

Qualification Pack



Electronic Hardware Design Engineer

QP Code: ELE/Q6102

Version: 3.0

NSQF Level: 5

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Qualification Pack

Contents

ELE/Q6102: Electronic Hardware Design Engineer	3
<i>Brief Job Description</i>	3
Applicable National Occupational Standards (NOS)	3
<i>Compulsory NOS</i>	3
<i>Qualification Pack (QP) Parameters</i>	3
ELE/N1002: Apply health and safety practices at the workplace	5
DGT/VSQ/N0102: Employability Skills (60 Hours)	13
ELE/N6102: Develop PCB design	21
Assessment Guidelines and Weightage	28
<i>Assessment Guidelines</i>	28
<i>Assessment Weightage</i>	29
Acronyms	30
Glossary	31



Qualification Pack

ELE/Q6102: Electronic Hardware Design Engineer

Brief Job Description

The individual at work is responsible for undertaking research on new products, work with R&D on developing the schematics, converting them to PCB layout using CAD and other software and generating the Gerber file to pass on to PCB manufacturers.

Personal Attributes

The job requires the individual to attention to detail, good eyesight, and physically fit with ability to work for long hours on computer.

Applicable National Occupational Standards (NOS)

Compulsory NOS:

1. [ELE/N1002: Apply health and safety practices at the workplace](#)
2. [DGT/VSQ/N0102: Employability Skills \(60 Hours\)](#)
3. [ELE/N6102: Develop PCB design](#)

Qualification Pack (QP) Parameters

Sector	Electronics
Sub-Sector	Industrial Automation
Occupation	Designing
Country	India
NSQF Level	5
Credits	25
Aligned to NCO/ISCO/ISIC Code	NCO-2015/2152.0801

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Minimum Educational Qualification & Experience	Diploma (After 10 (Electronics/Mechanical)) with 1 Year of experience Relevant OR 12th grade pass with 1 year NTC/ NAC with 1 Year of experience Relevant OR 12th grade Pass with 2 Years of experience Relevant OR Previous relevant Qualification of NSQF Level (4) with 3 Years of experience Relevant OR 10th grade pass with 4 Years of experience Relevant
Minimum Level of Education for Training in School	10th Class
Pre-Requisite License or Training	NA
Minimum Job Entry Age	21 Years
Last Reviewed On	NA
Next Review Date	27/01/2025
NSQC Approval Date	27/01/2022
Version	3.0
Reference code on NQR	QG-05-EH-01336-2023-V1.1-ESSC
NQR Version	1.0

Remarks:

NA

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ELE/N1002: Apply health and safety practices at the workplace

Description

This OS unit is about knowledge and practices relating to health, safety and security that candidates need to use in the workplace.

Scope

The scope covers the following :

- Deal with workplace hazards
- Apply fire safety practices
- Follow emergencies, rescue and first-aid procedures
- Effective waste management/recycling practices

Elements and Performance Criteria

Deal with workplace hazards

To be competent, the user/individual on the job must be able to:

- PC1.** identify job-site hazards and possible causes of accident in the workplace
- PC2.** perform work complying to organizational safe working practices and observing hazard signs displayed on containers, equipment and in various work areas such as inside buildings, in open areas and public spaces, etc.
- PC3.** use appropriate personal protective equipment (PPE) for specific tasks and work conditions, contaminant (concentration w.r.t air) requirements and severity of hazard while conforming to the Indian/International standards
- PC4.** follow standard safety procedures while handling tool/ ,equipment, hazardous substances and while working in hazardous environments
- PC5.** dispose electronic waste (such as toxins; metals such as lead, cadmium, barium; flame retardant plastics, welding slag etc.) as per industry approved techniques
- PC6.** avoid damage of components due to negligence in electrostatic discharge (ESD) procedures
- PC7.** locate general health and safety equipment in the workplace such as fire extinguishers; first aid equipment; safety instruments, clothing and installations (fire exits, exhaust fans)
- PC8.** maintain appropriate posture while handling heavy objects
- PC9.** apply good housekeeping practices at all times

Apply fire safety practices

To be competent, the user/individual on the job must be able to:

- PC10.** take preventive measures to prevent fire hazards
- PC11.**
 - use appropriate fire extinguishers for different types of fires
 - Types of fires: Class A: e.g. ordinary solid combustibles, such as wood, paper, cloth, plastic, charcoal, etc.; Class B: flammable liquids and gases, such as gasoline, propane, diesel fuel, tar, cooking oil, and similar substances; Class C: e.g. electrical equipment such as appliances, wiring, breaker panels, etc. (These categories of fires become Class A, B, and D fires when the electrical equipment that initiated the fire is no l
- PC12.** exhibit rescue and first-aid techniques in case of fire or electrocution

