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JEWELLERY CAD-CAM

Competency Standards

National Vocational Certificate Level 3

Version 1 - March 2020

NAVTTC

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Contents

INTRODUCTION

The National Competency Standards are written specifications of skill and knowledge competencies required in a particular trade. Industry experts from the relevant industries from different geographical locations across Pakistan were consulted during the development process of these competency standards to ensure input and ownership of all the stakeholders. The National Competency Standards shall be used as a referral document for the development of curricula to be used by training institutions.

This standard shall provide skilled manpower for the value addition on Gemstone and Jewellery of the existing Gems and Jewellery sector and related industry. This will improve the abilities and accreditation of a CAD-CAM Jewellery Designing in terms of national and international standards applicable in the field of Gems and Jewellery. The availability of quality Jewellery Designing and Rapid Prototyping in the local and international markets will ultimately bring economic benefits to the producers and processors. In addition this qualification will prepare youth to be employee in industry or work as an entrepreneur. Main purpose is to prepare and train students through skill training and enable them to earn their living either through employment in industry or to be self-employed.

PURPOSE OF THE QUALIFICATION

The purpose of this qualification is to set high professional standards for Jewellery CAD-CAM trade. The specific objectives of developing these qualifications are as under:

- Fulfil workforce needs of Gems and Jewellery sector
- Improve the personal and professional competence
- Provide opportunities for recognition of skills attained through formal or informal pathways
- Improve the quality and effectiveness of training and assessment
- Provide opportunities to reduce unemployment ratio through aforesaid skills set

DATE OF VALIDATION

The National vocational qualification Level-3 on Jewellery CAD-CAM has been validated by the Qualifications Validation Committee on March 9 -10, 2020.

CODES OF QUALIFICATIONS

The International Standard Classification of Education (ISCED) is a framework for assembling, compiling and analyzing cross-nationally comparable statistics on education and training. ISCED codes for these qualifications are assigned as follows:

CODE	DESCRIPTION
0214JC006	National Vocational Certificate level 3 in Jewellery CAD-CAM

ENTRY REQUIREMENTS

The entry for National Vocational Certificate level 3, in Jewellery CAD-CAM is Middle grade or equivalent. Entry to assessment for this qualification is open.

QUALIFICATIONS DEVELOPMENT COMMITTEE

The Qualifications Development Committee consisted of following members:

Sr. No.	NAME	DESIGNATION & ORGANIZATION
1.	Muhammad Shoaib	Instructor, GJTMC
2.	Hafiz M. Shoaib	Research Assistant, LUMS
3.	Nadir Ejaz	Jewellery Designer
4.	Muhammad Umer	HOD, PIFD
5.	Taufeeque Ahmed	Meemo's Collection
6.	Farheen Agha	Jewellery Designer
7.	Khurram Riaz	CAD/CAM Trainer
8.	Bashir Agha	DACUM Facilitator
9.	Abdul Sattar Ahmed	Electroplating expert
10.	M. Abdullah Sattar	CEO, Roop Nikhar
11.	Rehan Sheikh	CAD/CAM Expert
12.	Farooq Mahmood Butt	
13.	Waqas Bin Saeed	Principal, PGJDC
14.	Muhammad Yasir	Deputy Director (Skills Standard & Curricula), NAVTTC
15.	Muhammad Ishaq	Deputy Director (HR), NAVTTC
16.	Muhammad Salman Butt	Executive Director, Espire Consult
17.	Munazza Tanveer	Freelance Consultant

QUALIFICATIONS VALIDATION COMMITTEE

The Qualifications Validation Committee consisted of following members:

Sr. No.	Name	Designation & Organization
1.	M. Usman Yousaf	Research Assistant LUMS
2.	Aftab Ahmed	Technical Instructor
3.	Muhammad Rehan Sami	Master Trainer PGJDC, Cadrix
4.	Tanzeel ur Rehman	3D Consortium
5.	Sanaullah Durrani	CEO/ Consultant Innovative Pioneers
6.	Rasheed Ray	RAY Gold Pakistan
7.	Muhammad Shoaib	Instructor, GJTMC
8.	Hafiz M. Shoaib	Research Assistant, LUMS
9.	Muhammad Umer	HOD, PIFD
10.	Taufeeque Ahmed	Meemo's Collection
11.	Khurram Riaz	CAD/CAM Trainer
12.	Bashir Agha	DACUM Facilitator
13.	Abdul Sattar Ahmed	Electroplating expert
14.	M. Abdullah Sattar	CEO, Roop Nikhar
15.	Muhammad Salman Butt	Executive Director, Espire Consult
16.	Munazza Tanveer	Freelance Consultant
17.	Sabeel Asghar Kiani	Technical Advisor, TVET Sector Support Programme
18.	Muhammad Naeem Akhtar	Senior Technical Advisor, TVET Sector Support Programme

