



QUALIFICATION FILE

Senior Technician Electronics Engineering and Embedded systems

- ☐ Short Term Training (STT) ☒ Long Term Training (LTT) ☐ Apprenticeship
☐ Upskilling ☐ Dual/Flexi Qualification ☐ For ToT ☐ For ToA
- ☒ General ☐ Multi-skill (MS) ☐ Cross Sectoral (CS) ☐ Future Skills ☐ OEM

NCrF/NSQF Level: 4.5

Submitted By:

NETTUR TECHNICAL TRAINING FOUNDATION
23/24, II PHASE, PEENYA INDUSTRIAL AREA,
BENGALURU – 560058, KARNATAKA

Table of Contents

Section 1: Basic Details.....	3
Section 2: Module Summary	6
Section 3: Training Related	8
Section 4: Assessment Related.....	8
Section 5: Evidence of the need for the Qualification	9
Section 6: Annexure & Supporting Documents Check List	10
Annexure -1 Evidence of Level.....	11
Annexure 2: Tools and Equipment (Lab Set-Up)	14
Annexure 3: Industry Validations Summary.....	16
Annexure 4: Training & Employment Details	19
Annexure 5: Blended Learning	20
Annexure 6: Detailed Assessment Criteria	21
Annexure 7: Assessment Strategy	28
Annexure 8: Model Curriculum	32
Annexure 9: Career Progression	46
Annexure: 10 Assessment SOP	47
Annexure 11: Occupational Map	48
Annexure 12: Key Learning Outcome.....	50
Annexure: Acronym and Glossary	55

Section 1: Basic Details

1.	Qualification Name	Senior Technician- Electronics Engineering and Embedded systems	
2.	Sector/s	Electrical and Electronics	
3.	Type of Qualification: ☒ New ☐ Revised ☐ Has Electives/Options ☐ OEM	NQR Code & version of existing/previous qualification: (Change to previous, once approved)	Qualification Name of existing/previous version: Senior Technician Electronics Engineering and Embedded systems
4.	a. OEM Name b. Qualification Name (Wherever applicable)	NA	
5.	National Qualification Register (NQR) Code &Version (Will be issued after NSQC approval)	QG-4.5-EH-01403-2023-V1-NTTF	6. NCrF/NSQF Level: 4.5
7.	Award (Certificate/Diploma/Advance Diploma/ Any Other (Wherever applicable specify multiple entry/exits also & provide details in annexure)	Certificate	
8.	Brief Description of the Qualification	The Candidate will be able to do Electronic Hardware Design & Testing, Design & installation of PCB, Testing VLSI systems, Testing Embedded Hardware, Design and develop Electronics circuits, Automation of systems, Implement IoT Systems. Will have Exposure on VLSI design, Communication Protocols, Artificial Intelligence and Machine Learning, Embedded system, PLC and IoT. The subjects covered in this Programme are – Digital Communication, Advanced Microcontrollers- PIC & ARM, VLSI Technology, Artificial Intelligence and Machine Learning, IoT, Industrial Management, Data Communication, Programmable Logic Controller and Employability Skills. Hands- on projects emphasise design of Electronics Systems using Various Microcontrollers, communication protocols, Power electronics, Artificial Intelligence, IoT and Employability Skills.	
9.	Eligibility Criteria for Entry for Student/Trainee/Learner/Employee	a. Entry Qualification & Relevant Experience:	

		<table border="1"> <tr> <th>Sl. No.</th><th>Academic/Skill Qualification (with Specialization - if applicable)</th><th>Required Experience (with Specialization - if applicable)</th></tr> <tr> <td>1</td><td>Advance Certificate – Technician Electronics and Instrumentation (Level 4.0) from NTTF</td><td>NA</td></tr> </table>	Sl. No.	Academic/Skill Qualification (with Specialization - if applicable)	Required Experience (with Specialization - if applicable)	1	Advance Certificate – Technician Electronics and Instrumentation (Level 4.0) from NTTF	NA												
Sl. No.	Academic/Skill Qualification (with Specialization - if applicable)	Required Experience (with Specialization - if applicable)																		
1	Advance Certificate – Technician Electronics and Instrumentation (Level 4.0) from NTTF	NA																		
10.	Credits Assigned to this Qualification, Subject to Assessment (as per National Credit Framework (NCrF))	Total Credits – 46																		
11.	Common Cost Norm Category (I/II/III) (Wherever applicable):	NA																		
12.	Any Licensing requirements for Undertaking Training on This Qualification (wherever applicable)	NA																		
13.	Training Duration by Modes of Training Delivery (Specify Total Duration as per selected training delivery modes and as per requirement of the qualification)	☐ Offline ☐ Online ☒ Blended <table border="1"> <thead> <tr> <th>Training Delivery Modes</th><th>Theory (Hours)</th><th>Practical (Hours)</th><th>OJT/Project Mandatory (Hours)</th><th>OJT Recommended (Hours)</th><th>Total (Hours)</th></tr> </thead> <tbody> <tr> <td>Classroom (offline)</td><td>390</td><td>600</td><td>330</td><td>NIL</td><td>1320</td></tr> <tr> <td>Online</td><td>60</td><td></td><td></td><td></td><td>60</td></tr> </tbody> </table> (Refer Blended Learning Annexure for details)	Training Delivery Modes	Theory (Hours)	Practical (Hours)	OJT/Project Mandatory (Hours)	OJT Recommended (Hours)	Total (Hours)	Classroom (offline)	390	600	330	NIL	1320	Online	60				60
Training Delivery Modes	Theory (Hours)	Practical (Hours)	OJT/Project Mandatory (Hours)	OJT Recommended (Hours)	Total (Hours)															
Classroom (offline)	390	600	330	NIL	1320															
Online	60				60															
14.	Aligned to NCO/ISCO Code/s (if no code is available mention the same)	NCO Code – 2015/7311.0101, 2015/3114.0100																		
15.	Progression path after attaining the qualification (Please show Professional and Academic progression)	Professional Progression: After Completion of Course and after 3 years of Industry Experience the Job Holder can work as Test Engineer, R&D Engineer, Servicing Engineer, and Maintenance Engineer. Academic Progression: Post Diploma, B VoC, and B Tech Degree Course in Relevant areas. After Completion of 3 years of Full Time Programme and after 3 years of Industry Experience the Job Holder Vertical Progression: Senior Technician - Engineer - Supervisor – Manager - General Manager - Entrepreneur																		

16.	Other Indian languages in which the Qualification & Model Curriculums are being submitted	Hindi	
17.	Is similar Qualification(s) available on NQR-if yes, justification for this qualification	☐ Yes ☒ No URLs of similar Qualifications: NA	
18.	Is the Job Role Amenable to Persons with Disability	☐ Yes ☒ No If "Yes", specify applicable type of Disability:	
19.	How Participation of Women will be Encouraged	Yes - Admission open to women candidates (30% seats reserved)	
20.	Are Greening/ Environment Sustainability Aspects Covered (Specify the NOS/Module which covers it)	☒ Yes ☐ No Industrial Management Subject code: CP04601T	
21.	Is Qualification Suitable to be Offered in Schools/Colleges	Schools ☐ Yes ☒ No Colleges ☐ Yes ☒ No	
22.	Name and Contact Details of Submitting / Awarding Body SPOC (In case of CS or MS, provide details of both Lead AB & Supporting ABs)	Name: Mr. R Rajagopalan Position in the Organization: Joint Managing Director Tel number: 080 – 28390215 Mobile Number: 9844013448 Email: rg@nttf.co.in Website: nttftrg.com	
23.	Final Approval Date by NSQC: 30 Nov 2023	24. Validity Duration: 3 years	25. Next Review Date: 30 Nov 2026

Section 2: Module Summary**NOS/s of Qualifications** (In exceptional cases these could be described as components)**Mandatory Modules/NOS/s:** Specify the training duration and assessment criteria at NOS/ Module level. For further details refer curriculum document– In Annexure
Th.-Theory Pr.-Practical OJT-On the Job Man.-Mandatory Training Rec.-Recommended Proj. -Project

Sl. No.	NOS/Module Name	NOS/ Module Code & Version	Core/ Non- Core	NCrF/ NSQF Level	Credit s as per NCrF	Training Duration (Hours)					Assessment Marks					
						Th.	Pr.	OJT- Man.	OJT- Rec.	Total	Th.	Pr.	Proj.	Viva	Total	Weightage (%) (if applicable)
Semester – 5																
1	Advanced Microcontroller -PIC	CP04501T	Core	4.5	21	60	-	-	-	60	100	-	-	-	100	
2	Embedded System	CP04502T	Core	4.5		60	-	-	-	60	100	-	-	-	100	
3	VLSI Technology	CP04503T	Core	4.5		40	-	-	-	40	100	-	-	-	100	
4	Digital Communication	CP04505T	Core	4.5		40	-	-	-	40	100	-	-	-	100	
5	Artificial Intelligence and Machine Learning	CP04512T	Core	4.5		40	-	-	-	40	100	-	-	-	100	
6	Advanced Microcontroller-PIC Lab	CP04506P	Core	4.5		-	60	-	-	60	-	80	-	20	100	
7	Embedded System Lab	CP04507P	Core	4.5		-	60	-	-	60	-	80	-	20	100	
8	VLSI Lab	CP04508P	Core	4.5		-	60	-	-	60	-	80	-	20	100	
9	Digital Communication Lab	CP04510P	Core	4.5		-	60	-	-	60	-	80	-	20	100	
10	IoT - 2 Lab	CP04511P	Core	4.5		-	60	-	-	60	-	80	-	20	100	
11	Artificial Intelligence and Machine Learning Lab	CP04513P	Core	4.5		-	60	-	-	60	-	80	-	20	100	
12	Employability Skills	CP04514T	Core	4.5		30	-	-	-	30	75	-	-	25	100	
Duration (in Hours)/ Total Marks					21	270	360	-	-	630	575	480	-	145	1200	
Semester – 6																
13	Industrial Management	CP04601T	Core	4.5	25	30	-	-	-	30	100	-	-	-	100	
14	Data Communication	CP04602T	Core	4.5		30	-	-	-	30	100	-	-	-	100	
15	Advanced Microcontroller ARM	CP04603T	Core	4.5		60	-	-	-	60	100	-	-	-	100	
16	Programmable Logic Controller	CP04604T	Core	4.5		30	-	-	-	30	100	-	-	-	100	
17	Advanced Microcontroller-ARM Lab	CP04605P	Core	4.5		-	40	-	-	40	-	80	-	20	100	

18	Programmable Logic Controller Lab	CP04606P	Core	4.5	-	40	-	-	40	-	80	-	20	100	
19	Project	CP04607P	Core	4.5	-	160	-	-	160	-	80	-	20	100	
20	OJT	CP04608P	Core	4.5	-	-	330	-	330	-	75	-	25	100	
21	Employability Skill	CP04609T	Core	4.5	30				30	75	-	-	25	100	
Duration (in Hours)/ Total Marks					25	180	240	330	-	750	475	315	-	110	900
Total for 1-year Programme					46	450	600	330	-	1380	1050	795	-	255	2100

Elective Modules/NOS/s: NA

S. No	NOS/Module Name	NOS/Module Code & Version (if applicable)	Core/ Non-Core	NCrF/NSQF Level	Credits as per NCrF	Training Duration (Hours)					Assessment Marks					
						Th.	Pr.	OJT-Man.	OJT-Rec.	Total	Th.	Pr.	Proj.	Viva	Total	Weightage (%) (if applicable)
1.																
2.																
Duration (in Hours) / Total Marks																

Optional Modules/NOS/s: NA

S. No	NOS/Module Name	NOS/Module Code & Version (if applicable)	Core/ Non-Core	NCrF/NSQF Level	Credits as per NCrF	Training Duration (Hours)					Assessment Marks					
						Th.	Pr.	OJT-Man.	OJT-Rec.	Total	Th.	Pr.	Proj.	Viva	Total	Weightage (%) (if applicable)
1.																
2.																
Duration (in Hours) / Total Marks																

Assessment - Minimum Qualifying Percentage

Please specify **any one** of the following:

Minimum Pass Percentage : (Every Trainee should score specified minimum aggregate passing percentage at qualification level to successfully clear assessment)

To pass the Qualification, every trainee should score minimum of 40% in each Theory, 50% in Practical and 60% in Project work / Internship and viva-voce.