Qualification Pack

Follow emergencies, rescue and first-aid procedures

To be competent, the user/individual on the job must be able to:

- PC13.** administer appropriate first aid to victims in case of bleeding, burns, choking, electric shock, poisoning etc.
- PC14.** administer first aid to victims in case of a heart attack or cardiac arrest due to electric shock,
- PC15.** participate regularly in emergency procedures such as raising alarm, safe/efficient, evacuation, correct means of taking shelter and escaping, correct assembly point, roll call, correct return to work
- PC16.** use correct method to move injured people and others during an emergency

Effective waste management/recycling practices

To be competent, the user/individual on the job must be able to:

- PC17.** identify recyclable and non-recyclable, and hazardous waste generated
- PC18.** segregate waste into different categories
- PC19.** ensure disposal of non-recyclable waste appropriately
- PC20.** deposit non-recyclable and reusable material at identified location
- PC21.** follow processes specified for disposal of hazardous waste

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** importance of working in clean and safe work environment following safety practices and procedures
- KU2.** health and safety roles and responsibilities of relevant personnel within and outside the organisation
- KU3.** key internal and external sources of health and safety information
- KU4.** basic knowledge of electronic devices and related health risks
- KU5.** meaning of hazards and risks
- KU6.** various types of health and safety hazards commonly present in the work environment such as physical hazards, electrical hazards, chemical hazards, fire hazards, equipment related hazards, health hazards, etc.
- KU7.** methods of accident prevention
- KU8.** importance of using protective clothing/equipment while working
- KU9.** general principles for identifying and controlling health and safety risks
- KU10.** main hazards and preventive as well as control measures while working with different types of equipment
- KU11.** importance of carrying out electrical and non-electrical isolation to prevent hazards from loss of machine/system/process control
- KU12.** main hazards and preventive as well as control measures when working with electrical systems or using electrical equipment
- KU13.** forms and classifications of hazardous substances
- KU14.** safe working practices while working at various hazardous sites
- KU15.** prevention and control measures to reduce risks from exposure to hazardous substances

Qualification Pack

- KU16.** health effects associated with exposure to noise and vibration and the appropriate control measures
- KU17.** precautionary activities to prevent the fire accident
- KU18.** various causes of fire such as heating of metal, spontaneous ignition, sparking, electrical eating, loose fires (smoking, welding, etc.) chemical fires etc.
- KU19.** techniques of using the different fire extinguishers
- KU20.** different methods and material to extinguish fires
- KU21.** different materials used for extinguishing fire such as sand, water, foam, CO₂, dry powder
- KU22.** rescue techniques used during a fire hazard
- KU23.** various types of safety signs and their meaning
- KU24.** basic first aid treatment relevant to the common work place injuries e.g. shock, electrical shock, bleeding, breaks to bones, minor burns, resuscitation, poisoning, eye injuries
- KU25.** contents of written accident report
- KU26.** potential injuries and ill health associated with incorrect handling of tools and equipment
- KU27.** safe lifting and carrying practices
- KU28.** potential impact to a person who is moved incorrectly
- KU29.** personal safety, health and dignity issues relating to the movement of a person by others
- KU30.** ESD measures and 5S
- KU31.** efficient utilization and management of material and water
- KU32.** ways to recognize common electrical problems and practices of conserving electricity
- KU33.** usage of different colours of dustbins, categorization of waste into dry, wet, recyclable, nonrecyclable and items of single-use plastics
- KU34.** organization's procedure for minimizing waste
- KU35.** waste management and methods of waste disposal
- KU36.** common sources of pollution and ways to minimize it
- KU37.** names, contact information and location of people responsible for health and safety in the workplace
- KU38.** location of documents and equipment for health and safety compliance/practices in the workplace
- KU39.** safety notices, signs and instructions at workplace

Generic Skills (GS)

User/individual on the job needs to know how to:

- GS1.** interpret general health and safety guidelines labels, charts, signages
- GS2.** read operation manuals
- GS3.** write health and safety compliance report
- GS4.** write an accident/incident report in local language or English
- GS5.** provide an emergency or safety incident brief to seniors or relevant authorities in a calm, clear and to-the-point manner
- GS6.** communicate general health and safety guidelines to colleagues/co-workers



Qualification Pack

- GS7.** communicate appropriately with co-workers in order to clarify instructions and other issues
- GS8.** act in case of any potential hazards observed in the work place
- GS9.** plan and organize their own work schedule, work area, tools, equipment in compliance with organizational policies for health, safety and security
- GS10.** take adequate measures to ensure the safety of clients and visitors at the workplace
- GS11.** identify immediate or temporary solutions to resolve delays
- GS12.** evaluate the work area for health and safety risks or hazards
- GS13.** use cause and effect relations to anticipate potential issues, problems and their solution in the work area related to safety
- GS14.** recognise emergency and potential emergency situations
- GS15.** protect self and others from a health and safety risk or hazard
- GS16.** communicate and collaborate to incorporate sustainable practices (greening) in workplace processes
- GS17.** record data on waste disposal at workplace

