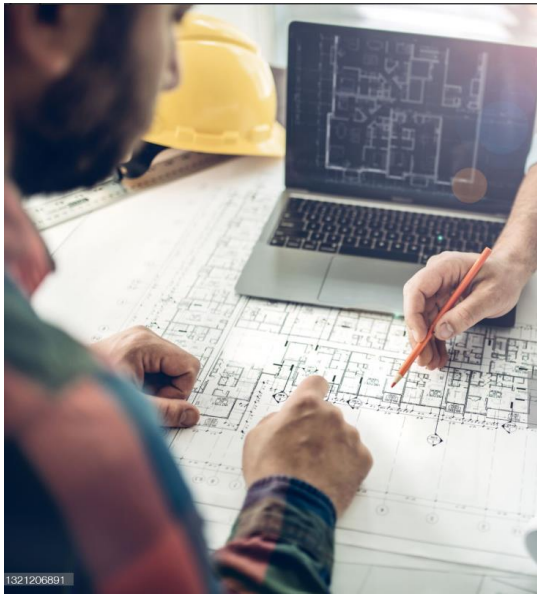
National Vocational Certificate Level 3 in Computer Aided Design & Manufacturing (CAD /CAM)

(CAD Operator)



(Curriculum)

National Vocational and Technical Training Commission (NAVTTC)

Government of Pakistan

National Vocational Certificate Level 3 in Computer Aided Design & Manufacturing (CAD Operator)

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Introduction

Definition/Description of training program (CAD Operator)

Construction sector is one of the booming industries of Pakistan. There is an increasing demand of the Junior draftsman in CAD/CAM Technology. Therefore, the skills are required to be inducted in the future generation. If an individual is planning to pursue a career in construction, this program will be helpful in targeting various commercial and non-commercial projects etc. If an individual is planning to take up junior draftsman in CAD/CAM Technology course, this course will help him weigh their choices better.

Keeping in view of the above the competency based national vocational qualifications have been developed by GIZ & NAVTTC to train the unskilled human resource on the technical and entrepreneurial skills to be employed / self-employed and inevitably set sustainable impact on their lives by increasing their livelihood income.

Training Course is based on competency standards which are defined by the industry and the traditional role of a trainer changes and shifts towards the facilitation of training. A trainer encourages and assists trainees to learn for themselves. Trainees are likely to work in groups (pairs) and all doing something different. Some are doing practical tasks in the computer Lab, some writing, some not even in the classroom or computer lab but in another part of the building doing safety exercise. As trainees learn at different pace they might be at different stages in their learning, thus learning must be tailored to suit individual needs. The following facilitation methods (teaching strategies) are generally employed.

Purpose of the training program:

The purpose of the training is to provide skilled manpower to improve the existing construction industry. More than 96 % of the Pakistani manpower is working in GCC countries where Saudi Arabia (50.90%)) and UAE (33.10%) are the largest destination countries followed by Oman (7.26%), Kuwait (1.90%), Bahrain

(1.58%), and Qatar (1.41%). The overseas Pakistanis are playing a pivotal role to support the economy in the form of remittances. For this purpose, new qualifications have been developed by GIZ & NAVTTC on CBT&A mode in order to train the unskilled human resource with employable skills.

Overall objectives of training program:

The main objectives of the National Vocational Certificate Level 3 in Computer Aided Design & Manufacturing (CAD/CAM) (CAD Operator) are as follows:

- Improve the professional competence of software skills
- Capacitate the local community and trainers in modern CBT training, methodologies and processes as envisaged under NVQF
- Provide flexible pathways and progressions in the designing
- Enable the trainees to perform their duties in efficient manner
- Establish a standardized and sustainable system of training for Computer Aided Design & Manufacturing across globe

Competencies to be gained after completion of course:

At the end of the course, the trainee has attained the following core competencies:

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- Develop 3D surfaces in AutoCAD
- Develop 3-D model in AutoCAD
- Develop 3-D model in Sketch Up
- Manipulate images in Adobe Photoshop
- Maintain Safety at Workplace
- Work in a Team Environment

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Possible available job opportunities, available immediately and later in the future:

- CAD Operator
- Senior CAD Operator

Trainee entry level:

The entry level for National Vocational Certificate Level 3in CAD/CAM Technology **(CAD Operator)** is given below:

Title	Entry requirements
National Vocational Certificate Level 3 in Computer Aided Design & Manufacturing **(CAD Operator)**	The entry requirement for this qualification would be National Vocational Certificate Level 2 in Computer Aided Design & Manufacturing **(Junior Draftsman)**

Minimum qualification of trainer:

A. Must be a holder of DAE/Level 5 Diploma in CAD/CAM with at least 2 years relevant experience

OR

B. B.Sc. Technology (Civil) / B.E Civil /BSc Civil Engineering

Recommended trainer: trainee ratio

The recommended maximum trainer: trainee ratio for this program is 1 trainer for 25 trainees.

