GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

REFRACTORY TECHNICIAN

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR – CAPITAL GOODS AND MANUFACTURING

Directorate General of Training

REFRACTORY TECHNICIAN

(Engineering Trade)

(Revised in March 2023)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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1. COURSE INFORMATION

During the two-year duration of Refractory Technician trade, a candidate is trained on Professional Skill, Professional Knowledge, Engineering Drawing, Workshop Calculation & Science and Employability Skill related to job role. In addition to this, a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The broad components covered under Professional Skill subject are as below:-

FIRST YEAR: In this year, the trainee learns about safety and environment, use of fire extinguishers, artificial respiratory resuscitation to begin with. He gets the idea of trade tools & its standardization, familiarize with basics of electricity, test the cable and measure the electrical parameter. Practice Arc welding gas cutting and welding process, fitting jobs of solid metal and pipes. Identify and test manufacturing process.

The candidate will be able to ensure quality control, handling of raw materials, checking consistency of mixed material, monitoring of moulding and pressing operation, drying bricks and dryer operation, loading / unloading of finished product and perform operation and maintenance of kiln and waste utilisation.

SECOND YEAR: In this year, the trainee will be able to perform brick cutting and joining, basic application of monolithic refractory, fitting of scaffold, operate gunning machine, ramming, patching. In addition, they can perform computer operation and packaging of refractory.

The candidate will be able to prepare heating chart and perform opening, repair, testing, checking of vibrator and identify physical defects, parts of furnaces, construct refractory lining, prepare technical report and documentation as per industrial need and operational function and maintenance of supporting tools and machines.

2. TRAINING SYSTEM

2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under the aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer schemes of DGT for strengthening vocational training.

The Refractory Technician Trade under CTS is delivered nationwide through a network of ITIs. The course is of two-year duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while Core area (Employability Skills) impart requisite core skill, knowledge and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Trainee broadly needs to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools.
- Perform tasks with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional knowledge, core skills & employability skills while performing the job, and repair & maintenance work.
- Check the task/job for functioning, identify and rectify errors in task/job.
- Document the technical parameters in tabulation sheet related to the task undertaken.

2.2 PROGRESSION PATHWAYS

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can join Apprenticeship programs in different types of industries leading to a National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming an instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of two-years: -

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

On the Job Training (OJT)/ Group Project	150	150
Optional Courses (10th/ 12th class certificate along with ITI certification or add on short term courses)	240	240

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification or add on short term courses.

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment** (Internal) during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in.

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure is being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final**

assessment. The examiner during final examination will also check individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examining body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60%-75% to be allotted during assessment	

For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the project/job.
(b) Marks in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
(c) Marks in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment. • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Refractory Technician; builds and repairs furnaces, ovens, kilns, fireboxes, fire places and other high temperature structures by laying and setting firebricks and refractory blocks, using chemical heat resistant cement, fireclay, mortar etc. with hand tools. Receives instructions from appropriate authority regarding nature and type of work to be done. Spreads minimum possible fireclay mortar evenly over furnace with trowel and lays and taps fire bricks or refractory blocks in position in correct alignment according to specification. Seals joints with fireclay mortar or chemically resistant cement to bind bricks together making provision for expansion of joints in furnace in linings. Prepares support to proper curvature to replace arched roofs of furnaces or to construct new ones as directed or specified. Patches portions of furnaces with fireclay, as necessary and removes excess of mortar. May specialize in building and repairing particular type of high temperature construction. May replace linings of ladles or tapping sports of furnaces. May build new smoke tunnels.

Reference NCO-2015:

a) 7112.0300 - Bricklayer, Refractory

Reference NOS: -

i. ISC/N1201
ii. ISC/N1202
iii. CSC/N0304
iv. CSC/N0301
v. PSC/N0130
vi. AAS/N9407
vii. ELE/N9412
viii. CSC/N9435
ix. CSC/N9436
x. CSC/N9437
xi. CSC/N9438
xii. RSC/N9407
xiii. CSC/N9440
xiv. CSC/N9441
xv. CSC/N9442
xvi. CSC/N9443
xvii. CSC/N9444
xviii. CSC/N9445
xix. ELE/N4063
xx. CSC/N9447
xxi. CSC/N9448
xxii. CSC/N9449
xxiii. CSC/N9450
xxiv. CSC/N9451
xxv. CSC/N0204
xxvi. CSC/N0201
xxvii. CSC/N0110
xxviii. CSC/N9402
xxix. CSC/N9401

4. GENERAL INFORMATION

Name of the Trade	**REFRACTORY TECHNICIAN**
Trade Code	DGT/1117
NCO - 2015	7112.0300
NOS Covered	ISC/N1201, ISC/N1202, CSC/N0304, CSC/N0301, PSC/N0130, AAS/N9407, ELE/N9412, CSC/N9435, CSC/N9436, CSC/N9437, CSC/N9438, RSC/N9407, CSC/N9440, CSC/N9441, CSC/N9442, CSC/N9443, CSC/N9444, CSC/N9445, ELE/N4063, CSC/N9447, CSC/N9448, CSC/N9449, CSC/N9450, CSC/N9451, CSC/N0204, CSC/N0201, CSC/N0110, CSC/N9402, CSC/N9401
NSQF Level	Level-4
Duration of Craftsmen Training	2 Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session
Eligibility for PwD	LD, LC, DW, AA, DEAF
Unit Strength (No. Of Students)	24(There is no separate provision of supernumerary seats)
Space Norms	130 Sq. m.
Power Norms	3 KW
Instructors Qualification for:	