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Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Deal with workplace hazards</i>	20	31	-	-
PC1. identify job-site hazards and possible causes of accident in the workplace	2	3	-	-
PC2. perform work complying to organizational safe working practices and observing hazard signs displayed on containers, equipment and in various work areas such as inside buildings, in open areas and public spaces, etc.	3	4	-	-
PC3. use appropriate personal protective equipment (PPE) for specific tasks and work conditions, contaminant (concentration w.r.t air) requirements and severity of hazard while conforming to the Indian/International standards	3	4	-	-
PC4. follow standard safety procedures while handling tool/ ,equipment, hazardous substances and while working in hazardous environments	3	4	-	-
PC5. dispose electronic waste (such as toxins; metals such as lead, cadmium, barium; flame retardant plastics, welding slag etc.) as per industry approved techniques	2	4	-	-
PC6. avoid damage of components due to negligence in electrostatic discharge (ESD) procedures	2	3	-	-
PC7. locate general health and safety equipment in the workplace such as fire extinguishers; first aid equipment; safety instruments, clothing and installations (fire exits, exhaust fans)	2	3	-	-
PC8. maintain appropriate posture while handling heavy objects	1	3	-	-
PC9. apply good housekeeping practices at all times	2	3	-	-
<i>Apply fire safety practices</i>	4	9	-	-
PC10. take preventive measures to prevent fire hazards	2	3	-	-

Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC11. <ul style="list-style-type: none"> • use appropriate fire extinguishers for different types of fires • Types of fires: Class A: e.g. ordinary solid combustibles, such as wood, paper, cloth, plastic, charcoal, etc.; Class B: flammable liquids and gases, such as gasoline, propane, diesel fuel, tar, cooking oil, and similar substances; Class C: e.g. electrical equipment such as appliances, wiring, breaker panels, etc. (These categories of fires become Class A, B, and D fires when the electrical equipment that initiated the fire is no l 	1	3	-	-
PC12. exhibit rescue and first-aid techniques in case of fire or electrocution	1	3	-	-
<i>Follow emergencies, rescue and first-aid procedures</i>	6	13	-	-
PC13. administer appropriate first aid to victims in case of bleeding, burns, choking, electric shock, poisoning etc.	1	3	-	-
PC14. administer first aid to victims in case of a heart attack or cardiac arrest due to electric shock,	1	2	-	-
PC15. participate regularly in emergency procedures such as raising alarm, safe/efficient, evacuation, correct means of taking shelter and escaping, correct assembly point, roll call, correct return to work	2	4	-	-
PC16. use correct method to move injured people and others during an emergency	2	4	-	-
<i>Effective waste management/recycling practices</i>	5	12	-	-
PC17. identify recyclable and non-recyclable, and hazardous waste generated	1	3	-	-
PC18. segregate waste into different categories	1	2	-	-
PC19. ensure disposal of non-recyclable waste appropriately	1	2	-	-
PC20. deposit non-recyclable and reusable material at identified location	1	3	-	-



Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC21. follow processes specified for disposal of hazardous waste	1	2	-	-
NOS Total	35	65	-	-



Qualification Pack

National Occupational Standards (NOS) Parameters

NOS Code	ELE/N1002
NOS Name	Apply health and safety practices at the workplace
Sector	Electronics
Sub-Sector	Generic
Occupation	Generic - Health Safety
NSQF Level	4
Credits	TBD
Version	3.0
Last Reviewed Date	24/02/2022
Next Review Date	24/02/2025
NSQC Clearance Date	24/02/2022



Qualification Pack

DGT/VSQ/N0102: Employability Skills (60 Hours)

Description

This unit is about employability skills, Constitutional values, becoming a professional in the 21st Century, digital, financial, and legal literacy, diversity and Inclusion, English and communication skills, customer service, entrepreneurship, and apprenticeship, getting ready for jobs and career development.