REGULATIONS FOR THE QUALIFICATION AND SCHEDULE OF UNITS

CATEGORIZATION AND LEVELLING OF THE COMPETENCY STANDARDS

Code	Competency Standards	Level	Credits	Category
0214JC006A	Prepare Drawing of Basic Jewellery Article Manually	3	10	Technical
0214JC006B	Create Computer Aided Drawing of Basic Level Jewellery	3	20	Technical
0214JC006C	Create Computer Aided Drawing of Intermediate Level Jewellery	3	20	Technical
0214JC006D	Create Computer Aided Drawing of Advance Level Jewellery	3	20	Technical
0214JC006E	Produce Prototype of Jewellery Article using 3D Printer	3	10	Technical

PACKAGING OF QUALIFICATIONS

The national vocational qualifications are packaged as per following:

National Vocational Qualification Level-3 in Jewellery CAD-CAM
Prepare Drawing of Basic Jewellery Article Manually
Create Computer Aided Drawing of Basic Level Jewellery
Create Computer Aided Drawing of Intermediate Level Jewellery
Create Computer Aided Drawing of Advance Level Jewellery
Produce Prototype of Jewellery Article using 3D Printer

0214JC006A Prepare Drawing of Basic Jewellery Article Manually

Overview

This competency standard covers the skills and knowledge required to perform free hand sketching and drawing technical drawings of jewellery articles on required scale.

Competency Units	Performance Criteria
CU1: Perform Basic Sketching	**P1**. Develop size chart of jewellery article. **P2**. Draw outline sketch of basic jewelry article with free hand **P3**. Draw jewellery designs elements.
CU2: Draw Technical drawing of Jewelry Articles	**P1.** Develop size chart of jewellery article **P2**. Draw three views of the jewellery article **P3**. Draw cross sections. **P4**. Mark dimensions on the drawing **P5**. Add design elements to three views. **P6**. Draw drawing panel.

Knowledge and Understanding

The candidate must possess underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes;

- Sketching material
- Assorted lines
- Correct angle to hold pencil
- Variation of line and shape
- Sketching and drawing techniques
- Jewellery motif shapes
- Use of geometry tool set
- Shapes of gemstone and anatomy

- Wear ability of jewellery designs
- Orthographic projections of jewellery forms

Critical Evidence(s) Required

The candidate must present evidence of practical observations showing their ability to Prepare Drawing of Basic Jewellery Article Manually

They must also complete a knowledge assessment test (written or oral) together with a portfolio of evidence that shows their knowledge and understanding needed to Prepare Drawing of Basic Jewellery Article Manually. Further guidance is provided in the Assessment Evidence Guide for this Competency Standard.

List of Tools and Equipment

Sr. No.	Items
1.	Geometrical box
2.	Pencils HB/Clutch Pencils
3.	Eraser
4.	Stencils
5.	Templates
6.	Drawing sheet (A4,A3,A2)
7.	File Folder
8.	Steel Rule
9.	Drawing boards
10.	Paper cutter
11.	Sharpener

0214JC006B Create Computer Aided Drawing of Basic Level Jewellery

Overview

This competency standard covers the skills and knowledge required to work with the interface of Jewelry CAD software, create 2D drawing, create basic level jewellery articles and performing basic level rendering.

Competency Units	**Performance Criteria**
CU1: Setup interface of Jewelry CAD software	**P1**. Analyse jewellery article on measurements (Rings, Earing, Bangles and Pendants). **P2**. Set up canvas in CAD Jewellery software. **P3**. Scan and import image of manual 2D drawing if required.
CU2: Create 2D Drawings	**P1**. Draw three views of the jewellery article **P2.** Mark dimensions on the drawing **P3.** Add design elements to three views. **P4.** Draw cross sections
CU3: Create 3D Drawing	**P1.** Generate 3D surface using cross sections. **P2.** Place simple design components (Gemstone, metal inserts etc.) on jewellery article if required. **P3.** Assign material to 3D model and calculate weight of jewellery article and its components. **P4.** Create design report of jewellery article
CU4: Perform Basic level Rendering	**P1**. Prepare 3D model for presentation. **P2**. Apply preset parameters as per environment **P3**. Render 3D model

