PRAVARA INSTITUTE OF MEDICAL SCIENCES
(DEEMED TO BE UNIVERSITY)
Loni, Tal. Rahata, Dist. Ahmednagar 413736
NAAC Re-accrediated with 'A' Grade

SYLLABUS
Post Graduate Diploma in Plant Tissue Culture
(Centre for Biotechnology)
(Academic Council Meeting Dated 25th August, 2022)

Title : Post Graduate Diploma in Plant Tissue Culture (PGD-PTC)

CONTENT

PREAMBLE

Tissue culture is the *in vitro* aseptic culture of cells, tissues, organs, or the whole plant under controlled nutritional and environmental conditions often to produce clones of plants. The resultant clones are true-to-type of the selected genotype. The controlled conditions provide the culture with an environment conducive to their growth and multiplication. These conditions include the proper supply of nutrients, pH medium, adequate temperature and proper gaseous and liquid environment.

Plant tissue culture (PTC) technology is being widely used for large-scale plant multiplication. Apart from their use as a tool of research, PTC techniques have in recent years, become of major industrial importance in the area of plant propagation, disease elimination, plant improvement and production of secondary metabolites. Small pieces of tissue (named explants) can be used to produce hundreds and thousands of plants in a continuous process. A single explant can be multiplied into several thousand plants in a relatively short time and space under controlled conditions, irrespective of the season and weather on a year-round basis. Endangered, threatened and rare species have successfully been grown and conserved by micropropagation because of the high coefficient of multiplication and small demands on the number of initial plants and space. The micropropagation technology has a vast potential to produce plants of superior quality, isolation of useful variants in well-adapted high yielding genotypes with better disease resistance and stress tolerance capacities.

PTC is considered to be the most efficient technology for crop improvement by the production of Somaclonal and Gametoclonal variants. Certain types of callus cultures give rise to clones that have inheritable characteristics different from those of parent plants due to the possibility of occurrence of somaclonal variability, which leads to the development of commercially important improved varieties. Commercial production of plants through micropropagation techniques has several advantages over the traditional methods of propagation through seed, cutting, grafting and air-layering, etc. It is rapid propagation processes that can lead to the production of plants virus free. *Coryodalis yanhusuo*, an important medicinal plant was propagated by somatic embryogenesis from tuber-derived callus to produce disease-free tubers. Meristem tip culture of banana plants devoid of the banana bunchy top virus (BBTV) and brome mosaic virus (BMV) were produced. Higher yields have been obtained by culturing pathogen-free germplasm *in vitro*. An increase in yield of up to 150% of virus-free potatoes was obtained in controlled conditions.

1. INTRODUCTION OF THE PROGRAMME:

Plant tissue culture (PTC) is fundamental to most aspects of plant biotechnology. PTC has a great opportunity for the production of quality planting material that is virus free and true to type/ genetically uniform (compare to their stock source) produced through micropropagation techniques. The products of PTC are being transferred rapidly from laboratories to the fields. Propagates derived from PTC exhibit several applications in horticulture, crops, and forestry.

The main purpose of the course is to generate a human resource of specialized skilled manpower for the PTC industry. Such a diploma course program will provide to young people for high-quality hands-on training by proper handling of different modern relevant instruments and specialized techniques for PTC in the area of agriculture biotechnology.

It is fact in the present Indian scenario, there are around 200 commercial tissue culture companies in India with a gross installed production capacity of about 500 million platelets per annum (Source: DBT Report). A large number of properly trained, skilled manpower is essential for this industry as well as technical manpower for PTC research lab. Excellent prospects for self-employment as well. This course will develop skilled manpower in the modern PTC industry.

2. SCOPE AND HIGHLIGHTS

The past decades of plant cell biotechnology have evolved as a new era in the field of biotechnology, focusing on the production of a large number of secondary plant products. During the second half of the last century, the development of genetic engineering and molecular biology techniques allowed the appearance of improved and new agricultural products which have occupied an increasing demand in the productive systems of several countries worldwide. Nevertheless, these would have been impossible without the development of tissue culture techniques, which provided the tools for the introduction of genetic information into plant cells. Nowadays, one of the most promising methods of producing proteins and other medicinal substances, such as antibodies and vaccines, is the use of transgenic plants. Transgenic plants represent an economical alternative to fermentation-based production systems. Plant-made vaccines or antibodies (plantibodies) are especially striking, as plants are free of human diseases, thus reducing screening costs for viruses and bacterial toxins. The number of farmers who incorporated transgenic plants into their production systems in 2008 was 13.3 million, in comparison to 11 million in 2007.

