Government of Pakistan

National Vocational and Technical Training Commission

Prime Minister's Hunarmand Pakistan Program

"Skills for All"

Course Contents / Lesson Plan

Course Title: Tissue Culture

Duration: 3 Months

Trainer Name	
Author	**Muhammad Saeed Ahmed** Agriculture Officer University of Veterinary and Animal Sciences Lahore
Course Title	**Tissue Culture**
Objectives and Expectations	**Employable skills and hands-on practice in Tissue Culture** This is a special course designed to address unemployment in the youth. The course aims to achieve the above objective through hands on practical training delivery by a team of dedicated professionals having rich market/work experience. This course is therefore not just for developing a theoretical understanding/back ground of the trainees. Contrary to that, it is primarily aimed at equipping the trainees to perform commercially in a market space in independent capacity or as a member of a team. The course therefore is designed to impart not only technical skills but also soft skills (i.e. interpersonal/communication skills; personal grooming of the trainees etc.) as well as entrepreneurial skills (i.e. marketing skills; free lancing etc.). The course also seeks to inculcate work ethics to foster better citizenship in general and improve the image of Pakistani work force in particular. **Main Expectations:** In short, the course under reference should be delivered by professional instructors in such a robust hands-on manner that the trainees are comfortably able to employ their skills for earning money (through wage/self-employment) at its conclusion. This course thus clearly goes beyond the domain of the traditional training practices in vogue and underscores an expectation that a market-centric approach will be adopted as the main driving force while delivering it. The instructors should therefore be experienced enough to be able to identify the training needs for the possible market roles available out there. Moreover, they should also know the strengths and weaknesses of each trainee to prepare them for such market roles during/after the training. **i.** Specially designed practical tasks to be performed by the trainees have been included in the Annexure-I to this document. The record of all tasks performed individually or in groups must be preserved by the management of the training Institute clearly labeling name, trade, session, etc. so that these are ready to be physically inspected/verified through monitoring visits from time to time. The weekly distribution of tasks has also been indicated in the weekly lesson plan given in this document. **ii.** To materialize the main expectations, a special module on **Job Search & Entrepreneurial Skills** has been included in the latter part of this course through which, the trainees will be made aware of the Job search techniques in the local as well as international job markets (Gulf countries). Awareness around the visa process and immigration laws of the most favored labor destination countries also form a part of this module. Moreover, the trainees would also be encouraged to venture

into self-employment and exposed to the main requirements in this regard. It is also expected that a sense of civic duties/roles and responsibilities will also be inculcated in the trainees to make them responsible citizens of the country.

iii. A module on **Work Place Ethics** has also been included to highlight the importance of good and positive behavior in the workplace in the line with the best practices elsewhere in the world. An outline of such qualities has been given in the Appendix to this document. Its importance should be conveyed in a format that is attractive and interesting for the trainees such as through PPT slides +short video documentaries. Needless to say that if the training provider puts his heart and soul into these otherwise non-technical components, the image of the Pakistani workforce would undergo a positive transformation in the local as well as international job markets.

To maintain interest and motivation of the trainees throughout the course, modern techniques such as:

- Motivational Lectures
- Success Stories
- Case Studies

These techniques would be employed as an additional training tool wherever possible (these are explained in the subsequent section on Training Methodology).

Lastly, evaluation of the competencies acquired by the trainees will be done objectively at various stages of the training and a proper record of the same will be maintained. Suffice to say that for such evaluations, practical tasks would be designed by the training providers to gauge the problem-solving abilities of the trainees.

(i) Motivational Lectures

The proposed methodology for the training under reference employs motivation as a tool. Hence besides the purely technical content, a trainer is required to include elements of motivation in his/her lecture. To inspire the trainees to utilize the training opportunity to the full and strive towards professional excellence. Motivational lectures may also include general topics such as the importance of moral values and civic role & responsibilities as a Pakistani. A motivational lecture should be delivered with enough zeal to produce a deep impact on the trainees. It may comprise of the following:

- Clear Purpose to convey the message to trainees effectively.
- Personal Story to quote as an example to follow.
- Trainees Fit so that the situation is actionable by trainees and not represent a just idealism.
- Ending Points to persuade the trainees on changing themselves.