Scope

The scope covers the following :

- Introduction to Employability Skills
- Constitutional values - Citizenship
- Becoming a Professional in the 21st Century
- Basic English Skills
- Career Development & Goal Setting
- Communication Skills
- Diversity & Inclusion
- Financial and Legal Literacy
- Essential Digital Skills
- Entrepreneurship
- Customer Service
- Getting ready for Apprenticeship & Jobs

Elements and Performance Criteria

Introduction to Employability Skills

To be competent, the user/individual on the job must be able to:

- PC1.** identify employability skills required for jobs in various industries
- PC2.** identify and explore learning and employability portals

Constitutional values - Citizenship

To be competent, the user/individual on the job must be able to:

- PC3.** recognize the significance of constitutional values, including civic rights and duties, citizenship, responsibility towards society etc. and personal values and ethics such as honesty, integrity, caring and respecting others, etc.
- PC4.** follow environmentally sustainable practices

Becoming a Professional in the 21st Century

To be competent, the user/individual on the job must be able to:

- PC5.** recognize the significance of 21st Century Skills for employment
- PC6.** practice the 21st Century Skills such as Self-Awareness, Behaviour Skills, time management, critical and adaptive thinking, problem-solving, creative thinking, social and cultural awareness, emotional awareness, learning to learn for continuous learning etc. in personal and professional life

Basic English Skills

To be competent, the user/individual on the job must be able to:

Qualification Pack

- PC7.** use basic English for everyday conversation in different contexts, in person and over the telephone
- PC8.** read and understand routine information, notes, instructions, mails, letters etc. written in English
- PC9.** write short messages, notes, letters, e-mails etc. in English

Career Development & Goal Setting

To be competent, the user/individual on the job must be able to:

- PC10.** understand the difference between job and career
- PC11.** prepare a career development plan with short- and long-term goals, based on aptitude

Communication Skills

To be competent, the user/individual on the job must be able to:

- PC12.** follow verbal and non-verbal communication etiquette and active listening techniques in various settings
- PC13.** work collaboratively with others in a team

Diversity & Inclusion

To be competent, the user/individual on the job must be able to:

- PC14.** communicate and behave appropriately with all genders and PwD
- PC15.** escalate any issues related to sexual harassment at workplace according to POSH Act

Financial and Legal Literacy

To be competent, the user/individual on the job must be able to:

- PC16.** select financial institutions, products and services as per requirement
- PC17.** carry out offline and online financial transactions, safely and securely
- PC18.** identify common components of salary and compute income, expenses, taxes, investments etc
- PC19.** identify relevant rights and laws and use legal aids to fight against legal exploitation

Essential Digital Skills

To be competent, the user/individual on the job must be able to:

- PC20.** operate digital devices and carry out basic internet operations securely and safely
- PC21.** use e- mail and social media platforms and virtual collaboration tools to work effectively
- PC22.** use basic features of word processor, spreadsheets, and presentations

Entrepreneurship

To be competent, the user/individual on the job must be able to:

- PC23.** identify different types of Entrepreneurship and Enterprises and assess opportunities for potential business through research
- PC24.** develop a business plan and a work model, considering the 4Ps of Marketing Product, Price, Place and Promotion
- PC25.** identify sources of funding, anticipate, and mitigate any financial/ legal hurdles for the potential business opportunity

Customer Service

To be competent, the user/individual on the job must be able to:

- PC26.** identify different types of customers
- PC27.** identify and respond to customer requests and needs in a professional manner.

Qualification Pack

PC28. follow appropriate hygiene and grooming standards

Getting ready for apprenticeship & Jobs

To be competent, the user/individual on the job must be able to:

PC29. create a professional Curriculum vitae (Résumé)

PC30. search for suitable jobs using reliable offline and online sources such as Employment exchange, recruitment agencies, newspapers etc. and job portals, respectively

PC31. apply to identified job openings using offline /online methods as per requirement

PC32. answer questions politely, with clarity and confidence, during recruitment and selection

PC33. identify apprenticeship opportunities and register for it as per guidelines and requirements

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. need for employability skills and different learning and employability related portals

KU2. various constitutional and personal values

KU3. different environmentally sustainable practices and their importance

KU4. Twenty first (21st) century skills and their importance

KU5. how to use English language for effective verbal (face to face and telephonic) and written communication in formal and informal set up

KU6. importance of career development and setting long- and short-term goals

KU7. about effective communication

KU8. POSH Act

KU9. Gender sensitivity and inclusivity

KU10. different types of financial institutes, products, and services

KU11. how to compute income and expenditure

KU12. importance of maintaining safety and security in offline and online financial transactions

KU13. different legal rights and laws

KU14. different types of digital devices and the procedure to operate them safely and securely

KU15. how to create and operate an e- mail account and use applications such as word processors, spreadsheets etc.