1. Refractory Technician Trade	B.Voc/Degree in Mechanical/ Ceramic/ Metallurgy Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Mechanical /Ceramic/Metallurgy Engineering from AICTE recognized board of technical education or Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the Trade of "Refractory Technician" With three years' experience in the relevant field. **Essential Qualification:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT. ***Note: Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However both of them must possess NCIC in any of its variants.***
2. Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT

3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering/ Draughtsman group of trades with three years' experience. **<u>Essential Qualification:</u>** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade OR Regular/RPL variants NCIC in RoDA or any of its variants under DGT
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
5. Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1 LEARNING OUTCOMES:

FIRST YEAR:

1. Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. observing suitable care following safety precautions. (ISC/N1201)
2. Perform forging, piercing, bending, riveting, punching and edge cutting operation. CSC/N0304
3. Perform sheet metal work. CSC/N0301
4. Perform checking and measuring components with precision instrument. PSC/N0130
5. Make different fit of components for assembling observing principle of interchange ability and check for functionality. AAS/N9407
6. Perform Arc welding process. CSC/N0204
7. Perform gas cutting and welding process. CSC/N0201, CSC/N0204
8. Use proper taps and dies for making internal and external threads on solid metal and pipes. CSC/N0110
9. Perform basic electrical measurement. ELE/N9412
10. Enumerate the various types of refractories. (ISC/N1201)
11. Identify the major forms and sources of pollution and control techniques in refractory industry. (ISC/N1201)
12. Practice operation and maintenance of various fuel handling plant. CSC/N9435
13. Identify the different raw material and handling. (ISC/N1201)
14. Perform the measures of quality control. (ISC/N1201)
15. Demonstrate the manufacturing processes. CSC/N9436
16. Identify the different grain size, mixing machine – operation and adjustment and checking consistency of mixed material. CSC/N9437
17. Perform operation and monitoring of moulding and pressing (manual / hydraulic). CSC/N9438
18. Practice on drying bricks and dryers. (ISC/N1201)
19. Identify the different temperature measuring instrument and maintenance. RSC/N9407
20. Ensure proper loading/ unloading, drying schedule, firing schedule and inspect the finished product. CSC/N9440
21. Perform the operation and maintenance of kiln and waste utilisation. CSC/N9441
22. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9402

23. Read and apply engineering drawing for different application in the field of work. CSC/N9401

SECOND YEAR:

24. Demonstrate the basic application of monolithic refractory. CSC/N9442
25. Perform brick cutting and joining. (ISC/N1201)
26. Perform fitting of scaffold. CSC/N9443
27. Perform gunning, ramming and patching. CSC/N9444
28. Demonstrate the energy conservation followed by industry. CSC/N9445
29. Perform basic computer operation. ELE/N4063
30. Perform the method of packaging in refractory industry. CSC/N9447
31. Perform installation and repair of brick work. (ISC/N1202)
32. Perform opening, repair, testing, checking of vibrator and identify the physical defect. CSC/N9448
33. Identify the different parts of furnaces. CSC/N9449
34. Perform with skill in the model workshop / fields. (ISC/N1202)
35. Create report observing heating chart. CSC/N9450
36. Construct refractory lining. (ISC/N1202)
37. Prepare technical report and documentation as per industrial need. (ISC/N1202)
38. Demonstrate operational function and maintenance of supporting tools and machines. CSC/N9451
39. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9402

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. observing suitable care following safety precautions. ISC/N1201	Identify basic hand tools for fitting, riveting, drilling etc. with due care and safety.
	Use tool and job holding devices for metal sawing.
	Mark on the job with the help of marking tools.
	Cut metal piece by hacksaw, file the flat surfaces and check dimensions.
	Chip flat surface along the marked line.
	Drill holes on MS plate as per tap drill size and make thread by taping.
	Check flatness,squarenessand measure dimension of the job.
2. Perform forging, piercing, bending, riveting, punching and edge cutting operation. CSC/N0304	Prepare a hearth for forging.
	Make a centre punch by forging.
	Make a flat chisel.
	Make a screw driver.
	Make a cube from a MS round bar by a jack hammer.
	Perform piercing, bending, riveting punching and edge cutting in press tool.
3. Perform sheet metal work. CSC/N0301	Cut geometrical shapes from metal sheet.
	Make a funnel of metal sheet.
	Use of flat scraper to make the surface even of a dove tail fitting.
4. Perform checking and measuring components with precision instrument. PSC/N0130	Check surface roughness of a surface plate.
	Perform Angular Measurement using Bevel protector and Sine bar.
	Measure distance / clearance using dial test indicator.
	Perform Gear and Screw Thread Measurement. (two wire method and screw pitch gauge).
	Perform checking work piece by limit gauges.
5. Make different fit of components for assembling observing principle of	Make Step fit, angular fit, angle, surfaces.
	Scrap on flat surfaces, curved surfaces and parallel surfaces and test.
	Scrap a cylindrical bore.