Section 3: Training Related

1.	Trainer's Qualification and experience in the relevant sector (in years) (as per NCVET guidelines)	Diploma in relevant field with 3 years of trainer or industry experience B. Tech or BE with 2 years of trainer or industry experience
2.	Master Trainer's Qualification and experience in the relevant sector (in years) (as per NCVET guidelines)	Diploma in relevant field with 5 years as trainer industry experience B. Tech or BE with 5 years of trainer + industry experience
3.	Tools and Equipment Required for Training	☒ Yes ☐ No (If "Yes", details to be provided in Annexure)
4.	In Case of Revised Qualification, Details of Any Up skilling Required for Trainer	NA

Section 4: Assessment Related

1.	Assessor's Qualification and experience in relevant sector (in years) (as per NCVET guidelines)	Diploma with 4 years of trainer or Industry experience B. Tech or BE with 3 years as trainer or industry experience
2.	Proctor's Qualification and experience in relevant sector (in years) (as per NCVET guidelines)	Diploma or B. Tech or BE with 2 years of experience
3.	Lead Assessor's/Proctor's Qualification and experience in relevant sector (in years) (as per NCVET guidelines)	Diploma with 4 years as trainer or industry experience B. Tech or BE with 3 years as trainer or industry experience
4.	Assessment Mode (Specify the assessment mode)	Blended theory (online and offline in the centre) and practical
5.	Tools and Equipment Required for Assessment	Same as for training ☒ Yes ☐ No (details to be provided in Annexure-if it is different for Assessment)

Section 5: Evidence of the need for the Qualification*Provide Annexure/Supporting documents name.*

1.	Research Reports: The following reports establish the Skilled Resource requirement for the electronics Industries. 1. MSDE Annual Report 2021- 2022 predict very high growth in Electronics and Automobile sector in India. 2. MSDE/ NSDC Human Resources and Skill Requirements in Electronics and IT Hardware report (2013- 17, 2017–22) The Report Forecast a Higher growth in Electronics and IT Hardware sector. 3. Human Resources and Skill Requirements in Telecommunications sector report (2013-17, 2017 –22) The Report Forecast a Higher growth in Telecommunications sector. 4. Human Resources and Skill Requirements in Healthcare sector report (2013- 17, 2017 –22) The Report Forecast a Higher growth in Electronics and IT Hardware sector. 5. Annual reports 2021 – 22 of Ministry of Electronics and Information Technology Government of India The above Studies has found Higher growth in Electronics and IT Industries.
2.	Latest Market Research Reports or any other source (not older than 2 years) (Yes/No): The following reports establish the Skilled Resource requirement for the Electronics and Automobile Industries 1. Indian Skills Report 2021-22 by Wheebox – partnered CII predicts skill requirement in Engineering and Manufacturing sectors, Pharma & Health care Sector, Software/Hardware & IT sector 2. Study on T& A Consulting, The Indian Electronics Industry 3. The Study has found Test Engineer, R & D Engineer, Hardware Designer has new job roles emerging in the Manufacturing Sector. 4. Indian cellular and Electronics research report predicts very high growth in Domestic manufacturing and export of Electronics Manufacturing in India.
3.	Government /Industry initiatives/ requirement (Yes/No): Yes – - MSDE/ NSDC Human Resources and Skill Requirements in Electronics and IT Hardware report (2013- 17, 2017–22) The Report Forecast a Higher growth in Electronics and IT Hardware sector. - National Policy for skill Development and Entrepreneurship 2015 by MSDE has predicted skilled manpower requirement across key sectors by 2022 and has framed many initiatives.
4.	Number of Industry validation provided: 36
5.	Estimated nos. of persons to be trained and employed: 400 / year
6.	Evidence of Concurrence/Consultation with Line Ministry/State Departments: (Letter to be sent to the concerned ministry and copy attached) If “No”, why: Under Process

Section 6: Annexure & Supporting Documents Check List

Specify Annexure Name / Supporting document file name.

1.	Annexure 1: NCrf/NSQF level justification based on NCrf Level / NSQF descriptors <i>(Mandatory)</i>	Yes
2.	Annexure 2: List of tools and equipment relevant for qualification <i>(Mandatory, except in case of online course)</i>	Yes
3.	Annexure 3: Industry Validations Summary	Yes
4.	Annexure 4: Training & Employment Details	Yes
5.	Annexure 5: Blended Learning <i>(Mandatory, in case selected Mode of delivery is “Blended Learning”)</i>	Yes
6.	Annexure 6: Detailed Assessment Criteria <i>(Mandatory)</i>	Yes
7.	Annexure 7: Assessment Strategy <i>(Mandatory)</i>	Yes
8.	Annexure 13: Multiple Entry-Exit Details <i>(Mandatory, in case qualification has multiple Entry-Exit)</i>	No
9.	Annexure: Acronym and Glossary <i>(Optional)</i>	Yes
10.	Supporting Document: Model Curriculum <i>(Mandatory – Public view)</i>	Digital content available to trainees through Edusquares ERP (Will be made public after the qualification is approved)
11.	Supporting Document: Career Progression <i>(Mandatory – Public view)</i>	Yes (Annexure-9)
12.	Supporting Document: Occupational Map <i>(Mandatory)</i>	Yes (Annexure-11)
13.	Supporting Document: Assessment SOP <i>(Mandatory)</i>	Yes (Annexure-10)
14.	Supporting Document: Key Learning Outcome	Yes (Annexure-12)
15.	Any other document you wish to submit:	No

Annexure -1 Evidence of Level

NCrF/NSQF Level Descriptors	Key requirements of the job role/ outcome of the qualification	How the job role/ outcomes relate to the NCrF/NSQF level descriptor	NCrF/NSQF Level
Professional Theoretical Knowledge/Process	- Identify, Develop, analyse, Integrate and Troubleshoot Embedded and Computer Systems for Industrial applications. - Explain PLC & HMI - Demonstrate, Develop, Analyze, Simulate and Test Electronics & Power Circuits. - Demonstrate Professional Knowledge on Hardware Description Language & its use in designing electronic circuits. - Explain the architecture, programming of PIC and ARM Micro controllers - Will have Capability to organize and perform by self and/or work with others in the above areas - Explain IoT	- Job Holder Can Design, Fabricate, Validate and Trouble shoot Electronics, Power Circuits and Embedded Systems. - Can Program PLC for specific applications. - Can Perform VLSI Design - Design and troubleshoot the Microcontroller based systems. - Can organize work and perform tasks by self and as Team - Develop and troubleshoot IoT based systems	4.5
Professional and Technical Skills/ Expertise/ Professional Knowledge	- Able to explain Electrical & Electronics Components and Equipment - Knowledge of Programming using PLC and associated software and Circuits - Explain Artificial Intelligence and Machine learning. - Demonstrate Professional Knowledge on Hardware Description Language & its use in designing electronic circuits.	- Troubleshoot and maintain Electrical, Electronic Component/Equipment and their Appliances in the Industry. - Can Program PLC for specific applications. - Can relate Artificial Intelligence and Machine Learning to his or her job role context.	4.5

	- Demonstrate the Professional Knowledge on Keil, MPLAB, and Proteus for Programming and simulation of Microcontrollers and interface different Sensors to Node MCU, Arduino, Raspberry Pi Development boards. - Can analyze Data situations and take appropriate decisions. - Can do continuous improvement in processes (KAIZEN)	- Can Perform VLSI Design - Proficiency on programming and development of Microcontroller system with PIC, ARM, NODEMCU, Arduino and Raspberry Pi	
Employment Readiness & Entrepreneurship Skills & Mind - set/Professional Skill	- Able to communicate effectively with Peers and Supervisors in the work area. - Good Knowledge on Organization, ethical & moral values and Practice Time Management - Able to Analyze solutions Critically and Logically for fine decision making. - Able to work Effectively in a Team and lead a Team. - Knowledge of the latest Technologies and Industrial Trends. - Will have good Ingenuity and Creativity. - Will have good Leadership Skills and have an entrepreneurial for small startup.	- Good Communication with Peers, superiors both verbal and written, Good on Presentation Skills, QC,5S and KAIZEN. - Can Analyze situations Critically and Logically. - Adopt latest Technologies emerging in the Domain. - Can lead a group to work Effectively. - Can solve, adopt to new Situations Creatively.	4.5

Broad Learning Outcomes/Core Skill	- Proficiency in using simulation software for validating system performance - Perform programming of PIC & ARM Micro-controller and its applications. - Proficiency in programming and development of IoT based systems - Prepare emails for correspondence. - Use Internet to get additional Technical Information - Safety and standard operating Procedures and Practices in the work area. - Communicate with Peers and Superiors. - Critical Thinking, Creativity and Logical thinking. - Data collection, analysis, decision making ability. - Solve problems using QC tools and contribute for Kaizen in the work areas. - Knowledge on effective 5S, TPM and TQM activities.	- Ability to design for VLSI systems, performance evaluation and Inspection. - Design and develop any microcontroller application circuits - Develop and troubleshoot IoT based systems - Ability to retrieve necessary technical details from the Internet. - Will follow all safety norms and standard operating Procedures in the work area. - Maintain Good Relationship with Peers and Superiors and Will be able to Win Good will and Trust of Peers. - Analyze Critical problems in work area and real life. - Decision Making ability. - Process improvement and problem-solving skills.	4.5
Responsibility	- Aware of Personal/Industrial goals - Adapt to changes in the work area. - Through understanding of safety Procedures and SOPs in the relevant work area - Supervise, evaluate and improve the activities of team in the work area	- Able to Carry out Design and Integration of Embedded and Power Systems Under Minimum Supervision - Guide Junior Technicians in Fulfilling Tasks Assigned to them.	4.5

Annexure 2: Tools and Equipment (Lab Set-Up)
List of Tools and Equipment for a batch of 30 trainees

COMPUTER LAB

Sl. No.	Equipment	Specification	Quantity
1	Server	Intel Xeon Processor, 2.8GHz 8M Cache, 2TD SSD, RPS.	1
2	Networked Computers with Furniture	Core i5 10th Gen 23.8-inch FHD with Alexa (8GB/256 GB SSD+1TB HDD/Windows 10/MS Office	10
3	UPS	5kVA	1
4	LED Smart TV	73"	1

MICROCONTROLLER & EMBEDDED SYSTEM LAB

Sl. No.	Equipment	Specification	Quantity
1	PIC Development Board	With Interfacing modules	6
2	PIC Kit 3 Programmer		6
3	ARM Development Board	With Interfacing modules	6
4	VLSI Training Kit		3
5	Proteus software	10 users	1

AUTOMATION LAB

Sl. No.	Equipment	Quantity
1	PLC Trainer Kit - 2 Analog I/O and 8 Digital I/O with software	4

PROJECT LAB

Project Lab			
Sl. No.	Equipment	Specification	Quantity
1	Soldering Station	25W	1
2	Digital Oscilloscope	No of Channels - 2, Bandwidth: DC - 20 MHz	2

3	Dual - Power Supplies Regulated Power Supply, Adjustable	0-30V/1A	2
4	Function Generator	Frequency Range: 0.3 Hz to 3 MHz, Functions: Sine, Square, Triangle, DC Sweep	3

Note:

- The Tools and Equipments and other lab facilities are shared between Qualifications and batches.
- During the admission the trainees are supplied with toolkit containing DMM, soldering iron, Breadboard, and other tools for conducting experiments in different labs.
- Trainees are provided with Laptop.