KU16. how to identify business opportunities

KU17. types and needs of customers

KU18. how to apply for a job and prepare for an interview

KU19. apprenticeship scheme and the process of registering on apprenticeship portal

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read and write different types of documents/instructions/correspondence

GS2. communicate effectively using appropriate language in formal and informal settings



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- GS3.** behave politely and appropriately with all
- GS4.** how to work in a virtual mode
- GS5.** perform calculations efficiently
- GS6.** solve problems effectively
- GS7.** pay attention to details
- GS8.** manage time efficiently
- GS9.** maintain hygiene and sanitization to avoid infection

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Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Introduction to Employability Skills</i>	1	1	-	-
PC1. identify employability skills required for jobs in various industries	-	-	-	-
PC2. identify and explore learning and employability portals	-	-	-	-
<i>Constitutional values - Citizenship</i>	1	1	-	-
PC3. recognize the significance of constitutional values, including civic rights and duties, citizenship, responsibility towards society etc. and personal values and ethics such as honesty, integrity, caring and respecting others, etc.	-	-	-	-
PC4. follow environmentally sustainable practices	-	-	-	-
<i>Becoming a Professional in the 21st Century</i>	2	4	-	-
PC5. recognize the significance of 21st Century Skills for employment	-	-	-	-
PC6. practice the 21st Century Skills such as Self-Awareness, Behaviour Skills, time management, critical and adaptive thinking, problem-solving, creative thinking, social and cultural awareness, emotional awareness, learning to learn for continuous learning etc. in personal and professional life	-	-	-	-
<i>Basic English Skills</i>	2	3	-	-
PC7. use basic English for everyday conversation in different contexts, in person and over the telephone	-	-	-	-
PC8. read and understand routine information, notes, instructions, mails, letters etc. written in English	-	-	-	-
PC9. write short messages, notes, letters, e-mails etc. in English	-	-	-	-
<i>Career Development & Goal Setting</i>	1	2	-	-

Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC10. understand the difference between job and career	-	-	-	-
PC11. prepare a career development plan with short- and long-term goals, based on aptitude	-	-	-	-
<i>Communication Skills</i>	2	2	-	-
PC12. follow verbal and non-verbal communication etiquette and active listening techniques in various settings	-	-	-	-
PC13. work collaboratively with others in a team	-	-	-	-
<i>Diversity & Inclusion</i>	1	2	-	-
PC14. communicate and behave appropriately with all genders and PwD	-	-	-	-
PC15. escalate any issues related to sexual harassment at workplace according to POSH Act	-	-	-	-
<i>Financial and Legal Literacy</i>	2	3	-	-
PC16. select financial institutions, products and services as per requirement	-	-	-	-
PC17. carry out offline and online financial transactions, safely and securely	-	-	-	-
PC18. identify common components of salary and compute income, expenses, taxes, investments etc	-	-	-	-
PC19. identify relevant rights and laws and use legal aids to fight against legal exploitation	-	-	-	-
<i>Essential Digital Skills</i>	3	4	-	-
PC20. operate digital devices and carry out basic internet operations securely and safely	-	-	-	-
PC21. use e- mail and social media platforms and virtual collaboration tools to work effectively	-	-	-	-
PC22. use basic features of word processor, spreadsheets, and presentations	-	-	-	-

Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Entrepreneurship</i>	2	3	-	-
PC23. identify different types of Entrepreneurship and Enterprises and assess opportunities for potential business through research	-	-	-	-
PC24. develop a business plan and a work model, considering the 4Ps of Marketing Product, Price, Place and Promotion	-	-	-	-
PC25. identify sources of funding, anticipate, and mitigate any financial/ legal hurdles for the potential business opportunity	-	-	-	-
<i>Customer Service</i>	1	2	-	-
PC26. identify different types of customers	-	-	-	-
PC27. identify and respond to customer requests and needs in a professional manner.	-	-	-	-
PC28. follow appropriate hygiene and grooming standards	-	-	-	-
<i>Getting ready for apprenticeship & Jobs</i>	2	3	-	-
PC29. create a professional Curriculum vitae (Résumé)	-	-	-	-
PC30. search for suitable jobs using reliable offline and online sources such as Employment exchange, recruitment agencies, newspapers etc. and job portals, respectively	-	-	-	-
PC31. apply to identified job openings using offline /online methods as per requirement	-	-	-	-
PC32. answer questions politely, with clarity and confidence, during recruitment and selection	-	-	-	-
PC33. identify apprenticeship opportunities and register for it as per guidelines and requirements	-	-	-	-
NOS Total	20	30	-	-



Qualification Pack

National Occupational Standards (NOS) Parameters

NOS Code	DGT/VSQ/N0102
NOS Name	Employability Skills (60 Hours)
Sector	Cross Sectoral
Sub-Sector	Professional Skills
Occupation	Employability
NSQF Level	4
Credits	2
Version	1.0
Last Reviewed Date	30/11/2023
Next Review Date	30/11/2026
NSQC Clearance Date	30/11/2023

Qualification Pack

ELE/N6102: Develop PCB design

Description

This OS unit is about undertaking research on new products, design and create layout, verify prototype, and approve layout for PCB manufacture

Elements and Performance Criteria

Understanding new product specifications

To be competent, the user/individual on the job must be able to:

- PC1.** interact with customer and understand the requirement
- PC2.** interact with R&D team in order to confirm understanding on the products specifications and output
- PC3.** upgrade the existing products and designs as per market requirement
- PC4.** initiate and coordinate the overall design and development process
- PC5.** keep up to date with developments in technologies and regulations and comply with them

Designing and creating layout

To be competent, the user/individual on the job must be able to:

- PC6.** understand layout rules and details to develop design process and analysis
- PC7.** create schematic symbols and layer stack up
- PC8.** develop and finalize schematics along with R&D team
- PC9.** convert the schematic to PCB layout including component symbol and footprint, and manufacturing data packages
- PC10.** construct circuits according to engineering instructions, technical manuals, knowledge of electronic systems and components
- PC11.** create design blueprints using computer software
- PC12.** provide a detailed layout of complex PCB designs
- PC13.** generate, maintain and manage parts library, i.e., component building and selection
- PC14.** create Gerber artwork file
- PC15.** generate fabrication packages including: fabrication drawings, assembly drawings, peer reviews, DFM requests and preliminary RFQs
- PC16.** create net-list and routing rules for manufacturing process
- PC17.** perform high speed bus routing, differential pairs and impedance control routing to meet signal integrity
- PC18.** respond to customers requests and queries as they occur

Testing prototype and modifying designs

To be competent, the user/individual on the job must be able to:

- PC19.** create prototype, hand or machine assembled
- PC20.** verify the design outputs
- PC21.** test, debug and validate hardware design
- PC22.** analyse and interpret test data against customers specifications

Qualification Pack

PC23. support debugging, trouble shooting, and correction of latent defects

PC24. recommend changes in specifications to simplify assembly and maintenance

PC25. edit, develop and implement solutions as per customer specifications

Verifying and approving the design

To be competent, the user/individual on the job must be able to:

PC26. check drawing plots for against customers specifications and standards of conformance

PC27. review layouts and designs according to engineering specifications using and application software

PC28. approve final PCB design for production

PC29. create final Gerber file

PC30. work with PCB manufacturer and assembly line to finalise PCB manufacturing and assembly processes

PC31. create backup copies and file them securely

Achieving productivity and quality standards

To be competent, the user/individual on the job must be able to:

PC32. ensure customers specifications are met

PC33. ensure 100% product safety approvals are met

PC34. meet deadlines, schedule and commitments for assigned projects

PC35. work with quality assurance team to ensure quality standards

PC36. conform to statutory requirements on environment and criticality

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. companys policies on: incentives, delivery and quality standards, personnel management and IPR

KU2. work flow involved in assembly process of the company

KU3. importance of the individuals role in the workflow

KU4. reporting structure

KU5. organizational capabilities with respect to input materials and processes

KU6. safety and quality standards followed in the organization

KU7. electronics and electrical engineering

KU8. components values and polarities

KU9. CADSTAR, Cadence Or CAD & Allegro, AutoCAD LT, Eagle, Protel, Altium, AutoCAD, Hyper lynx and layout techniques for good signal integrity

KU10. Mentor graphics, Valor NPI, DXDesigner and PADs with DXDatabook, CAD packages,CAM350 and other software for schematic capture

KU11. other PCB design and layout tools

KU12. PCB layout design placement, routing, Gerber verification, building library (footprints, schematic symbols), ERP systems, BOM structures, design for test (DFT) and design for manufacturability (DFM), foot-printing, Net listing, constraint setup

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- KU13.** PCB manufacturing process, fabrication drawings and assembly process
- KU14.** modular design techniques, designing for double side and multilayer
- KU15.** design constraints and complete design cycle from understanding customers specifications to production
- KU16.** quality standards associated with PCB design
- KU17.** installing and configuring Operating Systems (Linux, Windows), Storage subsystems
- KU18.** servers, storage hardware, RAID technology, hardware design, testing, verification and validation
- KU19.** debugging, schematics, PCB design, assembly process, wire diagram and interpretation of technical drawings
- KU20.** procedure to make changes to the design
- KU21.** circuit diagrams and wiring
- KU22.** research sources for obtaining technical information
- KU23.** statutory regulations, standards and codes of practice and their implications
- KU24.** importance of keeping designs developed confidential and consequences of breaching IPR clause
- KU25.** IPC standards for printed circuit board

Generic Skills (GS)

User/individual on the job needs to know how to:

- GS1.** to read schematics, blueprints, product and customer specifications
- GS2.** to document designs
- GS3.** to read job sheet, process, production schedules, machine operation manuals
- GS4.** to use computer work with designing software
- GS5.** to effectively communicate with external PCB manufacturers
- GS6.** to communicate with in-house assembly team to deliver high quality boards and manufacturability in a timely manner
- GS7.** to communicate with customer in order to resolve any discrepancies in the design for manufacture aspect
- GS8.** to coordinate with various departments such as marketing, sales, production, research and development
- GS9.** to work in teams to devise creative solutions
- GS10.** to plan and organize own tasks
- GS11.** to multi-task, handle additional responsibility, and adapt quickly to changing priorities
- GS12.** to suggest on corrective actions to reduce repetitive errors
- GS13.** to improve work process with less rework within PCB layout function release process for high-volume product manufacturing
- GS14.** to demonstrated leadership in CAD system, library management and design release process for high-volume product manufacturing
- GS15.** to be prompt to resolve problems effectively
- GS16.** to use test and measurement equipment like Oscilloscopes, PCIe/SAS protocol analysers, etc.