Knowledge and Understanding

The candidate must possess underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes;

- Computer hardware specification & operating system
- Computability & Installation of Jewellery CAD software
- Associated commands of Main & sub menus.
- Various 2D & 3D View ports
- Various shapes of jewellery motifs & articles
- Various 3D solid shapes by using Curve, Surface, Solid, Gems ,Edit ,Transform, Dimension, Layers Menus & tools
- Methods of precision and accuracy through menus & sub-menus
- Closed profile shapes and solid surfaces of Jewellery Article.
- Standard ring sizes, surfaces thickness gauge ,weight and Karat calculations
- Associated commands of Curve, Surface, Solid, Gems ,Edit, Tools ,Transform, Dimension & Layers- Menus
- Types of Stone Settings(Prongs, Flush , Bezel, Channel, Cluster settings)
- Various Jewellery Measuring instruments /tools (Ring Sizer ,Vernier Callipers, Wire gauge, Steel Rule)
- Precious & semi-precious metals and gems stone names, shapes & properties
- Rendering Phenomenon & Various Rendering Software
- Various Rendering tools and parameters
- Types of Picture file format and VGA resolutions.
- Various colours/tones of jewellery articles and gemstone according to metals and Karat respectively.

Critical Evidence(s) Required

The candidate must present evidence of practical observations showing their ability to Create Computer Aided Drawing of Basic Level Jewellery.

They must also complete a knowledge assessment test (written or oral) together with a portfolio of evidence that shows their knowledge and understanding needed to Create Computer Aided Drawing of Basic Level Jewellery. Further guidance is provided in the Assessment Evidence Guide for this Competency Standard.

List of Tools and Equipment

Sr. No.	Items
1.	Dedicated Computer Machine as per Jewellery Software Compatible.
2.	Operating system (MS Windows Pack)
3.	Jewellery CAD Design Software (Rhinoceros 3D,Gemvision Matrix)
4.	Digital Vernier Callipers
5.	Steel Ruler
6.	Wire Gauge
7.	Ring and Bangle Sizer
8.	Ring Conversion Chart
9.	Magnifying Glass/ Eye Loupe/ Glass Head Band magnifier
10.	A4 Papers
11.	Colour Printer

0214JC006C Create Computer Aided Drawing of Intermediate Level Jewellery

Overview

This competency standard covers the skills and knowledge required to create intermediate level Jewellery Article (Rings, Earing, Bangles and Pendants) and Perform Intermediate level Rendering.

Competency Units	Performance Criteria
CU1: Setup interface of Jewellery CAD software	**P1**. Analyse jewellery article on measurements (Rings, Earing, Bangles and Pendants). **P2**. Set up canvas in CAD Jewellery software.
CU2: Create 2D Drawing	**P1**. Scan and import image of manual 2D drawing if required. **P2**. Create 2D drawing.
CU3: Create 3D Drawing	**P1**.Generate 3D surfaces using rails cross sections etc. **P2**. Place intermediate level design components (Gemstone, metal inserts etc.) on jewellery article if required. **P3**. Assign material to 3D model and calculate weight of jewellery article and its components. **P4**. Create design report of jewellery article.
CU4: Perform Intermediate level Rendering and Animation	**P1**.Prepare 3D model for presentation. **P2**. Apply customized parameters as per environment P3.Render 3D model **P4**. Create animation of 3D Jewellery Article for presentation.

Knowledge and Understanding

The candidate must possess underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes;

- Jewellery Manufacturing Techniques
- Standard bangle and pendants sizes by using surfaces thickness/gauges.
- Various Jewellery Measuring instruments (Digital Vernier Callipers, Wire gauge, Steel Ruler, Ring & bangle size chart)
- Types of Stone Settings (Pave, Cluster, Tension setting) with standard gauge thickness
- Methods of material subtraction / addition associated with commands and tools
- Rendering Phenomenon & Various Rendering Software
- Various Rendering tools and parameters
- Types of Picture file format and VGA resolutions.
- Various colours/ tones of jewellery articles according to metals and Karat.

Critical Evidence(s) Required

The candidate must present evidence of practical observations showing their ability to Create Computer Aided Drawing of Intermediate Level Jewellery.