Classroom Aids

The aids required to conduct sessions in the classroom are:

1. Black / white board.
2. Projector with screen / Smart TV
3. Laptop / computer

Annexure 3: Industry Validations Summary

Provide the summary information of all the industry validations in table. This is not required for OEM qualifications.

Sl. No	Organization Name	Representative Name	Designation	Contact Address	Contact Phone No	E-mail ID	LinkedIn Profile (if available)
1	Tata Power SED Limited (Presently TASL)	Mrs.Mahima		Electronics city, Bangalore	8067859900	mahima@tatapowerSED.com	
2	L&T Infotech Limited	Mr.joji George		saki vihar road, Powai ,Mumbai	2267766776	joji.george@lntinfotech.com	
3	National Instruments india Limited	Mr.yogesh Sundaramurthy		7th block, Koramangala, Bangalore	8051190000	yogesh.sundaramurthy@ni.com	
4	Lucas -TVS Limited	Mr.Kamalakaran D		Padi, Chennai	4426235515	kamalakannan.engg@lucastvs.co.in	
5	Coreel Technologies Limited	Mr Harish		21,7th main, 1st Block, Koramangala	080 41970400	harish@coreel.com	
6	Tessolve India Limited	Mrs.Shoba Annamalai		Tessolve Services Pvt Ltd, Plot No.31, Electronics City Phase II	8041812626	shoba.annamalai@tessolve.com	
7	Samsung India Limited	Mr.Suresh		Block - 'B',66/1, Bagmane Tech Park, Byrasandra C V Raman Nagar,	9845408281	s.suresh@samsung.com	
8	Delopt India	Ms.Seema		3 & 4, 1st Cross, 7th Main, J C Industrial Area, Off Kanakapura Main Road, J C Industrial Area	080-26668286	seema@delopt.co.in	
9	Wipro Technologies	Mr.Anjana Varma		No 72, Keonics Electronic City,	7259034096	anjana.varma@wipro.com	
10	Syscon Instruments	Ms.Gayatri		plot #66, Hosur road , Electronics city	91 80 28520772/3/4	gayatri@sysconinstruments.com	
11	Centum	Mr.Jason		44 Yelanhka New Town, KHB Industrial Area , Bangalore	91 80 41436000	agnellaj@centumelectronics.com	
12	Techno Sphere	Ms. Rohini		7, 1st East Main, ITI Layout, BSK 3rd Stage,	91-80-4171-1409	nk@technosphereindia.in	
13	Ecopower	Mr.Mohan		551, 14TH Main Sector 7, HSR Layout , Bangalore	9980585005	mohan@ecopower.in	

14	Radel Electronics	Mr. Manjunath		No.74/D, Hosur Road Electronics city , Bnagalore	9342420720/80 -28520720	hr@radel.in	
15	Sun Micro Components	Rakesh a bagadi		New city complex ,SN 101 to106 #13/30 to 13/35,1 st floor NR road cross	080-22293923	techsupport@sunmicrocompo nents.com	
16	Gemini Communications	Malakrishna TC		#1, Dr ranga road ,2 street , allwarpet, chennai	044-24996422	info@qci.in	
17	Park Controls	Ms. Manisha		#22,80 feet road , HAL, 3 rd stage ,	080-25297199	info@parkscontrols.com	
18	APLAB (team lease)	Mr. Deepak		BMTC complex ,6 th floor ,80 feet road , Koramangala	080-33002345	Deepak.p@aplab.com	
19	Unique tech integration	Savan G Gangadhol		#42/A9th a main BTM Layout , 1 st stage	080-25525546	blr@uniquetech.com	
20	Neuro synaptic	Mrs. Rich Kumar		10, 3RD floor, Next to swetha bakery, 29 th main, BTM layout 2nd stage	080-41313168	richa@neurosynaptic.com	
21	Panacea Medical Technologies	Mrs.Ambika		Plot # 119, Envision Technology Center, EPIP Area Phase 1, Whitefield.	080- 4242 8700	careers@panaceamedical.co m	
22	Micropack limited	Mrs. Lakshmi		Plot No 16,Jigani Industrial Area, Anekal Taluk	7760976713	hr@micropack.com	
23	All 3 Axes	Mr.Senthil		#32, 1st Floor, Krishna Reddy Layout, Domlur	9739469620	senthil@all3axis.com	
24	Juno Tele	Mr.Vikas		4th Block, Pattabhirama Nagar, Jayanagar, Bengaluru	8041477477	Vikas@junotele.com	
25	Source Technologies	Mr.Prasanth		# 67, Govindappa Road, Basavanagudi,	80-26571838	Prashanth@sourcetecnologi. com	
26	Rossel Techsys	Ms. Jenniffer		plant at No. 74, 3rd cross, Export Promotion Industrial Park, Whitefield,	7259821385	jennifer.james@rosselltechsys .com	
27	Usha Martin	Mr. Raju		2A,Shakespeare Sarani,'Mangal Kalash' ,Kolkata 700071	9339800300/39 800458	contact@ushamartin.co.in	
28	Qualcomm India Private Limited	Shailesh kumar		Bangalore	8892631728	kumarsha@qti.qualcomm.com	

29	Tata Cummins Pvt Ltd.	Phanindra Mishra		Pune	9264499320	phanindra.mishra@cummins.co	
30	Frauscher Sensor Technology	Poornima		Bangalore	8904062133	poornima.krishna@in.frauscher.com	
31	Amossys Digital Pvt Ltd	Raghavendra S		Jharkhand	7980095043	rajeev.k@acsg.co.in	
32	HTL	Rani Drairaj		Tamilnadu	9843683156	ananda.shankar@htlchennai.com	
33	Zenco India Pvt Ltd	Keshav Singh		Karnataka	9739993901	keshavksingh@zincoelectric.com	
34	Infosys	Richard Lovo		Karnataka	8028520261	askus@infosys.com	
35	Micromatic Machine Tools Pvt. Ltd.	Srinivasa V		Karnataka	080 4943 3100	srinavasav@acemicromatic.com	
36	Wistron	Ms Renuka prasad		Kolar	9008854352	renukaprasad_sg@wistron.com	

Annexure 4: Training & Employment Details

Training and Employment Projections: *Data to be provided year-wise for the next 3 years.*

Year	Total Candidates		Women		People with Disability	
	Estimated Training #	Estimated Employment Opportunities	Estimated Training #	Estimated Employment Opportunities	Estimated Training #	Estimated Employment Opportunities
2023	300	More than 3000	150	More than 2000	-	
2024	400	More than 3000	200	More than 2000	-	
2025	500	More than 3000	250	More than 2000	-	

Training, Assessment, Certification, and Placement Data for previous versions of qualifications: (Previous years)

Qualification Version	Year	Total Candidates				Women				People with Disability			
		Trained	Assessed	Certified	Placed / Higher Studies	Trained	Assessed	Certified	Placed / Higher Studies	Trained	Assessed	Certified	Placed
	2017- 2020	196	183	163	163	56	51	45	45	NIL			
	2018 - 2021	150	146	142	142	39	36	35	35				
	2019 - 2022	167	155	146	146	46	41	36	36				

Applicable for revised qualifications only, data to be provided year-wise for past 3 years.

List Schemes in which the previous version of Qualification was implemented:

Three years Full Time Programme

Content availability for previous versions of qualifications:

☐ Participant Handbook ☐ Facilitator Guide ☒ Digital Content ☐ Qualification Handbook ☒ Any Other: In NTTF LMS and Edusquares ERP

Languages in which Content is available: English.

Annexure 5: Blended Learning**Blended Learning Estimated Ratio & Recommended Tools:**

Refer NCVET “Guidelines for Blended Learning for Vocational Education, Training & Skilling” available on:

<https://ncvet.gov.in/sites/default/files/Guidelines%20for%20Blended%20Learning%20for%20Vocational%20Education,%20Training%20&%20Skilling.pdf>

S. No.	Select the Components of the Qualification	List Recommended Tools – for all Selected Components	Offline: Online Ratio
1	Theory/ Lectures - Imparting theoretical and conceptual knowledge	Physical classroom, LMS, Web based	90:10
2	Imparting Soft Skills, Life Skills, and Employability Skills /Mentorship to Learners	Physical classroom, Workshops, Mock sessions, Case study, Role play, Group Discussions, LMS	90:10
3	Showing Practical Demonstrations to the learners	Workshop / Lab, Video recording, Simulators	80:20
4	Imparting Practical Hands-on Skills/ Lab Work/ workshop/ shop floor training	Workshop machines, Lab equipment, Simulators, Mini projects, Project	80:20
5	Tutorials/ Assignments/ Drill/ Practice	Class assignments, LMS assignments, Simulators	60:40
6	Proctored Monitoring/ Assessment/ Evaluation/ Examinations	Physical classroom, Labs, Workshop, Quiz tests, Project	75:25
7	On the Job Training (OJT)/ Project Work Internship / Apprenticeship Training	Industry	100:00

Annexure 6: Detailed Assessment Criteria

Detailed assessment criteria for each NOS/Module are as follows:

NOS/Module Name	Assessment Criteria for Performance Criteria/Learning Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Semester – 5					
Advanced Microcontroller - PIC	Introduction to PIC Microcontrollers –PIC 16FXXX families, Harvard v/s Von Neumann Architecture	10	-	-	-
	PIC16F877A Architecture and Pin Diagram-features of 16F877A microcontroller	10	-	-	-
	PIC16F877A Memory Organization- Concepts data and program memory	10	-	-	-
	PIC16F877A I/O Ports – Applications and configurations	20	-	-	-
	PIC16F877A Instructions Set – Addressing modes & Simple Programming of 16F877A	18	-	-	-
	PIC In-built Peripherals Programming –Concepts of interrupts, internal Timer, counter, ADC and CCP module configuration	20	-	-	-
	PIC External Peripheral Programming –Applications	12	-	-	-
	Total Marks	100			
Embedded System	Introduction –Applications in industry	5	-	-	-
	Requirements in Embedded Systems – Basic requirements to develop the system	15	-	-	-
	Process of Embedded Systems Development - Proposal Preparation , Project Planning, Infrastructure, Design verification & Quality Management	20	-	-	-
	Hardware & Software Design – Block diagram, selection of processor, communication protocols, Compiler requirement, code optimization	30	-	-	-
	Testing – testing the product on host, target and environment	8	-	-	-
	Architecture of Embedded System –Hardware and software architecture includes memory, timer, clock, I/O, Communication Port ,embedded OS etc,	12	-	-	-

	Concepts of Embedded RTOS -Task, ISR ,Semaphore, Message queues and pipes	10	-	-	-
	Total Marks	100			
VLSI Technology	The Integrated Circuit –Classification, VLSI design Flow— Front End and Back End Design	10	-	-	-
	Introduction to HDL – Verilog –Type of designs and Programming data types and concepts	15	-	-	-
	Programming in Verilog - Modeling using basic Verilog gate primitives - AND, OR, NOT, NAND, NOR, EX-OR	20	-	-	-
	CMOS Logic - PMOS, NMOS characteristics & IC fabrication Process	20	-	-	-
	Design Methodology – Types of design methods and design flow	15	-	-	-
	Testing and Verification –Types of Testing, Design for testing and Design for manufacturability	20	-	-	-
	Total Marks	100			
Artificial Intelligence & Machine Learning	AI Basics –Introduction, Machine Learning v/s Traditional Programming and Applications	5			
	Data Preprocessing and Visualization-Excel & Python- Data cleaning, Data Transformation and Data Visualisation methods	10			
	Supervised Learning – Regression- Linear and Polynomial Regression	10			
	Supervised Learning – Classification- Logistic Regression, KNN, Evaluation Metrics for Classification Models	10			
	Unsupervised Learning – Introduction, K-means Clustering, Hierarchical Clustering	10			
	Model Selection and Validation - Cross-Validation Techniques	10			
	Introduction to Deep Learning - Neural Networks and their Architecture, Functions and Optimization	10			
	Convolutional Neural Networks (CNN) – Architectures, Image Classification	10			
	Recurrent Neural Networks (RNN)- Introduction	5			
	Model Deployment and AI Ethics - Strategies for model deployment and scaling, Cloud based AI services	5			

