NSDA Reference
To be added by NSDA

Revised Application Documentation: Version 4 /22 August, 2016

QUALIFICATION FILE – Certificate Course

Name and Address of submitting body:

- NIELIT Gorakhpur,
  M.M.M.U.T. Campus, Deoria Road Gorakhpur – 273010 (UP)
  Phone No.: 0551-2273371
  Branch Office
- NIELIT Lucknow
  A-1/9, Sumit Complex, VibhutiKhand, Gomti Nagar, Lucknow- 226010(UP)
  Phone No.: 0522 272 0590

Name and contact details of individual dealing with the submission

Name: C. Mohan.

Position in the organisation: Joint Director (Technical)

Address if different from above:NA

Tel number(s) 0551-2273872

E-mail address mohan@nielit.gov.in

List of documents submitted in support of the Qualifications File

1. Industry Validation Annexure-1
2. Detailed CurriculumAnnexure-2
3. Write up on Evolution of Course

Since the proposed job role has not been identified by SSC, the industry mapping will be as per progression pathways as indicated in the QF

QUALIFICATION FILE SUMMARY

Qualification Title	Certificate Course in EMI and EMC for Electronics Product Design.
Qualification Code	
Body/bodies which will assess candidates	**Examination Cell,** National Institute of Electronics and InformationTechnology, 6-CGO Complex, Electronics Niketan, Lodhi Road, New Delhi. 110003.
Body/bodies which will award the certificate for the qualification.	**Certification Division,** National Institute of Electronics and Information Technology 6-CGO Complex, Electronics Niketan Lodhi Road, New Delhi. 110003.
Body which will accredit providers to offer the qualification.	**Accreditation Division,** National Institute of Electronics and Information Technology 6-CGO Complex, Electronics Niketan Lodhi Road, New Delhi. 110003.
Occupation(s) to which the qualification gives access	• EMI – EMC engineer. • EMC Regulatory manager. • Automotive EMC Engineer. • EMC-RF Engineer. • EMC Test Technician Ref: *https://interferencetechnology.com/job-wanted/* *https://www.linkedin.com/jobs*
Proposed level of the qualification in the NSQF.	6
Notional Learning Hours	6 Months (600hours.)
Entry requirements / recommendations.	As a prerequisite to this course a candidate must have a minimum of Bachelor's Degree in Electronics Engineering / Electrical & Electronics Engineering / Electronics & Communication Engineering / Electrical Engineering or have M.Sc. in Electronics or M.E / M.Tech. in Electronics / Communication / RF and Microwave Engineering.
Progression from the qualification.	Progression of the work: - EMC - Printed Circuit Board Design - Circuit-to-Circuit Interference.

- Mechanical Design for EMC.
- Mastering the Spectrum Analyser for Electrical Noise Measurement.

Ref: *http://www.silent-solutions.com/education.html*

In India the companies like AltenCalsoft Labs (Mysore), Cisco systems (Bangalore), Infinite Computer Solutions (Bangalore), Agiliad Private Technologies (Pune) always have the requirement of EMI and EMC engineers.
International companies like HE Space (Netherland), Kelly Engineering (Texas, US), Siemens (UK/others), etc. regularly look to recruit the engineers with profound knowledge in EMC and EMI.

Ref: *https://interferencetechnology.com/job-wanted/*
https://www.naukri.com/emi-emc-testing-jobs

Planned arrangements for RPL.

- It will be incorporated once RPL strategy is finalized.
- Presently only candidates who undergo training shall be assessed

Formal structure of the qualification

Title of unit or other component	Mandatory / Optional	Estimated size (learning hours)	Level
EMC Fundamentals	Mandatory	80	6
Electrical Noise as EMI	Mandatory	40	
EMI analysis as Supression	Mandatory	55	
EMC standards	Mandatory	45	
EMC measurements	Mandatory	65	
PCB Trace Routing and Termination	Mandatory	70	
Grounding Techniques	Mandatory	30	
Filtering	Mandatory	45	
Shielding	Mandatory	55	
Electrical Gaskets	Mandatory	45	
Advanced Topics	Optional	70	
Total	**Mandatory**	**600**	

SECTION 1
ASSESSMENT

Name of assessment body:
Examination Cell,
National Institute of Electronics and Information Technology
6-CGO Complex, Electronics Niketan
Lodhi Road, New Delhi. 110003.

Will the assessment body be responsible for RPL assessment?

