

NSDA Reference
To be added by NSDA

QUALIFICATION FILE: Additive Manufacturing/ 3 D Printing

Name and address of submitting body:

National Institute Of Electronics and Information Technology (NIELIT),
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Name and contact details of individual dealing with the submission

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List of documents submitted in support of the Qualifications File

1. Detailed Curriculum(Annexure I)
2. Industry Validation (Annexure II)

QUALIFICATION FILE SUMMARY

Qualification Title	Additive Manufacturing /3D Printing
Qualification Code	NL/M/L5/C024 NIELIT/EM/L5/010
Body/bodies which will assess candidates	Examination Cell, National Institute of Electronics and Information Technology 6-CGO Complex, Electronics Niketan Lodhi Road, New Delhi. 110003.
Body/bodies which will award the certificate for the qualification.	Examination Cell, 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.	National Institute of Electronics and Information Technology (NIELIT), New Delhi-03
Occupation(s) to which the qualification gives access	Prototyping Engineer
Proposed level of the qualification in the NSQF.	Level 5
Notional Learning Hours	400 Hours
Entry requirements / recommendations.	Diploma holder or B.Sc. Graduate and not less than 18 years of age.
Progression from the qualification.	<p><u>Academic Progression:</u></p> <p>Additive Manufacturing (3D Printing)- Prototyping Engineer (NL/M/L5/C024)</p> <p style="text-align: center;">↓</p> <p style="text-align: center;">Certificate Course on 3-D printing (Level 6)</p> <p><u>Professional Progression:</u></p> <p>3D Printer System Operator, 3D CAD Design Engineer, Product Developer, Prototyping Engineer</p> <p style="text-align: center;">↓</p> <p>Senior 3D Printer System Operator, 3D CAD Design Engineer, Product Developer,</p>

	Prototyping Engineer ↓ System Manager
Planned arrangements for RPL.	It will be incorporated once RPL strategy is finalized.

Formal structure of the qualification

<i>Module Code</i>	<i>Module Name</i>	<i>Mandatory/ Optional</i>	<i>Estimated Size (Learning Hours)</i>	<i>Level</i>
AM 101	Introduction to 3 D Printing	Mandatory	25	5
AM 102	AM Technologies		100	
AM 103	3D Modelling for 3 D Printing		100	
AM 104	Application of 3 D Printing		100	
AM 105	Integrated Product Design and Post Processing		70	
AM 106	Interpersonal and Communication Skills/Reporting		5	

SECTION 1 ASSESSMENT

Name of assessment body:

Examination Cell, National Institute of Electronics and Information Technology (NIELIT), New Delhi-03

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)
Practical Assessment (The Practical examination will be based on the modules of Advanced Diploma – Additive Manufacturing (3 D Printing)/ Prototyping Engineer
- B. Project - The Project is carried out by the student under guidance and support of faculty and management of the respective Institute / Organization)

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 Examination Superintendent/ Head of Institution.
 2. The assessor verifies the authenticity of the candidate by checking the photo ID card/Hall Ticket 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 Registration/Examination Division assigns roll number.
- 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.

ASSESSMENT EVIDENCE

Job Role: Prototyping Engineer

(Detailed Curriculum attached As Annexure-I)

Assessable Outcomes	Assessment criteria for the outcome	Total Mark	Written	Practical	Internal/ Viva-voce
1. Demonstration about 3D Printing, Manufacturing, Fabrication, prototyping and advantages.	<ul style="list-style-type: none"> • Demonstration of different stages of AM Process • Programming of AM Parts. • Working with 3D printer. • Select and use correct CAD formats to manufacture a 3D printed part. 	25	10	12.5	2.5
2. Demonstration of FDM machine, about AM technologies, various AM process, 3 D printing principles etc.	<ul style="list-style-type: none"> • Selection of Laser Sintering Polyjet, Materials for Additive Manufacturing & 3D Printing, • Development of AM Technologies, Computers, Computer-Aided Design Technology - Other Associated Technologies, Lasers, Printing Technologies, Programmable Logic Controllers, Materials, Computer 	100	40	50	10