interchangeability and check for functionality. AAS/N9407	Locate accurate holes & make accurate hole for stud fit.
6. Perform Arc welding process. CSC/N0204	Practice Arc welding process.
	Striking straight beads left to right and right to left.
	Weld a square butt joint.
	Weld a Lap joint.
	Weld a Tee joint.
	Weld a Corner joint.
7. Perform gas cutting and welding process. CSC/N0201, CSC/N0204	Practice of Gas cutting and Gas welding.
	Cutting of straight and curved metal pieces.
	Fusion runs on a M.S. Sheet Left to Right.
	Fusion runs on a M.S. Sheet Right to Left.
8. Use proper taps and dies for making internal and external threads on solid metal and pipes. CSC/N0110	Use of dies and making of external threads.
	Use of tap and prepare tapped holes.
	Make threads on various dia. MS rods and fit the threaded rods on previous tapped holes.
	Use of Pipe fittings and prepare joints.
	Threading of pipes with the use of pipe die.
	Prepare a pipe line using different types of pipe joints.
9. Perform basic electrical measurement. ELE/N9412	Measure AC, DC by using multimeter.
	Measure AC voltage using step up & step down transformer.
	Measure resistance, Voltage &current.
10. Enumerate the various types of refractories. (ISC/N1201)	Ensure the different types of bricks and chemical composition.
	Practice various types of refractories and shapes.
11. Identify the major forms and sources of pollution and control techniques in refractory industry. (ISC/N1201)	Operate water spray gun, vacuum sweepers, Dry fog nozzles, water sprinkler.
	Practice on prevention of various health hazards occurring from refractory materials.
	Identify sources of pollution & various control techniques .
12. Practice operation and maintenance of various fuel handling plant. CSC/N0335	Practice on handling various fuels.
	Operation & maintenance of Producer gasplant.

13. Identify the different raw material and handling. (ISC/N1201)	Identify the different raw materials used in manufacturing refractory.
	Identify the physical and chemical properties of refractory materials.
14. Perform the measures of quality control. (ISC/N1201)	Identify the basic concept of 5S, Kaizen, TPM, TQM and ISO:9000.
	Ensure the quality control for refractory items.
15. Demonstrate the manufacturing processes. CSC/N9436	Demonstrate & practice different manufacturing processes at plant/video demonstration.
16. Identify the different grain size, mixing machine – operation and adjustment and checking consistency of mixed material. CSC/N9437	Demonstrate & practice on Sieve Analysis of different grain size.
	Identification of parts of mixing machine & operation of mixing machine.
	Practice on changing adjusting scrapper, adjustment of roller height.
	Checking consistency of mixed material and workability.
17. Perform operation and monitoring of moulding and pressing (manual / hydraulic). CSC/N9438	Practice on weighing of material, filling the mould & operating the pressing (Mechanical & Hydraulic) and gauging of the bricks.
	Physical inspection of bricks for cracks, lamination & wrecks, warpage.
	Checking of bulk density of bricks.
	Practice on operation /monitoring parameters of press. (Manual/Hydraulic).
	Identify the Segregation, Sizes, Edges & corner and any other physical defects.
18. Practice on drying bricks and dryers. (ISC/N1201)	practice on drying of bricks.
	Practice on operating dryers.

19. Identify the different temperature measuring instrument and maintenance. RSC/N9407	Demonstrate / practice of different temperature measuring instrument. Measure temperature by pyrometer reading. Perform the steps of preventive maintenance.
20. Ensure proper loading/ unloading, drying schedule, firing schedule and inspect the finished product. CSC/N9440	Observe the loading and unloading. Monitor the drying schedule and firing schedule. Inspect physically the finished product. Practice on loading/unloading of bricks.
21. Perform the operation and maintenance of kiln and waste utilisation. CSC/N9441	Practice on operation & maintenance of kiln. Practice on firing schedule. Practice on brick checking. Demonstration waste utilization.
22. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9402	Solve different mathematical problems Explain concept of basic science related to the field of study
23. Read and apply engineering drawing for different application in the field of work. CSC/N9401	Read & interpret the information on drawings and apply in executing practical work. Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters. Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
SECOND YEAR	
24. Demonstrate the basic	Practice different application method of monolithic refractory at plant.

application of monolithic refractory. CSC/N9442	Inspect defects follow the acceptance criteria.
25. Perform brick cutting and joining. (ISC/N1201)	Perform brick laying of shaped refractory. Perform brick cutting and brick joining by hand or machine.
26. Perform fitting of scaffold. CSC/N9443	Practice on fitting scaffolding. Identify the materials used in scaffolding. Maintain the safety aspect in scaffolding.
27. Perform gunning, ramming and patching. CSC/N9444	Practice with gunning machine. Practice in ramming, patching, shot crating, coating and hot repair.
28. Demonstrate the energy conservation followed by industry. CSC/N9445	Demonstration on energy conservation. Practice on 5S. Acquire practical knowledge on kiln maintenance.
29. Perform basic computer operation. ELE/N4063	Familiarization & Identification of computer parts. Practice on computer for MS word, MS power point, MS Excel.
30. Perform the method of packaging in refractory industry. CSC/N9447	Perform packaging of refractory. Arrange to load of different shapes in pallet.
31. Perform installation and repair of brick work. (ISC/N1202)	Cut brick in machine. Check perpendicularity of lining using plumb. Prepare mortar. Monitor thickness of mortar during installation. Demolish existing / used lining. Use of levelling tool, Sprit level, water level. Use of wooden hammer for adjusting brick level.