Presently only candidates undergoing training shall be assessed. Later on candidates having experience and knowledge shall be assessed. The information will be provided on finalization of such procedure.

Describe the overall assessment strategy and specific arrangements which have been put in place to ensure that assessment is always valid, consistent and fair and show that these are in line with the requirements of the NSQF:

The emphasis is on practical demonstration of skills & knowledge based on the performance criteria. Each OUTCOME is assessed & marked separately. Student is required to pass in all OUTCOMEs individually and marks are allotted. Following assessment methodologies are used.

A. Written Assessment (Multiple Choice Questions)
B. Practical Assessment
C. Viva Voce Assessment

Supporting evidences for Assessment

The assessment results are backed by following evidences.
1 The assessor collects a copy of the attendance for the training done under the scheme. The attendance sheets are signed and stamped by the In charge / Head of the Training Centre.
2 The assessor verifies the authenticity of the candidate by checking the photo ID card issued by the institute as well as any one Photo ID card issued by the Central/Government. The same is mentioned in the attendance sheet.
3 The assessor assigns roll number.
4 The assessor takes photograph of all the students along with the assessor standing in the middle and with the centre name/banner at the back as evidence.

Title of Unit/Component:

Overall Assessment strategy.

Assessable Outcomes	Assessment criteria for the outcome	Total Mark	Written	Practical / Term Work	Vivo-voce
1. To Familiarize With EMC Fundamentals	Definition of EMI and EMC, Electric and Magnetic Fields and Frequency Spectra (Fourier analysis)	100	20	4	4
	Draw Component Characteristics at RF Frequencies. Transmission Line Modelling and Various Materials Effects		20	8	8
	Concepts of EMI Radiation Mechanism. Detection of EMI Sources and Coupling Paths, EMI/EMC Modelling and Simulation		20	8	8
		Total	**60**	**20**	**20**
2 Acquire Knowledge of Electrical Noise as EMI	Aspects of EMI in System Environment and Electrical Noise Sources	100	30	10	10
	Current Flow – which path does it take?, Common-Mode and Differential-Mode Currents and Power and/or Return Bounce		30	10	10
		Total	**60**	**20**	**20**
3 Develop Concept of EMI Analysis and Suppression	Identification of EMI Hot Spot, Closed Loop Circuits	100	20	4	4
	RF Current Return and Flux Cancellation		20	8	8
	Describe Loop Area between Circuit and components, Primary Grounding, Filtering, Shielding		20	8	8
		Total	**60**	**20**	**20**
4 EMC and ESD Standards	Concept of EMC Standards, Radiated and Conducted Emission (RE/CE) Standards Demonstrate EMC Standards	100	30	10	10
	State Radiated and Conducted Immunity (RI/CI) Standards and Electrostatic Discharge (ESD) Standards		30	10	10
		Total	**60**	**20**	**20**
5 Acquire Knowledge of EMC Measurements	State and demonstrate EMC Measurements, Testing Equipment and Radiated Emission Test Setup	100	30	10	10
	Concepts & Measurement of Signals Noise and Interpretation of Measurement Results		30	10	10
		Total	**60**	**20**	**20**

6 Develop Concept of PCB Trace Routing and Termination	Typical PCB Trace Topologies, Transmission Line Effects, Impedance Control	100	15	5	5
	Read Trace Routing Design Guidelines, Routing Differential Pair Signals, Layer Jumping – Use of Vias		15	5	5
	Distinguish Routing over a Split Plane, Explain Trace Termination		15	5	5
	Termination Methodologies , Implementation and Simulation Examples		15	5	5
		Total	**60**	**20**	**20**
7. Use and practice of Grounding Techniques	Demonstration of various Grounds, Function of a Ground, Grounds Separation and Isolation	100	30	10	10
	View of Single-Point, Multi-Point, Hybrid Grounds Use of Internal Cables and Connectors Grounding		30	10	10
		Total	**60**	**20**	**20**
8 Develop Concept of Filtering	Defining a Filter, Common-Mode and Differential-Mode Filtering	100	30	10	10
	Basic Filter Component Characteristics and Filtering Guidelines		30	10	10
		Total	**60**	**20**	**20**
9 Develop Concept of Shielding	Transmission Line Theory of Shielding, Absorption Loss, Reflection Loss and Shielding Effectiveness	100	30	10	10
	Demonstration of Shielding Materials, Apertures in Shielded Walls and Waveguide below Cut-off		30	10	10
		Total	**60**	**20**	**20**
10 Demonstrate Electrical Gaskets	Examine Need for Gaskets	100	30	10	10
	Common Gaskets Material Use, Properties and Characteristics of RF Gaskets		30	10	10
		Total	**60**	**20**	**20**
11 Evaluate **Advanced Topics**	Advanced Electromagnetic Theory and Techniques	100	5	4	4
	EMC/EMI Modelling Techniques and Applications		10	2	2
	Express and practice Virtual EMC Lab		5	2	2
	Formulate New Radiation Testing Technology – from Near-field Scanning to Far-field Prediction		10	2	2