A good motivational lecture should help drive creativity, curiosity, and spark the desire needed for trainees to want to learn more.

The impact of a successful motivational strategy is amongst others commonly visible in increased class participation ratios. It increases the trainees' willingness to be engaged on the practical tasks for a longer time without boredom and loss of interest because they can see in their mind's eye where their hard work would take them in short (1-3 years); medium (3 -10 years) and long term (more than 10 years).

As this tool is expected that the training providers would make arrangements

for regular well planned motivational lectures as part of a coordinated strategy interspersed throughout the training period as suggested in the weekly lesson plans in this document.
Course-related motivational lectures online link is available in **Annexure-II**.

(ii) Success Stories

Another effective way of motivating the trainees is using Success Stories. Its inclusion in the weekly lesson plan at regular intervals has been recommended till the end of the training.
A success story may be disseminated orally, through a presentation, or using a video/documentary of someone that has risen to fortune, acclaim, or brilliant achievement. A success story shows how a person achieved his goal through hard work, dedication, and devotion. An inspiring success story contains compelling and significant facts articulated clearly and easily comprehendible words. Moreover, it is helpful if it is assumed that the reader/listener knows nothing of what is being revealed. The optimum impact is created when the story is revealed in the form of:-

- Directly in person (At least 2-3 cases must be arranged by the training institute)
- Through an audio/ videotaped message (2-3 high-quality videos must be arranged by the training institute)

It is expected that the training provider would collect relevant high-quality success stories for inclusion in the training as suggested in the weekly lesson plan given in this document.
The suggestive structure and sequence of a sample success story and its various shapes can be seen in **Annexure III**.

(iii)Case Studies

Where a situation allows, case studies can also be presented to the trainees to widen their understanding of the real-life specific problem/situation and to explore the solutions.
In simple terms, the case study method of teaching uses a real-life case example/a typical case to demonstrate a phenomenon in action and explain theoretical as well as practical aspects of the knowledge related to the same. It is an effective way to help the trainees comprehend in depth both the theoretical and practical aspects of the complex phenomenon in depth with ease. Case teaching can also stimulate the trainees to participate in discussions and thereby boost their confidence. It also makes the classroom atmosphere interesting thus maintaining the trainee interest in training till the end of the course.
Depending on suitability to the trade, the weekly lesson plan in this document may suggest case studies be presented to the trainees. The trainer may adopt a PowerPoint presentation or video format for such case studies whichever is deemed suitable but only those cases must be selected that are relevant and of a learning value.
The Trainees should be required and supervised to carefully analyze the cases.
For this purpose, they must be encouraged to inquire and collect specific information/data, actively participate in the discussions, and intended solutions to the problem/situation.
Case studies can be implemented in the following ways: -

i. A good quality trade-specific documentary (At least 2-3 documentaries must be arranged by the training institute)

	ii. Health &Safety case studies (2 cases regarding safety and industrial accidents must be arranged by the training institute) iii. Field visits(At least one visit to a trade-specific major industry/ site must be arranged by the training institute)
Entry-level of trainees	For an advanced course of tissue culture proposed entry level is F.Sc medical or Agriculture, so expectations from the trainees are: • Have knowledge of propagation techniques • Have studied basic of plant breeding • Have concept of Tissue culture techniques
Learning Outcomes of the course	By the end of this course, students will be able to: • Understand latest breeding technologies involved in plant propagation • Principles and practices involved in tissue culture techniques • Plants propagation through tissue culture • Tissue culture methodologies • Understand latest advancement in tissue culture • Understand commercial application of tissue culture techniques in plant propagation
Course Execution Plan	The total duration of the course: **3 months (12 Weeks)** Class hours: **4 hours per day** Theory: **20%** Practical: **80%** Weekly hours: **20 hours per week** Total contact hours: **260 hours**
Companies offering jobs in the respective trade	• Agriculture seed processing industries • Agriculture departments • Tissue culture labs • Commercial Plants nurseries • Plants breeding unit
Job Opportunities	• Plants Tissue Culture Technician • Tissue culture lab operators
No of Students	25
Learning Place	Classroom / Lab
Instructional Resources	● Introduction to tissue culture: https://www.youtube.com/watch?v=3KvREw5Eam8 In tis video we will discuss about introduction of plant tissue culture. * Definition of plant tissue culture * Properties * Procedure * Basic requirements * Advantages * Disadvantages ● Tissue Culture, Tissue culture plants, Tissue culture explanation, tissue culture