They must also complete a knowledge assessment test (written or oral) together with a portfolio of evidence that shows their knowledge and understanding needed to Create Computer Aided Drawing of Intermediate Level Jewellery. Further guidance is provided in the Assessment Evidence Guide for this Competency Standard.

List of Tools and Equipment

Sr. No.	Items
1.	Dedicated Computer Machine as per Jewellery Software Compatible.
2.	Operating system (MS Windows Pack)
3.	Jewellery CAD Design Software (Rhinoceros 3D,Gemvision Matrix)
4.	Paper Printer(Colour/Monochrome)
5.	A4 Papers

6.	File Folder
7.	Digital Vernier Callipers
8.	Steel Ruler
9.	Wire Gauge
10.	Ring Sizer
11.	Bangle Sizer
12.	Ring Conversion Chart
13.	Magnifying Glass/ Eye Loupe/ Glass Head Band magnifier

0214JC006D Create Computer Aided Drawing of Advance Level Jewellery

Overview

This competency standard covers the skills and knowledge required to create advance level jewellery article (Rings, Earing, Bangles, Pendants and Bracelets), perform advance level rendering, generating CAM file.

Competency Units	**Performance Criteria**
CU1: Setup interface of Jewellery CAD software	**P1.** Analyse jewellery article on measurements (Rings, Earing, Bangles, and Pendants etc.) **P2**. Set up canvas in CAD Jewellery software.
CU2: Create 2D Drawings	**P1**. Scan and import image of manual 2D drawing if required. **P2.** Create 2D Drawing **P3.** Draw rails and cross sections
CU3: Create 3D Drawing	**P1.** Generate 3D surfaces using rails, cross sections etc. **P2**. Place intermediate design components on jewellery article **P3**. Assemble different parts (links, hinges and findings etc.) of jewellery article. **P4**. Assign material to 3D model and calculate weight of jewellery article and its components. **P5**. Create design report of jewellery article.
CU4: Perform Advance Rendering and Animation	**P1**. Prepare 3D model for presentation. **P2**. Apply customized parameters **P3**. Create customized background image (s) / logo (s).

	P4. Create customized color of metal according to Karatage. **P5**. Create customized color of gems and pearls. **P6**. Assign color of Enameling film (if required). **P7**. Render 3D model. **P8**. Create advance level (object and camera) animation of 3D Jewellery Article for presentation.
CU5: Generate CAM file	**P1**. Ensure 3D solid model is water tight and excludes gems, naked edges, duplicate and open surfaces. **P2**. Export CAD file of 3D jewellery model according to CAM file format.

Knowledge and Understanding

The candidate must possess underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes;

- Types of Jewellery Manufacturing Techniques(2-tone , Filigree, Art work, Wire, Hatch, Texture)
- Various Jewellery Measuring instruments (Digital Vernier Callipers, Wire gauge, Steel Ruler, Ring & bangle size chart)
- Standard Sizes of Jewellery sets ,Choker, Hinges & Fittings to assemble jewellery parts
- Types of Stone Setting(Prongs, Bezel, Cluster ,Channel ,Pave, Tension, Flush, Bar , Illusion)
- Methods of material subtraction / addition associated with commands and tools.
- Wear ability of jewellery articles
- Various precious & semi-precious metals and gem stones names, shapes, weight and properties.
- Rendering Phenomenon & Various Rendering Software
- Various Rendering tools and parameters

- Types of Picture file format and VGA resolutions.
- Methods of customized Background.
- Various colours/tones of jewellery articles according to metals and Karat.
- Various colours of gems and pearls.
- Colour of Enamelling film
- Segregation of Curves, Gems, naked edges, open and duplicate surfaces.
- Validation of 3D CAD models
- CAM file format and resolution

Critical Evidence(s) Required

The candidate must present evidence of practical observations showing their ability to Create Computer Aided Drawing of Advance Level Jewellery.

They must also complete a knowledge assessment test (written or oral) together with a portfolio of evidence that shows their knowledge and understanding needed to Create Computer Aided Drawing of Advance Level Jewellery. Further guidance is provided in the Assessment Evidence Guide for this Competency Standard.

