SYLLABUS

GPB 510: SEED PRODUCTION AND CERTIFICATION (1+1)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*			
GPB 510	Seed Production and Certification	50	30	0	15	5	1	1	2

Legends: L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To impart knowledge on principles of seed production and certification. This will help the students to understand seed production practices and seed certification procedures in different crops.

Course Outcome

CO1: Students learn about the classes of seed, principles and procedure of seed certification for various crops.

CO2: To impart knowledge of seed production and their maintenance.

CO3: Students understand the value of the seed chain and how it helps to market new varieties commercially.

Theory

UNIT I

Unit I Importance of seed as basic input in agriculture; Seed quality concept and importance; Generation system of seed multiplication -Varietal replacement rate, Seed multiplication ratios, Seed replacement rate, Seed renewal period and seed demand and supply; Various factors influencing seed production –Physical and Genetic purity in seed production; Factors responsible for varietal and genetic deterioration.

UNIT II

Nucleus seed production and its maintenance - Maintenance of parental lines of hybrids, Production of breeder, foundation and certified seed and their quality maintenance; Principles of seed production in self- and cross-pollinated crops; Hybrid seed production - system and techniques involved in Seed village concept; Organic seed production and certification

UNIT III

Principles of seed production in field crops; Floral structure, pollination mechanism and seed production techniques in self- and cross-pollinated cereals and millets. Floral structure, pollination

mechanism and methods and techniques of seed production in major pulses and oilseed crops; Varietal and hybrid seed production techniques in Pigeon pea, Mustard, Castor and Sunflower.

UNIT IV

Floral structure, pollination mechanism and methods and techniques of seed production in major commercial fibres. Hybrid-seed production techniques in major vegetatively propagated crops.

UNIT V

Seed certification - history, concept, objectives; Central seed certification board Seed certification agency/ organization and staff requirement; Legal status - Phases of seed certification, formulation, revision and publication of seed certification standards; Minimum Seed Certification Standards (MSCS) for different crops - General and specific crop standards, Field and seed standards; Planning and management of seed certification programs; Eligibility of a variety for certification, area assessment, cropping history of the seed field.

Practical

- Planting design for variety- hybrid seed production techniques, planting ratio of male and female lines, synchronization of parental lines and methods to achieve synchrony;
- Identification of rogues and pollen shedders, supplementary pollination, detasseling, hand emasculation and pollination;
- Pollen collection and storage methods, pollen viability and stigma receptivity;
- Pre-harvest sanitation, maturity symptoms, harvesting techniques; • Visits to seed production plots - visit to seed industries;
- Planning for seed production: cost benefit ratio, seed multiplication ratio and seed replacement rate;
- General procedure of seed certification, identification of weed and other crop seeds as per specific crops, field inspection at different stages of a crop and observations recorded on contaminants and reporting of results, inspection and sampling, harvesting/ threshing, processing and after processing for seed law enforcement;
- Specifications for tags and labels to be used for certification purpose

Suggested Readings

- Agrawal PK and Dadlani M. 1987. Techniques in Seed Science and Technology, South Asian Publishers, Delhi.
- Agrawal RL. 1997. Seed Technology, Oxford & IBH Publishing.
- Anon, 1965. Field Inspection Manual and Minimum Seed Certification Standards, NSC Publication, New Delhi. Anon. 1999. Manual of Seed Certification procedures. Directorate of Seed Certification, Coimbatore, Tamil Nadu.
- Joshi AK and Singh BD. 2004. Seed Science and Technology, Kalyani Publishers, New Delhi.
- Kelly AF. 1988. Seed Production of Agricultural Crops. John Wiley, New York.
- Mc Donald MB and Copeland LO. 1997. Seed Science and Technology, Scientific Publisher, Jodhpur.

- Ramamoorthy K, Sivasubramaniam K and Kannan M. 2006. Seed Legislation in India. Agrobios (India), Jodhpur, Rajasthan.
- Singhal NC. 2003. Hybrid Seed Production in Field Crops, Kalyani Publications, New Delhi
- Tunwar NS and Singh SV. 1988. Indian Minimum Seed Certification Standards. Central Seed Certification Board, Ministry of Agriculture, New Delhi.

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GPB 512: CROP BREEDING-II (*Rabi* Crops) (2+1)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*			
GPB 512	Crop Breeding-II (*Rabi* Crops)	50	30	0	15	5	2	1	3

Legends: L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To provide insight into recent advances in improvement of Rabi cereals, legumes, oilseeds, fibre and vegetative propagated crops using conventional and modern biotechnological approaches.

Course Outcome

CO1: Students will be understanding Origin, evolution, mode of reproduction and breeding objectives of *Rabi* crops.

CO2: To impart the knowledge of conventional breeding and biotechnological approaches, Genetics-cytogenetics & genome relationship, biotic & abiotic stress resistance breeding, heterosis breeding for *Rabi* crops.

