



Model Curriculum

QP Name: Machine Learning (ML) Engineer

QP Code: TEL/Q6603

Version: 1.0

NSQF Level: 5

Model Curriculum Version: 1.0

Telecom Sector Skill Council || 3rd Floor, Plot No 126, Sector – 44
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Training Parameters

Sector	Telecom
Sub-Sector	Network Managed Services
Occupation	Data Handling - Network Managed Services
Country	India
NSQF Level	5
Aligned to NCO/ISCO/ISIC Code	NCO-2015/7422.6603
Minimum Educational Qualification and Experience	<p>B.E./B.Tech (Electronics/Telecom/IT and other relevant fields) OR Graduate in relevant field with 1 year of relevant experience OR Diploma (3 years after Class 12th in Electronics/Telecom/IT and other relevant fields) with 1 year of relevant experience OR Class 10th + ITI (2 years in Electronics/Telecom/IT and other relevant fields) with 4 years of relevant experience OR Class 12th Pass with 4 years of relevant experience OR Certified in NSQF-L4 AI – Telecom Data Analyst with 2 years of relevant experience</p>
Pre-Requisite License or Training	NA
Minimum Job Entry Age	21 Years
Last Reviewed On	30/06/2022
Next Review Date	30/06/2025
NSQC Approval Date	30/06/2022
QP Version	1.0
Model Curriculum Creation Date	30/06/2022
Model Curriculum Valid Up to Date	30/06/2025
Model Curriculum Version	1.0
Minimum Duration of the Course	570 Hours
Maximum Duration of the Course	570 Hours

Program Overview

This section summarizes the end objectives of the program along with its duration.

Training Outcomes

At the end of the program, the learner should have acquired the listed knowledge and skills to:

- Describe the process of preparing to develop machine learning systems.
- Demonstrate the process of developing and assisting in the implementation of machine learning systems.
- Explain the importance of implementing effective communication and coordination at work.
- Explain the importance of managing work and resources, and ensuring health and safety at work.

Compulsory Modules

The table lists the modules and their duration corresponding to the Compulsory NOS of the QP.

NOS and Module Details	Theory Duration	Practical Duration	On-the-Job Training Duration (Mandatory)	On-the-Job Training Duration (Recommended)	Total Duration
Bridge Module	08:00	04:00	12:00	-	24:00
Module 1: Introduction to the role of a Machine Learning Engineer	08:00	04:00	12:00	-	24:00
TEL/N6605: Prepare to Develop Machine Learning (ML) Systems NOS Version-1.0 NSQF Level- 5	60:00	110:00	54:00	-	224:00
Module 2: Process of preparing to develop machine learning systems	60:00	110:00	54:00	-	224:00
TEL/N6606: Develop and Assist in the Implementation of Machine Learning (ML) Systems NOS Version-1.0 NSQF Level- 5	80:00	108:00	54:00	-	242:00
Module 3: Process of developing and assisting in the implementation of machine learning systems	80:00	108:00	54:00	-	242:00

TEL/N9103: Implement effective communication and coordination at work NOS Version-1.0 NSQF Level-5	16:00	24:00	00:00	-	40:00
Module 4: Process of implementing Effective communication and coordination at work	16:00	24:00	00:00	-	40:00
TEL/N9104: Manage work and resources, and ensure health and safety at work NOS Version-1.0 NSQF Level-5	16:00	24:00	00:00	-	40:00
Module 5: Process of managing work and resources, and ensure health and safety at the work	16:00	24:00	00:00	-	40:00
Total Duration	180:00	270:00	120:00	-	570:00

Module Details

Module 1: Introduction to the role of a Machine Learning Engineer

Bridge Module

Terminal Outcomes:

- Discuss the job role of a Machine Learning Engineer.
- Explain the scope of work for a Machine Learning Engineer.

Duration: 08:00	Duration: 04:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> • Describe the size and scope of the Telecom industry and its sub-sectors. • Discuss the role and responsibilities of a Machine Learning Engineer. • Identify various employment opportunities for a Machine Learning Engineer. • Discuss the organisational policies on workplace ethics, managing sites, quality standards, personnel management and public relations (PR). • Describe the process workflow in the organization and the role of the Machine Learning Engineer in the process. • List the various daily, weekly, monthly operations/activities that take place at the site under a Machine Learning Engineer. 	<ul style="list-style-type: none"> • Role play based on case studies, outlining the scope, responsibilities, and challenges of a Machine Learning Engineer. • Analyse the requirements for the course and prepare for the pre-requisites of the course.
Classroom Aids	
Training Kit - Trainer Guide, Presentations, Whiteboard, Marker, Projector, Laptop, Video Films	
Tools, Equipment and Other Requirements	
NA	

Module 2: Process of preparing to develop machine learning systems

Mapped to TEL/N6605 v1.0

Terminal Outcomes:

- Explain the importance of determining the scope of work.
- Demonstrate the process of planning the development of machine learning systems.