Medium of instruction i.e., language of instruction:

Instructions will be in Urdu/ English/ Local language.

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Duration of the course (Total time, Theory & Practical time):

The distribution of contact hours is given below:

Total	**-**	**600 hours**
Theory	**-**	**120hours (20%)**
Practical	**-**	**480 hours (80%)**

Proposed Course Duration-6 Months

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Summary template-overview of the curriculum:

Following is the structure of the course:

Sr No	Code	Competency Standards	Occupation	NVQF Level	Category	Estimated Contact Hours			Cr Hr.
						Th	Pr	Total	
Level 3									
1	0720 C/C & M2 -A	Develop 3D surfaces in AutoCAD	**CAD Operator**	3	Technical	18	72	90	9
2	0720 C/C & M2 -B	Develop 3-D model in AutoCAD		3	Technical	35	140	175	17.5
3	0720 C/C & M2 -C	Develop 3-D model in Sketch Up		3	Technical	24	96	120	12
4	0720 C/C & M2 -D	Manipulate images in Adobe Photoshop		3	Technical	25	100	125	12.5

5	0720 C/C & M2 -E	Maintain Safety at Workplace		3	Technical	12	48	60	6
6	0720 C/C & M2 -F	Work in a Team Environment		3	Functional	6	24	30	3
		Total				**120**	**480**	**600**	**60**
		Percentage				**20**	**80**	**100**	

Module:1- Develop 3D Surfaces in AutoCAD

Objective: This module covers the skills and knowledge required to insert 3-Dimensional surfaces by using various tools and commands in AutoCAD software.

Duration: 90 Hours **Theory: 18 Hours** **Practice: 72 Hours** **Credit Hours: 9**

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Draw basic 3D surfaces	**Trainee will be able to:** • Locate Mesh tab from 3D Modelling dropdown option of solids panel • Apply different Mesh primitive options including; ✓ Box ✓ Cone ✓ Cylinder ✓ Pyramid ✓ Sphere ✓ Wedge ✓ Tours	• Knowledge of 3D modeling in AutoCAD ✓ 3D solids, ✓ surfaces, ✓ meshes, ✓ Wireframe objects. ✓ Differentiate between Surface Modeling and Solid Modeling. ✓ 3D face and Edges **Practical Activity:** ✓ Draw following basic 3D surfaces on AutoCAD. ✓ (Box	**Theory-9**Hrs **Practical-48** Hrs **Total-57** Hrs	• PCs/Laptops • Multimedia Projector • AutoCAD • Paper • Printer	Class Room Lab

	• Apply smoothness and refinement on Meshes (even legacy 2D drawings) with following commands; ✓ MESHSMOOTHMORE ✓ MESHSMOOTHLESS ✓ MESHSMOOTHREFINE • Add or Remove Mesh Creases using; ✓ MESHCREASE ✓ MESHUNCREASE • Enable Mesh editing using; ✓ MESHEXTRUDE ✓ MESHSPLIT (midpoint) ✓ MESHMERGE ✓ MESHCAP (close hole) • Perform convert Meshes using the command: ✓ CONVTOSURFACE	✓ Cone ✓ Cylinder ✓ Pyramid ✓ Sphere ✓ Wedge)			

LU2. Comprehend complex 3D surfaces	**Trainee will be able to:** • Develop following Surfaces; ✓ Revolved Surface (REVSURF) ✓ Tabulated Surface (TABSURF) ✓ Ruled Surface (RULESURF) using "Surftab" variables ✓ Edge Surface (EDGESURF) ✓ Plane Surface (PLANESURF) ✓ Extrude Surface (EXTRUDE) • Create 3D solid or surface in the space between several cross sections: ✓ Using "LOFT" command. ✓ Sweeping a 2D or 3D curve along a path using "SWEEP"	• Understanding of Boolean operation concepts ✓ Subtraction ✓ Intersection ✓ Union **Practical Activity:** • Comprehend complex 3D surfaces (provided by instructor) using Tools on AutoCAD.	**Theory-9**Hrs **Practical-42** Hrs **Total-51** Hrs	• PCs/Laptops • Multimedia Projector • AutoCAD • Paper • Printer	Class Room Lab

	command. • Build Surface Network. • Create a blend surface between two existing surfaces • using “SURFBLEND” command. • Create a new surface or cap to close an open edge of an existing surface using “SURFPATCH” command. • Create a parallel surface at a specified distance from the original surface using “SURFOFFSET” command. • Edit the existing surfaces through: ✓ Fillet ✓ Trim ✓ Un trim ✓ Extend ✓ Sculpt				