	Case Studies on AI/ML techniques to a real-world problem	15			
	Total Marks	100			
Digital Communication	Digital Communication Techniques – Types and applications	30	-	-	-
	Digital Modulation Techniques - Types and applications	25	-	-	-
	Error Detection & Correction -Types of Signals and Systems and Types of Error Detection methods	15	-	-	-
	Introduction to Telephone and Mobile Phone Communication – Types, working and applications	30	-	-	-
	Total Marks	100			
Employability Skill	Essential Skills for Success	20	-	-	5
	Quality Management	15	-	-	5
	Critical thinking and Problem solving	20	-	-	10
	Getting ready for Entrepreneurship	20	-	-	5
	Total Marks	100			
Advanced Microcontroller-PIC Lab	Develop a program to perform arithmetic operations and data memory management	-	18	-	2
	Develop a programs to perform port programming	-	7	-	3
	Develop a programs to data conversion	-	10	-	
	Write a “C” program to measure the Physical quantities	-	15	-	5
	To perform PIC In-built Peripherals Programming	-	10	-	5
	To perform PIC External Peripheral Programming	-	20	-	5
	Total Marks	100			
Embedded System Lab	To perform traffic light system	-	15	-	5
	To program the I/O port for controlling the appliances	-	25	-	5
	Perform the temperature monitoring/ measure physical quantities	-	15	-	5
	Interfacing of RTC using PIC microcontroller	-	25	-	5

	Total Marks	100			
VLSI Lab	Develop Verilog code for logic gates, sequential circuits and combinational circuits	-	40	-	10
	Develop Verilog code for data conversion	-	10	-	
	Develop Verilog code run a motor/peripherals	-	15	-	5
	Develop Verilog code to control domestic appliances	-	15	-	5
	Total Marks	100			
Artificial Intelligence & Machine Learning Lab	Python Programming for Data Science with basic operations, data structures and control statements		10		5
	Data Processing and Visualisation in Excel and python		10		
	Supervised Learning – Regression, KNN, Evaluation Metrics for Classification Models		10		5
	Unsupervised Learning –K-means Clustering, Hierarchical Clustering		10		
	Cross-Validation Techniques		10		
	Build CNN Architecture		5		
	Strategies for model deployment and scaling, Cloud based AI services		10		5
	Project on AI/ML techniques to a real-world problems		15		5
	Total Marks	100			
Digital Communication Lab	To verify sampling theorem	-	10	-	-
	To perform various modulation techniques	-	30	-	10
	to generate and Detect of BASK, BFSK, BPSK ,DPSK, QPSK signals	-	25	-	5
	To generate Dual Tone Multi Frequency (DTMF) signals and decode it	-	5	-	5
	To generate a) Unipolar – RZ, NRZ b) Bipolar – NRZ (AMI) c) Manchester – RZ	-	10	-	-
	Total Marks	100			
IoT - 2 Lab	Introduction to IoT –scope and applications	-	5	-	-
	IoT Architecture - Sensors, Actuators and controller, Gateway and Data Acquisition	-	15	-	-

	Introduction to various development Boards -Key features of Node MCU, Arduino, Raspberry Pi, Intel UP Squared boards	-	10	-	5
	Various cloud services and usage -Importance of cloud computing in IoT, Thinkspeak and AWS Cloud	-	5	-	5
	MQTT – Introduction and of MQTT with other protocols and PUB/SUB approach, broker ID creation	-	10	-	-
	Introduction to Raspberry Pi - Installation of Raspberian OS on Raspberry Pi board and interfacing of peripherals	-	15	-	-
	Introduction to Intel IoT platform -Intel IoT programming and hardware interfacing	-	7	-	3
	Need of IoT in Industries -Implementation strategies of IoT in Industries	-	5	-	5
	Mini Project work – Application based and Case studies and Implementation Examples	-	8	-	2
	Total Marks		100		
Semester – 6					
Industrial Management	Basics of Management	5	-	-	-
	Pollution Prevention and Waste Management	10	-	-	-
	Industrial Safety Management	10	-	-	-
	Inspection and Quality Control	10	-	-	-
	Modern Production Management	10	-	-	-
	Lean Management	10	-	-	-
	Total Productive Maintenance and Total Quality Management	25	-	-	-
	Human Resource Management	15	-	-	-
	Industrial Relation Legislation management	5	-	-	-
	Total Marks		100		
Data Communication	Introduction to Data Communication and Networks – Types of network topologies and Switching concepts	25	-	-	-

	Networking Protocols and OSI Models – Communication protocols, different layers of OSI model and its functionality	20	-	-	-
	TCP / IP –Types of layer and address mapping	15	-	-	-
	Communication Protocols -Concepts of Ports and Sockets, FTP connections	12	-	-	-
	Internet Devices and Protocols – Concepts of Switches, Repeaters, Bridges, Gateway	13	-	-	-
	Network Security – Application and Data Encryption	15	-	-	-
	Total Marks	100			
Advanced Microcontroller – ARM	Introduction to ARM Controller - ARM Processor Family and comparison with other controllers	8	-	-	-
	LPC 2148 ARM Controller -features, Architecture, Pin Diagram & Memory organization	20	-	-	-
	Programming of LPC 2148 -LPC2148 I/O Port programming	12	-	-	-
	KEIL IDE -Creating project, writing program and debugging with Keil	5	-	-	-
	Hardware Interface – as per the Application	15	-	-	-
	System Control –Pipelining, Interrupts ,power control	10	-	-	-
	Pin Connect Block and GPIO – interfacing of switches/LED through GPIO	8	-	-	-
	Timer, ADC and UART –Serial communication	12	-	-	-
	I2C, SPI and PWM – Types of Protocols and applications	10	-	-	-
	Total Marks	100			
Programmable Logic Controller	PLC Basics – Introduction and Application of PLC	8	-	-	-
	Basic PLC Programming - Basic PLC programming using ladder logic	20	-	-	-
	Basic PLC Functions –Concepts of Register, Timer and Counter	12	-	-	-
	Intermediate Functions –Arithmetic and logical functioning	10	-	-	-
	Data Handling Functions – Control flow of instructions	20	-	-	-
	PLC Functions working with Bits – bitwise operations and Robot control with PLC	8	-	-	-
	Advanced PLC Functions – Analog I/O operations and troubleshooting	12	-	-	-

	Introduction to HMI and SCADA - Application	10	-	-	-
	Total Marks	100			
Employability Skill	Labour Welfare and Legislation.	15	-	-	5
	Customer Interaction/ Service.	20	-	-	5
	Conflict resolution and Negotiation	20	-	-	10
	Job readiness and Exam Preparation	20	-	-	5
	Total Marks	100			
Advanced Microcontrollers- ARM Lab	To create a project, write the basic program and debug in Keil software	-	5	-	-
	To perform the arithmetic 8bit, 16bit and 32 bit operations in LPC2148 in Assembly language	-	15	-	5
	To perform the logical operations in LPC2148	-	18	-	2
	To perform the data conversion	-	12	-	3
	Perform different program for looping, branching	-	15	-	5
	To interface peripherals like switches, motor, SSD etc to LPC 2148	-	15	-	5
	Total Marks	100			
Programmable Logic Controller Lab	Develop the ladder diagram for various logical operations	-	17	-	3
	Develop the PLC Ladder Diagram of DOL Starter for motor	-	8	-	2
	Develop the PLC Ladder Diagram for Logic Gates	-	10	-	-
	Develop the PLC Ladder Diagram for a conveyer control system	-	8	-	2
	Develop the PLC Ladder Diagram for Timer Applications	-	10	-	-
	To perform I/O operations using PLC	-	10	-	5
	Develop the PLC Ladder Diagram for Counter Applications	-	7	-	3
	Develop the PLC Ladder Diagram for controlling the appliances	-	10	-	5
	Total Marks	100			
Project	Internal Practical	-	25	-	-
	Semester Practical	-	55	-	20
	Total Marks	100			
OJT	Presentation	-	75	-	25
	Total Marks	100			

Annexure 7: Assessment Strategy

1 ASSESSMENT STRATEGY

The Criteria for assessment is based on Modules, and. will be assigned marks proportional to its importance.

The assessment for the semester-based qualification is carried out by conducting Formative and Summative Assessments.

Regarding Theory – Sessional is based on Intermediate Tests, File / Assignments & Viva –voce: Semester end examination wherein for each Individual batch, A&E dept. at Corporate office, Bangalore creates unique question papers for theory part as well as practical – Theory comprises MCQ and descriptive questions drawn randomly from Question Bank.

Regarding the practical part, the experiments/ exercises are performed by the trainees during the LAB Hours and the trainees are allowed to record the learning of it which will be carried as their Record Marks & one Lab Test and semester end examination. Semester end examination is outcome-based experiments/ exercises of the course will be given to trainees to perform and based on the performance the mark will be awarded. The passing criteria is based on practical's performance, viva or oral exam, Test and final semester end examination.

Theory and practical Examinations are carried out by Examiners under the overall supervision of the Assessment & Evaluation Dept.

Evaluation of Theory & Practical examination is carried out by the Trained Assessors (NTTF faculty members) under the supervision of Shopfloor Manager / senior faculty in a fair manner as per the assessment criteria set by A&E dept. of NTTF.

The Tabulation and processing of results shall be carried out under EDUSQUARE campus Software.

Assessment comprises the following components:

- Job carried out in Labs / workshops
- Record book
- ONLINE Examination
- Answer sheet of assessment
- Viva-voce
- Semester end examination
- ON-THE-JOB training
- Tech Talk / Shop Talk
- Extracurricular and Co-curricular Activities
- Projects
- Attendance and punctuality

2. ASSESSORS

Evaluation of Theory & Practical examination is carried out by the Trained Assessors (NTTF faculty members) in a fair manner as per the assessment criteria set by A&E dept. of NTTF.

Assessors / Faculties are trained from time to time to upgrade their skills on various aspects such as conduct of assessments, teaching methodology etc.

3 ELIGIBILITY TO APPEAR FOR THE EXAM:

- The candidates should have an attendance of a minimum 90% in a semester.
- The candidates should have secured minimum Sessional Marks in Theory & Practical

4 PASS CRITERIA:

To pass the Qualification, every trainee should score a minimum of 40% in each Theory and 50% in each Practical and 60% in OJT / Projects.

5 RESULTS AND CERTIFICATION:

The assessment results are backed by evidence collected by assessors. Successful trainees are awarded the Diploma certificate by NTTF Corporate Office.

6 ON THE JOB:

1. The candidate must score 60% to successfully complete the OJT.
2. Tools of Assessment that will be used for assessing whether the candidate is having desired skills and etiquette of dealing with customer needs & requirements and perform Soft Skills effectively:
 - Videos/photos of Trainees during OJT
 - Suggestions / Kaizens from trainees
 - Rewards and appreciation to trainees as applicable
3. Assessment will ensure the following:
 - Effective engagement with the customers
 - Understand the working of various tools and equipment.