	Measure, cutting & Installation of Key brick.
	Practice on hand grinding.
	Use of brick holder & brick.
	Use of skew brick & Arch making, use of screw jack.
32. Perform opening, repair, testing, checking of vibrator and identify the physical defect. CSC/N9448	Opening & repair of vibrator needle, rammer, pneumatic breaker, replacement of chisel.
	Testing of water quality using litmus paper. Water temperature, quantity of mixing water, time of mixing, Lead time/ measurement, Mixer operation, adjustment of scrapper & Cleaning mixer after use & preventive maintenance.
	Preparation & Fixing of shuttering, Checking Vibrator for capability, vibration time, Height of Castable for vibration, Roding practice.
	Sprinkling water on casted segment for natural/wet curing.
	Identifying & reporting physical defects after Dry out.
33. Identify the different parts of furnaces. CSC/N9449	Identify the parts of furnaces.
34. Perform with skill in the model workshop / fields. (ISC/N1202)	Practical training in the model workshop / fields.
35. Create report observing heating chart. CSC/N9450	Preparation of heating chart & report making.
	Perform curing, preheating and dry out.
36. Construct refractory lining. (ISC/N1202)	Practice on refractory lining.
	Construction of vertical wall, brick laying, gunning, anchor welding, fixing of shuttering & formers, vibro casting, Ramming, Patching/Troweling, fettling.
37. Prepare technical report and documentation as per industrial need. (ISC/N1202)	Prepare different Types of documentation as per industrial need by different methods of recording information.

38. Demonstrate operational function and maintenance of supporting tools and machines. CSC/N9451	Demonstration & practice Tools, Tackles and Operation.
	Perform operation of fixing devices and extraction devices.
	Maintenance of Refractory lining. : Different types of refractory practices like LD converter, Laddle, Tundishes, Slide gate refractory, rotary kiln, Mills, Reheating furnace.
39. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9402	Solve different mathematical problems
	Explain concept of basic science related to the field of study

SYLLABUS FOR REFRACTORY TECHNICIAN TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 150 Hrs; Professional Knowledge 24 Hrs	Perform basic workshop operations using suitable tools for marking, drilling, chipping and fitting observing suitable care following safety precautions.	**Trade and Orientation** 1. Visit to various sections of the institute and identify location of various installations. 2. Identify safety signs for danger, warning, caution & personal safety message. 3. Use of personal protective equipment (PPE). 4. Practice elementary first-aid. 5. Preventive measures for electrical accidents & steps to be taken in such accidents. 6. Use of Fire extinguishers.	Familiarization with the working of Industrial Training Institute system. Importance of safety and precautions to be taken in the industry/shop floor. Introduction to PPEs. Introduction to First-Aid. Response to emergencies e.g. power failure, fire, and system failure. Importance of housekeeping & good shop floor practices. Occupational Safety & Health**:** Health, Safety and Environment guidelines, legislations & regulations as applicable.

		Hand tools and their uses 7. Identify the different hand tools. 8. Use of vice, clamps, holding the job in the vice and practice of metal sawing. 9. Marking practice using hermaphrodite caliper, surface gauge, engineers" try square, marking off table etc. 10. Marking out lines, gripping suitably in the vice jaw, hacksawing to given dimensions. 11. Workshop practice on filing flat surfaces and hacksawing. 12. Practice of checking flatness and squareness. 13. Filing four edges, checking all dimensions with outside caliper and steel rule.	Identification, specifications, uses and maintenance of commonly used hand tools, such as:- Steel rule, Divides, Callipers, Centre punch, Dot punch, Prick punch and hammers, V-block, marking off table. State the correct shape of files for filing different profiles. Bench vice, types, use, care and maintenance, vice clamp, hacksaw frame and blade, their types, uses. Method of sawing.

		14. Marking of straight, arcs and parallel lines with odd leg callipers, scribing block and steel rule. 15. Marking practice with divider. (Circles, arcs and parallel lines). 16. Chipping flat surfaces along a marked line. 17. Finding and marking centre line of cylindrical system, with the help of "spirit level and plumb". 18. Drilling of various sizes of holes on a MS plate. 19. Tapping of different sizes tapped holes on drilled job. 20. Measurement of different dimensions using Vernier height gauge, Vernier caliper and micrometer.	Scribing block, Chisel - types, metal and use. Marking block and uses. Surface plates, parallel block, angle plate and Trammel. Surface plate, its use, care and maintenance. Use of Spirit level. Types of drill bits and parts. Method of drill grinding, cutting angle, defects in drilling and its remedy. Drill chuck and its use. Drilling Process: Types of drilling machines and their use. Taps and Tapping: Types, parts, formula for tapped hole, method of cutting thread with tap. Tap handle, method of extract a broken tap. Vernier height gauge, vennier caliper its leastcount, use, care and maintenance. Outside and inside micrometer. It's reading least count, use, care and maintenance. Gauge and indication classification. Types of gauges and their use. Use of slip gauge. Ringing action. Working principle of dial gauge.
Professional Skill 25 Hrs; Professional Knowledge 08 Hrs	Perform forging, piercing, bending, riveting, punching and edge cutting operation.	**Forging:** 21. Preparation of hearth. 22. Making of centre punch. 23. Making of flat chisel. 24. Making of screwdriver.	Blacksmith and Forging/Heat treatment: Forge types and uses. Forge tools. Forging operations such as: Marking, Cutting, Drawing out, Jumping, Bending, Punching, Setting down and Forge welding.