	• Add and edit control vertices on a NURBS surface or spline using Surface CV edit bar. • Convert object to NURBS using “CONVTONURBS” command. • Apply following NURB Vertex Controls; ✓ Surface CV-Show ✓ Surface CV-Hide ✓ Surface CV-Rebuild ✓ Surface CV-Add ✓ Surface CV-Remove • Distinguish surface analysis via: ✓ Analysis Zebra ✓ Analysis Curvature ✓ Analysis Draft • Develop Surface associatively.				

Module:2- Develop 3D Model in AutoCAD

Objective: This module covers the skills and knowledge required to create 3-Dimensionalmodels by using various tools and commands in AutoCAD software.

Duration:175 Hours **Theory:35 Hours** **Prctical:140 Hours** **Credit Hours:17.5**

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Develop 3D Objects	**Trainee will be able to:** • Setup 3D drawing interface for required specifications. • Setup 3D user interface settings for required specifications. • Create 3D objects with given measurements.	• Knowledge of 3D modeling in AutoCAD ✓ 3D solids, ✓ surfaces, ✓ meshes, ✓ Wireframe objects. ✓ Differentiate between Surface Modeling and Solid Modeling. ✓ 3D face and Edges **Practical Activity:** Develop 3D Objects on AutoCAD.	**Theory-10**Hrs **Practical-48**Hrs **Total-20**Hrs	• PCs/Laptops • Multimedia Projector • AutoCAD • Paper • Printer	Class Room Lab

		• Hexagonal nut and bolt • Types of Rivets • Spiral Stair case			
LU2. Manipulate 3D objects using 3D Editing Tools	**Trainee will be able to:** • Modify 3D objects in line with the requirements. • Make customized 3D models according to the requirement of given job. • Convert 3D Face objects into a single mesh object.	• Understanding of Boolean operation concepts ✓ Subtraction ✓ Intersection ✓ Union **<u>Practical Activity:</u>** Manipulate 3D of following objects using 3D Editing Tools on AutoCAD. • Hexagonal nut and bolt • Types of Rivets • Spiral Stair case	**Theory-15**Hrs **Practical-60**Hrs **Total-20**Hrs	• PCs/Laptops • Multimedia Projector • AutoCAD • Paper • Printer	Class Room Lab
LU3. Render 3D Model	• Apply material to required 3D Model as per given specification • Apply lights to get the requisite scene of required 3D model	• 3D Navigate control ✓ Functions of different camera settings. ✓ Importance of scene creation	**Theory-10**Hrs **Practical-32**Hrs **Total-42**Hrs	• PCs/Laptops • Multimedia Projector • AutoCAD • Paper Printer	Class Room Lab

	• Assign cameras to execute different views of required3D Model. • Render and print the 3D model according to required size& orientation. • Apply texture to 3D model as per given specification.	✓ Understanding of Preset views such as isometric, top, bottom, front, left, etc. ✓ Knowledge of Perspective projection and parallel projection ✓ Walk and Constrained Orbit • Material and light control ✓ Planner mapping ✓ Texture map ✓ Opacity control ✓ Render context ✓ Render sampling **Practical Activity:** • Apply materials and Render 3D Model of following objects on AutoCAD.			

		○ Hexagonal nut and bolt ○ Types of Rivets ○ Spiral Stair case • Print out the designed rendered model on different paper sizes			

Module:3- Develop 3D Model in Sketch Up

Objective: This module covers the skills and knowledge required to develop 3D model using sketch up.