7 SYSTEM OF GRADING:

An alphabetical letter grade will be assigned for each subject based on the total marks scored in the sessional and end semester examination.

Equivalent Grade Points are used: A = 9.5, B = 8.5, C = 7.5, D = 6.5, E = 5.5, F = 0 (FAIL), I = Incomplete (MP/AB/SP) Supplementary cleared = E

The student will be issued Semester Grade Report calculating SGPA / CGPA as follows:

$$\text{Semester Grade Point Average (SGPA)} = \frac{\sum (\text{No. of Credits} \times \text{Grade Point})}{\sum (\text{No. of Credits for the Program})}$$

$$\text{Cumulative Grade Point Average (CGPA)} = \frac{\sum (\text{SGPA} \times \text{total Credits of each semester})}{\text{Total credits Acquired.}}$$

Awarding of class:**a) Awarding of class for semester:**

SGPA	Classification
8.5 and above	First class with distinction
7.5 to 8.4	First class
6.0 to 7.4	Second class
5.5 to 5.9	Pass class

b) Awarding of class for Programme:

First class with Distinction	Should have scored CGPA 8.5 and above and should have cleared all Semesters in the first attempt.
First class	Should have scored CGPA 7.5 to 8.4
Second class	Should have scored CGPA 6.0 to 7.4
Pass class	5.5 to 5.9

8 ASSESSMENT TOOLS

All assessment and evaluation activities are carried out under EDUSQUARE campus software which includes Formative assessment & Summative assessment.

- EDUSQUARE : NTTF ERP/CRM used for academic purpose EDUSQUARE erp.nttftg.com used as SaaS (software as a service) mode
- Digital Valuation System: Digital Valuation system is an innovative software solution which automates manual evaluation and help institutions to minimize the time, effort and human errors in the entire valuation process.
- Remote proctoring which includes AI based Auto Proctoring, Student authentication & Multi secure Exam browser as and when the need arises.

List of ICT Tools:

Desktop and laptops

Interactive White Board

CCTV Camera

Pen Drive

Video Conferencing

Biometric

Edusquare: NTTF ERP/CRM used for academic purpose Edusquare erp.nttftg.com used as SaaS (Software as a Service) mode

Networking: Includes Wireless access Points, Switches, Routers, Controllers across all NTTF

AWS Cloud: AWS Cloud computing platform to host NTTF website www.nttftg.com and used as backup storage.

Firewall: Network security device protecting our network by filtering traffic and blocking outsiders.

Microsoft (O365/M-365) – Email/office (Word, Excel, PPT, One Drive for all staff/students are provided using Microsoft O365 MDM (BYOD) policies implemented through M365 used as SaaS

Annexure 8: Model Curriculum

Semester – 5			Module Name: Advanced Microcontroller - PIC	Module code: CP04501T
Sl. No	Module Details			Theory Hours 60
1	Introduction to PIC Microcontrollers			5h
2	PIC16F877A Architecture and Pin Diagram			4h
3	PIC16F877A Memory Organization			4h
4	PIC16F877A I/O Ports			5h
5	PIC16F877A Instructions Set and Simple Programming			10h
6	PIC16F877A Interrupts			4h
7	PIC16F877A Timers			4h
8	PIC16F877A Capture, Compare and PWM Module			3h
9	PIC16F877A ADC Module			4h
10	PIC16F877A Serial Communication Module			7h
11	PIC16F877A Applications			10h

Semester – 5			Module Name: Embedded System	Module code: CP04502T
Sl. No.	Module Details			Theory Hours 60
1	Introduction			6h
2	Black Box (Block Diagram of Embedded Systems)			2h
3	Requirements in Embedded Systems			6h
4	Process of Embedded Systems Development			6h
5	Hardware Design			7h
6	Software Design			8h
7	Testing			4h

8	Architecture of Embedded Systems	9h
9	Concepts of Embedded RTOS	6h
10	Overview of types of RTOS	6h

Semester – 5 Module Name: VLSI Technology Module code: CP04503T		
Sl. No.	Module Details	Theory Hours 40
1	The Integrated Circuit	5h
2	Introduction to HDL – Verilog	6h
3	Programming in Verilog	7h
4	CMOS Logic	8h
5	Design Methodology	6h
6	Testing & Verification	8h

Semester – 5 Module Name: Digital Communication Module code: CP04505T		
Sl. No.	Module Details	Theory Hours 40
1	Digital Communication Techniques	13h
2	Digital Modulation Techniques	8h
3	Error Detection and Correction	9h
4	Introduction to Telephone and Mobile Phone Communication	10h

Semester – 5 Module Name: Artificial Intelligence and Machine Learning Module code: CP04512T		
Sl. No	Module Details	Theory Hours 40
1.	Introduction to Artificial Intelligence & Machine Learning	1h
2.	Data Preprocessing and Visualization-Excel & Python	4h
3.	Supervised Learning – Regression	4h
4.	Supervised Learning – Classification	4h
5.	Unsupervised Learning	4h
6.	Model Selection and Validation	4h

7.	Introduction to Deep Learning	4h
8.	Convolutional Neural Networks (CNN)	4h
9.	Recurrent Neural Networks (RNN)	2h
10.	Model Deployment and AI Ethics	2h
11.	Case Studies on AI/ML techniques to a real-world problem	7h

Semester - 5			Module Name: Employability Skills	Module code: CP04514T
Sl. No	Module Details			Theory Hours 30
1	Essential Skills for Success			5h
2	Quality Management			5h
3	Critical thinking and Problem solving			10h
4	Getting ready for Entrepreneurship			10h

Semester – 5			Module Name: Advanced Microcontroller-PIC Lab	Module code: CP04506P
Sl. No.	Module Details			Practical Hours 60
1	a) Write a program to ADD the values 38h and 2Fh. Show the status of C, DC & Z flags. Store the result in WREG. b) Write a program to ADD the values 9Ch and 64h. Show the status of C, DC & Z flags. Store the result in WREG. c) Write a program to ADD the values 88h and 93h. Show the status of C, DC & Z flags. Store the result in WREG. d) Identify the difference in the status of flags in each case.			2h
2	a) Write a program to ADD the bytes stored in RAM locations 40h to 43h. Store the result in location 6 of File Register (lower byte) & location 7 of File Register (higher byte). b) Write a program to ADD two 16-bit numbers. The numbers are 9D3Ch & A7B8h. Assume that File Register location 6 = (3Ch) & location 7 = (9Dh). Store the result in location 6 of File Register (lower byte) & location 7 of File Register (higher byte).			2h
3	a) Write a program to SUBTRACT 3Fh – 23h. Store the result in File Register location 7. b) Write a program to SUBTRACT 4Ch – 6Eh using 2's Complement method. Store the result in Working Register. c) OCB Ex: Write a program to SUBTRACT two 16-bit numbers. The numbers are 9D3Ch & 2762h. Assume that File Register location 6 = (3Ch) & location 7 = (9Dh). Store the result in location 6 of File Register (lower byte) & location 7 of File Register (higher byte).			2h
4	a) Write a program to do byte-by-byte Multiplication. b) An ADC is connected to Port B. The ADC represents the temperature or pressure. The output of ADC is an 8-bit data in hex (00h – FFh). Write a program to convert this hex data to decimal data.			2h

5	a) Write a program to clear WREG & then add 3 to WREG ten times. Place the result in SFR of Port B. Use the DECFSZ instruction to perform the looping. b) OCB Ex: Write a program to clear WREG & then add 3 to WREG ten times. Place the result in SFR of Port B. Use the Zero Flag & BNZ. c) OCB Ex: What is the maximum no. of times that the loop in Q. 5. (a) & (b) can be repeated?	2h
6	a) Assume that Port B bit RB2 is used to control an outdoor light, and bit RB5 to control a light inside a building. Show how to turn "ON" the outdoor light. & turn "OFF" the inside light. b) Assume W Register = 45h. Write a program to do masking operation. Store 05h in file register location 1 & 04h in file register location 2. c) OCB Ex: Write a program to toggle the bits of an 8-bit data. d) OCB Ex: Read & test Port B to see whether it has value 45h. If it does, send 99h to Port C, else it stays clear.	2h
7	a) Write a program to get data from the SFRs of Port B & send it to SFRs of Port C continuously. b) Write a program to get data from the SFRs of Port B. Add the value 5 to it & send it to the SFRs of Port C.	2h
8	a) Toggle all the bits of SFR register of Port B continuously. Put the time delay in between each issuing of data to Port B. b) OCB Ex: Write a program to count up from 00h to FFh & send the count to SFR of Port B. Use on CALL subroutine for sending the data to Port B & another one for time delay. Put the time delay in between each issuing of data to Port B.	2h
9	a) Configure Port A as Input Port. Receive the data from Port A and save it in RAM Location of File Register. b) Toggle all the bits of Port B, Port C & Port D every ¼ of a second. Assume crystal frequency of 10MHz. c) OCB Ex: An LED is connected to each pin of Port D. Write a program to turn on each LED from pin D0 to pin D7. Call a delay subroutine before turning on the next LED.	2h
10	a) Generate a square wave of 50% duty cycle on Bit 0 of Port C. b) Generate a square wave of 66% duty cycle on Bit 3 of Port C.	2h
11	Write a program to perform the following: a) Keep monitoring the RB2 bit until it becomes HIGH. b) When RB2 becomes HIGH, write value 45h to Port C & also send a High-to Low pulse to RD3.	2h
12	Write a program to perform the following: a) Make RB3 is an input and represents the condition of a door alarm. If it goes LOW, it means that the door it open. Monitor the bit continuously. b) Whenever it goes LOW, send a HIGH-to-LOW pulse to port RC5 to turn on a buzzer.	2h

13	a) A switch is connected to pin RB0 & an LED to pin RB7. Write a program to get the statute of SW & send it to LED. b) OCB Ex: A switch is connected to pin RB4. Write a program to get the status of SW & save it in D0 of File Register location 0x20.	2h
14	a) Write a program to toggle RB2, RC5, RD7 bits continuously without disturbing the rest of the bits. b) Write a program to get the status of RC3 & put it ion RC4.	2h
15	a) Write a program to monitor the RB7 bit. When it is LOW, send 55h & AAH to Port C continuously. b) OCB Ex: Write a program to monitor the RE0 bit. When it is HIGH, send 99h to Port B & when it is LOW, send 66h to Port C.	2h
16	a) Write a program to transfer value 8Ch serially (one bit at a time) via pin RB1. Put one high at the start and end of the data. Send the LSB first. b) Write a program to bring in a byte of data serially (one bit at a time) via pin RC7 & save it in file register location 0x25h. The byte comes in with the LSB first.	2h
17	a) Write a program to count the number of 1s in a given byte. b) Write a program that finds the position of the first HIGH bit in an 8-bit data. The data is scanned from D0 to D7. Give the result for value 68h. OCB Ex: Write a program that finds the position of the first HIGH bit in an 8bit data. The data is scanned from D7 to D0. Give the result for value 68h.	2h
18	a) Write a program to interchange the nibbles WITHOUT using SWAPF instruction. b) A stepper motor uses the following sequence of binary numbers to move the motor. Write a program to generate the following sequence – CCh, 66h, 33h, 99h	2h
19	a) Write a program to convert packed BCD into two ASCII numbers & place them in file register locations 4 & 5. Assume that the Packed BCD number is in WREG. b) Assume that numbers 4 & 7 are pressed on keyboard. The goal is to produce 47h which is packed BCD. Write a program to convert the ASCII numbers to Packed BCD. c) OCB Ex: Assume that the lower four bits of Port B are connected to four switches. Write a program to send the following ASCII characters to a Port C, based on the status of the switches as below: 0000 – “0” 0001 – “1” 0010 – “2” 1110 – “E” 1111 – “F”	2h
20	a) Write a program to see if the RAM location 35h contains an EVEN number. IF so, send the value Port B. If not, make it even and then send it to Port B. Write a program for Port B to count up from 0000 to 1111 (binary).	2h

