NATIONAL COMPETENCY STANDARDS FOR INDUSTRY ELECTRICAL TECHNICIAN (CERTIFICATE 3)

TVET QUALITY COUNCIL
BHUTAN QUALIFICATIONS AND PROFESSIONALS CERTIFICATION AUTHORITY
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FOREWORD

The TVET Quality Council, BQPCA is pleased to present the National Competency Standards (NCS) for INDUSTRY ELECTRICAL TECHNICIAN BQF Certificate 3, which is developed in consultation with the field experts and trainers. The main objective of developing National Competency Standards is to set up a well-defined nationally recognized TVET Qualifications that will help in setting a benchmark for the TVET Qualifications in our country aligned to the international best practices.

The standards are developed to ensure that the TVET trainees possess the desired Skills, Knowledge and Attitude required by the industries. In order to ensure the relevancy of the competencies, the standards are developed in close consultation and partnership with industry experts and trainers from training institutes.

A training system based on National Competency Standards shall ensure that the training is relevant to the needs of the labour market. As a result, future TVET trainees will be better skilled to meet the needs and expectations of industries and employers. Such a positive impact on the employability of TVET graduates will enhance the reputation of the TVET system and make it attractive to the youths.

While acknowledging the existing level of cooperation and collaboration, the Council earnestly requests employers and training providers to extend the fullest support and cooperation in development and implementation of the National Competency Standards. The ultimate objective is to build a competent and productive national workforce that will contribute to the socio-economic development of our country.

We gratefully acknowledge the valuable contributions made by experts from industries and trainers during the consultation and validation processes of the NCS development. We further look forward to improved industry engagement and active participation of trainers in the development of a quality-assured demand driven TVET system.

Director
BQPCA

ACKNOWLEDGEMENT

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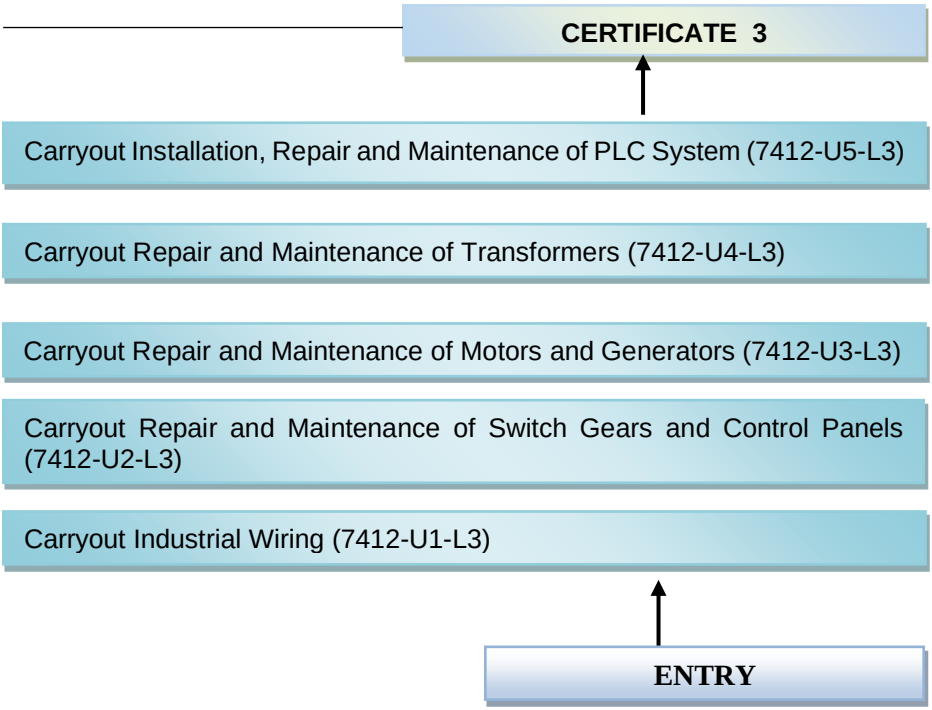
PACKAGING OF QUALIFICATIONS