Duration: 120 Hours **Theory: 24 Hours** **Practice: 96 Hours** **Credit Hours: 12**

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU 1 Develop 3D Objects	**Trainee will be able to:** • Set up template for required specifications. • Import/create 2D Drawing/image as per assigned specification. • Create 3D object from 2D drawing/image in line with given measurements.	• Steps to set Axes in Sketch up • Knowledge of Short commands Line, rectangle and circle • Push/Pull **Practical Activity:** Develop 3D of following Objects on sketch up. ○ Hexagonal nut and bolt ○ Types of Rivets	**Theory-6**Hrs **Practical-30**Hrs **Total-36**Hrs	• PCs/Laptops • Multimedia Projector • Sketch Up • AutoCAD • Paper • Printer • I Render • V Ray • Lumion	Class Room Lab

		2 storied building			
LU 2 Modify 3D objects	**Trainee will be able to:** • Navigate 3D objects as per required job. • Modify 3D objects in line with the requirements.	• Knowledge of Short command of Pan and Orbit • Protractor Tool and Tape Measure Tool • Scaling and Stretching • Scale and paper sizes **Practical Activity:** Modify 3D of following Objects on sketch up. o Hexagonal nut and bolt o Types of Rivets 2 storied building with gable roof	**Theory-6**Hrs **Practical-30**Hrs **Total-36**Hrs	• PCs/Laptops • Multimedia Projector • Sketch Up • AutoCAD • Paper • Printer • IRender • VRay • Lumion	Class Room Lab
LU 3 Apply material and textures on 3D objects	**Trainee will be able to:** • Create/assign specified materials and textures to 3D Model.	• Different modeling techniques. • Different types of materials and textures.	**Theory-6**Hrs **Practical-18**Hrs **Total-24**Hrs	• PCs/Laptops • Multimedia Projector • Sketch Up • AutoCAD • Paper	Class Room Lab

	• Edit materials and textures to get realistic outcome.	**Practical Activity:** Apply material and textures on following 3D objects on sketch up. ○ Hexagonal nut and bolt ○ Types of Rivet ○ 2 storied building with gable roof (masonry structure)		• Printer • IRender • VRay • Lumion •	
LU 4 Render 3D model	**Trainee will be able to:** • Install plug-ins to meet specific outcome as per requirement. • Add scene of 3D model according to specification • Add lights for illumination to get the requisite scene of 3D model.	• Setting of Shadow and fog views. • Principles of lighting and rendering. • Two-Point perspective **Practical Activity:** Render 3D model on sketch up.	**Theory-6**Hrs **Practical-18**Hrs **Total-24**Hrs	• PCs/Laptops • Multimedia Projector • Sketch Up • AutoCAD • Paper • Printer • IRender • VRay • Lumion •	Class Room Lab

	• Assign cameras to execute different views of 3D Model. • Add Render Components to make scene more realistic. • Render the 3D model according to required image size or resolution& orientation.	○ Hexagonal nut and bolt ○ Types of Rivets 2 storied building			

Module: 4- Manipulate Images in Adobe Photoshop

Objective: This module covers the skills and knowledge required to manipulate images in Photoshop.

Duration: 125 Hours **Theory: 25 Hours** **Practice: 100 Hours** **Credit Hours: 12.5**

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Format an Image in Adobe Photoshop	**Trainee will be able to:** • Open the Image. • Select the required tool and apply on image • Check the image.	• Photoshop interface • Steps to Customize the workspace • Usage of pen tool • Lasso tool • Image conversion **Practical Activity:** • Format an Image (provided by instructor) in Adobe Photoshop	**Theory-6** Hrs **Practical-33**Hrs **Total-39**Hrs	• Computer system • Adobe Photoshop	Class Room Lab
	Trainee will be able to:	• Layer panel	**Theory-07**Hrs	• Computer system	Class Room

LU2. Design layers in moving objects	• Create layers and open image or draw object or image on layer. • Select all objects on a specific layer and also move object from one layer to another layer and also copy past the object on different layer • Duplicate specific layer and also inert new layer • Show or hide layers and objects. • Lock or unlock the object or layers. And also merge the layers.	• Layers and layers merging • Image saves with different graphic extensions • Setting of color space **Practical Activity:** Design layers in moving objects (provided by instructor) on sketch up.	**Practical-16**Hrs **Total-23**Hrs	• Adobe Photoshop • Printer	Lab
LU3. Design an object	**Trainee will be able to:** • Draw different shapes as required • Reshape the objects • Align the objects as required • Transform the object as required • Save edited object	• Usage of pen tool • Lasso tool • Filter effects • Image saves with different graphic extensions • Setting of color space **Practical Activity:** • Design an object (provided by instructor) in photoshop.	**Theory-6**Hrs **Practical-27**Hrs **Total-33**Hrs	• Computer system • Adobe Photoshop • Printer	Class Room Lab