21	a) Write a “C” program to send the hex values for ASCII Characters of 0, 1, 2, 3, 4, 5, A, B, C and D to Port B. b) Write a “C” program to toggle all the bits of Port B continuously with a 250ms delay. Assume the crystal frequency is 10 MHz. OCB Ex: Write a “C” program to get a byte of data from Port B, wait ½ second, and then send it to Port C.	2h						
22	a) Write a “C” program to monitor LED connected to bit PC5. If LED is “ON”, send 55h to Port B; otherwise send AAh to Port D. b) A door sensor is connected to RB1 pin, a buzzer is connected to RC7. Write a “C” program to monitor door sensor, when it opens, sound the buzzer. You can sound the buzzer by sending a square wave of a few 100 Hz frequency to it. c) OCB Ex: LEDs are connected to bits of Port B & Port C. Write a “C” program that shows the count from 00h to 55h on the LEDs. OCB Ex: Write a “C” program to generate a frequency of 2.5 kHz on pin PB.1. Use Timer 1 to create the delay.	2h						
23	a) Write a “C” program to transfer the message “HELLO” serially at 9600 baud 8-bit data & 1 stop bit. Do this continuously. Write a “C” program to receive the bytes of data serially and put them on Port B. Set the baud rate at 9600, 8-bit data & 1 stop bit.	2h						
24	a) Write a “C” program wherein the data is received on Channel 0 of ADC and is displayed on Port C & Port D. This is done every ¼ of a second.	2h						
25	Write a “C” program to send the data to DAC to generate following waveforms: a) Square. b) Rectangle c) Stair-case Ramp d) Ramp e) Triangle f) Sine	2h						
26	a) A switch is connected to pin RD7. Write a “C” program to monitor the status of SW & perform the following: - If SW = 0, the stepper motor moves Clockwise - If SW = 1, the stepper motor moves Counterclockwise b) Write a “C” program to monitor the status of switch & perform the following: - If Port D.1 = 1, the DC Motor moves for 25% duty cycle pulse - If Port D.1 = 0, the DC Motor moves for 50% duty cycle pulse c) OCB Ex: Two switches are connected to pins RD0 & RD1. Write a “C” Program to monitor the status of both switches & perform the following: <table border="1"> <tr> <td>SW2 (RD1)</td><td>SW1 (RD0)</td><td>Condition</td></tr> <tr> <td>0</td><td>0</td><td>DC Motor moves slowly (25%)</td></tr> </table>	SW2 (RD1)	SW1 (RD0)	Condition	0	0	DC Motor moves slowly (25%)	2h
SW2 (RD1)	SW1 (RD0)	Condition						
0	0	DC Motor moves slowly (25%)						

			duty cycle)		
	0	1	DC Motor moves moderately (50% duty cycle)		
	1	0	DC Motor moves fast (75% duty cycle)		
27	Write a "C" program to interface RFID Module with PIC16F877A.				2h
28	Write a "C" program to measure the distance & display it on LCD. Interface distance measurement sensor with PIC16F877A. Suggested Sensor Module HC-04				2h
29	Write a "C" program to measure the barometric pressure & temperature & display the same on LCD. Interface pressure sensor with PIC16F877A Suggested Sensor Module: BMP280				2h
30	Write a "C" program to measure the speed/rpm and distance covered & display the same on LCD. Interface Hall Effect Sensor with PIC16F877A. Suggested Sensor Module: US1881/04E				2h

Semester – 5		Module Name: Embedded System Lab	Module code: CP04507P
Sl. No.	Module Details		Practical Hours 60
1	Revision of Keil vision 3, MP LAB and Proteus 8 simulation software.		3h
2	Design a Traffic Light Module for a crossroad junction of three roads A, B and C in anticlockwise direction having three signal Indicators		3h
3	ELECTRONIC DICE USING 8051 Using 8051 Microcontroller design an electronic dice by using LED interfacing with the following conditions: Initially microcontroller displays 1 on LEDs display just like in real dice. Then in the main while loop it waits for switch attached to pin 0 of port 1 to be pressed. Until the switch remains pressed it generates random numbers from 1 to 6 and displays it on LEDs. When the button is released, it generates and displays a new random number on LEDs. It repeats from step 2 to step 5 until power is applied to the system.		6h
4	ROBOT CAR Using 8051 Microcontroller design the ROBOT CAR by using switch and DC motor interfacing. For Remote section use five switches which will operate the motor in following conditions: Switch 1 connected on P2.1 for forward direction. 2 Switch 2 connected on P2.2 for Backward Direction. Switch 3 connected on P2.3 to STOP. Switch 4 connected on P2.4 for Right Turn. Switch 5 connected on P2.5 for Left Turn.		6h

5	WAVEFORM GENERATOR Using 8051, write a program to design waveforms generator depending on the conditions as below. Square wave when switch 1 is pressed. Rectangular wave when switch 2 is pressed. Saw tooth wave when the switch 3 is pressed.	6h
6	DC MOTOR SPEED CONTROL USING PWM Using 8051 Microcontroller write a program for PWM based DC Motor speed control to maintain the different duty cycles. When S/W 1 is pressed slow speed (25% duty cycle). When S/W 2 is pressed medium speed (50% duty cycle). When S/W 3 is pressed high speed (75% duty cycle). When S/W 4 is pressed full speed (100% duty cycle). When S/W 5 is pressed the Motor should STOP.	6h
7	Write a program by using 8051 Microcontroller when a switch 1 is pressed the system has to monitor the status of 2 switches connected on it,	6h
8	Design the metal shorting module where the three types of metal sensors are sensing three objects (A, B & C) are placed on a conveyor. When all the sensors count are equal to 2 then Motor 1, Motor 2 and Motor 3 starts moving which moves the respective conveyor	6h
9	A hall has a defined strength of 40 with one entry and one exit point. Monitor the strength of the hall continuously when. It is below 40, display the message "Welcome" on LCD and a green indicator (LED) should ON. Whenever it reaches to its maximum count of 40, display the message on LCD "Please wait" and a red indicator (LED) should be on for visual indication and the entry gate should be close automatically.	6h
10	TEMPERATURE MONITORING SYSTEM Using PIC16f877a Microcontroller write a program to monitor the room temperature. When Temp < 40, green LED should glow. When Temp = 40, yellow LED should glow When Temp > 40, red LED should glow.	6h
11	DIGITAL CLOCK Design the digital clock by interfacing the RTC DS12C887 with 8051 based on I2C protocol.	6h

Semester – 5		Module Name: VLSI Lab	Module code: CP04508P
Sl. No.	Module Details		Practical Hours 60
1	Introduction to VHDL using Xilinx Tool		3h

2	Write a VERILOG code to realize all the Logic Gates	3h
3	Write a VERILOG code for Half Adder & Full Adder	3h
4	Write a VERILOG code for Half Subtractor & Full Subtractor	3h
5	Write a VERILOG code for 4-bit Comparator	3h
6	Write a VERILOG code for 8 to 3 Encoder	3h
7	Write a VERILOG code for 3 to 8 Decoder	3h
8	Write a VERILOG code for 8 to 1 Multiplexer	3h
9	Write a VERILOG code for 1 to 8 Demultiplexer	3h
10	Write a VERILOG code for 4-bit Binary Code to Gray Code Converter	3h
11	Write a VERILOG code for 4-bit Gray Code to Binary Code Converter	3h
12	Write a VERILOG code for RS Flip flop, & D Flip flop	3h
13	Write a VERILOG code for JK Flip flop, T Flip flop	4h
14	Write a VERILOG code for 3-bit Binary Asynchronous Counter	4h
15	Write a VERILOG code for 3-bit Binary Synchronous Counter	4h
16	Write a VERILOG code for 4-bit BCD Counter	4h
17	Write a VERILOG code to run Bidirectional DC Motor	4h
18	Write a VERILOG code to Control External Lights using Relays	4h

Semester – 5		Module Name: Digital Communication Lab	Module code: CP04510P
Sl. No.	Module Details		Practical Hours 60
1	Conduct an experiment to prove the Sampling Theorem for Low-Pass Signals		3h
2	Conduct an experiment to Study the effect of Aliasing, Guard Band and Nyquist Criteria		6h
3	Conduct an experiment to Know the Working of Pulse Amplitude Modulator		3h
4	Conduct an experiment to study Pulse Code Modulation and Demodulation		3h

5	Conduct an experiment to Generate the Delta Modulated signal and Adaptive Delta Modulated signal	6h
6	Conduct an experiment to study Differential Pulse Code Modulation and Demodulation	6h
7	Conduct an experiment to Generate and Detect of BASK signal using Trainer Kit	3h
8	Conduct an experiment to Generate and Detect of BFSK signal using Trainer Kit	3h
9	Conduct an experiment to Generate and Detect of BPSK signal using Trainer Kit	6h
10	Conduct an experiment to Generate and Detect of DPSK signal using Trainer Kit	3h
11	Conduct an experiment to Generate and Detect of QPSK signal using Trainer Kit	3h
12	Conduct an experiment to Dual Tone Multi Frequency (DTMF) signals	6h
13	Conduct an experiment to Know the Working of DTMF Decoder	3h
14	Conduct an experiment for the given Binary Data, Generate a) Unipolar – RZ, NRZ b) Bipolar – NRZ (AMI) c) Manchester – RZ	6h

Semester – 5		Module Name: IoT - 2 Lab	Module code: CP04511P
Sl. No.	Module Details	Practical Hours 60	
1	Introduction to IoT and IIoT	2h	
2	IoT Architecture	3h	
3	Introduction to various development Boards	2h	
4	Various cloud services and usage	4h	
5	MQTT	3h	
6	Introduction to Raspberry Pi	16h	
7	Introduction to Intel IoT platform	18h	
8	Need of IoT in Industries	2h	
9	Mini Project work – Application based	4h	
10	Case studies and Implementation Examples	4h	
11	Assessment for certification	2h	

Semester – 5		Module Name: Artificial Intelligence and Machine Learning Lab	Module code: CP04513P
Sl. No.	Module Details	Practical Hours 60	
1	Python for Data Science	4h	
2	Data Preprocessing and Visualization-Excel & Python	8h	
3	Supervised Learning - Regression	6h	
4	Supervised Learning - Classification	6h	
5	Unsupervised Learning	6h	
6	Model Selection and Validation	6h	
7	Introduction to Deep Learning	6h	
8	Convolutional Neural Networks (CNN)	6h	
9	Model Deployment and AI Ethics	3h	
10	Case Studies on AI/ML techniques to a real-world problem	9h	

Semester – 6		Module Name: Industrial Management	Module code: CP04601T
Sl. No.	Module Details	Theory Hours 30	
1	Basics of Management	2h	
2	Pollution Prevention and Waste Management	2h	
3	Industrial Safety Management	2h	
4	Inspection and Quality Control	5h	
5	Modern Production Management	2h	
6	Lean Manufacturing	4h	
7	Total Productive Maintenance and Total Quality Management	9h	
8	Human Resource Management	2h	
9	Industrial Relation Legislation management	2h	

Semester – 6 Module Name: Data Communication Module code: CP04602T		
Sl. No.	Module Details	Theory Hours 30
1	Introduction to Data Communication and Networks	5h
2	Networking Protocols and OSI Models	8h
3	TCP/IP	6h
4	Communication Protocols	4h
5	Internet Devices and Protocols	2h
6	Network Security	5h

