NATIONAL COMPETENCY STANDARDS
FOR
DIGITAL FABRICATION TECHNICIAN
(CERTIFICATE 3)

MANUFACTURING SECTOR

FOREWORD

The TVET Quality Council, BQPCA, is pleased to present the National Competency Standards (NCS) for Digital Fabrication Technician, Certificate 3, developed in collaboration with industry experts and trainers. These standards establish a nationally recognized qualification aligned with international best practices, setting a benchmark for TVET qualifications in Bhutan.

The NCS ensures that trainees acquire the necessary skills, knowledge, and attitude required by industries. Developed through close consultation with experts, it enhances the relevance of training to labor market needs, equipping graduates to meet industry expectations and improving their employability. A strong and responsive TVET system will also make vocational education more attractive to youth.

The Council acknowledges the valuable contributions of industry experts and trainers in the development of these standards. We urge employers and training providers to continue their support in implementing the NCS, fostering a skilled and productive workforce that contributes to national socio-economic development. Moving forward, we look forward to enhanced industry engagement and collaborative efforts in building a quality-assured, demand-driven TVET system.
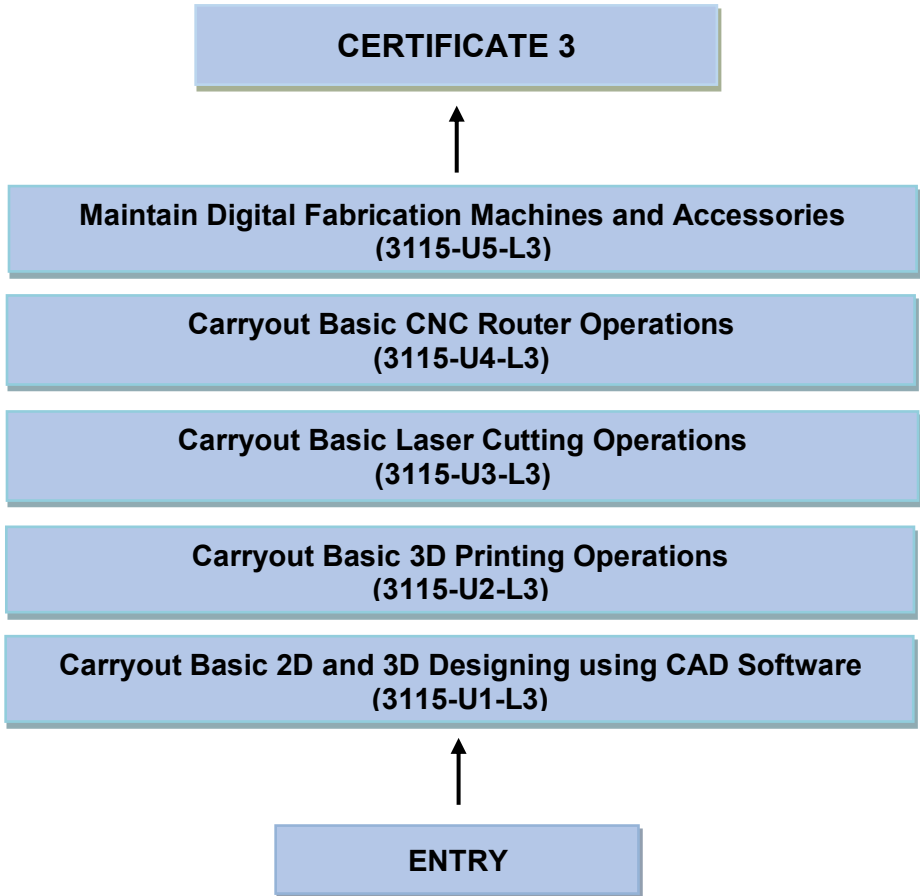

Director
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ACKNOWLEDGEMENT

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PACKAGING OF QUALIFICATIONS

CERTIFICATE 3

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Maintain Digital Fabrication Machines and Accessories (3115-U5-L3)

Carryout Basic CNC Router Operations (3115-U4-L3)

Carryout Basic Laser Cutting Operations (3115-U3-L3)

Carryout Basic 3D Printing Operations (3115-U2-L3)

Carryout Basic 2D and 3D Designing using CAD Software (3115-U1-L3)