	<p>Numerically Controlled Machining ,</p> <ul style="list-style-type: none"> • Use of Layers , Classification of AM Processes, New AM Classification Schemes, Metal Systems, Hybrid Systems, Milestones in AM Development, AM Around the World, Rapid Prototyping Develops into Direct Digital Manufacturing. 				
<p>3. Will be able to perform 3D Printing slicing, STL and Formats, AM simulation etc</p>	<ul style="list-style-type: none"> • Use of slicing tools. • Prepare STLs for 3D Printing • Prepare CAD Models with STL file • Process Simulations Using Finite Element Analysis. 	100	40	50	10
<p>4. Will be able to do functional testing & use of AM to support in many Applications like medical, product prototyping etc.</p>	<ul style="list-style-type: none"> • Functional Testing, Rapid Tooling, • Use of AM to Support Medical Applications, Surgical and Diagnostic Aids, Prosthetics Development • Outline on Manufacturing, Tissue Engineering and Organ Printing • Able to give Software Support, Product Prototyping, Art, Jewellery 	100	40	50	10
<p>5. Integrated Product Development and explore opportunities in 3D printing.</p>	<ul style="list-style-type: none"> • identify opportunities to apply 3D printing Technology for time and cost saving. • Identify Entrepreneurial opportunities in 3D Printing. 	65	26	32.5	6.5

6. Communicate clearly with clients & colleagues & can prepare job report etc.	<ul style="list-style-type: none"> • Interaction with colleagues, clients etc. • Interpret manual and can prepare job report. 	10	4	5	1
	Total	400	160	200	40

Means of assessment 1

Proctored online assessments (LAN and Web based), carried out using a variety of question formats applicable for linear / adaptive methodologies; performance criteria being assessed via tests, simulations, and multiple choice questions etc.

Pass Percentage

To qualify for a pass in a module, a candidate must have obtained at least 40% in theory and practical examination. And overall marks for all test should be 50% or above to pass the Examination.

SECTION 2

EVIDENCE OF NEED

What evidence is there that the qualification is needed?

Major 3D Printing / 3D Scanning Cos. in India

Some of the major 3D Printing cos. present in India are listed below:

- Stratasys (USA) – Bangalore
- Objet (Israel) – Bangalore
- EOS (Germany) – Chennai
- Solidscape (USA) – Mumbai
- Melting Mints – Mumbai
- Build Protos – Hyderabad
- Profectus – Hyderabad
- Small Sensations – Ahmedabad
- Nutz & Boltz – New Delhi
- Global 3D – Bangalore
- Fracktal Works – Bangalore
- Design & Prototyping Centre – Hyderabad
- Steinbichler (Germany) – Bangalore
- Faro (USA) – Hyderabad
- Hexagon (USA) – Hyderabad
- Creator Bot – Bangalore
- Fabonix – Bhubaneshwar
- Printzworldwide – Calcutta
- Novabeans – New Delhi

Please note that there are several other small and medium size 3D printing cos. across the

country. Only the major names have been showcased here.

Job Description

Persons trained in the digital fabrication (3D Printing, 3D Scanning and CNC) program will have the following new skills which are directly relevant to industry.

- 3D Modeling
- Slicing & Orientation
- Post Processing of 3D Printed models
- 3D Printer machine maintenance
- Design for 3D Printing
- 3D Scan processing
- Estimation and scheduling

Industry Acceptability

The following target segments are addressable immediately over the upcoming years:

No. of SMEs in India, 2012 – 3.2 crore

No. of SMEs in India, 2013 – 4.8 crore

Investment in SMEs in India, 2013 – Rs. 978 crore

Contribution by SMEs to India's GDP, 2013 – Rs. 2000 crore

SMEs in Manufacturing

*3D Printing is a manufacturing technology that is much faster than all conventional manufacturing technologies. As a result, the immediate market with significant value are the **manufacturing SMEs** as they require 3D Printing and Digital Fabrication technologies to make what they need. Additionally, the **Make in India** mission has many advantages for manufacturing companies.*

No. of SMEs in Manufacturing in 2013 – 10 lakh (17%)

Estimated no. manufacturing SMEs using 3D Printing by 2018 – 6 lakh

That is a direct job requirement for 6 lakh people.