LU4. Design Shapes	**Trainee will be able to:** • Open Adobe Photosop • Design the Shapes as required • Save the Shapes or objects in jpg, png etc. format.	• Usage of pen tool • Filter effects • Image saves with different graphic extensions • Setting of color space **Practical Activity:** • Design shapes (provided by instructor) in photoshop.	**Theory-6**Hrs **Practical-24**Hrs **Total-30**Hrs	• Computer system • Adobe Photoshop • Printer	Class Room Lab

Module: 5 Maintain Safety at Workplace

Objective: This competency standard covers the skills and knowledge required to maintain safe work condition, emergency response activity at workplace. Your underpinning knowledge will be sufficient to provide you the basis for your work.

Duration: 60 Hours **Theory: 12 Hours** **Practice: 48 Hours** **Credit Hours:6**

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Maintain Safe work Conditions at Site	***Trainee be able to:*** • Recognize the safety signs and symbols • Identify potential hazards at work site • Identify the risk of slip, trip and fall at work place	• Describe the safety signs at work place • Demonstrate the fall protection measures • Describe unsafe act and unsafe conditions • Knowledge of hazardous materials and relevant safety procedures **Practical Activity:**	**Total** 25 hrs **Theory:** 5 hrs **Practical:** 20 hrs	Consumable • Notebooks • Pencils • Erasers • Sharpeners • White board marker Non Consumable • White board • Multimedia • Computer	• Class Room Simulated environment

		• Visit the work site and identify the potential hazards and apply control measures			
LU2. Perform fire fighting	***Trainee be able to:*** • Identify source of fire. • Identify classes of fire • Raise fire alarms • Select suitable fire extinguishers • Check expiry of fire extinguisher • Check wind direction • Locate emergency exits • Perform PASS (Pull, aim, squeeze and sweep) on fire extinguisher	• Describe the fire triangle • State principles of fire fighting • Describe the source of fire • Explain classes of fire • Demonstrate firefighting techniques • Recognize different types of fire extinguisher **Practical Activity:** • Perform mock exercise of firefighting on a source of fire	**Total** 26 hrs **Theory:** 5 hrs **Practical:** 21 hrs	Consumable • Notebooks • Pencils • Erasers • Sharpeners • White board marker Non Consumable • White board • Multimedia	• Class Room Simulated environment

		• Participate in emergency response drill			
LU3. Perform Basic Electrical Work safely at Workplace	***Trainee be able to:*** • Check the connectivity of earthing with power equipment • Check leads and cable for any visual damage before use • Tag damaged lead, cable and connection points and report to the supervisor	• Knowledge of electric hazards • Describe protective measures against the electric hazards **Practical Activity:** Practice to check and tag extension leads and cable for any visual damage	**Total** 9 hrs **Theory:** 3 hrs **Practical:** 6 hrs	Consumable • Notebooks • Pencils • Erasers • Sharpeners • White board marker Non Consumable • White board • Multimedia • Computer	• Class Room Simulated environment

Module:6 Work in a Team Environment

Objective: This unit covers the knowledge, skills and attitudes required to gather, interpret and convey information in response to workplace requirements. It also identifies role and responsibility as a member of a team. Your underpinning knowledge will be sufficient to provide you the basis for your work.

Duration: 30 Hours **Theory: 06 Hours** **Practice: 24 Hours** **Credit Hours:3**

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Obtain and convey Workplace information	***Trainee be able to:*** • Assess the specific and relevant information from the appropriate sources • Convey the information using the appropriate medium and ideas • Use appropriate non- verbal communication • Identify appropriate lines of communication with supervisors and colleagues	• Describe the importance of effective communication • State different Sources of information • State different mode of communication • Explain types of non-verbal communication • Explain mode of communication while operating machines	**Total:7**hrs **Theory:**2hrs **Practical:6**hrs	Consumable • Notebooks • Pencils • Erasers • Sharpeners • Pen • White board marker Non-Consumable • White board	Class Room/Lab

	• Use the defined workplace procedures for storage of information Inform co-workers and superiors about any deviation	• Explain the method of recording the information/instructions. **Practical Activity:** • Role Play each trainee introduce himself. Convey the job description and company general rules and regulations to fellow workers		• Multimedia • Internet Computer system	
LU2. Participate in workplace meetings and discussions	***Trainee be able to:*** • Express your own opinions • Listen other's point of view without interruption Prepare simple questions about workplace procedures	**The trainee will be able to:** • Express your own opinions • Listen other's point of view without interruption • Prepare simple questions about workplace procedures	**Total:**7hrs **Theory:**1hrs **Practical:**6hrs	**Total:**7hrs **Theory:**2hrs **Practical:5**hrs	• Class Room