Mass propagation of true-to-type and disease-free, quality ornamental plants, fruit and forest trees through tissue culture throughout the year has already been highly commercialized into a multi-million dollar industry in India and abroad. Various techniques of plant tissue and cell cultures *viz.*, wide hybridization through embryo rescue, somatic hybridization, callus cultures from another culture, genetic engineering and genetic transformation are being extensively used for plant improvement. Synthetic/artificial seeds are being developed through the encapsulation of somatic embryos in sodium alginate beads. The plant cells are grown in bioreactors for the enhanced production of secondary metabolites and bioprocessing. The plants multiplied or regenerated through tissue cultures have to be suitably acclimatized and hardened for long-distance transportation and field plantation, in greenhouses with controlled temperature, humidity and light regimes. Both imported and indigenously developed greenhouse technology is in great demand for the production of high-valued ornamentals and off-season vegetables for local markets and export. Bioreactors and fermenters are being used for bulk production of biopesticides, biofertilizers, antibiotics, vitamins, amino acids, enzymes and food processing using various micro-organisms.

Keeping in view the applications of PTC in various biotechnological approaches for plant, animal and microbial improvement, production and utilization, a considerable number of trained technicians are required to meet the demand for human resources in different sectors of research and development. It is anticipated that the technicians trained under this programme will find job opportunities and also self-employment prospects in the following areas:

1. Plant propagation and improvement.
2. Greenhouse fabrication installations, operation and maintenance.
3. Research and Development sector in:
    I. Universities and Institutions
    II. Health care and pharmaceutical industries
    III. Biopesticides and biofertilizer industries
    IV. Food industry

3. OBJECTIVES:

- To provide knowledge of both basic and applied aspects of Plant Tissue Culture (PTC) as well as its commercial applications.
- To offer comprehensive hands-on training for learning the basics with an insight to the laboratory.
- To provide hands-on training in PTC to propagate plants under sterile conditions for crop improvements, conserve endangered, threatened, and rare species.
- To provide knowledge & training on increasing plant's production of secondary metabolites (phytochemicals) with therapeutic values using PTC.

4. LEARNING OUTCOMES OF P.G. DIPLOMA PROGRAMME IN PLANT TISSUE CULTURE:

S. No.	Learning Outcomes
After undergoing this programme, students will be able to:	
1.	Initiate tissue culture and establish their lab.
2.	Execute/ accomplish micropropagation through bud culture, organogenesis and somatic embryogenesis.
3.	Develop/produce artificial seeds.
4.	Enhance secondary metabolite content in different medicinal plants through *in vitro* culture techniques
5.	Able to define Pharmacognosy; traditional systems of therapy; classification methods of crude drugs, preparation of herbal formulations, the study of medicinally important plant parts, analytical pharmacognosy, etc.
6.	Able to get adequate knowledge on patent and copyright for their innovative research works
7.	Able to get information in patent documents to provide useful insight on the novelty of their idea from state-of-the-art search. This provides a further way for developing their idea or innovations

5. ELIGIBILITY

A candidate for being eligible for admission to the Post Graduate Diploma in Plant Tissue Culture must have taken either:

- Bachelor of Science in Basic and Applied Sciences/Agricultural Sciences/Ayurveda

6. FEE STRUCTURE: As per the PIMS-DU rules

Fee Structure for PG Diploma Programmes at Centre for Biotechnology

No	PG Diploma Programme	Intake	Tuition Fee	Eligibility & Registration Fee	Other Fee	Security Deposit	Total Fee
1	PG Diploma in Plant Tissue Culture	5	**20,000**	2000	6,500	5,000	**33,500**

7. DURATION OF THE COURSE AND COURSE COMPLETION

The duration of the Diploma Course shall be one year and there shall be a University Examination at the end of the course. The Diploma in Plant Tissue Culture shall not be conferred upon a candidate unless he/she has passed in all subjects, practicals and successful completion of the project.

8. EXAMINATION FOR COURSE.

The performance of the student for a semester for each course shall be evaluated as under.

a. For the theory & practical courses, there shall be two components of the examination.
   1. Continuous Internal Assessment (CIA) for a maximum of 30 % of total marks of a course comprising of two tests (written test/home assignments/ seminars etc.)
   2. Semester-end examinations (SEE) for each course for a maximum of 70% of total marks. The duration of the theory examination shall be 3 hours.

b. For the practical courses, there shall be semester-end examinations for the entire 70% marks allotted to the course as per course structure and matrix. The duration of the practical examinations shall be for 6 hours.

c. The marks sheet/list for internal assessment shall be submitted to the office of the Controller of Examination at least one week before the commencement of SEE.

9. CONDUCTION OF EXAMINATION AND EVALUATION.

a. The Office of the Controller of Examination (CoE) shall arrange to conduct the semester-end examination for subjects.

b. The Controller of Examination shall announce the calendar of examination specifying the aspects regarding the registration of candidates, eligibility certification for the list of candidates, payment of fees prescribed and tentative schedule of examination.

c. The Controller of Examination shall arrange to assign the registration numbers and issue 'Hall Tickets' through the centre/college to the certified eligible students.

d. The Controller of Examination shall announce the detailed 'Time-Table' and arrange to conduct the examination as per the prescribed rules and procedures specified in Examination Manual.

e. The University Board of Appointment of Examiners (BoAE), would constitute the Board of Examiners (BoE) for each subject.

f. The Board of Studies of each subject shall submit the approved list of examiners to the office well in time based on seniority, specialization, and other details.

g. The Board of Examiners shall arrange to set 3 sets of question papers for each of the assigned courses based on the syllabi. It shall set separate sets of question papers for repeaters/improvement candidates, in case of change in the syllabi. It shall follow the model question paper approved by the Board of Studies.

h. There shall be a Central Evaluation of the theory answer scripts for subjects. The Semester End Practical or Field Work Examination for each course shall be conducted by two examiners: preferably one internal and one external examiner.

i. The Office of the Registrar (Evaluation) shall arrange for the tabulation of marks awarded and determine the results.