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ENTRY

OVERVIEW OF THE NCS

Unit Title	Element of Competence
1. Carryout Basic 2D and 3D Designing using CAD Software	1. Create Basic 2D Digital Model 2. Create Basic 3D Digital Models 3. Perform file processing
2. Carryout Basic 3D Printing Operations	1. Prepare 3D printer for operation 2. Execute 3D Printing Jobs 3. Perform post-processing on 3D printed parts
3. Carryout Basic Laser Cutting Operations	1. Prepare for laser cutting 2. Perform Laser Cutting Operations 3. Finish and Assemble Laser-cut Components.
4. Carryout Basic CNC Router Operations	1. Set up CNC machines for milling/cutting. 2. Perform Basic CNC machining operations. 3. Inspect and finish CNC-machined parts.
5. Maintain Digital Fabrication Machines and Accessories	1. Prepare for maintenance works 2. Maintain 3D Printer 3. Maintain Laser Cutting Machine 4. Maintain CNC Router Machine

UNIT TITLE	Carryout Basic 2D and 3D Designing using CAD Software
DESCRIPTOR	This unit contains competencies required to carryout basic 2D and 3D Designing using CAD software.
CODE	3115-U1-L3
ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Create Basic 2D Digital Models	1.1. Install designing software 1.2. Create 2D sketch 1.3. Modify 2D sketches
2. Create Basic 3D Digital Models	2.1. Install designing software 2.2. Design 3D model 2.3. Assemble 3D models
3. Perform file processing	3.1. Convert *files* 3.2. Compress files 3.3. Archive files

RANGE STATEMENT
Files may include but not limited to:

• STL (3D) • SVG (2D)	• DXF (2D)

Critical Aspects
• Follow Safety at workplace • Follow standard procedure for all the tasks • Create 2D sketches • Design 3D models

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
• Ethics and Integrity • Occupational Health and Safety regulations • Basic first Aid • Digital Design Ecosystem Overview • Importance of Design Constraints and Machine Compatibility • Intellectual Property and Digital Design Ethics • Design File Integrity and Format Suitability • Material Behavior from a Design Standpoint • Future Trends and Emerging Tools in Digital Design	• Team Work • Communication • Problem Solving • Interpersonal Relationship • Time Management • Innovation

UNIT TITLE	Carryout Basic 3D Printing Operations
DESCRIPTOR	This unit contains competencies required to carryout basic 3D printing operations
CODE	**3115-U2-L3**
ELEMENTS OF COMPETENCE	**PERFORMANCE CRITERIA**
1. Prepare 3D printer for operation	1.1. Select and use **PPEs** as per the job requirement 1.2. Select **Tools and Equipment** as per the job requirement 1.3. Select **Materials** as per the job requirement 1.4. Calibrate print bed and nozzle height for best print quality 1.5. Load and change filaments as per the job requirement 1.6. Configure temperature and cooling settings as per the job requirement.
2. Execute 3D Printing Jobs	2.1. Slice models with correct **settings** as per the job requirement 2.2. Monitor print progress and intervene if errors occur 2.3. Remove finished prints safely without damage

3.	Perform post-processing on 3D printed parts.	3.1 Remove supports and clean surfaces
		3.2 Apply sanding, priming, or painting techniques as per the job requirement
		3.3 Assemble multi-part printed components as per the job requirement

RANGE STATEMENT

PPEs may include but not limited to:

- Safety Boot
- Work Dress
- Safety Gloves
- Mask

Tools and Equipment may include but not limited to:

- Scrapper
- Sandpaper
- Snippers
- Files
- Tweezer
- Cleaning tools

Settings may include but not limited to:

- Layer Height
- Speed
- Infill
- Temperature

Critical Aspects

- Follow Safety practices at workplace
- Follow standard procedure for all the tasks
- Calibrate print bed and nozzle height
- Slice models with appropriate settings

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
• Ethics and Integrity • Occupational Health and Safety regulations • Basic first Aid • 5S Pillars • Material Science fundamentals • Machine Mechanics and Electronics • Software and firmware concepts • Industry standards and compliance • Emerging technologies	• Team Work • Communication • Problem Solving • Interpersonal Relationship • Time Management • Innovation

UNIT TITLE	**Carryout Basic Laser Cutting Operations**
DESCRIPTOR	This unit covers competencies required to carryout laser cutting operations following standard procedure.
CODE	**3115-U3-L3**
ELEMENTS OF COMPETENCE	**PERFORMANCE CRITERIA**
1. Prepare for laser cutting	1.1 Select and use required ***Personal Protective Equipment (PPE)*** as per the Job requirement following standard procedures 1.2 Select and use required ***tools and equipment*** as per the job requirement following standard procedures 1.3 Import and position vector designs in laser software as per the job requirement 1.4 Select correct power/speed settings as per the material 1.5 Perform test runs to optimize results.
2. Perform Laser Cutting Operations	2.1 Load materials and adjust focus as per the job requirement 2.2 Monitor cutting/engraving to prevent hazards 2.3 Handle flammable materials with precautions