Duration: 60:00	Duration: 110:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> • Describe the process of determining the business objectives, project outcomes, and the scope of resolution required. • Explain the importance and process of evaluating the existing Machine Learning (ML) processes. • Explain the criteria for selecting appropriate datasets and data representation methods. • Explain how to analyse large and complex datasets to extract insights and select the appropriate technique to be used. • Explain how to create the data validation strategies. • Describe the process of determining the pre-processing or feature engineering to be carried out on a given dataset. • Explain how to determine the data augmentation pipelines. • Describe the process of developing models to achieve the business objectives, along with the relevant metrics to track the progress. 	<ul style="list-style-type: none"> • Demonstrate the process of evaluating the existing Machine Learning (ML) processes. • Demonstrate how to analyse large and complex datasets to extract insights and select the appropriate technique to be used.
Classroom Aids	
Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector	
Tools, Equipment and Other Requirements	
Laptop/ Desktop with pre-installed (Java, C++) languages / Software.	

Module 3: Process of developing and assisting in the implementation of machine learning systems

Mapped to TEL/N6606 v1.0

Terminal Outcomes:

- Demonstrate the process of collecting, cleaning and preparing data.
- Describe the process of developing relevant algorithms.
- Demonstrate the process of performing data analysis.
- Demonstrate the process of performing machine learning tests.
- Describe the process of training and retraining models.
- Describe the process of assisting in the implementation of machine learning systems.

Duration: 80:00	Duration: 108:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> • Explain how machine learning engineering integrates data science and software engineering. • Explain how self-running software functions to use data and automate predictive models. • Explain how data structures, algorithms, computability and complexity and computer architecture are applied in machine learning engineering. • Explain the application of computer science, computational linguistics, data science, mathematics, statistics, and algorithms in machine learning. • Explain the benefits and process of using Python, Java, R code writing software, etc. • Explain the ML frameworks, libraries, data structures, data modelling, and software architecture. • Explain the end-to-end application of machine learning algorithms. • Describe the software engineering and software design processes. • Describe the process of explaining complex processes in simple terms. • Describe the process of designing and developing machine learning and deep learning systems. 	<ul style="list-style-type: none"> • Demonstrate how to create algorithms based on statistical modelling procedures. • Demonstrate the process of performing the relevant computations and using the relevant algorithms for programming. • Show how to use data modelling and evaluation strategy to find patterns and predict unseen instances. • Demonstrate the process of carrying out machine learning tests, interpreting the test results and making appropriate adjustments based on test results. • Show how to evaluate and transform data science prototypes. • Demonstrate the process of performing statistical analysis to resolve data set problems. • Show how to solve complex problems with multi-layered data sets. • Show how to implement appropriate ML algorithms and libraries. • Demonstrate how to analyse the ML algorithms that could be used to solve a given problem and rank them by their success probability. • Show how to develop ML algorithms to analyse huge volumes of historical

<ul style="list-style-type: none"> • Explain the importance of performing data cleaning to ensure the quality of data. • Explain how to identify differences in data distribution that could affect performance when deploying the model in the real world. • Explain how to research and implement appropriate ML algorithms and libraries. • Describe the process of analysing the ML algorithms that could be used to solve a given problem and rank them by their success probability. • Explain how to optimise existing machine learning libraries and frameworks. • Explain the importance of ensuring the algorithms generate accurate user recommendations. • Explain how to train models and optimise their hyper-parameters. • Explain the importance of carrying out research and implementing best practices to improve the existing machine learning infrastructure. • Describe the process of retraining the existing systems based on new machine learning models. • Explain the importance of following the latest machine learning developments and technologies. • State the infrastructure and data pipelines needed to bring code to production. • Explain the importance of monitoring production to ensure production is carried out based on the developed machine learning system(s). 	<p>data to make predictions.</p> <ul style="list-style-type: none"> • Demonstrate the process of designing machine learning systems/ applications and self-running artificial intelligence (AI) software to automate predictive models. • Show how to create useful information from unstructured data by auto-tagging images and text-to-speech conversions. • Show how to analyse the errors of the model and develop appropriate strategies to rectify them. • Demonstrate how to document the machine learning processes as per the organisational policy. • Demonstrate the process of setting up and maintaining scalable machine learning solutions in production.
<p>Classroom Aids</p>	
<p>Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop</p>	
<p>Tools, Equipment and Other Requirements</p>	
<p>Laptop / Desktop with pre-installed (Python, R Code writing Software, Google Cloud Auto Machine Learning, Azure Machine Learning studio) languages / Software.</p>	

Module 4: Process of implementing Effective communication and coordination at work

Mapped to TEL/N9103, v1.0

Terminal Outcomes:

- Explain the importance of interacting effectively with superiors, colleagues and customers.
- Explain the need of respecting differences of gender and ability.