10. STANDARD OF PASSING

a. A candidate securing minimum marks of 50% and above in aggregate of Internal Assessment Marks and of Semester End Examination for each of the courses in a semester shall be declared to have passed in the said course.
b. There will be 50% marks for passing in continuous internal assessment.
c. The minimum for passing in the semester-end examination of any course is 50% of the maximum marks, wherever there is an internal assessment component.
d. Candidates failing in any of the courses of a semester are eligible to reappear for the supplementary exanimation of said courses of the semester within 6 months.

11. DECLARATION OF RESULTS AND AWARD OF CLASS AND RANKS

a) The degree shall be awarded to the candidates who have passed all the courses of the programme for the two semesters.
b) After the completion of tabulation of marks for each course, grade points, and credit points for each course is calculated, only in the case of successful candidates.
c) Then the SGPA of the semester and CGPA of the semesters are calculated. The specimen of the marks card is given in **Annexures 1-2.**
d) The class will be awarded to the successful candidates considering the total marks secured in the courses during the I to VI semesters.
e) The classification of successful candidates for the award of classes and CGPA, letter grade for the Programme is as follows:

Cumulative Grade Point Average (CGPA)	Total Percentage of Marks	Class to be Awarded	Letter Grade
7.5 to 10.0	> 75%	First class with Distinction	A +
6.0 and above but below 7.5	60 – 74.9%	First Class	A
5.5 and above but below 6.0	55 – 59.9 %	High Second Class	B +
5.0 and above but below 5.5	50 – 54.9 %	Second Class	B
Below 5.0	-	Fail	F

The CoE / Registrar Evaluation shall arrange to issue the marks cards for all the semesters and overall passes of all semesters indicating both marks system with the class system as well CGPA with a letter grade. Only the grades and class shall be used for only the declaration of final /overall results. On other semester examinations, it is pass or fails remarks.

12. COURSE STRUCTURE

S. N.	Course Code	Course Name	No. of Hours per Week			Credit	Distribution of Marks		
			Lecture/ Tutorials	Practical	Total		Int. Exam	Univ. Exam	Total
FIRST SEMESTER									
1.	**PGD-PTC 101**	Plant Tissue Culture, methods and applications	4	-	4	4	30	70	100
2.	**PGD-PTC 102**	Plant Improvement and complementary techniques	4	-	4	4	30	70	100
3.	**PGD-PTC 103**	Bioprospecting & Pharmacognosy	4	-	4	4	30	70	100
4.	**PGD-PTC 104**	Nursery Techniques & Vegetative Propagation	4		4	4	30	70	100
5.	**PGD-PTC 105**	Practical – 1 based on Paper PGD-PTC 101	-	4	4	2	30	70	100
6.	**PGD-PTC 106**	Practical – 2 based on Paper PGD-PTC 102	-	4	4	2	30	70	100
7.	**PGD-PTC 107**	Practical – 3 based on Paper PGD-PTC 103		4	4	2	30	70	100
		Total	**16**	**12**	**-**	**22**	**-**	**-**	**700**
SECOND SEMESTER									
1.	**PGD-PTC 201 - ELE**	Research Methodology / IPR & Laboratory Practices **(Choose any one)**	4	-	4	4	30	70	100
2.	**PGD-PTC 202**	Green House Technology	4	-	4	4	30	70	100
3.	**PGD-PTC 203**	Project Dissertation & Viva Voce	-	-		16	-	-	250
4.	**PGD-PTC 204**	Seminar, Presentation/ Group Discussion	2	-		2	-	-	50
		Total	**10**	**-**	**08**	**26**	**-**	**-**	**500**

FIRST SEMESTER

Plant Tissue Culture, Method and Applications (PGD-PTC 101)

Course Code	Category	Course Name	L/T	P	Total Hours	Credits (T+P)
PGD-PTC101	Core	Plant Tissue Culture, Method and Applications	4	2	120	6

Sr. No.	Topic	Details of Syllabus	Hrs.
Unit I	Introduction	• Introduction to plant cell structure, tissues & organs and their function • Introduction to Plant Tissue culture, Terms and definitions • Historical background • Laboratory organization • Tools and techniques • Methods of sterilization • Laboratory contaminants- it's control and measures	10
Unit II	Media and Culture Preparation	• Role of Micro and macronutrients • Vitamins and carbon sources in tissue culture • Role of PGRs • Media preparation- pH, Temperature, Solidifying agents, Slant Preparations etc. • Maintenance of cultures • Environmental Conditions	15
Unit III	Culture techniques	• Explants selection • sterilization and inoculation • Various media preparations; MS, B5, White's etc. • Callus and cell suspension culture	10
Unit IV	Initiation of Cultures	• Callus – initiation and culture • Micropropagation – stages, through various explants (Leaf, Stem, Axillary bud, Tuber, Corms and Bulbills). • Somatic embryogenesis-induction, factors, comparison with zygotic embryogenesis • Synthetic seed- technique, advantages.	15
Unit V	*In-vitro*	• Role of Ovary and ovule in *in-vitro*	10