Other Markets where 3D Printing is being adopted

1. Custom gifting/Small Scale Entrepreneurs
2. Medical Devices and Implants
3. Architectural Sector/Civil Construction
4. Education
5. Jewelry
6. Large Scale PSUs/ Research & Development Govt. Labs
7. Consumer/Hobbyist

Justification of Course in ESDM Sector

As shown above, the figure of 6 lakh jobs in this field are encouraging. The manufacturing SMEs are already adopting 3D Printing. It would be prudent to begin skilling and enable entrepreneurs and skilled labour in 3D Printing in India.

What is the estimated uptake of this qualification and what is the basis of this estimate?

30 students / Batch - 3 Batches / Year tentatively.

What steps were taken to ensure that the qualification(s) does/do not duplicate already existing or planned qualifications in the NSQF?

As the understanding and adoption models of Qualification Packs (QPs) evolve in the industry and across its sub-sectors, we foresee consolidation of qualification packs as a natural progression. The Qualification does not exist as per information available in public domain.

What arrangements are in place to monitor and review the qualification(s)? What data will be used and at what point will the qualification(s) be revised or updated?

The Qualification is to be monitored and reviewed every two years.

The following data will be used

1. Results of assessments
2. Employer feedback will be sought post-placement
3. Student feedbacks
4. Workshops and seminar for reviewing the qualifications
5. Industry Requirements
6. Consultation/ Tie-up with Industries or Expert for review of the Curriculum.

SECTION 3**SUMMARY EVIDENCE OF LEVEL**

Level of qualification:5

Summary of Direct Evidence:

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

NSQF Domain	Outcomes of the Qualification/Component	How the job role relates to the NSQF Level Descriptors	NSQF Level
Process required	The job holder must be able to: 1. Select and use correct CAD formats to manufacture a 3D printed part. 2. Design & prototype products 3. Operate and maintain a 3D Printer	Job that requires well developed skill, with clear choice of procedures in familiar context.	5

Professional knowledge	<p>An individual on the job needs to know and understand:</p> <ul style="list-style-type: none"> • Products and its production process. • To be able to understand design constraints specific to the company. • To learn slicing tools. • To introduce a bottom-up and top-down design approaches. • Relevant reference sheets, manuals and documents regarding prototyping. 	<p>Knowledge of facts, principles, processes and general concepts, in a field of work or study.</p>	<p>5</p>
Professional skill	<p>An individual on the job needs to know and understand:</p> <ul style="list-style-type: none"> • Explain current and emerging 3D printing applications in a variety of industries • Describe the advantages and limitations of each 3D printing technology • Evaluate real-life scenarios and recommend the appropriate use of 3D printing technology • Identify opportunities to apply 3D printing technology for time and cost savings • Discuss the economic implications of 3D printing including its impact on start-up businesses and supply chains • Design and print objects containing moving parts without assembly • Identify and recommend the right material based on the application need 	<p>A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information</p>	<p>5</p>
Core skill	<p>An individual on the job should have following:</p>	<p>Desired mathematical skill;</p>	<p>5</p>

	<ul style="list-style-type: none"> • Providing support for production and design team • Able to give support and advice whenever necessary to all stakeholders involved. • Over the whole product development life cycle, intervene with 3D Printing technologies to optimize the process, reduce production cost, and ease the prototyping activities. 	<p>understanding of social, political; and some skill of collecting and organizing information, communication.</p>	
Responsibility	<p>The job holder must be able to efficiently design and 3D Print objects and devices by leveraging the freedom offered by 3D Printing technologies and open source electronics.</p>	<p>Responsibility for own work and learning and some responsibility to other's works and learning.</p>	5

SECTION 4

EVIDENCE OF RECOGNITION OR PROGRESSION

What steps have been taken in the design of this or other qualifications to ensure that there is a clear path to other qualifications in this sector?

This qualification comprises of much relevant topics in all aspects of the industrial requirement. Hence an incumbent can possibly get higher job roles like 3D Printer System Operator, 3D CAD Design Engineer, Product Developer, Prototyping Engineer Senior 3D Printer System Operator, 3D CAD Design Engineer, Product Developer, Prototyping Engineer and System Manager. And ensure that the design of the course will timely be modified as per the industrial demands. Incumbent can go for higher level course in this field.

SECTION 5

EVIDENCE OF INTERNATIONAL COMPARABILITY

*** NIL***