Theory

UNIT I

Wheat: Origin, evolution, mode of reproduction, chromosome number; Genetics – cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc., breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, heterosis breeding, released varieties, examples of MAS used for improvement.

Oats: Origin, evolution, mode of reproduction, chromosome number; Genetics – cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc., breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, released varieties, examples of MAS used for improvement.

Barley: Origin, evolution, center of origin, mode of reproduction, chromosome number; Genetics – cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc., breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, released varieties, examples of MAS used for improvement

UNIT II

Chickpea: Origin, evolution mode of reproduction, chromosome number; Genetics – cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress

resistance, etc., breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, released varieties, examples of MAS used for improvement.

Other pulses: Lentil, field pea, Rajma, Horse gram: Origin, evolution, mode of reproduction, chromosome number; Genetics. cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc., breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, heterosis breeding, released varieties, examples of MAS used for improvement. Interspecific crosses attempted and its implications, reasons for failure, ways of overcoming them.

UNIT III

Rapeseed and Mustard: Origin, evolution, mode of reproduction, chromosome number; Genetics – cytogenetics and genome relationship; Breeding objectives; yield, quality characters, biotic and abiotic stress resistance, etc., breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, heterosis breeding, released varieties, examples of MAS used for improvement, Oil quality, Improvement for oil quality.

Sunflower, Safflower: Origin, mode of reproduction, chromosome number; Genetics, cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc., breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, heterosis breeding, released varieties, examples of MAS used for improvement

UNIT IV

Mesta and minor fibre crops: Origin, mode of reproduction, chromosome number, Genetics– cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc., breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, released varieties, examples of MAS used for improvement.

Forage crops: Origin, evolution mode of reproduction, chromosome number; Genetics–cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc., breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance.

UNIT V

Seed spices: Origin, evolution, mode of reproduction, chromosome number; Genetics– cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance, etc., breeding approaches, introgression of alien gene(s) (if required), biotic and abiotic stress resistance, scope of heterosis breeding, released varieties, examples of MAS used for crop improvement.

Practical

- Floral biology, emasculation and pollination techniques in wheat, oats, barley, chickpea, rajma, rapeseed mustard, sunflower;
- Study of range of variation for yield and yield components;
- Study of segregating populations in cereal, pulses and oilseed crops;

- Use of descriptors for cataloguing; Learning on the crosses between different species;
- Trait based screening for stress resistance;
- Learning on the Standard Evaluation System (SES) and descriptors;
- Use of software for database management and retrieval

Suggested Readings

- Agarwal RL. 1996. Identifying Characteristics of Crop Varieties. Oxford & IBH.
- Bahl PN and Salimath PM. 1996. Genetics, Cytogenetics and Breeding of Crop Plants. Vol. I. Pulses and Oilseeds. Oxford & IBH.
- Gupta SK. 2012. Technological Innovations in Major World Oil crops. Vol. I. Springer, USA.
- Gupta SK. 2012. Technological Innovations in Major World Oil crops. Vol. II. Springer, USA.
- Gupta SK. 2016. Breeding of Oilseed Crops for Sustainable Production. Academic Press, USA.
- Kannaiyan S, Uthamasamy S, Theodore RK and Palaniswamy S. 2002. New Dimensions and Approaches for Sustainable Agriculture. Directorate of Extension Education, TNAU, Coimbatore.
- Parthasarathy VA. 2017. Spices and Plantation Crops Vol.1 (Part A) Breeding of Breeding and Genetics. John Wiley & Sons.

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MBB 509: PLANT TISSUE CULTURE (2+1)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*			
MBB 509	Plant Tissue Culture	50	30	0	15	5	2	1	3

Legends: L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

• To provide insight into principles of plant cell culture and genetic transformation.

• To get a hands-on training in basic plant tissue culture techniques, callusing, micropropagation and analysis.

Course Outcome

CO1: Students will get familiar with the concept of Totipotency, Plant hormones and Morphogenesis, Micropropagation, Somatic hybridization, Artificial seeds, Somaclonal variation etc.

CO2: To learn protocol of media preparation, techniques of micropropagation, Protoplast culture and Genetic Fidelity testing and Virus indexing methods – PCR, ELISA.

Theory

UNIT I

History of plant tissue culture, the principle of Totipotency; Tissue culture media; Plant hormones and morphogenesis; Direct and indirect organogenesis; Direct and indirect somatic embryogenesis; Applications of plant tissue culture; National certification and Quality management of TC plants; Genetic Fidelity testing and Virus indexing methods – PCR, ELISA

UNIT II

Micropropagation of field and ornamental crops; Virus elimination by meristem culture, meristem tip culture and micrografting; Androgenesis and gynogenesis - production of androgenic and gynogenic haploids - diploidization.

UNIT III

Protoplast culture - isolation and purification; Protoplast culture; Protoplast fusion; Somatic hybridization - Production of Somatic hybrids and Cybrids;, Wide hybridization - embryo culture and embryo rescue techniques; Ovule, ovary culture and endosperm culture.