OVERVIEW OF NATIONAL COMPETENCY STANDARDS

Unit Title	Element of Competence
1. Carryout Industrial Wiring	1.1 Prepare to Perform Industrial Wiring 1.2 Perform Industrial Wiring 1.3 Perform Repair and Maintenance of Industrial Electrical Wirings
2. Carryout Repair and Maintenance of Switch Gears and Control Panels	2.1 Diagnose the Faults of Switch Gears and Control Panels 2.2 Perform Repair and Maintenance of Switch Gears and Control Panels
3. Carryout Repair and Maintenance of Motors and Generators	3.1 Diagnose the Faults of Motors and Generators 3.2 Perform Repair and Maintenance of Motors and Generators
4. Carryout Repair and Maintenance of Transformer	4.1 Diagnose the Faults of Transformer 4.2 Perform Repair and Maintenance of Transformer
5. Carryout Installation and Maintenance of PLC System	5.1 Perform Installation of appropriate programmable logic control system 5.2 Perform Repair and Maintenance of Programmable Logic Control System

UNIT TITLE	Carryout Industrial Wiring
DESCRIPTOR	This unit describes the competencies required to prepare for industrial wiring and perform industrial wiring following standard procedures at all times
CODE	7412-U1-L3
Credit	5
ELEMENTS OF COMPETENCE	**PERFORMANCE CRITERIA**
1. Prepare to Carryout Industrial Wiring	1.1 Select and use ***personal protective equipment (PPE***) as per the job requirement following standard procedure 1.2 Select and use required ***tools and equipment*** as per the job requirement following standard procedure 1.3 Select and use required ***materials*** as per the job requirement following standard procedure 1.4 Interpret ***industrial wiring drawing and design*** as per the job requirement following standard procedure

2. Perform Industrial Wiring	2.1 Execute industrial wiring for lighting as per the drawing following standard procedures 2.2 Execute industrial wiring for power circuit as per the drawing following standard procedure 2.3 Execute industrial wiring for ***control circuit*** as per the drawing following standard procedure 2.4 Conduct test of industrial wiring circuit as per the standard procedure
3. Perform Repair and Maintenance of Industrial Wiring	3.1 Diagnose the wiring faults as per the job requirement following standard procedure 3.2 Replace/Repair the ***faulty components*** following standard procedure 3.3 Conduct ***test*** of the industrial wiring as per the standard procedures

RANGE STATEMENT	
Personal protective equipment may include but not limited t	
• Safety Glove • Safety Helmet • Safety Boot / Gum Boot • Fire Extinguisher • Uniform	• Safety Goggle • Ear Muff • Respiratory Mask • Safety Belt • Reflector Jacket

Tools and equipment may include but limited to:	
• Cables and Wires • Control and Protective Switchgear(s) • Insulation resistance (IR) Tester • Cleaning Agents and Cotton • Insulation Tester	• Electrician Tool Set • Mechanical tool Set • Multi-Meter • Breakdown Voltage Test Kit
Materials may include but not limited to:	
• Contactor • Relay • Wires and Cables • Push Buttons • Distribution Box	• Timer • Lug • Indicator • Sensor • Bus Bar
Industrial wiring drawing and design may include but not limited to:	
• Lighting • Power and	• Control Circuit
Control Circuit may include but not limited to:	
• Switch Gears • Line Indications • Timers	• Metering Device • Motor Control
Faulty Components may include but not limited to:	
• Capacitor • Resistor • Transistor • Diode	• Transformer • Fuse • Indicator • MCB

Test may include but not limited to:	
• Functional • Short Circuit • Earthing Test	• Continuity • IR Test
Critical Aspects	
• Select and use personal protective equipment (PPE) as per the job requirement following standard procedures • Interpret industrial wiring drawing and design as per the job requirement following standard procedures • Perform different types of industrial wiring work and test industrial wiring circuit as per the standard procedures	