Sr. No.	Topic	Details of Syllabus	Hrs.
	Fertilization	fertilization in production of agricultural and horticultural crops. • Techniques and significance of Androgenesis and Gynogenesis (ovary, ovule, egg, synergids culture).	

Recommended Books/ References

1. Bhojwani, S.S. 1990. Plant Tissue Culture: Theory and Practical (a revised edition). Elsevier Science Publishers, New York, USA.
2. Bhojwani, S.S. 1996. Plant Tissue Culture: Application and Limitations. Elsevier Science Publishers, New York, USA.
3. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, the Netherlands.
4. Shantharam, S. and Montgomery, J.F. 1999. Biotechnology, Biosafety and Biodiversity. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5. Glick, B.R. and Thomson, J. E. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
6. A Text Book of Biotechnology, R. C. Dubey, S. Chand Publication

Plant Improvement and Complementary Techniques (PGD-PTC 102)

Course Code	Category	Course Name	L	P	Total Hours	Credits (T+P)
PGD-PTC102	Core	Plant Improvement and Complementary Techniques	4	2	120	6

Sr. No.	Topic	Details of Syllabus	Hrs.
Unit I	Plant Improvement	• Meristem culture – methods, advantages, applications • Haploid production • Somaclonal variations – causes, advantages and applications. • Protoplast-Isolation regeneration and Viability test, Somatic hybridization and methods of protoplast fusion- chemical, Viral, electrofusion. Practical applications of somatic hybridization and cybridization • Role of tissue culture in rapid clonal propagation, production of pathogen-free plants and "synthetic seeds	15
Unit II	Transgenic	• Methods of gene transfer in plants-*Agrobacterium* and CaMV mediated gene transfer; direct gene transfer using PEG, microinjection, electroporation, microprojectile (biolistics) method, liposome-mediated DNA delivery; Transposons as vectors. • Molecular markers (RFLP, RAPD and DNA fingerprinting) in the crop improvement program • Transgenic plants for crop improvement (Dicot and Monocot including Maize, Rice, Wheat, Cotton, Brinjal etc. • Resistance to herbicide, insecticide, virus and other diseases, Flaour save tomato, etc. barnase and barstar). • Transgenic plants for molecular farming.	20
Unit III	Preservation & Conservation	• Germplasm preservation- Definition, Importance and Methods, In-situ and Ex-situ conservation, Centers of germplasm preservation in India. • Challenges and limitations of germplasm conservation • Cryopreservation- methods, cryoprotectants	10

Sr. No.	Topic	Details of Syllabus	Hrs.
Unit IV	Secondary Metabolites	• Outlines of plant secondary metabolites through heterogeneous gene expression in lower organisms. • Primary versus Secondary metabolites, Production of Secondary Metabolites and other compounds • Phytochemistry- primary and secondary metabolites • Biotransformation and bioreactors • Hairy root cultures - methods, applications • Immobilized cell system	15

Recommended Books/References

1. S.S. Bhojwani and M.K. Razdan: Plant Tissue Culture - Theory & Practice, Elsevier, London, 1983.
2. J. Reinert and Y.P.S. Bajaj: Plant Cell, tissue and Organ Culture, Narosa Publishing House, New Delhi, 1989.
3. H.S. Chawla: Introduction to Plant Biotechnology. CRC Press, New Delhi, 2007.
4. W.B. Jakoby and F.H. Pastan: Cell Culture - Methods in Enzymology, Academic Press, London, 1979.
5. K. Vasil and I. Vasil: Cell Culture and Somatic Cell Genetics, Academic Press, London, 1985.
6. J. Reinart and Y.P.S. Bajaj: Plant Tissue Culture Methods - Applications in Agriculture, Springer - Verlag, Berin, 1989.
7. A. Stafford and G. Warren: Plant Cell Culture. Open University Press, Buchingham,1990.
8. H. Maitell, J. Mathew and R.A. Mackee: Principles of Plant Biotechnology, BlackwellScientific Publishers, Oxford, 1985.
9. M.M. Yeoman: Plant Cell Culture Technology, Blackwell Scientific Publication, Oxford, 1986.
10. J. Reinert and M.M. Yeoman : Plant Cell & Tissue Culture - a laboratory manual, NarosaPublishing House, New Delhi, 1982.
11. Introduction to Plant Tissue Culture, Razdan, Oxford and BH, Delhi.
12. Plant from Test tubes; Kyte and Kleyn, Timer Press,Portland