	https://youtu.be/KQrE9oxSBlo?si=OBnvWnzr7WAbE_xd **What are laboratory requirements for plant tissue culture | Advantages of Tissue Culture** https://youtu.be/jtQ4yzw6sJA?si=JJSjihtmF453RZsw **PLANT TISSUE CULTURE CSIR** https://youtu.be/TORRxwbz7aY?si=4gT7lOK9V4xsWDx5 **Plant Tissue Culture in 3 minutes!** https://youtu.be/ykKs5icYwq0?si=9tzLTHO2vIstGDCh

MODULES

Scheduled Weeks	Module Title	Days	Hours	Learning Units	Home Assignment
Week 1	**Introduction to plant tissue culture techniques**	**Day 1**	**Hour 1**	Course Introduction and Expectations	
			Hour 2	Plant propagation techniques	
			Hour 3	Job Market Overview	
			Hour 4	Work Ethics in Institute	
		Day 2	**Hour 1**	History of Tissue culture	
			Hour 2	Current State of plant Tissue culture	
			Hour 3	Applications of plant Tissue culture	• **Task 1**
			Hour 4	Ethical Considerations of plant Tissue culture	*Details may be seen at Annexure-I*
		Day 3	**Hour 1 & 2**	Overview of modern Plant Tissue Culture Techniques	
			Hour 3 & 4	Understand lab layout and lab SOP's	
		Day 4	**Hour 1**	Maintain personal hygiene and lab sanitation	
			Hour 2	Maintain personal hygiene and lab sanitation	
			Hour 3	Identify Good lab practices	
			Hour 4	Disposal of lab waste	

		Day 5	**Hour 1**	Ensure safety at the lab	
			Hour 2	Handle toxic chemicals with appropriate precaution	
			Hour 3	Perform procedures for controlling operational risks according to work instructions	
			Hour 4	First aid Kit and its use	
Week 2	**Prepare Culture media**	**Day 1**	**Hour 1**	Success Stories of Plant Tissue Culture	• **Task 2** *Details may be seen at Annexure-I*
			Hour 2	Fundamentals of plant propagation	
			Hour 3	Identification of different media components (macronutrients, micronutrients, vitamins, amino acids, sugar, undefined organic supplements, solidifying agents, growth regulators etc.)	
			Hour 4	Understand types of media	
		Day 2	**Hour 1**	Understand types of media	
			Hour 2	Functions of medium	
			Hour 3	Preparation of stock solutions for nutrient medium	
			Hour 4	Preparation of stock solutions for nutrient medium	

		Day 3	**Hour 1**	Understand methods of media preparation	
			Hour 2	Understand methods of media preparation	
			Hour 3	Identification of different media components	
			Hour 4	Understand methods of media preparation	
		Day 4	**Hour 1**	Sterilization techniques	
			Hour 2	Sterilization techniques	
			Hour 3	Sterilization techniques	
			Hour 4	Motivational lecture	
		Day 5	**Hour 1**	Media Components	
			Hour 2	Media Components	
			Hour 3	Plant growth conditions & micro-climate maintenance	
			Hour 4	Plant growth conditions & micro-climate maintenance	
Week 3	**Prepare Culture media**	**Day 1**	**Hour 1**	Success Story	• **Task 3** *Details may be seen at Annexure-I*
			Hour 2	Screening of contaminants	
			Hour 3	Screening of contaminants	
			Hour 4	Personal hygiene & lab sanitation	