3. Finish and Assemble Laser-Cut Components.	3.1 Remove residues (charring, adhesive backings).
	3.2 Assemble parts using joining techniques as per the job requirement
	3.3 Ensure final product meets the design requirement

RANGE STATEMENT	
PPEs may include but not limited to:	
● Safety shoes	● Mask
● Work dress	● Safety Gloves
● Safety Goggles	● Ventilation
● Fire extinguisher	
Tools and equipment may include but not limited to:	
● Focusing tools	● Allen key set
● Measuring instruments	● Cleaning tools
● Weights	● Hand tool Set

Critical Aspects
● Follow safety practices at workplace
● Follow standard procedure for all the tasks
● Select correct power/speed settings for material.
● Adjust focus as per the job requirement.

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
• Ethics and Integrity • OHS regulations • Basic first Aid • Laser Physics & Optics • Material Science • Machine Calibration • Industrial Safety & Compliance • Emerging Technologies	• Team Work • Communication • Problem Solving • Interpersonal Relationship • Time Management • Innovation

UNIT TITLE	Carryout Basic CNC Router Operations
DESCRIPTOR	This unit covers competencies required to arryout basic CNC router operations following standard procedure.
CODE	**3115-U4-L3**
ELEMENTS OF COMPETENCE	**PERFORMANCE CRITERIA**
1. Set up CNC machines for milling/cutting.	1.1. Select and use required ***PPEs*** as per the Job requirement following standard procedures 1.2. Select and use required ***tools and equipment*** as per the job requirement following standard procedures 1.3. Secure workpiece and select correct cutting tools 1.4. Generate toolpath/G-code as per the job requirement 1.5. Load and verify G-code programs as per the job requirement 1.6. Set work offsets and tool lengths.
2. Perform Basic CNC machining operations.	2.1. Run simulations to detect errors 2.2. Monitor machining process and adjust feed/speed as needed 2.3. Perform tool changes when required

3. Inspect and finish CNC-machined parts.	3.1. Measure dimensions using calipers/gauges.
	3.2. Deburr and polish machined edges.
	3.3. Verify that the machined parts meet the design specifications

RANGE STATEMENT

PPEs may include but not limited to:

● Safety shoes	● Mask
● Goggles	● Safety Gloves
● Ear Muff	● Work dress

Tools and Equipment may include but not limited to:

● Clamps	● Wrench Set
● Measuring tools	● Finishing tools
● Cleaning tools	● Drill Set

Critical Aspects

- Follow safety practices at workplace
- Follow standard procedure for all the tasks
- Generate toolpath/G-code
- Select correct cutting tools

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
- Ethics and Integrity - Occupational Health and Safety regulations - Basic first Aid - CNC Machine Mechanics & Kinematics - Cutting Tool Engineering - Metallurgy & Material Behavior - G-Code & CAM Theory - Precision & Metrology - Industrial Safety & Compliance - Emerging Technologies	- Team Work - Communication - Problem Solving - Interpersonal Relationship - Time Management - Innovation

UNIT TITLE	Maintain Digital Fabrication Machines and Accessories
DESCRIPTOR	This unit covers competencies required to maintain digital fabrication machines and accessories.
CODE	3115-U5-L3
ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Prepare for maintenance works	2.1. Select and use **PPEs** as per the job requirement following standard procedure. 2.2. Select **Tools and Equipment** as per the job requirement following standard procedure. 2.3. Select **Materials** as per the job requirement following standard procedure. 2.4. Prepare and follow maintenance plan for the machines
2. Maintain 3D Printer	2.1. Clean nozzle, extruder, and build surface as per the maintenance plan 2.2. Calibrate printer components 2.3. Lubricate and inspect moving parts 2.4. Replace extruders, nozzles, or bed surfaces based on the job requirement
3. Maintain Laser Cutting Machine	3.1 Lubricate rails and guides as per the maintenance plan 3.2 Clean lens, mirror and machine bed

	3.3 Test safety features
	3.4 Inspect belts and pulleys
	3.5 Check and Clean exhaust system
4. Maintain CNC Router Machine	4.1 Clean and lubricate the machine parts as per the maintenance plan
	4.2 Test Emergency Stop & Safety Features
	4.3 Check belt tension and pulleys
	4.4 Inspect and maintain cutting tools
	4.5 Check and Clean exhaust system

RANGE STATEMENT

PPEs may include but not limited to:

- Safety boot
- Hand gloves
- Face Mask

- Goggles
- Work dress
- Ear Muff

Tools and Equipment may include but not limited to:

- Hand tool set
- Oil Can
- Cleaning tools

- Pliers
- Vacuum cleaner
- Tweezer

Materials may include but not limited to:

• Lubricants	• Cleaning agents
• Microfiber cloth	

Critical Aspects

- Follow Safety at workplace
- Follow standard procedure for all the tasks
- Prepare and follow maintenance plan

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
• Ethics and Integrity • Occupational Health and Safety regulations • Basic first Aid • Mechanical Systems Theory • Electronics & Control Systems • Types of Maintenances • Failure Root Cause Analysis • Industry Standards & Compliance • Emerging Technologies	• Team Work • Communication • Problem Solving • Interpersonal Relationship • Time Management • Innovation

ANNEXURE

National Competency Standards (NCS)

The National Competency Standards specify the skill, knowledge and attitudes applied to a particular occupation. Standards also specify the standards or criteria of performance of a competent worker and the various contexts in which work may take place. Standards provide explicit advice to assessors regarding the skill and knowledge to be demonstrated by candidates seeking formal recognition either following training or through work experience.
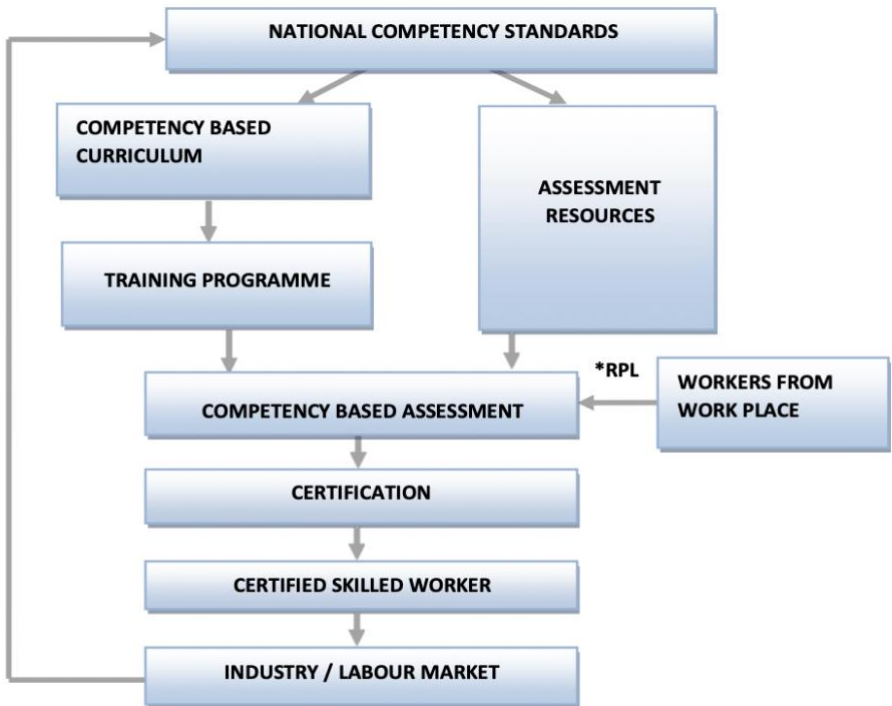
Purpose of National Competency Standards

National Competency Standards serve a number of purposes including:

- Providing advice to curriculum developers about the competencies to be included in the curriculum.
- Providing specifications to assessment resource developers about the competencies within an occupation to be demonstrated by candidates.
- Providing advice to industry/employers about job functions, which in turn can be used for the development of job descriptions, performance appraisal systems and work flow analysis.

Bhutan Qualifications Framework (BQF)

Bhutan Qualifications Framework is an integrated national framework that outlines all types of qualification in Bhutan. As an established and nationally accepted instrument, the BQF has been benchmarked against international practices in terms of standards. The BQF aims to recognize all forms of learning systems, including formal, non-formal, and informal learning. It acknowledges technological advancements and recognizes contemporary modes of delivery. It covers a broad range of education systems including the TVET education.

Implementation of TVET Qualifications

* RPL = Recognition of Prior Learning

TVET Qualifications Levels

TVET Qualifications have seven levels as per the BQF as follows:

Bhutan Qualifications Framework 2023

Table 2: Qualification Types and Levels Based on Education Sector.