UNIT IV

Large-scale cell suspension culture - Production of alkaloids and other secondary metabolites-techniques to enhance secondary metabolite production, Somaclonal and gametoclonal variations – causes and applications;

UNIT V

Callus culture and in vitro screening for stress tolerance; Artificial seeds, In vitro germplasm storage and cryo-preservation. Commercial Tissue Culture: Case studies and success stories, Market assessment; project planning and preparation, economics, government policies

Practical

- •Preparation of stocks - macronutrients, micronutrients, vitamins and hormones, filter sterilization of hormones and antibiotics. Preparation of Murashige and Skoog medium.
- •Micro-propagation of plants by nodal and shoot tip culture.
- • Embryo culture to overcome incompatibility, Anther culture for haploid production.
- • Callus induction in tobacco leaf discs, regeneration of shoots, root induction, role of hormones in morphogenesis.
- • Acclimatization of tissue culture plants and establishment in greenhouse.
- • Virus indexing in tissue culture plants. (Using PCR and ELISA).
- • Plan of a commercial tissue culture unit.

Suggested Readings

- Razdan, M.K. 2003. Introduction to plant tissue culture, 2nd edition, Oxford publications Group
- Butenko, R.G. 2000. Plant Cell Culture University Press of Pacific
- Herman, E.B. 2008. Media and Techniques for Growth, Regeneration and Storage, Agritech Publications, New York, USA.
- Bhojwani, S.S and Dantu P. 2013. Plant Tissue Culture – An Introductory Text. Springer Publications.
- Gamborg, O.L and G.C. Philips (eds.). 2013. Plant Cell, Tissue and Organ culture-Lab Manual. Springer Science & Business media.

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MBB 512: IPR, BIO-SAFETY & BIOETHICS (2+0)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*			
MBB 512	IPR, Bio-Safety & Bioethics	50	40	10	00	00	2	0	2

Legends: L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

• To familiarize the students about ethical and biosafety issues in plant biotechnology.

• To gain knowledge about Intellectual Property Rights and International Agreements and Regulations with respect to Biosafety.

Course Outcomes

CO1: To gain knowledge about Intellectual Property Rights

CO2: Students will understand the International Agreements and Regulations with respect to Biosafety.

CO3: Students will get familiarized with ethical and biosafety issues in plant biotechnology.

Theory

UNIT I

IPR: historical background in India; trade secret; patent, trademark, design& licensing; procedure for patent application in India; Patent Cooperation Treaty (PCT); Examples of patents in biotechnology-Case studies in India and abroad; copyright and PVP; Implications of IPR on the commercialization of biotechnology products, ecological implications; Trade agreements- The WTO and other international agreements, and Cross border movement of germplasms

UNIT II

Biosafety and bio-hazards; General principles for the laboratory and environmental bio-safety; Biosafety and risk assessment issues; handling and disposal of bio-hazards; Approved regulatory laboratory practice and principles, The Carta Protocol on biosafety; Biosafety regulations in India; national Biosafety Policy and Law; Regulations and Guidelines related to Biosafety in other countries

UNIT III

Potential concerns of transgenic plants – Environmental safety and food and feed safety. Principles of safety assessment of Transgenic plants – sequential steps in risk assessment. Concepts of familiarity and substantial equivalence**.**

UNIT IV

Risk - Environmental risk assessment – invasiveness, weediness, gene flow, horizontal gene transfer, impact on non-target organisms; food and feed safety assessment – toxicity and allergenicity. Monitoring strategies and methods for detecting transgenics.

UNIT V

Field trails – Biosafety research trials – standard operating procedures, labeling of GM food and crop, Bio-ethics- Mankind and religion, social, spiritual & environmental ethics; Ethics in Biotechnology, labeling of GM food and crop; Biopiracy

Suggested Readings

- Goel, D. and Parashar, S. 2013. IPR, biosafety, and bioethics.
- Joshi, R. 2006. Biosafety and Bioethics.
- Nambisan, P. 2017. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology.

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PGS 504: BASIC CONCEPTS IN LABORATORY TECHNIQUES (0+1)

Course code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teacher's Assessment*			
PGS 504	Basic Concepts in Laboratory Techniques	00	00	00	60	40	0	1	1

Legends: L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

- Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
- Gabb MH & Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

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PGS 505: AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES (1+0)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*			
PGS 505	Agricultural Research, Research Ethics and Rural Development Programmes	50	40	10	0	0	1	0	1

Legends: L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions.

UNIT II

Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT III

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT IV

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme.

UNIT V

Integrated Rural Development Programme (IRDP), Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

- Bhalla G S & Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
- Punia M S. *Manual on International Research and Research Ethics*. CCS, Haryana Agricultural University, Hisar.
- Rao B S V. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives*. Mittal Publ.
- Singh K. 1998. *Rural Development - Principles, Policies and Management*. Sage Publ.

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