Duration: 16:00	Duration: 24:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> • Explain the importance of effective and different means of communication and establishing good working relationships with colleagues and superiors. • Explain the importance of helping colleagues with problems, in order to meet quality and time standards as a team. • Describe different methods of communication. • State different types of information that colleagues might need and the importance of providing this information in an appropriate manner. • Explain the importance of helping colleagues with problems, in order to meet quality and time standards as a team. • Describe the organization's policies and procedures for working with colleagues and superiors. • Explain the importance of understanding the consequences of gender-based behaviour. • Describe gender-based concepts, issues and legislation • State the organization standards and guidelines to be followed for PwD and knowledge about laws, acts and provisions defined for PwD by the statutory bodies and the right way to use them including various medical conditions associated with PwD 	<ul style="list-style-type: none"> • Demonstrate the process of reporting any unforeseen disruptions or delays to superiors and/or concerned persons. • Show how to communicate information using different techniques such as face-to-face, telephonic and written means. • Demonstrate sensitivity towards gender and person with a disability while communicating.

<ul style="list-style-type: none"> • Explain the health and safety requirements at a workplace for PwD. • List various rights and duties at a workplace with respect to PwD • Describe the process of recruiting people for a particular job profile w.r.t PwD and gender. • Explain various government / private schemes and benefits available for PwD and information about various institutes working for PwD to enable in providing livelihood opportunities for PwD. 	
<p>Classroom Aids</p>	
<p>Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop</p>	
<p>Tools, Equipment and Other Requirements</p>	
<p>Personal Protective Equipment, Hygiene Equipment and Materials like Sanitizer, Soap, Mask, etc.</p>	

Module 5: Process of managing work and resources, and ensure health and safety at the work

Mapped to NOS TEL/N9104 v1.0

Terminal Outcomes:

- Explain how to manage learning and self-direction.
- Explain the importance of developing critical thinking and problem solving.
- Explain the importance of performing work as per quality standards and maintaining a safe and secure working environment.
- Describe the process of complying with material / energy / electricity conservation practices.

Duration: 16:00	Duration: 24:00
Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
<ul style="list-style-type: none"> • Explain the strategies pertinent to the field that can be used to pursue the advancement of skills. • State the key performance indicators for the new tasks. • Describe the feedback processes and formats. • State the timelines and goals as well as their relevance to work allocated. • Explain the importance of quality and timely delivery of the product/service. • State the layout of the workstation and equipment used. • Explain the escalation matrix and its importance, especially in case of emergencies. • Explain various ways of time and cost management. • Explain the rules/regulations for maintaining health and safety at the workplace. • Explain the meaning of hazard, different types of health and safety hazards found in the workplace, risks and threats based on the nature of work. • Describe the procedures to report breaches in health, safety and security. • Explain ways of managing resources 	<ul style="list-style-type: none"> • Demonstrate the process of creating schedules and rosters for the team to ensure they understand individual work requirements. • Demonstrate the process of reporting any hazard outside the individual's authority to the relevant person in line with organizational procedures and warn others who may be affected. • Demonstrate the process of carrying out routine cleaning of tools, machines and equipment.

<p>and material efficiently.</p> <ul style="list-style-type: none"> • Explain ways to recognize common electrical problems and common practices of conserving electricity. 	
<p>Classroom Aids:</p>	
<p>Training Kit (Trainer Guide, Presentations). Whiteboard, Marker, Projector, Laptop</p>	
<p>Tools, Equipment and Other Requirements</p>	
<p>Relevant stationery, First Aid Kit and Equipment used in Medical Emergencies.</p>	

Module 6: On-the-Job Training

Mapped to Machine Learning Engineer (TEL/Q6603 v1.0)

Mandatory Duration: 120:00	Recommended Duration: 00:00
Location: On-Site	
<p>Terminal Outcomes</p> <ol style="list-style-type: none"> 1. Explain the process of evaluating the existing Machine Learning (ML) processes. 2. Explain the criteria for selecting appropriate datasets and data representation methods. 3. Create algorithms based on statistical modelling procedures. 4. Use data modelling and evaluation strategy to find patterns and predict unseen instances. 5. Carry out machine learning tests, interpret the test results and make appropriate adjustments based on test results. 6. Perform statistical analysis to resolve data set problems. 7. Develop ML algorithms to analyse huge volumes of historical data to make predictions. 8. Set up and maintain scalable machine learning solutions in production. 9. Create schedules and rosters for the team to ensure they understand individual work requirements. 10. Carry out routine cleaning of tools, machines and equipment. 	