Bioprospecting & Pharmacognosy (PGD-PTC 103)

Course Code	Category	Course Name	L	P	Total Hours	Credits (T+P)
PGD-PTC103	Core	Bioprospecting & Pharmacognosy	4	4	8	6

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction to Bioprospecting	• Bioprospecting: Definition, Introduction, Current practices in Bioprospecting for Conservation of Biodiversity and Genetic resources. • Bioprospecting Act: Introduction, Phases of Bioprospecting, Exemption to Act. Fields of Bioprospecting.	15
Unit II	Medicinal Plants Bioprospecting/ Pharmaceutical Bioprospecting	• Prospecting for new drugs, assays in Bioprospecting. Antioxidant assay – NO free radical scavenging assay, Antigenotoxicity assay – MTT assay, Antiviral activities of plants – SRB assay.	10
Unit III	Medicinal and Aromatic plants	• Botany, Chemistry, Properties and uses of Medicinal and Aromatic plants.	5
Unit IV	Introduction to Pharmacognosy	• History & Definition and scope of pharmacognosy; • Systems of Indian Medicines – Siddha, Unani, Ayurveda, Homeopathy; Terminologies.	5
Unit V	Preparation of Drug	• Classification of the crude drug. • Preparation of crude and commercial drugs. • Preparation of herbal infusions, decoctions, lotions, insect repellents, suppositories, tinctures, syrups, poultices, plasters, ointments, oils and salves.	10
Unit VI	Analytical Pharmacognosy	• Drug adulteration and its detection. • Introduction to phytochemical screening (alkaloids, polyphenolic compounds and glycosides). Introduction to biological testing of herbal drugs (analgesics, anti-inflammatory and antianxiety agents)	15

Recommended Books/References

1. Arora, R.K. and Nayar, E.R. (1984), Wild relatives of crop plants in India, NBPGR Science MonographNo.7.
2. Baker, H.G. (1978), Plants and civilization. Ill Ed. (A. Wadsworth, Belmount).
3. Bole, P.V. and Vaghani, Y. (T986). Field guide to common Indian trees, Oxford University Press, Mumbai.
4. Thakur, R.S., Puri, H.S. and Husain, A. (1969). Major medicinal plants of India, Central Institute of medicinal and aromatic plants, Lucknow.
5. Swaminathan, M.S. and Kocchar, S.L. (Es.) (1989). Plants and Society, MacMillan Publication Ltd.,
6. Sharma, O.P. (1996). Hills Economic Botany, Tata McGraw Hill co., Ltd., New Delhi,
7. Kocchar, S.L. (1998). Economic Botany of the tropics, II Edn. MacMillan India Ltd.,
8. Pharmacognosy - G. E. Trease and W.C. Evans. Saunders Edinburgh, New York.
9. Pharmacognosy-Tyler, Brady, Robbers.
10. Modern Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I&II.
11. Textbook of Pharmacognosy by T.E. Wallis.
12. Textbook of Pharmacognosy, C. K. Kokate, Purohit, Ghokhale, Nirali Prakasshan.

Nursery Techniques & Vegetative Propagation (PGD-PTC 104)

Course Code	Category	Course Name	L	P	Total Hours	Credits (T+P)
PGD-PTC104	Core	Nursery techniques & Vegetative Propagation	4	-	4	4

Sr. No.	Topic	Details of Syllabus	Hrs.
Unit I	General Nursery	• Introduction to nursery, types, needs and importance • Establishment of nursery • Nursery site selection, layout • Nursery management, problems and its control. • Nursery accreditation and certification	15
Unit II	Nursery Management	• Different types of nursery beds-flat beds, raised buds and sunken beds, their merits & demerits • Different types of media, tools and equipment, fertilizer and pesticides • Nursery structures- potting and repotting	08
Unit III	Seed Propagation	• Seed as a propagule • Germination of seeds • Seed dormancy and viability • Seed production - method of collection and processing • Seed treatment • Classes of seed • Seed testing • Commercial vegetable seedling production	15
Unit IV	Vegetative Propagation	• Asexual reproduction- importance, advantages and disadvantages • Propagation through stolons, runners, offsets, bulbs, corms, rooted crowns, division, cuttings, layering, Grafting and budding • Special practices in nursery management	10
Unit V	Commercial Nursery Management	• Nursery- site selection, lay out, records • Nursery structures; Potting, de-potting and repotting • Nursery management of major crops • Mother plant orchard • Problems in nursery management and their control • Nursery registration	12

Recommended Books/References:

1. Alan Toogood, "American Horticultural Society Plant Propagation: The Fully Illustrated Plant-by-Plant Manual of Practical Techniques", 1999.
2. Graham Clarke & Alan Toogood, "The Complete Book of Plant Propagation" 1992
3. Vegetative Propagation Techniques Perrenial Crop Support Series. Jalalabad, Afghanistan Publication No. 2007-003-AFG November 18, 2007.
4. DueepJyot Singh, John Davidson & Mendon Cottage Books, "Gardening series Introduction to Plant Propagation: The Essential Guide to Plant Propagation Methods and Techniques" 8 Mar 2015.

