methods*. Kalyani Publishers, Ludhiana.

D.S. Falconer. *Introduction to quantitative genetics*. Longman Scientific & Technical, Longman Group, UK, Ltd., England.

G K Kallo. *Breeding of vegetables*. Panima publishers, New Delhi

G. S. Chahal and S.S. Gosal. 2002. *Principles and Procedures of Plant Breeding*. Narosa Publishing House, New Delhi.

Hays and Garber. *Breeding crop plants*. Mc Graw Hill Publications, New York

J.R. Sharma. *Principles and practices of plant breeding*. Tata McGraw Publishing Company Ltd., New Delhi

K. Mather and J.L Jinks. *Introduction to Biometrical genetics*. Chapman and Hall, London Phundan Singh. *Essentials of plant breeding*. Kalyani Publishers

Poehlman, J.M. and Borthakar, D. 1995. *Breeding Asian Field Crops*. Oxford& IBH Publishing Co., New Delhi

Pundan Singh. *Essentials of plant breeding*.

Kalyani. India R.C. Chaudhary. *Plant Breeding*

R.K. Singh and B.D. Chaudhary. *Biometrical methods in quantitative genetic analysis.* Kalyani Publishers, Ludhiana.

R.W. Allard. *Principles of plant breeding*. John Wiley & Sons, New York**.**

V.L. Chopra. *Plant breeding: Theory and Practice.* Oxford & IBH Publishing CO. Pvt. Ltd., New Delhi.

W.R. Fehr. *Principles of cultivar development: theory and technique (Vol. 1).* Macmillan Publishing Company, New York.

e-reading: **http://ecourses.iasri.res.in/**

Course No. H/BOT 112 **Course title- Principles of Genetics and Cytogenetic**
Credit hours - (2+1) 3 **Semester- I**

Theroy- Historical background of genetics, theories and hypothesis.Physical basis of heredity, cell reproduction, mitosis, meiosis and its significance.Gametogenesis and syngamy in plants.Mendelian genetics–Mendel's principles of heredity, deviation from Mendelian inheritance, pleiotropy, threshold characters, co-dominance, penetrance and expressivity.Chromosome theory of inheritance, gene interaction.Modification of monohybrid and dihybrid rations. Multiple alleles, quantitative inheritance linkage and crossing over, sex linked inheritance and characters. Cytoplasmic inheritance and maternal effects.Chemical basis of heredity, structure of DNA and its replication.Evidence to prove DNA and RNA – as genetic material.Mutations and their classification.Chromosomal aberrations, changes in chromosome structure and number.

Practical- Study of fixatives and stains. Squash and smear techniques. Demonstrations of permanent slides and cell division, illustration in plant cells, pollen fertility and viability, determination of gametes, Solving problems of monohybrid, dihybrid, and test cross ratios using chi-square test, gene interactions, estimation of linkages using three point test cross from F_2 data and construction of linkage maps. Genetics variation in pea.

Lesson /Course plan - Theory

Lect. No.	Topic	Weightage (%)
1	History of Genetics, relation of Genetic with other fields of science, scope and importance	5
2	Ultra structure of cell, cell organelles and their functions.	5
3	Study of Chromosome structure, morphology, number, types, karyotypes and ideogram	5
4	Mitosis: Stages, importance/ significance	4
5	Meiosis: Stages, importance, difference between mitosis & meiosis	5
6	Mendel's contribution -Mendel's law of Segregation, monohybrid	5
7	Mendel's Laws of inheritance : Di & tri-hybrid ratio, deviation from Mendelian inheritance	5
8	Gene interactions different types with example and test cross ratio	4
9	Types of gene action, Multiple Alleles-its characteristics, pseudoalleles	4
10	Pleiotropism, penetrance- complete and incomplete, expressivity, Atavism	4

12	Quantitative and qualitative traits; difference between them	4
13	Multiple factor hypothesis with example-ear length in maize	4
14-15	Cytoplasmic inheritances-its characteristics features;	4

Practical programme

Practical No.	Title
1	Simple compound, phase contrast, fluorescent and electron microscope
2	Preparation of stains and fixatives
3	Preparation of microscopic slide of mitosis-onion root tips and identification
4	Preparation of microscopic slide of meiosis-*Tradescantia*/ Bajra. Identification of stages of meiosis.
5	Microphotography: Conventional and digital.
6	Methods of finding out the gametes and gametic recombinations.
7	Monohybrid ratio and its modifications.
8	Di-hybrid ratio and its modifications.
9	Trihybrid ratio
10	Chi-square test
11	Interaction of genes- I, Without modification of F2 ratio, Complementary
12	Gene interactions-II, Supplementary, Epistatis, & Inhibitory
13	Gene interactions-III, Additive, Duplicate and Lethal
14	Inheritance of multiple alleles
15	Study of linkage of genes
16	Induction of polyploidy using colchicines, Induction of mutation by using chemicals

Suggested Reading:

Reference books:

B.D. Singh. *Fundamental of Genetics*. Kalyani. India

Benjamin Lewin. *Genes (II edn).* John Wiley & Sons, New York.

Farook& Khan. *Genetics & Cytogenetics* (I Ed.). Premier Publishing House, Hyderabad.

Gardner E J, Simmons M J &Snustard D P. *Principles of Genetics (VIII Edn)*. John Wiley & Sons, New York.

George Acquaah. *Principles of Plant Genetics and Breeding*. Blackwell

Griffiths, Miller, Suzuki Lewontin & Gelbart. *An introduction to Genetic Analysis* (V *Ed.).* W.H.Freeman & Company, Newyork

Gupta, P.K. 1985.*Cytology, genetics and cytogenetics*. Rastogi Publication, India.

Joseph Jahier& INRA working group. *Techniques of Plant Cytogenetics* (1986). Oxford & IBH Publishing Co Pvt.Ltd., New Delhi

Khanna VK. Genetics–*Numerical Problems*. Kalyani Publishers, New Delhi.

Loewy & Siekevitz. *Cell Structure & Function* (II Ed.). Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.

Norman,V. Rothwell. *Understanding Genetics* (IV Ed.). Oxford University Press, Oxford. Phundan Singh. *Elements of Genetics*. Kalyani publishers, New Delhi.

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