Annexure

Trainer Requirements

Trainer Prerequisites						
Minimum Educational Qualification	Specialization	Relevant Industry Experience		Training Experience		Remarks
		Years	Specialization	Years	Specialization	
B.E./B.Tech/ BCA/B.Sc.	Electronics/Telecom /IT and other relevant domains	1	Active Networks/IoT Domain	0	NA	Eligible for ToT program

Trainer Certification	
Domain Certification	Platform Certification
Job Role “ Machine Learning (ML) Engineer ”, “TEL/Q6603, v1.0”, Minimum accepted score is 80%	Job Role: “ Trainer ”, “MEP/Q2601 v1.0”, Minimum Accepted score is 80%

Assessor Requirements

Assessor Prerequisites						
Minimum Educational Qualification	Specialization	Relevant Industry Experience		Training Experience		Remarks
		Years	Specialization	Years	Specialization	
B.E./B.Tech/ BCA/B.Sc.	Electronics/Telecom /IT and other relevant domains	1	Active Networks/IoT Domain	0	NA	Eligible for ToA program

Assessor Certification	
Domain Certification	Platform Certification
Job Role “ Machine Learning (ML) Engineer ”, “TEL/Q6603, v1.0”, Minimum accepted score is 80%	Job Role: “ Assessor ”, “MEP/Q2701 v1.0”, Minimum Accepted score is 80%

Assessment Strategy

1. Assessment System Overview:

- Batches assigned to the assessment agencies for conducting the assessment on SDSM/SIP or email.
- Assessment agencies send the assessment confirmation to VTP/TC looping SSC.
- The assessment agency deploys the ToA certified Assessor for executing the assessment.
- SSC monitors the assessment process & records.

2. Testing Environment:

- Confirm that the centre is available at the same address as mentioned on SDMS or SIP.
- Check the duration of the training.
- Check the Assessment Start and End time to be as 10 a.m. and 5 p.m.
- If the batch size is more than 30, then there should be 2 Assessors.
- Check that the allotted time to the candidates to complete Theory & Practical Assessment is correct.
- Check the mode of assessment—Online (TAB/Computer) or Offline (OMR/PP).
- Confirm the number of TABs on the ground are correct to execute the Assessment smoothly.
- Check the availability of the Lab Equipment for the particular Job Role.

3. Assessment Quality Assurance levels / Framework:

- Question papers created by the Subject Matter Experts (SME).
- Question papers created by the SME verified by the other subject Matter Experts.
- Questions are mapped with NOS and PC.
- Question papers are prepared considering that level 1 to 3 are for the unskilled & semi-skilled individuals, and level 4 and above are for the skilled, supervisor & higher management.
- An assessor must be ToA certified & the trainer must be ToT Certified.
- The assessment agency must follow the assessment guidelines to conduct the assessment.

4. Types of evidence or evidence-gathering protocol:

- Time-stamped & geotagged reporting of the assessor from assessment location.
- Center photographs with signboards and scheme-specific branding.
- Biometric or manual attendance sheet (stamped by TP) of the trainees during the training period.
- Time-stamped & geotagged assessment (Theory + Viva + Practical) photographs & videos.

5. Method of verification or validation:

- A surprise visit to the assessment location.
- A random audit of the batch.
- Random audit of any candidate.

6. Method for assessment documentation, archiving, and access:

- Hard copies of the documents are stored.
- Soft copies of the documents & photographs of the assessment are uploaded / accessed from Cloud Storage.
- Soft copies of the documents & photographs of the assessment are stored in the Hard Drives.

References

Glossary

Term	Description
Declarative Knowledge	Declarative knowledge refers to facts, concepts and principles that need to be known and/or understood in order to accomplish a task or to solve a problem.
Key Learning Outcome	A key learning outcome is a statement of what a learner needs to know, understand and be able to do in order to achieve the terminal outcomes. A set of key learning outcomes will make up the training outcomes. Training outcome is specified in terms of knowledge, understanding (theory) and skills (practical application).
OJT (M)	On-the-job training (Mandatory); trainees are mandated to complete specified hours of training on-site
OJT (R)	On-the-job training (Recommended); trainees are recommended the specified hours of training on-site
Procedural Knowledge	Procedural knowledge addresses how to do something, or how to perform a task. It is the ability to work or produce a tangible work output by applying cognitive, affective or psychomotor skills.
Training Outcome	Training outcome is a statement of what a learner will know, understand and be able to do upon the completion of the training.
Terminal Outcome	The terminal outcome is a statement of what a learner will know, understand and be able to do upon the completion of a module. A set of terminal outcomes help to achieve the training outcome.

Acronyms and Abbreviations

Term	Description
NOS	National Occupational Standard (s)
NSQF	National Skills Qualifications Framework
OJT	On-the-job Training
QP	Qualifications Pack
PwD	People with Disability
PPE	Personal Protective Equipment