Practicals

Paper – PGD-PTC 105: Practical 1 Based on paper PGD- PTC 101

1. Handling and Instrumentation of Plant Tissue Culture.
2. Glassware Washing & Sterilization Techniques.
3. Preparation of stock solutions and nutrient media.
4. Surface sterilization of Explants.
5. Monocot and Dicot Seed cultures for the establishment of organ cultures.
6. Establishment of organ cultures for the induction of callus
7. Establishment of organ cultures for the induction of multiple shoots
8. Primary hardening of tissue culture plants for their acclimatization
9. Cytological study of calli cells and their subculturing

Paper – PGD-PTC 106 Practical 2 Based on paper PGD- PTC 102

1. Meristem Culture.
2. Haploid production through another culture
3. Somatic Hybridization
4. Primary hardening of tissue culture plants for their acclimatization
5. Production of Secondary Metabolites
6. Protoplast Isolation and culture (demonstration).
7. Induction of embryogenic callus and encapsulation of artificial seeds.

Paper – PGD-PTC 107: Practical 3 Based on paper PGD- PTC 103

1. Study of Medicinal and aromatic plants: At least 5 medicinal and 5 aromatic plants and their morphology, and anatomy.
2. Study of Oil yielding crops: Mustard, groundnut, soybean, coconut, sunflower, castor: Morphology, microscopy of oil yielding tissue, test for oil, acid, Iodine numbers.
3. Phytochemical screening of medicinal plants (alkaloids, polyphenolic compounds and glycosides).
4. Antioxidant assay – NO free radical scavenging assay.
5. Antigenotoxicity assay – MTT assay.
6. Antiviral activities of plants – SRB assay.
7. Biological testing of herbal drugs (anti-inflammatory, anti-arthritic, anti-urolithic, etc).
8. Scientific visits to laboratories / Industries / Research Institutes and field and submission of the report.

SECOND SEMESTER

Research Methodology (PGD-PTC 201 ELV)

Course Code	Category	Course Name	L	P	Total Hours	Credits (T+P)
PGD-PTC 201 ELV	Elective	Research Methodology	4	-	60	4

Sr. No.	Topic	Details of Syllabus	Hrs.
Unit I	Introduction of Research	• Characteristics of Research • Steps involved in Research • Research in Pure and Applied Sciences - Inter-Disciplinary Research. • Factors that hinder Research • Significance of Research • Research and scientific methods • Research Process– Criteria of Good Research • Problems encountered by Researchers • Literature review.	12
Unit II	Identification of Research Problem	• Selecting the Research problem • The necessity of defining the problem • Goals and Criteria for identifying problems for research.	08
Unit III	Research Design	• Need for Research design • Formulation of Research design • Features of a research design • Important concepts related to Research design. • Different research designs • Computer and internet in research designs.	10
Unit IV	Interpretation and Report Writing	• Meaning and Technique of Interpretation • Precautions in interpretation • Significance of report writing • Different steps in writing a report • The layout of a Research report. • Types of reports • Mechanics of writing a research report • Precautions for writing a research report	10
Unit V	Statistical Techniques and Tools	• Introduction to statistics, Functions & Limitations • Sample size estimation • Measures of central tendency • Calculation of percentage and frequency • Arithmetic mean – Median – Mode • Standard deviation & Standard Error • Co-efficient of variation (Discrete serious and continuous serious) • Correlation & Regression	20

Sr. No.	Topic	Details of Syllabus	Hrs.
		• Sampling distribution • Concept of point and interval estimation • Level of significance • Degree of freedom • Analysis of variance (ANOVA & ANOVA followed by different tests) • One-way and two-way classified data • 'F'-test, 'Z ' test & Chi-square Test • Basic knowledge of SPSS, GraphPad Prism, R and EPI-Info	

Recommended Books/References

1. A Hand Book of Methodology of Research, Rajammall, P. Devadoss and K. Kulandaivel, RMM Vidyalaya press, 1976.
2. Research Methodology Methods & Techniques, C.R. Kothari – New Age International Publishers, Reprint 2008.
3. Research Methodology, R. Panneerselvam, PHI Learning Pvt. Limited, Delhi.
4. Thesis and Assignment Writing, J. Anderson, Wiley Eastern Ltd., 1997.
5. Research Methodology, Mukul Gupta, Deepa Gupta – PHI Learning Private Ltd., New Delhi, 2011.
6. Fundamentals of Mathematical statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand& Sons, New Delhi,1999.
7. Statistical Methods, G.W. Snedecor and W.G. Cochrans, Lowa State University Press, 1967.
8. Methods in Biostatistics by B. K. Mahajan
9. Fundamentals of Biostatistics by Khan & Khanum
10. Fundamentals of Biostatistics by U.B.Rastog
11. Basic & Clinical Biostatistics, Beth Dawson and Robert G. Trapp. Lange Medical Books/McGraw-Hill Medical Publishing Division

IPR & Laboratory Practices (PGD-PTC 201 ELV)