		Day 2	**Hour 1**	Operation and maintenance of various lab equipment	
			Hour 2	Operation and maintenance of various lab equipment	
			Hour 3	Operation and maintenance of various lab equipment	
			Hour 4	Operation and maintenance of various lab equipment	
		Day 3	**Hour 1**	Maintain controlled conditions of growth room	
			Hour 2	Maintain controlled conditions of growth room	
			Hour 3	Handling of hazardous chemicals	
			Hour 4	handling of hazardous chemicals	
		Day 4	**Hour 1**	Prepare media	
			Hour 2	Prepare media	
			Hour 3	Prepare media	
			Hour 4	Prepare media	
		Day 5	**Hour 1**	Prepare media	
			Hour 2	Operation and maintenance of hardening unit/mist chamber	
			Hour 3	Operation and maintenance of hardening unit/mist chamber	
			Hour 4	Operation and maintenance of hardening unit/mist chamber	

Week 4	**Preparation of Explants**	**Day 1**	**Hour 1**	Micro propagation techniques	
			Hour 2	Selection of Mother plants of different crops	
			Hour 3	Selection of Mother plants of different crops	
			Hour 4	Monitor aseptic condition in lab	
		Day 2	**Hour 1**	Maintain mother plants according to requirement	
			Hour 2	Maintain mother plants according to requirement	
			Hour 3	Perform labeling	
			Hour 4	Perform transportation of mother plants	• **Task 4** *Details may be seen at Annexure-I*
		Day 3	**Hour 1**	Maintain virus free conditions for plants	
			Hour 2	Selection of plant parts for explant (shoot tip, nodes, buds, leaves and rhizomes etc.)	
			Hour 3	Selection of plant parts for explant (shoot tip, nodes, buds, leaves and rhizomes etc.)	
			Hour 4	Selection of plant parts for explant (shoot tip, nodes, buds, leaves and rhizomes etc.)	
		Day 4	**Hour 1**	Prepare explants	
			Hour 2	Prepare explants	

			Hour 3	Perform sterilization of explants	
			Hour 4	Maintain sterile conditions	
		Day 5	**Hour 1**	Plant Growth Regulators (Auxins)	
			Hour 2		
			Hour 3	Plant Growth Regulators (Ethylene)	
			Hour 4		
Week 5	**Inoculation of explants**	**Day 1**	**Hour 1**	Plant Growth Regulators (Cytokinins)	
			Hour 2		
			Hour 3	Plant Growth Regulators (Gibberellins)	
			Hour 4		
		Day 2	**Hour 1 & 2**	Maintain inoculation room according to SOP's	• **Task 5** *Details may be seen at Annexure-I*
			Hour 3 & 4	Prepare laminar flow for inoculation	
		Day 3	**Hour 1**	Inoculate the prepared expalnts according to SOP's	
			Hour 2	Inoculate the prepared expalnts according to SOP's	
			Hour 3	Inoculate the prepared expalnts according to SOP's	

			Hour 4	Inoculate the prepared expalnts according to SOP's	
		Day 4	**Hour 1, 2, 3 & 4**	Establishment of Primary Culture	
		Day 5	**Hour 1**	Check for contamination	
			Hour 2	Disposal off contaminated cultures	
			Hour 3	Aseptic transfer and subculturing techniques	
			Hour 4	Aseptic transfer and subculturing techniques	
Week 6	**Callus Induction or Growth of Explants**	**Day 1**	**Hour 1**	Maintain environmental conditions	
			Hour 2	Maintain environmental conditions	
			Hour 3	Maintain environmental conditions	
			Hour 4	Maintain environmental conditions	• **Task 6** *Details may be seen at Annexure-I*
		Day 2	**Hour 1, 2, 3 & 4**	Maintain Subcultures	
		Day 3	**Hour 1, 2, 3 & 4**	Maintain Subcultures	
		Day 4	**Hour 1, 2, 3 & 4**	Transfer of growing cultures in fresh medium	
		Day 5	**Hour 1, 2, 3 & 4**	Prevention of aging and contamination	
Week 7	**Differentiation and Regeneration**	**Day 1**	**Hour 1**	Understanding of growth regulators	• **Task 7**