Qualification Pack

- GS17.** to use various design tools, equipment, and computer applications and software
- GS18.** to ensure designs are feasible with knowledge on physics, engineering and mathematics
- GS19.** to have a creative and innovative approach for generating new ideas
- GS20.** to spot process disruptions and delays
- GS21.** to troubleshoot and identify problems
- GS22.** to propose possible solutions

Qualification Pack

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Understanding new product specifications</i>	4	5	-	-
PC1. interact with customer and understand the requirement	1	1	-	-
PC2. interact with R&D team in order to confirm understanding on the products specifications and output	1	1	-	-
PC3. upgrade the existing products and designs as per market requirement	1	1	-	-
PC4. initiate and coordinate the overall design and development process	1	1	-	-
PC5. keep up to date with developments in technologies and regulations and comply with them	-	1	-	-
<i>Designing and creating layout</i>	13	20	-	-
PC6. understand layout rules and details to develop design process and analysis	-	1	-	-
PC7. create schematic symbols and layer stack up	-	1	-	-
PC8. develop and finalize schematics along with R&D team	1	1	-	-
PC9. convert the schematic to PCB layout including component symbol and footprint, and manufacturing data packages	-	2	-	-
PC10. construct circuits according to engineering instructions, technical manuals, knowledge of electronic systems and components	1	1	-	-
PC11. create design blueprints using computer software	1	2	-	-
PC12. provide a detailed layout of complex PCB designs	1	1	-	-

Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC13. generate, maintain and manage parts library, i.e., component building and selection	-	2	-	-
PC14. create Gerber artwork file	1	1	-	-
PC15. generate fabrication packages including: fabrication drawings, assembly drawings, peer reviews, DFM requests and preliminary RFQs	1	3	-	-
PC16. create net-list and routing rules for manufacturing process	2	2	-	-
PC17. perform high speed bus routing, differential pairs and impedance control routing to meet signal integrity	2	2	-	-
PC18. respond to customers requests and queries as they occur	3	1	-	-
<i>Testing prototype and modifying designs</i>	11	13	-	-
PC19. create prototype, hand or machine assembled	2	2	-	-
PC20. verify the design outputs	2	2	-	-
PC21. test, debug and validate hardware design	1	2	-	-
PC22. analyse and interpret test data against customers specifications	1	2	-	-
PC23. support debugging, trouble shooting, and correction of latent defects	2	2	-	-
PC24. recommend changes in specifications to simplify assembly and maintenance	2	2	-	-
PC25. edit, develop and implement solutions as per customer specifications	1	1	-	-
<i>Verifying and approving the design</i>	7	12	-	-
PC26. check drawing plots for against customers specifications and standards of conformance	-	2	-	-
PC27. review layouts and designs according to engineering specifications using and application software	1	2	-	-

Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC28. approve final PCB design for production	1	2	-	-
PC29. create final Gerber file	2	2	-	-
PC30. work with PCB manufacturer and assembly line to finalise PCB manufacturing and assembly processes	2	2	-	-
PC31. create backup copies and file them securely	1	2	-	-
<i>Achieving productivity and quality standards</i>	5	10	-	-
PC32. ensure customers specifications are met	1	2	-	-
PC33. ensure 100% product safety approvals are met	1	2	-	-
PC34. meet deadlines, schedule and commitments for assigned projects	1	2	-	-
PC35. work with quality assurance team to ensure quality standards	1	2	-	-
PC36. conform to statutory requirements on environment and criticality	1	2	-	-
NOS Total	40	60	-	-

Qualification Pack

National Occupational Standards (NOS) Parameters

NOS Code	ELE/N6102
NOS Name	Develop PCB design
Sector	Electronics
Sub-Sector	Industrial Automation
Occupation	Designing
NSQF Level	5
Credits	TBD
Version	1.0
Last Reviewed Date	27/01/2022
Next Review Date	27/01/2025
NSQC Clearance Date	27/01/2022

Assessment Guidelines and Assessment Weightage

Assessment Guidelines

1. Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council. Each Performance Criteria (PC) will be assigned marks proportional to its importance in NOS. SSC will also lay down proportion of marks for Theory and Skills Practical for each PC.
2. The assessment for the theory part will be based on knowledge bank of questions created by the SSC.
3. Assessment will be conducted for all compulsory NOS, and where applicable, on the selected elective/option NOS/set of NOS.
4. Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training centre (as per assessment criteria below).
5. Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/training centre based on this criterion.
6. To pass the Qualification Pack, every trainee should score a minimum of 70% of aggregate marks to successfully clear the assessment.
7. In case of unsuccessful completion, the trainee may seek reassessment on the Qualification Pack.