Course Code	Category	Course Name	L	P	Total Hours	Credits (T+P)
PGD-PTC 201 ELV	Elective	IPR & Laboratory Practices	4	-	60	4

Sr. No.	Topic	Details of Syllabus	Hrs.
Unit I	Overview of Intellectual Property	• Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design • Genetic Resources and Traditional Knowledge • Trade Secret • IPR in India: Genesis and development • IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994	09
Unit II	Patent	• Patents - Elements of Patentability: Novelty, Non-Obviousness (Inventive Steps), • Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and license, • Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties – • Patent office and Appellate Board	08
Unit III	Trademarks	• Concept of Trademarks • Different kinds of marks (brand names, logos, signatures, symbols, well-known marks, certification marks and service marks) • Non Registrable Trademarks • Registration of Trademarks • Rights of holder and assignment and licensing of marks • Infringement, Remedies & Penalties • Trademarks registry and appellate board	08
Unit IV	Other forms of IP	• Design: meaning and concept of the novel and original - Procedure for registration, the effect of registration and term of protection • Geographical Indication (GI) Geographical indication: meaning, and the difference between	05

Sr. No.	Topic	Details of Syllabus	Hrs.
		GI and trademarks -	
Unit V	Introduction Good Documentation Practices -GLP and Quality Assurance	• History of Good Laboratory Practices • Good Laboratory Practices- Introduction, OECD, FDA and WHO Guidelines on GLP & GMP • Quality assurance in Good Laboratory Practices • Good record keeping: Forms update: Form-C, Form-D, Part-A, Part -B, Firm -E etc.,	08
Unit VI	Quality standards and Quality Assurances	• Quality Standards- Advantages and Disadvantages • Quality Assurance- Their functions and advantages • Quality assurance and quality management in the industry • Customer requirement of quality • Government and trade standards of quality Federal Food and Drug Law FDA Action BSTI Laws, BSTI action and activities Other food laws (Legalization) • Trade and Company Standards Control by National, International, Social Organizations (example: FAO, GAFTA, WHO, UNICEF, CAB), Society (example: NSB, Professional societies)	12
Unit VII	Biosafety	• General lab equipment • Introduction & development of Biosafety • Practices & Principles • Definitions & Biosafety levels, 1, 2, 3, 4,; Biological safety cabinets • Shipment of biological specimens • Decontaminations • Biosafety manuals; Medical surveillance, Emergency response. • Biological waste management	10

Recommended Books/References/Website:

1. T. M. Murray & M. J. Mehlman, Encyclopedia of ethical, legal and policy issues in biotechnology, John Wiley & sons 2000.
2. Ethical Issues in Biotechnology by Richard Sherlock & John D. Morrey, Rowman& Littlefield Publishers.
3. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
4. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
5. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
6. Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf

7. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.
8. Cell for IPR Promotion and Management (http://cipam.gov.in/)
9. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
10. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)
11. Quality Assurance Guide by organization of Pharmaceutical Procedures of India, Volume I & II, Mumbai.
12. Good Laboratory Practice Regulations, Sandy Weinberg Vol. 69, Marcel Dekker Series.
13. Quality Assurance of Pharmaceuticals- A compedium of Guide lines and Related materials Vol I & II, WHO Publications.
14. Good laboratory Practice Regulations – Allen F. Hirsch, Volume 38, Marcel Dekker Series.

Green House Technology (PGD-PTC 202)

Course Code	Category	Course Name	L	P	Total Hours	Credits (T+P)
PGD-PTC203	Core	Green House Technology	4	-	60	4

Sr. No.	Topic	Detail of syllabus	Hrs.
Unit I	Introduction	• Greenhouses –Introduction, history, definition, greenhouse effect, advantages of greenhouses. • Classification of greenhouses –Greenhouse types are based on shape, utility, construction and covering material. • Plant response to greenhouse environment –light, temperature, relative humidity, ventilation and carbon dioxide	10
Unit II	Environmental requirements for crops	• Environmental requirement for crops – Temperature requirement of horticultural crops, light requirement of crops and lighting control methods, Greenhouse shading methods, Greenhouse supplemental lighting systems. • Environmental control inside the greenhouse – Manual controlling, thermostats, microprocessors and computerized control systems.	10
Unit III	Structure and Construction of a Green House	• Location, framework for various types of a greenhouse, covering materials, construction of a typical glass house/poly house/net house • Construction of the pipe-framed greenhouse • Construction of floors and layouts • Design and development of low-cost greenhouse structures • Greenhouse world scenario and status in India	10
Unit IV	Installation and maintenance of greenhouse	• Erection of Greenhouse Structures • Covering with nets and shades (Types of glazing material and its characteristics) • Checking of gutters • Maintenance of erected structures • Maintenance of operational elements of the greenhouse for periodic checking, tightening, greasing, etc.	12
Unit V	Greenhouse media and irrigation	• Greenhouse media and nutrition preparation of soil for planting • Plant nutrition: fertilizers, nutrient deficiencies and toxicities, carbon dioxide water quality, water sanitation • Methods of irrigation: irrigation, rules of watering, hand watering, perimeter watering, overhead sprinklers, boom water, drip irrigation,	12