		Press Tool 25. Practice on pneumatics tools like jack hammer, rammer & pressure gauge. 26. Piercing, bending, riveting punching and edge cutting in press tool machine.	Mechanism of force transmission in presses. Details of hydraulic and pneumatic presses.
Professional Skill 25 Hrs; Professional Knowledge 04 Hrs	Perform sheet metal work.	**Sheet metal work** 27. Cutting various types of Geometrical shapes. 28. Use of flat scraper to make the surface even of a dove tail fitting.	Sheet metal work: Introduction, sheet metal hand tools, shears, sheet metal bench tools such as vice and machine tools. Scrapers: Types, method of scraping, Precautions during scraping operation.
Professional Skill 25 Hrs; Professional Knowledge 04 Hrs	Perform checking and measuring components with precision instrument.	29. Check surface roughness of a surface plate. 30. Perform Angular Measurement using Bevel protector and Sine bar. 31. Measure distance/clearance using dial test indicator. 32. Perform Gear and Screw Thread Measurement.(two wire method and screw pitch gauge). 33. Perform checking work piece by limit gauges.	Definition of accuracy, precision and error. Principle of vernier scale and least count. Measuring methods with Vernier calliper, Micrometers (inside & outside), Telescopic gauge, Height gauge, Depth gauge, Slip gauge. Major parts, functions and measuring methods of Bevel Protector, Sine bar, Angle gauges, Spirit level, Clinometers, Auto collimator. Application of Dial Test Indicator/gauge. Measuring methods of Straightness, Flatness, Squareness, Parallelism, Perpendicularity, Roundness, Concentricity, Cylindricity, run out, ovality.

Professional Skill 25 Hrs; Professional Knowledge 04 Hrs	Make different fit of components for assembling observing principle of interchangeability and check for functionality.	**Fitting Joints** 34. File and make Step fit, angular fit, angle, surfaces (Bevel gauge accuracy 1 degree). 35. Scrap on flat surfaces, curved surfaces and parallel surfaces and test. 36. Scrap cylindrical bore. 37. Locate accurate holes & make accurate hole for stud fit.	Fasteners: Kinds of fastening Bolts, their types and uses, Nuts, their types and uses, Washers, types and uses, Screws, Key and Key way, types and uses. Studs. Pins and cotters.
Professional Skill 25 Hrs; Professional Knowledge 04 Hrs	Perform Arc welding process.	**Welding** 38. Practice Arc welding process. 39. Striking straight beads leftto right and right to left. 40. Weld a square butt joint. 41. Weld a Lap joint. 42. Weld a Tee joint. 43. Weld a Corner joint.	Arc welding process: Welding method, welding machines, electrode, coding, polarity, edge preparation, types of welding joints and beads.
Professional Skill 25 Hrs; Professional Knowledge 04 Hrs	Perform gas cutting and welding process.	**Gas Cutting** 44. Practice of Gas cutting and Gas welding. 45. Cutting of straight and curved metal pieces. 46. Fusion runs on a M.S. Sheet Left to Right. 47. Fusion runs on a M.S. Sheet Right to Left.	Gas welding methods: Oxy-acetylene welding, Flames, Gas and Arc welding tools, Oxygen and Acetylene cylinder, Gas regulator, Gas welding equipment, backward and rightward welding. Welding positions.

Professional Skill 50 Hrs; Professional Knowledge 08 Hrs	Use proper taps and dies for making internal and external threads on solid metal and pipes.	48. Use of dies and making of external threads. 49. Use of tap and prepare tapped holes. 50. Make threads on various dia. MS rods and fit the threaded rods on previous tapped holes. 51. Use of Pipe fittings and prepare joints. 52. Threading of pipes with the use of pipe die. 53. Prepare a pipe line using different types of pipe joints.	Dies and its use: Types of dies, die handle, method of using a die, Reamer parts, kinds of reamer, stud extraction. Pipe and pipe fittings: Different types of pipes, Pipe Accessories, G.I Pipe accessories, Tools and signs (symbols) of pipefitting.
Professional Skill 25 Hrs; Professional Knowledge 04 Hrs	Perform basic electrical measurement.	54. Measure AC, DC by using multimeter. 55. Measure AC voltage using step up & step down transformer. 56. Measure resistance, Voltage &current.	Fundamental of AC & DC, voltmeter, ammeter, ohm meter, transducer and sensors. Principle of magnetic induction (Self & mutual), Electric passive component – resistor, capacitor & inductor.
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Enumerate the various types of refractories.	54. Demonstrate & practice of various types of refractories.	Definition of refractory. Classification of refractory. Properties of refractories. Bricks classification, chemical composition and its application area wise, insulation, Bricks expansion material (ceramic fibre, Hysil block etc.), Different Shapes: ● Regular Straight shapes. ● Side Arch Shape. ● End Arch Shape. ● Key and Mini key Shape. ● Semi Universal Shape. ● Circular Bricks. Skewback Shape. ● Checkers Bricks. Other refectory product like castable, motaretc.

Professional Skill 25 Hrs; Professional Knowledge 08 Hrs	Identify the major forms and sources of pollution and control techniques in refractory industry.	55. Practice on operation of water spray gun, vacuum sweepers, Dry fog nozzles, water sprinkler etc. 56. Demonstrate &practice on prevention of various health hazards.	Safety and environment measures. Major forms of pollution in refractory industry. Sources of pollution & various control techniques. Occupational health hazards and its control. Different hazards in refractory industry. Prevention of occupational diseases.
Professional Skill 50 Hrs; Professional Knowledge 08 Hrs	Practice operation and maintenance of various fuel handling plant.	57. Practice on handling various fuels. 58. Operation & maintenance of Producer gasplant.	Types of fuel used in refractory industry: ● Coal ● Coke ● Producer Gas ● Furnace oil ● LPG Safety & occupational hazard aspect in handling Producer gas plant.
Professional Skill 25 Hrs; Professional Knowledge 04 Hrs	Identify the different raw material and handling.	59. Demonstrate & practice of different raw material & handling of same.	Different raw materials used in manufacturing refractory & their basic physical & chemical properties.
Professional Skill 25 Hrs; Professional Knowledge 04 Hrs	Perform the measures of quality control.	60. Demonstrate &practice on quality control.	Quality assurance, Definition & importance of Quality control, quality circle. Basic Concept of 5S, Kaizen, TPM, TQM & ISO9000.
Professional Skill 25 Hrs; Professional Knowledge 08 Hrs	Demonstrate the manufacturing processes.	61. Demonstrate & practice different manufacturing processes at plant/video demonstration.	Different processes involved in refractory. a) Crushing, Grinding and Sieving b) Batching & mixing c) Hand moulding d) Pressing e) Vibro casting f) Drying g) Firing h) Physical checking.