List of Tools and Equipment

Sr. No.	Items
1.	Dedicated Computer Machine as per Jewellery Software Compatible.
2.	Operating system (MS Windows Pack)
3.	Jewellery CAD Design Software (Rhinoceros 3D,Gemvision Matrix, Materialize Magics for CAM)
4.	Paper Printer (Colour/Monochrome)
5.	A4 Papers
6.	File Folder
7.	Digital Vernier Callipers
8.	Steel Ruler
9.	Wire Gauge

10.	Ring Sizer
11.	Bangle Sizer
12.	Ring Conversion Chart
13.	Magnifying Glass/ Eye Loupe/ Glass Head Band magnifier

0214JC006E Produce prototype of jewellery article using 3D Printer

Overview

This competency standard covers the skills and knowledge required to identify personal hazards at work place, Prepare CAM file for 3D printing (rapid prototyping) and Printing 3D jewellery model on CAM machine.

Competency Units	Performance Criteria
CU1: Identify personal hazards at work place	**P1.** Identify hazards and risks at work place **P2.** Identify risk control measures. **P3.** Segregate hazardous or non-hazardous wastes as per approved procedure. **P4.** Use personal protective equipment according to risk at workplace.
CU2: Prepare CAM file for 3D Printing (Rapid Prototyping)	**P1**. Import CAM file into printable format in CAM software **P2**. Fix surface errors of CAM file. **P3**. Generate support of 3D Jewellery model. **P4**. Determine estimated production time, Weight & shrinkage of 3D jewellery model in printing material.
CU3: Print 3D Jewellery model on CAM machine	**P1**. Set parameters of CAM machine **P2**. Load printable liquid (Resin) considering minimum & maximum level. **P3**. Align and arrangement of multiple 3D jewelry models on machine platform **P4**. Build the job on CAM machine.

Knowledge and Understanding

The candidate must possess underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes;

- Hazards ,Exposure and Risks
- Personal protection and safety equipment.
- Safety signs and symbols
- Safety related standards operating procedures/guidelines , best practices
- Waste disposal methods of hazardous substances.
- Various CAM file formats for 3D printer
- Types of surfaces errors in 3D Jewellery Model
- Reduce file size according to geometry of 3D Jewellery Model
- Method of Support generation according to surface Anatomy
- Method for Calculating estimated Production Time, Shrinkage, Weight / Volume.
- Specification and parameters of 3D Printer for production
- Methods of Supports removing and Curing of 3D printed Models
- Supporting Equipment ,Apparatus and consumables for production of 3D Printed Models

Critical Evidence(s) Required

The candidate must present evidence of practical observations showing their ability to produce prototype of jewellery article using 3D Printer.

They must also complete a knowledge assessment test (written or oral) together with a portfolio of evidence that shows their knowledge and understanding needed to produce prototype of jewellery article using 3D Printer. Further guidance is provided in the Assessment Evidence Guide for this Competency Standard.

List of Tools and Equipment

Sr. No.	Items
1.	3D Printer (Jewellery Specific) with accessories
2.	Computer Machine Compatible to CAM software
3.	Operating System (MS Windows Pack)

4.	Model Repair Software (Magics, Nettfab, MeshLab, 3D Builder etc.)
5.	CAM Software
6.	Personal protective equipment
7.	Ultrasonic Cleaner
8.	UV-Curing Unit
9.	Weighing Scale Machine (0-50 gm)
10.	Air Blower (with regulator and nozzle
11.	Digital Vernier Callipers
12.	Steel Rule

LIST OF TOOLS AND EQUIPMENT

Sr. No.	Items
1.	3D Printer (Jewellery Specific) with accessories
2.	Air Blower (with regulator and nozzle)
3.	Bangle Sizer
4.	CAM Software
5.	Colour Printer
6.	Computer Machine Compatible to CAM software
7.	Computer Machine as per Jewellery Software Compatibility
8.	Digital Vernier Callipers
9.	Drawing boards
10.	Eraser
11.	Geometrical box
12.	Jewellery CAD Design Software (Rhinoceros 3D, Gemvision Matrix, Materialize Magics for CAM)
13.	Magnifying Glass/ Eye Loupe/ Glass Head Band magnifier
14.	Model Repair Software (Magics, Nettfab, MeshLab, 3D Builder etc.)
15.	Monochrome Printer
16.	Paper cutter
17.	Personal protective equipment
18.	Ring Sizer
19.	Ring Conversion Chart

20.	Steel Ruler
21.	Stencils
22.	Ultrasonic Cleaner
23.	UV-Curing Unit
24.	Weighing Scale Machine (0-50 gm)
25.	Wire Gauge

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