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
• Ethics and Integrity • OHS Rules and Regulation • Basic First Aid • Relevant Rules and Regulations • Types and sizes of cables • Cable trench and trays routing • Types of jointing • Types of lugs • Basic estimation and costing • Record keeping and reporting • 5S Pillars	• Team Work • Communication • Problem Solving • Interpersonal Relationship • Creativity • Time Management

UNIT TITLE	**Carryout Repair and Maintenance of Switch Gears and Control Panels**
DESCRIPTOR	This unit covers the competencies required to diagnose the faults and perform repair and maintenance of switch gears and control panels following standard procedures at all times
CODE	**7412-U2-L3**
CREDIT	**10**
ELEMENTS OF COMPETENCE	**PERFORMANCE CRITERIA**
1. Diagnose the Faults in Switch Gears and Control Panels	1.1 Select and use required ***Personal Protective Equipment*** as per the job requirement following standard procedure 1.2 Select and use ***tools and equipment*** as per the job requirement following standard procedure 1.3 Identify ***faults*** in switch gears and control panels following standard procedure
2. Perform Repair and Maintenance of Switch Gear and Control Panels	2.1 Disassemble the switchgear and control panels as per the job requirement following standard procedure 2.2 Replace/Repair defective ***switchgea***r and ***control panel components*** as per the job requirement following standard procedure

	2.3 Execute ***servicing*** of switch gears and control panels as per the job requirements following standards procedure 2.4 Reassemble the ***Switch gears and control panel components*** as per the job requirement following standard procedure 2.5 Adjust required setting of relay, timer and breaker (contact gap) as per the manufacturer's instructions and specifications 2.6 Conduct ***test*** and commissioning of the switch gears and control panels following standard procedure

RANGE STATEMENT	
Personal Protective Equipment may include but not limited to:	
• Safety gloves • Safety helmet • Safety goggles • Safety boot • Uniform	• Dust Masks • Apron • Ear muff • Respiratory mask • Safety belt
Tools and Equipment may include but not limited to	
• Cables and wires	• Electrician tool set • Mechanical tool set

• Control and protective switchgear(s) • Insulation resistance tester • Cleaning agents and cotton • Phase sequence meter • Forward reverse starter	• Multi-meter • Bracket and board • Crimping tool • Direct on line (DOL) starter • Star-delta starter
Faults may include but not limited to:	
• Leakages • Breakages	• Short circuits
Switchgear and Control Panel components may include but not limited to:	
• Lightning Arrestor • Contact kits • Coils • Relays • Contactors • Circuit Breaker • Fuse	• Thermostats • Push button • Indicator lamp
Servicing may include but not limited to:	
• Adding Lubricants • Cleaning • Painting	• Tightening of nuts and bolts • Checking Alignment
Test may include but not limited to:	
• Continuity	• IR Test
Critical Aspects	

- Select and use required Personal Protective Equipment as per the job requirement following standard procedure
- Troubleshoot to identify the faults of switch gears and control panels following standard procedure
- Perform test and commissioning of the switch gears and control panels following standard procedure

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
• Ethics and Integrity • OHS rules and regulations • Basic First Aid • Circuit diagrams/ wiring diagram and manufacturer's specifications • Service manuals • Types of electrical tools and measuring instrument • Types of Switch Gear(s) • Principle of operation of circuit breakers and their applications • Types of wires, cables and their rating • Related trade theory • Common faults in switch gears • Relays • Importance of testing and periodic inspection of switchgear(s) • Troubleshooting and repair Procedures of switchgear(s)and control panel • Basic fundamentals of Programmable Logic Controller (PLC)	• Team Work • Communication • Problem Solving • Interpersonal Relationship • Creativity • Time Management

• PID Controller Basic field instruments (Resistance Temperature Detector (RTD,) Thermo couple, Pressure switch, Transducers) • 5S Pillars	