Professional Skill 50 Hrs; Professional Knowledge 08 Hrs	Identify the different grain size, mixing machine – operation and adjustment and checking consistency of mixed material.	**Crushing & grinding** 62. Demonstrate & practice on Sieve Analysis of different grain size. 63. Identification of parts of mixing machine & operation of mixing machine. 64. Practice on changing adjusting scrapper, adjustment of roller height. 65. Checking consistency of mixed material and workability.	**Crushing & grinding**: Knowledge of adjustment for fineness of the output. Various types/parts of Mixing machine. Maintenance of mixing machines. Mixing sequence of different quality mixtures. Physical check of mixture to ensure completion of mixing. Unloading of mixture to bucket and moisture content of mixture.
Professional Skill 75 Hrs; Professional Knowledge 17 Hrs	Perform operation and monitoring of moulding and pressing (manual / hydraulic).	**Moulding and pressing** 66. Practice on weighing of material, filling the mould & operating the pressing (Mechanical & Hydraulic) and gauging of the bricks. 67. Physical inspection of bricks for cracks, lamination & wrecks, warpage. 68. Checking of bulk density of bricks. 69. Practice on operation /monitoring parameters of press. (Manual/ Hydraulic). 70. Segregation, Sizes, Edges & corner and any other physical defects.	**Moulding and pressing**: Types of press & sequence of operation of press machine. Press capacity linked with bulk density. Different defects, identification & reporting. Shaping/Moulding methods. The various processes of shaping/moulding and their limitation. The process of release from mould and handling of bricks to prevent damage. Pre weighing of mixture for consistent product.
Professional Skill 30 Hrs; Professional Knowledge 08 Hrs	Practice on drying bricks and dryers.	71. Demonstrate/ practice on drying of bricks. 72. Practice on operating dryers.	Drying of bricks. The objectives of drying. Classification of dryers. The various dryers used in refractory industries and the process involved in these.

Professional Skill 25 Hrs; Professional Knowledge 04 Hrs	Identify the different temperature measuring instrument and maintenance.	73. Demonstrate / practice of different temperature measuring instrument. 74. Reading of temperature. 75. Practice on preventive maintenance.	Temperature, Measurement & instruments used in measuring temperature. Thermocouple & its application in measuring temperature (Pyrometer). Maintenance system. Types of maintenance. Importance of preventive maintenance. Preventive maintenance steps on various plant& machinery.
Professional Skill 60 Hrs; Professional Knowledge 12 Hrs	Ensure proper loading/ unloading, drying schedule, firing schedule and inspect the finished product.	76. Observation and practice on loading/unloading. 77. Drying schedule, monitoring of firing schedule. 78. Physical Inspection of finished product. 79. Practice on loading/unloading of bricks.	Types of kilns for calcinations of raw materials. Different zones of kiln, Fuel used in the kiln.

Professional Skill 50 Hrs; Professional Knowledge 08 Hrs	Perform the operation and maintenance of kiln and waste utilisation.	80. Practice on operation & maintenance of kiln. 81. Practice on firing schedule. 82. Practice on brick checking. 83. Demonstration waste utilization.	Firing of bricks. Kilns for firing of refractory and loading pattern of bricks. Firing schedule& Maturing temperature. Different types of kilns used for firing of bricks. ● Tunnel kiln. ● Chamber kiln. ● Shuttle kiln. ● Down Draught (DD) kiln. Checking of bricks after firing: Sizes, lamination / Cracks, Spongy / Segregation and Edge and corner breakage and other physical defects. **Waste Utilization**: Recycling of refractory. Control of dust and gasses leakage during the process. Efficient utilization of resources. Optimization of kiln loading Mill house. Operational discipline & control, Firing criteria.
ENGINEERING DRAWING: (40 Hrs.)			

Professional Knowledge ED – 40	Read and apply engineering drawing for different application in the field of work.	**ENGINEERING DRAWING:** Introduction to Engineering Drawing and Drawing Instruments – ● Conventions ● Sizes and layout of drawing sheets ● Title Block, its position and content ● Drawing Instrument Lines- Types and applications in drawing Free hand drawing of – ● Geometrical figures and blocks with dimension ● Transferring measurement from the given object to the free hand sketches. ● Free hand drawing of hand tools and measuring tools. Drawing of Geometrical figures: ● Angle, Triangle, Circle, Rectangle, Square, Parallelogram. ● Lettering & Numbering – Single Stroke. Dimensioning ● Types of arrowhead ● Leader line with text ● Position of dimensioning (Unidirectional, Aligned) Symbolic representation – ● Different symbols used in the Refractory Technician trade. Concept and reading of Drawing in ● Concept of axes plane and quadrant ● Concept of Orthographic and Isometric projections ● Method of first angle and third angle projections (definition and difference) Reading of Job drawing related to Refractory Technician
WORKSHOP CALCULATION & SCIENCE: (38 Hrs)		