	Initiate Wireless Power Transfer – from Theory to Design		10	2	2
	Novel Radiation Mitigation Design – Defected Ground Structure (GDS), Meta-surface		5	2	2
	Grounds Separation and Isolation		5	2	2
	Structure Single-Point, Multi-Point and Hybrid Grounds		5	2	2
	Internal Cables and Connectors Grounding		5	2	2
		Total	**60**	**20**	**20**

Means of assessment 1

The theory examination for each module would be for duration of three hours and the total marks for each subject would be 100. The theory exam will be of 60 marks, the Practical examination of three hours duration will be of 20 marks. It will include theLaboratory/ Practical work and will be conducted at Institutions / organizations, which are running the course. There will also be viva-voce of 20 marks. The Society will be responsible for holding the examination for theory and practical both for the students from Accredited Centres and student at large.

Pass Percentage

To qualify for a pass in a module, a candidate must have obtained at least 50% in each theory and practical examination. The marks will be translated into grades, while communicating results to the candidates. The gradation structure is as below:-

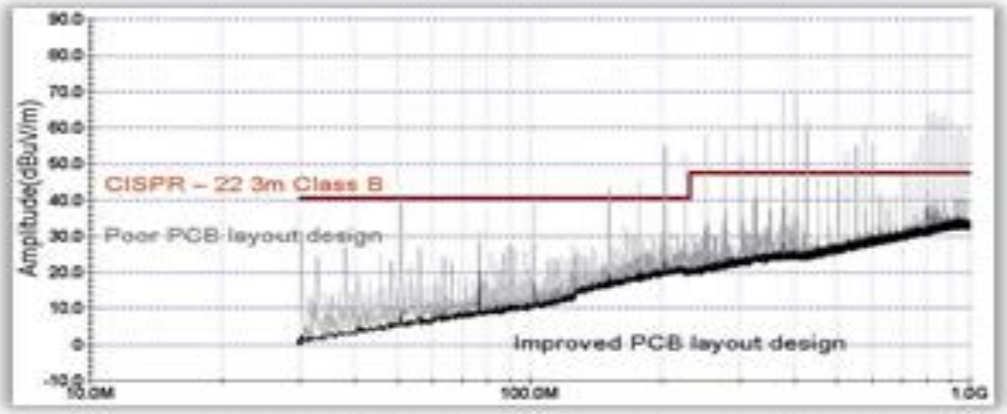
Pass percentage	**Grade**
Failed (<50)	F
50%-54%	C
55%-64%	B-
65%-74%	B
75%-84%	A-
85% and over	A

SECTION 2
EVIDENCE OF NEED

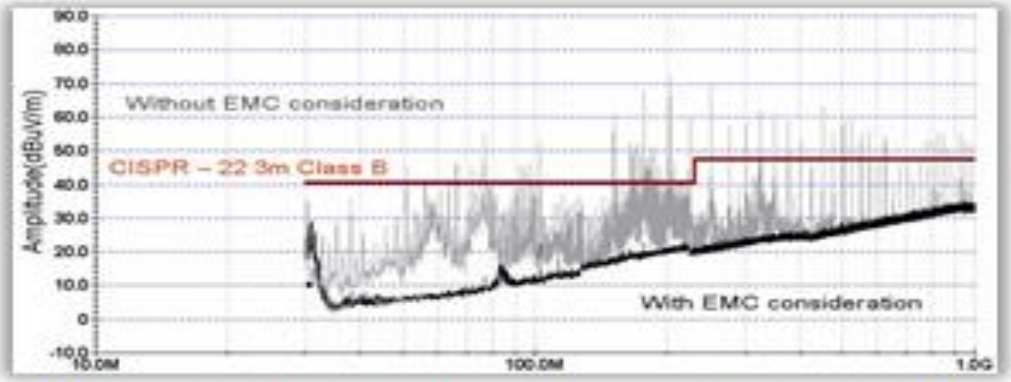
Electromagnetic compatibility (EMC) is concerned with the unintentional generation, propagation and reception of electromagnetic energy which may cause unwanted effects such as electromagnetic interference (EMI) or even physical damage in operational

equipment. The goal of EMC is the correct operation of different equipment in a common electromagnetic environment.