UNIT TITLE	Carryout Repair and Maintenance of Motors and Generators
DESCRIPTOR	This unit covers the competencies required to diagnose and perform repair and maintenance of faults in motors and generators following standard procedures at all times
CODE	7412-U3-L3
CREDIT	10
ELEMENTS OF COMPETENCE	**PERFORMANCE CRITERIA**
1. Diagnose the Faults in Motors and Generators	1.1 Select and use required ***tools and equipment*** as per the job requirement following standard procedure 1.2 Select and use ***PPE*** as per the job requirement following standard procedure 1.3 Identify the ***faults*** in motors and generators as per the job requirement following standard procedure
2. Perform Repair and Maintenance of Motors	2.1 Dismount the motors as per the job requirement following standard procedure 2.2 Disassemble the motors as per the job requirement following standard procedure 2.3 Service components as per the job requirement following standard procedure

	2.4 Repair/Replace the faulty motor components as per the job requirement following standard procedure 2.5 Execute motor rewinding as per the job requirement following standard procedure 2.6 Reassemble the ***motor components*** as per the job requirement following standard procedure 2.7 Conduct ***Test*** of motors as per the job requirements following standard procedure
3. Perform Repair and Maintenance of Generators	3.1 Disassemble the ***generator components*** as per the job requirement following standard procedure 3.2 Service the generator components as per the job requirement following standard procedure 3.3 Replace the faulty components of generator as per the job requirement following standard procedure 3.4 Reassemble the generator components as per the job requirement following standard procedure 3.5 Conduct test of generators as per the job requirements following standard procedure

RANGE STATEMENT
Tools and Equipment may include but not limited to:

• Electrician tool set • Tachometer • Insulation tester • Insulation resistance (IR) tester • Phase sequence meter • Multi-meter	• Mechanical tool set • Pulley puller / pusher • Bearing puller / pusher • Work bench • Cleaning agents and cotton • Temperature gun
Personal Protective Equipment (PPE) may include but not limited to:	
• Safety gloves • Safety helmet • Safety goggle • Ear muff • Safety boot	• Respiratory mask • Safety belt • Uniform
Faults may include but not limited to:	
• Loose connection • Burnt • Insulation failure • Improper settings • Worn out bearing housing	• Leakages • Breakages • Improper Phase sequence • Improper alignment • Discharge battery (s)
Motor components may include but not limited to:	
• Windings • Capacitor • Cooling system components	• Bearings • Insulators • Terminals
Generator components may include but not limited to:	
• Carbon brush • Bearings • Cooling system components • Rectifiers	• Windings • Couplings • Commutators • Slip-rings

Test may include but not limited to:	
• Load test • IR test	• Short circuit test • Open circuit test
Critical Aspects	
• Select and use ***PPE*** as per the job requirement following standard procedure • Perform motor rewinding as per the job requirement following standard procedure • Test motors and generator as per the job requirement following standard procedure	

UNDERPINNING KNOWLEDGE	**UNDERPINNING SKILLS**
• Ethics and Integrity • OHS rules and regulations • Basic First Aid • Motor/Generator specifications • Fundamental of electrical rotating machines • Type of motors and its construction • Working principles of motors and generator • Types of measuring and testing instruments • Common faults in motors / generator • Troubleshooting method • Types of switchgear(s) and accessories used in motors and generator • Record keeping and reporting • Starting methods of motors • Basic fundamentals of electricity	• Team Work • Communication • Problem Solving • Interpersonal Relationship • Creativity • Time Management

● Preventive maintenance work on motors and generator ● Fire precautions ● Types of Backup supply ● 5S Pillars	

UNIT TITLE	Carryout Repair and Maintenance of Transformer
DESCRIPTOR	This unit covers the competencies required to diagnose the faults, perform repair and maintenance of transformer following standard procedures at all times
CODE	7412-U4-L3
CREDIT	10
ELEMENTS OF COMPETENCE	**PERFORMANCE CRITERIA**
1. Diagnose the Faults in Transformer	1.1 Select and use required ***tools and equipment*** as per the job requirement following standard procedure 1.2 Select and use ***personal protective equipment (PPE)*** as per the job requirement following standard procedure 1.3 Identify the faults in transformer as per the job requirement following standard procedure
2. Perform Monitoring of Transformer	2.1 Conduct physical check of transformer condition as per the job requirement following standard procedure 2.2 Check the condition / level of transformer oil and take necessary action as per the job requirement following standard procedure