Qualification Pack

Minimum Aggregate Passing % at QP Level : 70

(Please note: Every Trainee should score a minimum aggregate passing percentage as specified above, to successfully clear the Qualification Pack assessment.)

Assessment Weightage

Compulsory NOS

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
ELE/N1002.Apply health and safety practices at the workplace	35	65	-	-	100	25
DGT/VSQ/N0102.Employability Skills (60 Hours)	20	30	-	-	50	25
ELE/N6102.Develop PCB design	40	60	-	-	100	50
Total	95	155	-	-	250	100



Qualification Pack

Acronyms

NOS	National Occupational Standard(s)
NSQF	National Skills Qualifications Framework
QP	Qualifications Pack
TVET	Technical and Vocational Education and Training
NOS	National Occupational Standard(s)
NSQF	National Skills Qualifications Framework
QP	Qualifications Pack
TVET	Technical and Vocational Education and Training
IPR	Intellectual Property Rights

Qualification Pack

Glossary

Sector	Sector is a conglomeration of different business operations having similar business and interests. It may also be defined as a distinct subset of the economy whose components share similar characteristics and interests.
Sub-sector	Sub-sector is derived from a further breakdown based on the characteristics and interests of its components.
Occupation	Occupation is a set of job roles, which perform similar/ related set of functions in an industry.
Job role	Job role defines a unique set of functions that together form a unique employment opportunity in an organisation.
Occupational Standards (OS)	OS specify the standards of performance an individual must achieve when carrying out a function in the workplace, together with the Knowledge and Understanding (KU) they need to meet that standard consistently. Occupational Standards are applicable both in the Indian and global contexts.
Performance Criteria (PC)	Performance Criteria (PC) are statements that together specify the standard of performance required when carrying out a task.
National Occupational Standards (NOS)	NOS are occupational standards which apply uniquely in the Indian context.
Qualifications Pack (QP)	QP comprises the set of OS, together with the educational, training and other criteria required to perform a job role. A QP is assigned a unique qualifications pack code.
Unit Code	Unit code is a unique identifier for an Occupational Standard, which is denoted by an 'N'
Unit Title	Unit title gives a clear overall statement about what the incumbent should be able to do.
Description	Description gives a short summary of the unit content. This would be helpful to anyone searching on a database to verify that this is the appropriate OS they are looking for.
Scope	Scope is a set of statements specifying the range of variables that an individual may have to deal with in carrying out the function which have a critical impact on quality of performance required.

Qualification Pack

Knowledge and Understanding (KU)	Knowledge and Understanding (KU) are statements which together specify the technical, generic, professional and organisational specific knowledge that an individual needs in order to perform to the required standard.
Organisational Context	Organisational context includes the way the organisation is structured and how it operates, including the extent of operative knowledge managers have of their relevant areas of responsibility.
Technical Knowledge	Technical knowledge is the specific knowledge needed to accomplish specific designated responsibilities.
Core Skills/ Generic Skills (GS)	Core skills or Generic Skills (GS) are a group of skills that are the key to learning and working in today's world. These skills are typically needed in any work environment in today's world. These skills are typically needed in any work environment. In the context of the OS, these include communication related skills that are applicable to most job roles.
Electives	Electives are NOS/set of NOS that are identified by the sector as contributive to specialization in a job role. There may be multiple electives within a QP for each specialized job role. Trainees must select at least one elective for the successful completion of a QP with Electives.
Options	Options are NOS/set of NOS that are identified by the sector as additional skills. There may be multiple options within a QP. It is not mandatory to select any of the options to complete a QP with Options.
Sector	Sector is a conglomeration of different business operations having similar business and interests. It may also be defined as a distinct subset of the economy whose components share similar characteristics and interests.
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Qualification Pack

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Description	Description gives a short summary of the unit content. This would be helpful to anyone searching on a database to verify that this is the appropriate OS they are looking for.
Scope	Scope is a set of statements specifying the range of variables that an individual may have to deal with in carrying out the function which have a critical impact on quality of performance required.
Knowledge and Understanding (K)	Knowledge and Understanding (KU) are statements which together specify the technical, generic, professional and organisational specific knowledge that an individual needs in order to perform to the required standard.
Organisational Context	Organisational context includes the way the organisation is structured and how it operates, including the extent of operative knowledge managers have of their relevant areas of responsibility.
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