EMC pursues two main classes of issue. Emission is the generation of electromagnetic energy, whether deliberate or accidental, by some source and its release into the environment. EMC studies the unwanted emissions and the countermeasures which may be taken in order to reduce unwanted emissions. The second class, susceptibility is the tendency of electrical equipment, referred to as the victim, to malfunction or break down in the presence of unwanted emissions, which are known as Radio frequency interference (RFI). Immunity is the opposite of susceptibility, being the ability of equipment to function correctly in the presence of RFI, with the discipline of "hardening" equipment being known equally as susceptibility or immunity. A third class studied is coupling, which is the mechanism by which emitted interference reaches the victim.



Comparison of Radiated Emission from poorly and well designed PCB

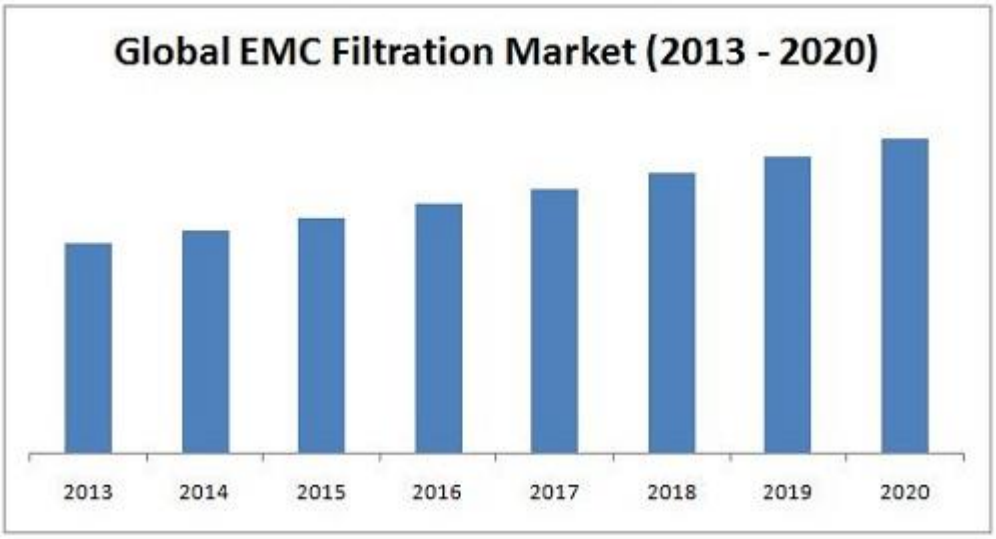


Comparison of Radiated Emission from poorly and well designed

Interference mitigation and hence electromagnetic compatibility may be achieved by addressing any or all of these issues, i.e., quieting the sources of interference, inhibiting coupling paths and/or hardening the potential victims. In practice, many of the engineering techniques used, such as grounding and shielding, apply to all three issues

Around the world, RF emissions or EMI is regarded as a potential threat to broadcast

reception and to sensitive services such as radio navigation and radio astronomy. Therefore the spectrum or radio regulator in each country or region is usually charged with the widest responsibility for controlling EMI. Immunity, on the other hand, may be reserved as a performance issue for critical applications such as medical or military – and the regulator may differ in each case. The combination of EMI and immunity as EMC may also be used as a means to establish uniform trade rules across a region, as it is in the EU.



The present market trend and the estimated growth of Global EMC Filtration is shown above. The future growth is estimated by markets and markets analytics agency.

- *https://www.ieee.li/pdf/essay/guide_to_global_emc_requirements_2007.pdf*
- *Learn EMC Web Site: Common-Impedance Coupling.*
- *EMC Testing and Standards in Transient Immunity Testing, RF Immunity. Electronics-project-design.com. Retrieved on 2011-07-19.*
- *ISO 7637-2:2004/Amd 1:2008. Iso.org (2011-03-01). Retrieved on 2011-07-19.*

The estimated uptake of this qualification will be around 15 – 20.
It may further change as per requirement or any industrial collaboration.