	2.3 Monitor and record the ***transformer parameters*** following standard procedure 2.4 Check the condition of breather and take necessary action as per the job requirement following standard procedure
3. Perform Repair and Maintenance of Transformer	3.1 Dismount the transformer as per the job requirement following standard procedures 3.2 Disassemble the transformer components as per the job requirement following standard procedure 3.3 Repair/Replace the faulty transformer components as per the job requirement following standard procedure 3.4 Reassemble the ***transformer components*** as per the job requirement following standard procedure 3.5 Conduct ***Test*** of the transformer as per the job requirement following standard procedure

RANGE STATEMENT	
Tools and equipment may include but not limited to:	
● Cables and Wires ● Control and protective switchgear(s)	● Electrician tool set ● Mechanical tool set

● Insulation resistance (IR) tester ● Cleaning agents and cotton ● Insulation Tester	● Multi-meter ● Breakdown voltage test kit
Personal Protective Equipment may include but not limited to:	
• Safety gloves/Insulation gloves • Safety helmet • Safety boot / gum boot • Safety goggles	• Ear muff • Respiratory mask • Safety belt
Faults may include but not limited to:	
● Burnt ● Leakages ● Breakages	● Short circuit ● Open circuit
Transformer parameters may include but not limited to:	
● Oil temperature	● Winding temperature
Transformer components may include but not limited to:	
• Buchholz relay • Explosion vent • Breather • Conservator tank • Magnetic oil gauge (MOG) • Windings • Gaskets	• Bushing • Tap changer • Cooling system • Pressure relieve valve • Arcing horn • Pipes and valves
Test may include but not limited to:	
● Open circuit test ● Short circuit test	● IR test

Critical Aspects
• Select and use personal protective equipment (PPE*)* as per the job requirement following standard procedures • Troubleshoot to identify the faults of transformer as per the job requirement following standard procedures • Perform Test of transformer components as per the job requirement following standard procedures

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
● Ethics and integrity ● OHS rules and regulation ● Basic First Aid ● Types and sizes of transformer ● Working principle of transformer and its construction ● Function of tap changer ● Types of transformer cooling system ● Record keeping and reporting (logbook) ● Preventive maintenance schedule ● Transformer testing method ● Transformer earthing and protections ● 5S Pillars	● Team Work ● Communication ● Problem Solving ● Interpersonal Relationship ● Creativity ● Time Management

UNIT TITLE	**Carryout Installation, Repair and Maintenance of PLC System**
DESCRIPTOR	This unit covers the competencies required to install the PLC system, diagnose faults and perform repair and maintenance of the input and output devices within PLC system following standard procedures at all times
CODE	**7412-U5-L3**
CREDIT	**5**
ELEMENTS OF COMPETENCE	**PERFORMANCE CRITERIA**
1. Perform Installation of appropriate Programmable Logic Control System	1.1 Select and use required ***tools and equipment*** as per the job requirement following standard procedure 1.2 Select and use ***personal protective equipment (PPE)*** as per the job requirement following standard procedure 1.3 Connect Input/output devices to the PLC as per the job requirement following standard procedure 1.4 Install PLC software following standard procedure 1.5 Set up PLC communication following standard procedure

	1.6 Execute Programing of PLC system following standard procedure 1.7 Conduct sequence control test of the input/output devices following standard procedure 1.8 Execute input/output signals/results following standard procedure
2. Perform Repair and Maintenance of Programmable Logic Control System	2.1 Identify the ***faults*** of input and output devices as per the job requirement following standard procedures 2.2 Repair/Replace the ***faulty components*** of Input and output devices as per the job requirement following standard procedures 2.3 Execute uploading/downloading of the PLC programs following standard procedure 2.4 Upgrade/update PLC software as per the job requirement following standard procedure 2.5 Run the PLC system following standard procedure