Professional Knowledge WSC – 38	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**WORKSHOP CALCULATION & SCIENCE:** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, substraction, multiplication & division Decimal fractions - Addition, subtraction, multilipication & division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and suare root Simple problems using calculator Applications of pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Precentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non ferrous metals Physical and mechanical properties of metals Introduction of iron and cast iron Difference between iron & steel, alloy steel and carbon steel Properties and uses of rubber, timber and insulating materials **Mass, Weight, Volume and Density** Mass, volume, density, weight and specific gravity Related problems for mass, volume, density, weight and specific gravity **Speed and Velocity, Work, Power and Energy** Work, power, energy, HP, IHP, BHP and efficiency **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Scales of temperature, celsius, fahrenheit, kelvin and conversion between scales of temperature Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, convection and radiation Co-efficient of linear expansion and related problems with assignments Problem of heat loss and heat gain with assignments Thermal conductivity and insulators Concept of pressure - Units of pressure, atmospheric pressure, absolute pressure, gauge pressure and gauges used for measuring pressure **Basic Electricity** Introduction and uses of electricity, electric current AC,DC their comparison, voltage, resistance and their units.

SYLLABUS FOR REFRACTORY TECHNICIAN TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Demonstrate the basic application of monolithic refractory.	84. Demonstrate& practice different application method at plant/ video demonstration.	Basic Application of monolithic refractory 1. Storage 2. Worksite 3. Equipment 4. Installation 5. Steel surface 6. Anchoring 7. Formwork / shuttering 8.Water quality 9. Mixing 10.Sampling 11.Vibrating / Rodding 12.Application 13.Joints in monolitics 14.Curing 15. Dry out 16. Criteria for acceptance Cracks 17.Defects and acceptance criteria 18. Inspection.
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Perform brick cutting and joining.	85. Brick cutting (m/c & hand), Brick joining.	Basic application of shaped refractory. Various Heat Treatment Processes 1. Hardening 2. Normalizing 3. Tempering 4. Annealing 5. Case Carburizing.
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Perform fitting of scaffold.	86. Practice on fitting scaffolding.	Scaffolding. Purpose of scaffolding. Materials used in scaffolding & safety aspect in it.

Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Perform gunning, ramming and patching.	87. Practice with gunning machine, ramming, patching.	Gunning, Ramming, Shot crating, Patching, Coating, hot repair.
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Demonstrate the energy conservation followed by industry.	88. Demonstration on energy conservation. 89. Practice on 5S.	Energy conservation. Concerns for energy conservation. Energy conservation drive. Areas of improvement. Best practices to be adopted for energy conservation.
		90. Industry visit to get practical knowledge of kiln maintenance.	Maintenance of kilns. Preventive, Periodical &break down maintenance. Various parameters to be checked during maintenance. Melting practice of Pig Iron. Melting practice of Grey Cast Iron
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Perform basic computer operation.	**Introduction to computer basics** 91. Familiarization & Identification of computer parts. 92. Practice on computer for MS word, MS power point, MS Excel.	Introduction to computer basics: Basics of computer, MS word, MS power point, MS Excel. Report writing as per Proforma.
Professional Skill 75Hrs; Professional Knowledge 23Hrs	Perform the method of packaging in refractory industry.	93. Practice on packaging.	Packaging of refractory : Design of pallets. Pallet dimensions. Arrangement of loading of different shapes in the pallets. Outer packaging for container shipment. Stretch wrapping. Primary packing. Secondary packing. Final packing.

Professional Skill 100 Hrs; Professional Knowledge 35 Hrs	Perform installation and repair of brick work.	94. Operation of brick cutting m/c. 95. Checking perpendicularity of lining using plumb. 96. Mortar preparation. 97. Monitoring thickness of mortar during installation. 98. Demolition of existing/ used lining. 99. Use of levelling tool, Sprit level, water level. 100. Use of wooden hammer for adjusting brick level. 101. Measuring, cutting & Installation of Key brick. 102. Practice on hand grinding. 103. Use of brick holder & brick. 104. Use of skew brick & Arch making, use of screw jack.	**Sorting tools** • Hand tools to remove packing materials **Survey tools** • Levelling tools • Length level 2 m1 • Marking paint red **Carpenter tools** • Hammer; nails; wood; electric/handsaw **Demolishing / wrecking** • Wrecking Machine, wrecking hammers **Brickwork tools** -- Marking Pen -- Hammer; (metallic / rubber/ wood) -- Buckets -- Rigging chisels -- Trowel for applying mortar -- Measuring tools (meter; stick; level; brick layer string -- Profiles; brick-layer string; -- Brick Cutting machine, (diamond saw) -- Level instrument; -- Paddle mixer for mixing mortar, -- Brick Laying Machine, /screw jack.