		• Describe the protocol of meeting • Describe the role and objective of team. **Practical Activity:** • Participate in mock meeting for preparation to perform job.			
LU3. Identify own role and responsibility within team	***Trainee be able to:*** • Identify the individual role and responsibilities within the team environment. • Recognize the roles and responsibility of other team members. • Report relationships within team and external to team Share report with co-workers.	• Describe the importance of creating cooperative work environment • Describe the role and objective of team. • Explain risk of failure team work on the project. • Describe the importance of resolving the co-worker's problems • State plan work and organize required	**Total:**7hrs **Theory:**1hrs **Practical:**6hrs	Consumable • Notebooks • Pencils • Erasers • Sharpeners • White board marker Non Consumable • White board • Multimedia	• Class Room/Lab

		resources in coordination with team **Practical Activity:** • Role Play, get instruction regarding job order from supervisor and convey it to coworkers according		• Internet • Computer system • White board marker	
LU4. Support the co-workers	***Trainee be able to:*** • Hand over the required materials and tools timely to interfacing team • Work together with co-workers in an effective manner • Address the problems of co-worker effectively Report to immediate boss	• Describe the importance of creating cooperative work environment • Describe the importance of resolving the co-worker's problems **Practical Activity:** • Role Play, Support and guide stressed co-worker in his work-related activity	**Total:**8hrs **Theory:**2hrs **Practical:**6hrs	Consumable • Notebooks • Pencils • Erasers • Sharpeners Non Consumable • White board • Multimedia • Internet Computer system	• Class Room

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List of Tool, Machinery and Equipment:

SR#	Items/Tools & Equipment	Quantity
1.	First Aid Kit	01
2.	Computer	26
3.	Multimedia	01
4.	Clip Board	30
5.	Structural drawing (3D Blocks)s	15
6.	Scale cards	30
7.	Drawing boards	26
8.	Printer	1

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List of Consumable Supplies

SR#	Consumable Supplies	Quantity
1.	PPEs Surgical Face Masks	2 Boxes
2.	Stationary	As per requirement
3.	Drawing pencils (Different Nos)	100
4.	Clutch pencils	25
5.	Pointer	25
6.	Printer paper	As per requirement
7.	Safety sign boards	As per requirement

National Vocational Certificate Level 3 in Computer Aided Design & Manufacturing (CAD Operator)

Members of the Curriculum Development Committee

S#	Name	Designation
1	**Sadyia Qureshi**	Coordinator
2	**Aftab Hussain**	DACUM Facilitator
3	**Ali Raza**	DACUM Facilitator
4	**Muhammad Abbas Arshad**	Site Engineer

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S#	Name	Designation
5	**Muhammad Faizan**	Interior/CAD Designer
6	**Syed Farhan Hamid Ali**	Sr. Instructor Pak Swiss Training Center Karachi
7	**Muhammad Hassan Arshad**	Architect Bahria Town
8	**Malik Abdul Basit**	Consultant (IT & Overseas employment)
9	**Javeed Hayat**	Consultant (Survey and Research)

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Members of the Curriculum Validation Committee

S#	Name	Designation
1	**Dr. Muhammad Bakhsh** **DD IT/CS**	Pakistan Academy of rural development, Peshawar
2	**Jawaria Qazi** **Web Admin**	PBTE, Lahore
3	**Ali Raza**	Principal Quaid-e-Azam College of Engineering & Technology Okara
4	**Aftab Hussain**	DACUM Facilitator
5	**Nadeem Zaigham** **Senior Instructor**	P-TEVTA

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S#	Name	Designation
6	**Muhammad Abbas Arshad** **Project Engineer**	United Engineering Pvt Ltd Jehlum
7	**Muhammad Faizan** **Architectural Designer**	Gleaming Architectural
8	**Navid Ali** **Lecturer**	KP-TEVTA
9	**Amjad Waheed Khan** **Lecturer**	KP-TEVTA
10	**Syed Shadab Ali Shah** **Assistant Professor**	KP-TEVTA

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S#	Name	Designation
11	**Sammar Jan Siddiqui**	P-TEVTA
12	**Dr. Muhammad Bakhsh** **DD IT/CS**	Pakistan Academy of rural development, Peshawar