To ensure that the qualification(s) does (do) not duplicate already existing or planned qualifications in the NSQF, we have foreseen the consolidation of qualification packs as a natural progression. As the understanding and adoption models of QPs evolve in the industry and across its sub-sectors, we foresee consolidation of qualification packs as a natural progression. The Qualification, providing the complete package and hands-on experience, does not exist as per information available in public domain.

There will be a proper review and monitoring of the course in every two years.
The following data will be used for this purpose.

1. Results of assessments
2. Employer feedback will be sought post-placement
3. Student feedbacks
4. Trainer feedback
5. Workshops and seminar for reviewing the qualifications
6. Industry Requirements

Consultation/ Tie-up with Industries or Expert for review of the Curriculum

SECTION 3
SUMMARY EVIDENCE OF LEVEL

Level of qualification: 6

Summary of Direct Evidence:

Justify the NSQF level allocated to the QP by building upon the five descriptors of NSQF. Explain the reasons for allocating the level to the QP.

Generic NOS is/are linked to the overall authority attached to the job role.

Title :Certificate Course in EMI and EMC for Electronics Product Design.			**Level : 6**
NSQF Domain	**Outcomes of the Qualification/Component**	**How the job role relates to the NSQF Level Descriptors**	**NSQF Level**
Process required	It provides a better understanding of electronic products, systems electromagnetic characteristics and EMC standard requirements, which include basic fundamentals of EMI/EMC; EMC standards; computer modelling and simulation for electromagnetic emission, immunity and ESD.	Job that requires well developed skill, with clear choice of procedures in familiar context.	**5**
Professional knowledge	After acquiring professional knowledge the EMI/EMC engineer can: Recognize and reduce the efficiency of the most common EMI antenna structures that cause emissions and immunity problems. Apply diagnostic techniques in a systematic way to investigate and improve circuit designs.	Knowledge of facts, principles, processes and general concepts, in a field of work or study.	**6**
Professional skill	They are proficient in developing solution based on detailed design and practical knowledge gained during course. Students will learn to identify and utilize their ground structure, control the flow of high and low-frequency currents, identify and characterize potential sources and victims of EMI, control bandwidths, ignore structures and coupling paths that cannot contribute to EMC problems, and systematically identify and evaluate structures and coupling paths capable of causing a product to be non-compliant.	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information	**5**
Core skill	Students completing the course will learn to systematically review their designs to find problems before the first hardware is built and tested. They are able to make independent decision involved in providing solution.	Desired mathematical skill; understanding of social, political; and some skill of collecting and organizing information, communication.	**6**
Responsibility	They will be responsible for designing and testing the EMI/EMC circuits and will be able to lead team as well as work in team.	Responsibility for own work and learning and some responsibility to other's works and learning.	**6**

SECTION 4

EVIDENCE OF RECOGNITION OR PROGRESSION

After undergoing this course the student can further go for the international certification or can further go for mastering a particular technique.

The international certification like iNARTE can be taken by the candidate to get an international recognition.

The topics which can be mastered further are as follows:
Mechanical Design for EMC – There are several short term courses which are designed to give theory and demonstrations for the successful design of mechanical enclosures for good system emissions and immunity performance. Key topics focused in such courses, includes grounding at the PCB and enclosure, system ground maps, PCB component placement and control drawings, enclosure and cable shielding, PCB device "cans", resonant slots and enclosures, heat sinks, unintentional antennas, as well as connector, screw, and conductive gasket spacing.

Grounding for EMC – The grounding technique can be expertized by understanding the Signal Integrity and Instrumentation - Theory, applications and hardware demonstrations and also understanding effective design and troubleshooting techniques. The hands-on experience of spectrum analyser, oscilloscope and signal generators to illustrate inductance, common-impedance coupling, and ground loops can be done to enhance the skills further.

Mastering the Spectrum Analyser for Electrical Noise Measurement – In such a course one can get the hands-on experience of spectrum analyser and start measuring and troubleshooting electrical noise and EMC problems.

Ref: *http://www.elitetest.com/blog/2015-01/upcoming-professional-development-opportunities*

SECTION 5

EVIDENCE OF INTERNATIONAL COMPARABILITY

The certification course is comparable to the international certification course of iNARTE.
The course also matches the standards of the course of EMC training by Rohde and Schwarz Singapore.