Sr. No.	Topic	Detail of syllabus	Hrs.
		micro-irrigation fertigation, management of nutrients through fertigation.	
Unit VI	Hydroponics	• Method of soil less cultivation, media • Nutrient film technique (NFT) • Advantages and disadvantages of hydroponics • Applications of hydroponics in agriculture	06

Recommended Books/References:

1. Bose, T.K. and Som, T. K. 1986. Vegetable Crops in India. Naya Prakash, Kolkata
2. Bose, T.K. and Yadav, L.P. 1992. Commercial Flowers. Naya Prakash, Kolkata.
3. Randhawa, G.S. and Mukhopadhyaya, A. 1994. Floriculture in India. Allied Publishers Pvt. Ltd. New Delhi.
4. Shanmugavelu, K.G. 1985. Production Technology of Vegetable Crops. Oxford and IBM Publishing Co. Pvt. Ltd., New Delhi.
5. Prasad S and Kumar U 2003. Commercial Floriculture. Agrobios.
6. Prasad S and Kumar U 2003. Greenhouse management of horticultural crops. 2nd Edition. Agrobios.
7. Principles of drip irrigation system, Dr. M.S. Mane, B.L.Ayare, Dr.S.S.Magar., Jain Bros., New Delhi
8. Principles of sprinkler irrigation, Dr. M.S. Mane, Dr.B.L.Ayare. Jain Bros., New Delhi

PGD- PTC 203: Project

The purpose of introducing project work is to enable the students to apply the knowledge, skills, and attributes, acquired during the entire course, to the solution of specific problems related to practical work. The students will have to go through all the steps of problem-solving such as defining the problem, analysis of the problem, collecting required information and resources, formulating alternatives, selecting the best solution, and practicing it.

The project work aims at, besides developing problem-solving abilities in the students, the development of confidence and expertise in a particular field. The student may get the required skills to analyze the problem, use instruments, and use techniques and orientation of learning experiences towards their applications in the world of work. Students shall identify the problem with the help of their project guide.

Annexure-1

PRAVARA INSTITUTE OF MEDICAL SCIENCES

(DEEMED TO BE UNIVERSITY)

Centre for Biotechnology

Loni 413736, Ahmednagar District, Maharashtra State, India

Post Graduate Diploma Program in Plant Tissue Culture
The Pattern of Marks Statement

Semester: I
Month & Year: _____ Name of the Student:_____ Reg. No: _____

	Course number & code	Title of course	Credits	Internal Assessment marks		Semester End Exam.			Total Marks			GP	CP
				Max.	Secured	Max.	Min. for pass	Marks secured	Max.	Min. for pass	Secured		
	PGD-PTC 101	Plant Tissue Culture, methods and applications	4	30		70	35		100	50			
	PGD-PTC 102	Plant Improvement and complementary techniques	4	30		70	35		100	50			
	PGD-PTC 103	Bioprospecting & Pharmacognosy	4	30		70	35		100	50			
	PGD-PTC 104	Nursery Techniques & Vegetative Propagation	4	30		70	35		100	50			
	PGD-PTC 105	Practical – 1 based on Paper PGD-PTC 101	2	30		70	35		100	50			
	PGD-PTC 106	Practical – 2 based on Paper PGD-PTC 102	2	30		70	35		100	50			
	PGD-PTC 107	Practical – 3 based on Paper PGD-PTC 103	2	30		70	35		100	50			
Grand Total			**22**						**700**				

Annexure-2

PRAVARA INSTITUTE OF MEDICAL SCIENCES

(DEEMED TO BE UNIVERSITY)

Centre for Biotechnology

Loni 413736, Ahmednagar District, Maharashtra State, India

Post Graduate Diploma Program in Plant Tissue Culture
The Pattern of Marks Statement

Semester: II
Month & Year: _____ Name of the Student:_____ Reg. No: _____

	Course number & code	Title of course	Credits	Internal Assessment marks		Semester End Exam.			Total Marks			GP	CP
				Max.	Secured	Max.	Min. for pass	Marks secured	Max.	Min. for pass	Secured		
	PGD-PTC 201-ELE	Research Methodology	4	30		70	35		100	50			
	PGD-PTC 201-ELE	IPR & Laboratory Practices **(Choose any one)**				70	35						
	PGD-PTC 202	Green House Technology	4	30		70	35		100	50			
	PGD-PTC 203	Project Dissertation & Viva Voce	16	30					250	50			
	PGD-PTC 204	Seminar, Presentation/ Group Discussion	2	30					50	50			
Grand Total			**26**						**500**				

PRAVARA INSTITUTE OF MEDICAL SCIENCES * (Deemed to be University) * Loni - 413736 Tal - Rahata Dist. Ahmednagar (M.S. India)

Registrar
Pravara Institute of Medical Sciences
(Deemed to be University)
Loni - 413736, Tal. Rahata
Dist. Ahmednagar (M.S. India)