			Hour 2	Understanding of growth regulators	*Details may be seen at Annexure-I*
			Hour 3	Determine the specific requirements of the required plant	
			Hour 4	Determine the specific requirements of the required plant	
		Day 2	**Hour 1, 2, 3 & 4**	Adjustment of type and concentrations of PGRs for desired outcome	
		Day 3	**Hour 1, 2, 3 & 4**	Induce callus formation	
		Day 4	**Hour 1, 2, 3 & 4**	Monitor shoot induction	
		Day 5	**Hour 1, 2, 3 & 4**	Root induction	
Week 8	**Acclimatization and hardening off**	**Day 1**	**Hour 1 & 2**	Preparation of Growing Medium	
			Hour 3 & 4	Transfer of Plantlets	
		Day 2	**Hour 1**	Controlled environment	
			Hour 2 & 3	Adjusting light exposure	• **Task 8** *Details may be seen at Annexure-I*
			Hour 4	Watering management	
		Day 3	**Hour 1,2 & 3**	Irrigation fertilization management	
			Hour 4	Monitoring and care of Plantlets	
		Day 4	**Hour 1 & 2**	Extended exposure	

			Hour 3 & 4	Practice Hardening off technique	
		Day 5	**Hour 1,2,3 &4**	Transplantation of developed plants	
Week 9	**Calibration and record keeping**	**Day 1**	**Hour 1**	Maintain SOPs charts and booklet of relevant equipment	• **Task 9** *Details may be seen at Annexure-I*
			Hour 2	Maintain SOPs charts and booklet of relevant equipment	
			Hour 3	Handling of tools	
			Hour 4	Handling of tools	
		Day 2	**Hour 1,2,3 & 4**	Calibrate equipment according to written instructions	
		Day 3	**Hour 1,2,3 & 4**	Calibrate equipment according to written instructions	
		Day 4	**Hour 1,2,3 & 4**	Perform troubleshooting	
		Day 5	**Hour 1,2,3 & 4**	Maintain records and inventory	
Week 10	**Advance Tissue culture techniques**	**Day 1**	**Hour 1,2,3 & 4**	Maintain records and inventory	• **Task 10** *Details may be seen at Annexure-I*
		Day 2	**Hour 1,2,3 & 4**	Mutation and differentiation	
		Day 3	**Hour 1,2,3 & 4**	Organogenesis	
		Day 4	**Hour 1,2,3 & 4**	Micro-propagation	

		Day 5	**Hour 1,2,3 & 4**	Somaclonal variations	
Week 11	**Advance Tissue culture techniques**	**Day 1**	**Hour 1,2,3 & 4**	Disease elimination	• **Task 11** *Details may be seen at Annexure-I*
		Day 2	**Hour 1,2,3 & 4**	In vitro selection	
		Day 3	**Hour 1,2,3 & 4**	Protoplast fusion and cybrid development	
		Day 4	**Hour 1,2,3 & 4**	Gene identification and isolation	
		Day 5	**Hour 1,2,3 & 4**	DNA fingerprinting	
Week 12	**Tissue culture in different crops**	**Day 1**	**Hour 1,2,3 & 4**	Practice in tissue culture lab for media preparation, culturing of different crops	• **Task 12** *Details may be seen at Annexure-I* **Final Project**
		Day 2	**Hour 1,2,3 & 4**	Practice in tissue culture lab for media preparation, culturing of different crops	
		Day 3	**Hour 1,2,3 & 4**	Practice in tissue culture lab for media preparation, culturing of different crops	
		Day 4	**Hour 1,2,3 & 4**	Practice in tissue culture lab for media preparation, culturing of different crops	
		Day 5	**Hour 1,2,3 & 4**	Practice in tissue culture lab for media preparation, culturing of different crops	