Semester – 6 Module Name: Advanced Microcontroller ARM Module code: CP04603T		
Sl. No.	Module Details	Theory Hours 60
1	Introduction to ARM Controller	6h
2	LPC 2148 ARM Controller	13h
3	Programming of LPC 2148	11h
4	KEIL IDE	4h
5	Hardware Interface	2h
6	System Control	5h
7	Pin Connect block, GPIO	9h
8	Timer, ADC and UART	5h
9	I2C, SPI and PWM	5h

Semester – 6 Module Name: Programmable Logic Controller Module code: CP04604T		
Sl. No.	Module Details	Theory Hours 30
1	PLC Basics	1h
2	Basic PLC Programming	4h
3	Basic PLC Functions	4h

4	Intermediate Functions	4h
5	Data Handling Functions	6h
6	PLC Functions Working with Bits	3h
7	Advanced PLC Functions	4h
8	Introduction To HMI and SCADA	4h

Semester - 6		Module Name: Employability Skills	Module code: CP04609T
Sl. No	Module Details		Theory Hours 30
1	Labour Welfare and Legislation.		5h
2	Customer Interaction/ Service.		5h
3	Conflict resolution and Negotiation		10h
4	Job readiness and Exam Preparation		10h

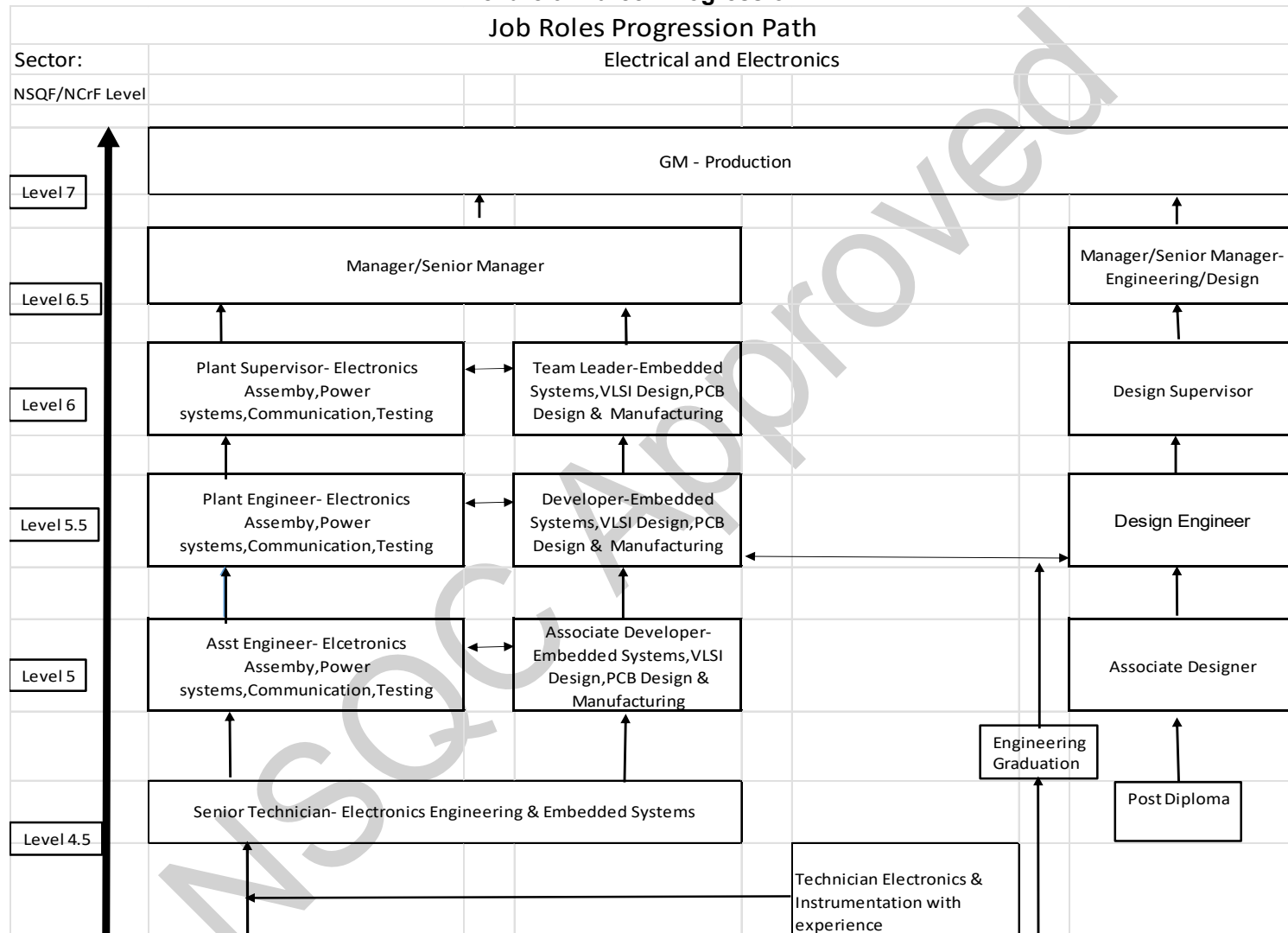
Semester – 6		Module Name: Advanced Microcontroller-ARM Lab	Module code: CP04605P
Sl. No.	Module Details		Practical Hours 40
1	Familiarization of KEIL Compiler		2h
2	Arithmetic operations - Addition, Subtraction, Multiplication		8h
3	Arithmetic operations – Division, 1's and 2's Complement		4h
4	Sum of an Array of 16-Bit Numbers		2h
5	Find Smallest / Largest number in an array		2h
6	Convert HEX to ASCII and ASCII to HEX		2h
7	Interfacing LED to ARM		4h
8	Interfacing Switch to ARM		2h

9	Interfacing SSD to ARM	4h
10	Interfacing Motor to ARM	4h
11	Waveform Generation in ARM	2h
12	Interfacing Relay	2h
13	Interfacing a Buzzer	2h

Semester – 6 Module Name: Programmable Logic Controller Lab Module code: CP04606P		
Sl. No.	Module Details	Practical Hours 40
1	Basic PLC Programming	10h
2	Digital PLC Programming	4h
3	PLC Timers Programming	14h
4	PLC Counters Programming	12h

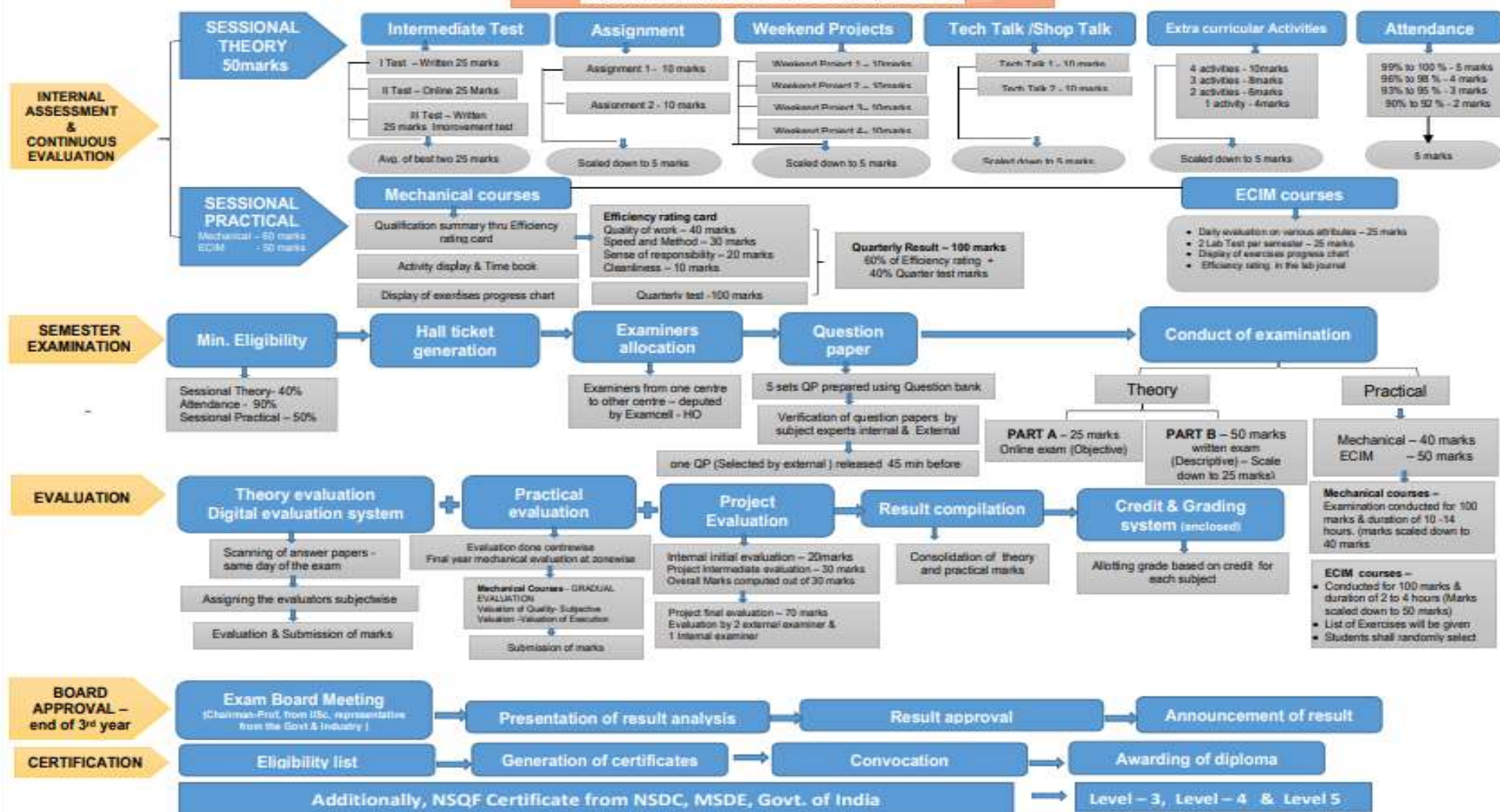
Semester - 6 Module Name: Project Module code: CP04607P		
Sl. No.	Module Details	Practical Hours 160
1	The objective of project work is to demonstrate the candidates' skill and knowledge in solving a real work Engineering problem involving Electronics, Power Electronics, Embedded, IoT System Design.	160h

Semester -6 Module Name: OJT Module code: CP04608P		
Sl. No.	Module Details	Practical Hours 330
1	OJT - On the Job Training in the Industry	330h

Annexure 9: Career Progression

Annexure: 10 Assessment SOP

Annexure: Assessment SOP



Annexure 11: Occupational Map
Occupational Map - Sector Name: Electrical & Electronics

As per NCrF		As per NCO-2015	Sub-Sector 1/Automotive, Aerospace, Home appliances, Textile, Construction machinery	
NCrF Level (1-8)	Level Descriptors	NCO-15 -- Family (First 4 digits code/s for the given level crosscutting the OM Sub-Sectors/Occupations)	Occupation 1/Electronics System design and Manufacturing	Occupation 2/VLSI & Embedded System Design and Development
Level 8	1. Professional Theoretical Knowledge: Mastery of knowledge / Innovation driven/ Comprehensive knowledge 2. Professional and Technical Skills/ Expertise: Most advanced Technical and Managerial skills 3. Employment Readiness & Entrepreneurship Skills & Mind-set: Significant authority, transformational leadership, social intelligence 4. Broad Learning Outcomes: Lead large transformational projects 5. Responsibility: Business Vision Chairperson/ Board Member / CMD	1120	Managing Director	Managing Director
Level 7	1. Professional Theoretical Knowledge: Advanced knowledge with critical understanding of emerging developments 2. Professional and Technical Skills/ Expertise: Highly specialized skills, transdisciplinary skills, leadership skills 3. Employment Readiness & Entrepreneurship Skills & Mind-set: Cross cultural competency, transformational leadership 4. Broad Learning Outcomes: Apply acquired advanced technical skills, technical appraisal and reviews 5. Responsibility: Business Management (like GM/ CEO / CXO, etc.)	1321 2151	GM -Production/ System Development/ Entrepreneur	GM -Production/ System Development/ Entrepreneur
Level 6.5	1. Professional Theoretical Knowledge: Advanced multidisciplinary and specialized knowledge 2. Professional and Technical Skills/ Expertise: Advanced Technical and Managerial Skills	1223 2151	Manager/Senior Manager- Electronics Assembly, Power Systems, communication, testing,	Manager/Senior Manager- Engineering Design