BQF Level	Community Education	School Education	TVET	Higher Education	Monastic Education
8				Doctoral Degree	*Khewang* མཁས་དབང་།
7			Master's Degree Postgraduate Diploma Postgraduate Certificate	Master's Degree Postgraduate Diploma Postgraduate Certificate	*Tsugla Gongma* གཙུག་ལག་གོང་མ།
6			Applied Degree	Bachelor's Degree Bachelor's Degree (Honours) Graduate Diploma Graduate Certificate	*Tsugla Wogma* གཙུག་ལག་འོག་མ།
5			Advanced Diploma	Advanced Diploma	
4			Diploma	Diploma	
3		Bhutan Higher Secondary Education Certificate	Certificate 3		*Dringrim Gongma* འབྲིང་རིམ་གོང་མ།
2		Bhutan Certificate for Secondary Education	Certificate 2		*Dringrim Barma* འབྲིང་རིམ་བར་མ།
1	ALC		Certificate 1		

Level Descriptors

The TVET Qualification levels are set based on the level descriptors, as defined in the BQF. The detail of the qualification level descriptor is as follow:

Level	Knowledge Knowledge that is:	Skills Demonstrate skills that involve:	Values Demonstrate values that involve:	Application Applied in contexts that involve:
4	Broad theoretical, technical and operational	Selecting and applying a range of standard processes relevant to varied and sometimes unpredictable tasks Selecting and applying a range of solutions involving formulation of solutions to resolve complex issues Demonstrating a high level of proficiency in English and Dzongkha	Strong level of awareness of self and others; and an appreciation of belief system, role of social norms, and the importance of relationship building Application of ethical norms and legal rules in decision-making; and comprehending the correlation between values and behavior Commitment to own profession and quality of work	Stable tasks with predictable changes Broad guidance with some self-direction that requires sound judgement Taking some responsibility for planning and coordination with others
3	Theoretical with some technical and operational processes	Applying a range of standard processes to known but varied tasks Selecting and applying a range of solutions to	Sound level of self-awareness and beliefs; and ability to apply social norms and build relationships	Stable tasks with some aspects of change General guidance and supervision that require

		familiar and unfamiliar problems Communicating effectively and clearly, both oral and written, in both English and Dzongkha	Application of a set of ethical norms Commitment to own field of interest and apply self- management of learning and performance	discretion and judgement Adapting to own behaviour to work with others
2	Basic, factual and conceptual	Applying standard processes relevant to carry out known tasks Applying a set of known solutions to solve simple and straightforward issues Using simple and direct exchange of information on familiar and routine matters Developing basic proficiency in Dzongkha and English	Some level of self-awareness and beliefs, and appreciation of social norms; and significance of relationships Awareness of ethical norms, and openness to different activities Developing own knowledge and skills	Structured and stable tasks General support and Supervision that require some discretion and judgement Collaboration with others to achieve goals
1	Foundational, every day and general	Applying operational literacy, numeracy skills required to carry out simple tasks Applying simple solutions to solve simple and straightforward everyday issues Communicating using everyday expressions and simple phrases in	Basic awareness of self, beliefs, and social norms; and understand the significance of relationships Basic awareness of fundamental ethical norms, basic civil rights, and responsibilities Willingness to understand tasks and motivated to	Highly structured tasks with close support and supervision Minimal Discretion and judgement Readiness to work together and share knowledge with others

		Dzongkha and English	implement them successfully	

CODING USED FOR NATIONAL COMPETENCY STANDARDS
The coding and classification system developed in Bhutan is logical, easy to use, and also aligned with international best practices. The Bhutanese coding and classification system is based on the International Standard Classification of Occupations, 2008 (ISCO-08) developed by the International Labour Organisation (ILO).The coding of the National competency standards forms the basis of the identification code for the Technical & Vocational Education and Training Management Information System (TVET – MIS) both in terms of economic sector identification and that of the individual standard.
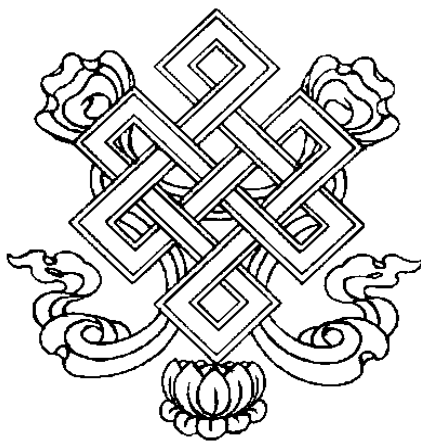
Coding the individual national competency standards

Coding the individual skills standard has a multiple purpose:
● to identify the level,
● to identify to which module the standard belongs,
● to identify in which order the standard is clustered within that module.
A job can include a number of competencies described in the national competency standards.

However, in order to follow a logical order, only national competency standards related to each other and following a logical sequence in terms of training delivery, from the simple to the complex, are clustered into a module. Some standards are so complex that they need to stand alone.

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