Tasks for Certificate in Tissue Culture

Task No.	Task	Description	Week
1.	**Prepare lab charts**	Make detailed lab layout, lab charts and Sop's chart	**Week 1**
2.	**Prepare stock solutions**	Make given stock solution according to requirements	**Week 2**
3.	**Adjust pH of plant tissue culture media**	Perform pH adjustment of media according to standard procedure	**Week 3**
4.	**Prepare explants**	Collect explants of given plants according SOP's	**Week 4**
5.	**Inoculate required explants**	Prepared explants will be inoculated according to given instruction	**Week 5**
6.	**Transfer callus into fresh media**	Perform transferring of callus in fresh media to improve growth	**Week 6**
7.	**Understand PGRs response**	Perform concentration adjustment of given PGR according to required results	**Week 7**
8.	**Understand acclimatization and hardening off plantlets**	Perform acclimatization of developed plantlets according to SOP and elaborate hardening off plantlets	**Week 8**
9.	**Perform calibration**	Calibrate given equipment and maintain records also perform troubleshooting of given equipment	**Week 9**
10.	**Demonstrate disease elimination**	Demonstrate disease elimination process in tissue culture	**Week10**
11.	**Demonstrate DNA fingerprinting**	Elaborate DNA fingerprinting technique through demonstration	**Week11**
12.	**Perform tissue culture**	Develop tissue culture plants of given crops according to SOP	**Week12**

Annexure-II:

Motivational Lectures
Tissue culture

NARGS Talk - "What's the Fun about Plant Tissue Culture?"

https://youtu.be/EYGxJMUQN5I?si=qvYwHrbdUqDn6UHM

Tissue Culture-Raised Apple Rootstock in India – A Success Story

https://www.apaari.org/tissue-culture-raised-apple-rootstock-in-india-a-success-story/

Micropropagation, or Plant Cloning

https://www.cornell.edu/video/history-of-plant-cloning-6-micropropagation-or-plant-cloning

7 Cs - Best Motivational Video On Skill Development By Speaker Munawar Zama | English House Academy

https://www.youtube.com/watch?v=wdCoHHVY3eo

Annexure-IV:

Workplace/Institute Ethics Guide

Work ethic is a standard of conduct and values for job performance. The modern definition of what constitutes good work ethics often varies. Different businesses have different expectations. Work ethic is a belief that hard work and diligence have a moral benefit and an inherent ability, virtue, or value to strengthen character and individual abilities. It is a set of values-centered on the importance of work and manifested by determination or desire to work hard.

The following ten work ethics are defined as essential for student success:

1. **Attendance:**
   Be at work every day possible, plan your absences don't abuse leave time. Be punctual every day.
2. **Character:**
   Honesty is the single most important factor having a direct bearing on the final success of an individual, corporation, or product. Complete assigned tasks correctly and promptly. Look to improve your skills.
3. **Team Work:**
   The ability to get along with others including those you don't necessarily like. The ability to carry your weight and help others who are struggling. Recognize when to speak up with an idea and when to compromise by blend ideas together.
4. **Appearance:**
   Dress for success set your best foot forward, personal hygiene, good manner, remember that the first impression of who you are can last a lifetime
5. **Attitude:**
   Listen to suggestions and be positive, accept responsibility. If you make a mistake, admit it. Values workplace safety rules and precautions for personal and co-worker safety. Avoids unnecessary risks. Willing to learn new processes, systems, and procedures in light of changing responsibilities.
6. **Productivity:**
   Do the work correctly, quality and timelines are prized. Get along with fellows, cooperation is the key to productivity. Help out whenever asked, do extra without being asked. Take pride in your work, do things the best you know-how. Eagerly focuses energy on accomplishing tasks, also referred to as demonstrating ownership. Takes pride in work.

7. **Organizational Skills:**

   Make an effort to improve, learn ways to better yourself. Time management; utilize time and resources to get the most out of both. Take an appropriate approach to social interactions at work. Maintains focus on work responsibilities.

8. **Communication:**

   Written communication, being able to correctly write reports and memos.

   Verbal communications, being able to communicate one on one or to a group.

9. **Cooperation:**

   Follow institute rules and regulations, learn and follow expectations. Get along with fellows, cooperation is the key to productivity. Able to welcome and adapt to changing work situations and the application of new or different skills.

10. **Respect:**

    Work hard, work to the best of your ability. Carry out orders, do what's asked the first time. Show respect, accept, and acknowledge an individual's talents and knowledge. Respects diversity in the workplace, including showing due respect for different perspectives, opinions, and suggestions.