	3. Employment Readiness & Entrepreneurship Skills & Mind-set: Leadership, effective resource management 4. Broad Learning Outcomes: Judgement in complex problems 5. Responsibility: Vertical/ Business unit management – Manager or Senior Manager		Development Manager - Embedded Systems, VLSI Design, PCB Design & Manufacturing.)	
Level 6	1. Professional Theoretical Knowledge: Multidisciplinary and specialized knowledge 2. Professional and Technical Skills/ Expertise: Range of skills along with specialized domain skills 3. Employment Readiness & Entrepreneurship Skills & Mind-set: Entrepreneurial mindset, self-management 4. Broad Learning Outcomes: Judgement / decision making – specialized 5. Responsibility: Team leader – Junior technical supervisor, technical supervisor or junior/ deputy manager	1223 2151 2152	Plant Supervisor - Electronics Assembly, Power Systems, communication, testing, Team Leader Development - Embedded Systems, VLSI Design, PCB Design & Manufacturing.	Design Supervisor
Level 5.5	1. Professional Theoretical Knowledge: Specialized knowledge 2. Professional and Technical Skills/ Expertise: Specialized skills 3. Employment Readiness & Entrepreneurship Skills & Mind-set: Team readiness, self-entrepreneurship readiness 4. Broad Learning Outcomes: Specialized/ complex jobs/tasks 5. Responsibility: Self and team responsibility – Sr. Technician or Master Technician	2152 3114 3122	Plant Engineer - Electronics Assembly, Power Systems, communication, testing, Developer - Embedded Systems, VLSI Design, PCB Design & Manufacturing.	Design Engineer
Level 5		2152 3114 3122 2512	Assistant Engineer - Electronics Assembly, Power Systems, communication, testing, Associate Developer - Embedded Systems, VLSI Design, PCB Design & Manufacturing.	Associate Designer
Level 4.5	1. Professional Theoretical Knowledge: Range of knowledge 2. Professional and Technical Skills/ Expertise: Range of technical skills 3. Employment Readiness & Entrepreneurship Skills & Mind-set: Team readiness & Entrepreneurial readiness 4. Broad Learning Outcomes: Carry out Range of tasks and may provide range of solutions 5. Responsibility: Accountable/ responsible - Jr. Technician & Technician	2152 3114 3122 2512	Senior Technician- Electronics Engineering & Embedded Systems, Circuit Analyst, System validator Design, Testing and Installation	Study Post Diploma, System validator, Embedded programmer and tester

Annexure 12: Key Learning Outcome

SL NO	MODULE NAME	KNOWLEDGE AND UNDERSTANDING	TECHNICAL & PROFESSIONAL SKILLS	APPLICATION OF KNOWLEDGE AND SKILLS
3rd Year				
1	Advanced Microcontroller – PIC (CP04501T) Advanced Microcontroller – PIC Lab (CP04506P) Advanced Microcontroller – ARM (CP04603T) Advanced Microcontroller – ARM Lab (CP04605P) Understanding the Architecture of different Microcontrollers, their programming and interfacing with peripheral devices.	Know the evolution of Microcontrollers and latest trend in industry. Understand the Architecture of PIC controller/ARM processor. Write Embedded C Programming for the respective microcontroller.	Use PIC 16F877A microcontroller, connect 8 LED to the port, and blink the LED with a switch. Use PIC 16F877A/LPC2148 microcontroller to interface LCD, Relay, Keypad, motor, drivers and seven segments. Perform the use of an ADC and DAC to read input voltage and provide output voltage. Perform the use of RS232 and USB interface with Computer interface. Demonstrate entering of simple programs, execute & monitor the results	Select the Microcontroller/ Sensors/ Peripherals as per the requirement, optimize the code, interpret the datasheet, use the suitable protocols like I2C, SPI and CAN in various applications.
2	Embedded System (CP04502T) Embedded System Lab (CP04507P) Understanding the Various fields, requirements, Embedded System Development, Architecture, Code Optimization and Real Time OS	Understand the various fields of Embedded system. Explain the Block diagram and requirements of Embedded system. Explain the Process of Embedded system development. Knowledge about the Processor, Memory management, Code optimization, various compilers Explain the concepts of Embedded RTOS	Will be able to perform testing on host, testing on target, Environment testing. Design an Embedded Product Will be able to program and execute to control various output devices using 8051/PIC 16F877A (temperature monitoring systems, traffic light controller etc. Interface peripherals to 8051/PIC 16F877A/LPC 2148 Microcontroller. (Peripherals: Keyboard, LEDs, LCD display, relay and motor, drivers)	Select the Microcontroller/ Sensors/ Peripherals as per the requirement, optimize the code, use the suitable protocols, test the hardware and firmware in testing unit and Environment in various applications

			Perform the use of RS232 and USB interface with Computer interface.	
3	VLSI Technology (CP04503T) VLSI Technology Lab (CP04508P)	To explain IC design process, Front End and Back End process in VLSI technology To explain CMOS circuits and design methodology in VLSI	To compile, simulate and synthesize the Verilog code of Hardware Description Language and its use in designing electronic circuits.	Perform Logic verification, digital debugging.
4	Artificial Intelligence and Machine Learning (CP15512T) Artificial Intelligence and Machine Learning Lab (CP15513P) Ability to develop applications and AI Services	Explain the applications of AI and ML Knowledge on Data Processing & visualization Distinguish various methods in supervised Learning Explain the cross-validation techniques. Differentiate CNN and RNN Knowledge on Python programming for Data science Explain the cross-validation techniques	Perform data cleaning, transformation and Visualisation Implement model deployment and scaling using deep learning Create Evaluation Metrics for Classification Models	Develop the applications or Cloud based AI services using AI and ML methodologies. Apply the Supervised learning methods in the appropriate applications.
5	Digital Communication (CP04505T) Digital Communication (CP04510P) Understanding of different Digital communication components and techniques.	Describe the basics of signals and systems. Understand the digital communication techniques using digital modulation techniques, multiplexing and Multiple Access techniques- FDM, TDM GSM Architecture, CDMA Systems, Working of Modem and types. Describe types of Error, Error Detection	Able to explore Sampling Theorem, effect of Aliasing, Guard Band & Nyquist Criteria	Able to analyse and rectify any Communication device faults.

		methods, Error Correction Techniques- e.g.: telephone system and working of FAX machine		
6	Industrial Management (CP04601T) Understanding Management structure, safety, Productivity improvement practices and Factory Acts and regulations	Understand the basics of management structure and management strategies of an industry. Understand the impacts of industrial pollution and waste. Understand the concepts of Lean manufacturing. Understand the Importance of industrial & factories	Able to use the tools used in the industry to improve and control the quality of products. Able to apply the Importance of TPM & TQM Concepts	Apply the importance of Industrial safety. Apply the Importance of modern production management system.
7	Data Communication (CP04602T) Understanding of various networking concepts.	Describe network and network topologies, LAN, MAN, WAN, basic data communication methods. Understand TCP/IP model, addressing methods, secured communication, FTP, Domain name system and email communication protocols. Knowledge on Routers, Switches, Repeaters, Bridges, Gateway, Leased Lines and Basics of Threats and Fire Wall	Able to use Communication protocols, different layers of OSI model and its functionality, Concepts of encapsulation and decapsulation. Able to use network security - Data Encryption, various methods involved, digital signatures	Able to analyse and rectify any network related issues.
8	Programmable Logic Controller (CP04604T) Programmable Logic Controller Lab (CP04606P) Ability to create simple projects using PLC/HMI/SCADA to interface	Understanding on Basic PLC, its configuration and components. Knowledge on Input/ Output ports, relationship with basic GATES, Knowledge and understanding on Basic Functions (Registers, Timers,	Creating ladder diagram using different functions (Basic functions, Intermediate functions, Data handling functions etc). Able to troubleshoot PLC functions. Able to control output devices using PLC programs.	Creation, Testing, simulation of different Ladder diagrams, Function diagrams using Gates, Timers, counters in a PLC system.

	and control analog and digital devices.	Counters)		
9	IoT - 2 Lab (CP04511P) Understanding IoT, IIoT architecture, cloud computing and their applications.	Basic knowledge on IoT and IIoT architecture, various development boards and various Cloud services.	Design and Implementation of Cloud based projects. Able to use various communication protocols, develop and Implement different IoT applications using IIoT sensors	Develop applications using to control various devices using NODE MCU, Arduino processor and Raspberry Pi.
10	Project (CP04607P) Ability to create a working model using the skill developed during the course of their training.	Understand various electronic components, Characteristics and their specifications. Knowledge on selection of components as per the Power rating	Design and develop Mechanical sub system. Able to use simulation/Electrical or Mechanical Drawing/Programming Software. Able to do the Product development and code optimizations. Prepare Electrical/Electronic circuit, and interface. Develop and download PLC / Embedded program. Integrate, Test and Repair for functionality. Perform project work on application of Electronics	Project should comprise of Hardware, Software as well as Display/ User Interface systems. Project shall be based on Electrical/ Electronic Circuits, IoT / Power electronics / Embedded /Automation.

11	Employability Skills (CP04514T) (CP04609T) Understand Labour Welfare and Legislation. Understand the concept of Quality Management Getting ready for Employment/ Entrepreneurship Learn to interact with customers/ provide service.	Knowledge on benefits guaranteed under various Acts, legislations, Factories act, Apprenticeship Act, ESI, EPF Acts, Payment of wages act, women's compensation Act, POSH, and other industrial laws. Understanding of Quality concepts, QMS, PDCA QC Tools, 5S, Kaizen. ISO Process. Distinguishing between Job and Career, Awareness of different job roles in the related sector. Understanding on the pathway and progression. Creating resume and apply for Jobs.	Explain various Acts enacted for labour welfare by various Governments. Attend mock interviews, create Resume documents. Body language, relationship building, probing techniques.	Use of various QC tools and Kaizen for problem solving and Quality improvement themes. Customer handling from greeting, grievance handling.
----	--	--	---	---

Annexure: Acronym and Glossary**Acronym**

Acronym	Description
AA	Assessment Agency
AB	Awarding Body
ISCO	International Standard Classification of Occupations
NCO	National Classification of Occupations
NCrF	National Credit Framework
NOS	National Occupational Standard(s)
NQR	National Qualification Register
NSQF	National Skills Qualifications Framework
OJT	On the Job Training

Glossary

Term	Description
National Occupational Standards (NOS)	NOS define the measurable performance outcomes required from an individual engaged in a particular task. They list down what an individual performing that task should know and also do.
Qualification	A formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards
Qualification File	A Qualification File is a template designed to capture necessary information of a Qualification from the perspective of NSQF compliance. The Qualification File will be normally submitted by the awarding body for the qualification.
Sector	A grouping of professional activities on the basis of their main economic function, product, service or technology.
Long Term Training	Long-term skilling means any vocational training program undertaken for a year and above. https://ncvet.gov.in/sites/default/files/NCVET.pdf