RANGE STATEMENT	
Tools and equipment may include but not limited to:	
● Communication Cables and Wires ● Control and Protective Switchgear(s) ● Insulation Tester ● Computer with Necessary Software / Hardware ● PLC Based Electrical Control Device/Machine	● Electrician tool set ● Multi-Meter ● Logic probe ● Allen Key ● Logic analyser
Personal Protective Equipment may include but not limited to:	
• Safety gloves • Safety helmet • Safety boot	• Safety goggle • Ear muff • Respiratory mask
Faults may include but not limited to:	
● Communication fault ● Power Fault ● Program Fault	● Short circuit ● Module Failure
Faulty Components may include but not limited to:	
● Input/Output module ● Computers ● Circuit breaker	● CPU ● Communication Module
Critical Aspects	
• Select and use personal protective equipment (PPE***)*** as per the job requirement following standard procedure	

- Perform sequence control test of the input/output devices following standard procedure
- Troubleshoot to identify the faults of PLC components as per the job requirement following standard procedure

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
● Ethics and Integrity ● OHS rules and regulation ● Basic First Aid ● Interpretation of circuit diagrams, service manuals, technical sketches, graphic symbols and wiring diagrams and manufacturer's specifications ● Fundamentals of Digital / Analog Electronics ● Troubleshooting techniques in PLC based machines ● Motor control switchgear and their applications with PLC ● Common faults in industry PLC system ● PID instruments ● Method of programming Analog / Digital input and output devices ● Type of PLC and Programming Language ● 5S Pillars	● Team Work ● Communication ● Problem Solving ● Interpersonal Relationship ● Creativity ● Time Management

ANNEXURE

1.1. 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.

1.2. 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.

1.3. 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.

1.4 Implementation of TVET Qualifications

*** RPL = Recognition of Prior Learning**

1.5 TVET Qualifications Levels

TVET Qualifications has six levels as per the BQF. The six levels are:
Applied Degree: Level 6
Advanced Diploma: Level 5
Diploma: Level 4
Certificate 3
Certificate 2
Certificate 1

1.6. 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:

Certificate 1

Skills	Knowledge:	Application
● 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	● Foundationa, every day and general: ● Basic operational knowledge and skill ● Utilization of basic available information ● Known solutions to familiar problems ● Little generation of new ideas	● Highly structured tasks with close support and supervision ● Minimal discretion and judgement ● Readiness to work together and share knowledge with others

Certificate level 2

Skills	Knowledge	Application
● Applying standard processes relevant to carry out known tasks	● Basic, factual and conceptual	● Structured and stable 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	● Some relevant theoretical knowledge ● Interpretation of available information ● Discretion and judgments ● A range of known responses to familiar problems	● General support and supervision that require some discretion and judgement ● Collaborati on with others to achieve goals

Certificate 3

Skills	**Knowledge:**	**Application:**
● Applying a range of standard processes to known but varied tasks ● Selecting and applying a range of solutions to familiar and unfamiliar problems	● Theoretical with some technical and operational processes: ● A broad knowledge base which incorporates some theoretical concepts ● Analytical interpretation of information ● Informed judgment ● A range of sometimes innovative responses to concrete but often unfamiliar problems	● Stable tasks with some aspects of change ● General guidance and supervision that require discretion and judgement ● Adapting to own behaviours to work with others

Diploma

Skills:	Knowledge	Application
● 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	• Broad theoretical, technical and operational • Specialist knowledge with depth in more than one area • Analysis reformatting and evaluation of a wide range of information • Formulation of appropriate responses to resolve both concrete and abstract problems	● Stable tasks with predictable changes ● Broad guidance with some selfdirection that require sound judgement ● Taking some responsibilit y for planning and coordinatio n with others

1.6 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 Vocational Education and Training Management Information System (VET – MIS) both in terms of economic sector identification and that of the individual standard.

1.7. 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.
Implementation and operational procedures for National Competency Standards (NCS).