Professional Skill 75Hrs; Professional Knowledge 25 Hrs	Perform opening, repair, testing, checking of vibrator and identify the physical defect.	105. Opening & repair of vibrator needle, rammer, pneumatic breaker, replacement of chisel. 106. Testing of water quality using litmus paper. Water temperature, quantity of mixing water, time of mixing, Lead time/measurement, Mixer operation, adjustment of scrapper & Cleaning mixer after use & preventive maintenance. 107. Preparation & Fixing of shuttering, Checking Vibrator for capability, vibration time, Height of Castable for vibration, Roding practice. 108. Sprinkling water on casted segment for natural/wet curing. 109. Identifying & reporting physical defects after Dry out.	1. Storage 2. Worksite 3. Equipment 4. Installation ● Steel surface ● Anchoring ● Formwork / shuttering ● Water quality ● Mixing ● Sampling ● Vibrating / Rodding ● Application ● Joints in monolitics 5.Curing 6. Dry out 7. Criteria for acceptance ● Cracks ● Defects and acceptance criteria 8. Inspection.
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Identify the different parts of furnaces.	110. Demonstration on different parts of the furnaces.	**Application of refractory**: Nomenclature of different parts of the furnaces. The industries of application of refractory: • Iron & Steel • Aluminium & non-ferrous • Foundry • Cement • Thermal Power/Inclinator • Petrochemical/Refinery • Chemical/Fertilizer • Glass.

Professional Skill 50 Hrs; Professional Knowledge 21 Hrs	Perform with skill in the model workshop / fields.	111. Practical training in the model workshop / fields.	Iron & steel:- Hot metal transfer Ladle, Torpedo Ladles, Sponge iron kilns. Video/Visual display(audio visual display) Induction furnace, Electric Arc furnace, LD converter, Ladles, Tundish.
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Create report observing heating chart.	112. Preparation of heating chart & report making.	Curing, Preheating/Dry out, tempering schedule/cycle of furnaces after refractory installation.
Professional Skill 70 Hrs; Professional Knowledge 28 Hrs	Construct refractory lining.	113. Refractory lining practices. 114. Construction of vertical wall, brick laying, gunning, anchor welding, fixing of shuttering & formers, vibro casting, Ramming, Patching/ Troweling, fettling (Construction/ expansion joints)	Study of the refractory lining drawings. Shaped & Unshaped refractory lining. Anchor types, Construction joints, Expansion joints. Iron & steel: Slide gate fixing, Porous plug fixing, Fixing of CC refractories.
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Prepare technical report and documentation as per industrial need.	115. Prepare different Types of documentation as per industrial need by different methods of recording information.	Importance of Technical English terms used in industry –(in simple definition only)Technical forms, process charts, activity logs, in required formats of industry, estimation, cycle time, productivity reports, job cards.

Professional Skill 70 Hrs; Professional Knowledge 28 Hrs	Demonstrate operational function and maintenance of supporting tools and machines.	116. Demonstration & practice Tools, Tackles and Operation.	Tools, Tackles and Operation: Trainings : (Understanding different parts, function and operation), Gunning machine, Spray machine, Fixing devices – PP, SGP, CC Extraction devices – PP, SGP, CC; Pneumatic Rammer, Pencil Vibrator, Vibrating & Casting machines. Maintenance of Refractory lining. : Different types of refractory practices like LD converter, Laddle, Tundishes, Slide gate refractory, rotary kiln, Mills, Reheating furnace. Occupational Health Hazards and its control. Types of hazards. Knowledge about hazardous materials in the process and how to handle them. Fundamental of fire and explosion and how to prevent fire. Identification of fire extinguisher. Metal safety data sheet (MSDS).
WORKSHOP CALCULATION & SCIENCE (28 hrs.)			

Professional Knowledge WSC – 28	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**WORKSHOP CALCULATION & SCIENCE:** **Centre of Gravity** Centre of gravity - Centre of gravity and its practical application **Area of cut out regular surfaces and area of irregular surfaces** Area of cut out regular surfaces - circle, segment and sector of circle Related problems of area of cut out regular surfaces - circle, segment and sector of circle Area of irregular surfaces and application related to shop problems **Elasticity** Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus Elasticity - Ultimate stress and working stress **Heat Treatment** Heat treatment and advantages Heat treatment - Different heat treatment process – Hardening, tempering, annealing, normalising and case hardening **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs + 60 Hrs)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in/ dgt.gov.in

ANNEXURE-I

List of Tools & Equipment			
REFRACTORY TECHNICIAN (For Batch of 24 Candidates)			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Steel Rule	12"	25 Nos.
2.	Hammer Ball Pin	0.45 Kg	25 Nos.
3.	Hammer Flat (optional)		25 Nos.
4.	Chisel Cold Flat	2cmX22Cm	25 Nos.
5.	File Flat	300 mm Bastered	25 Nos.
6.	File Flat	300 mm Second Cut	25 Nos.
7.	File Half Round Bastard	200 mm	25 Nos.
8.	Safety goggles		25 Nos.
9.	Googles Furness, Antigua Around Heat Proof		25 Nos.
10.	Head wear anticoncusion Furness		7 Nos.
11.	Pliers	20cm	25 Nos.
12.	Vice bench	12cm Jaw	25 Nos.
13.	Sledge Hammer	5 kg	5 Nos.
14.	Buckets	10 Ltr. Capacity	7 Nos.
15.	Sprit level	150 mm	7 Nos.
16.	Pocket steel Tape	1800mm long	25 Nos.
17.	Crow Bar	1500mm	2 Nos.

18.	Screw Driver	300mm	25 Nos.
19.	Bench Grinder		2 Nos.
20.	Hacksaw	30cm adjustable	25 Nos.
21.	Work Bench	2400mm x 1300mm x 800 mm	5 Nos.
22.	Shovel		5 Nos.
23.	Trammel		2 Nos.
24.	Scriber		25 Nos.
25.	Callipers Odd leg		25 Nos.
26.	Caliper inside	150 mm	25 Nos.
27.	Centre Punch	150 mm	25 Nos.
28.	Trowels	(Suare& triangle, 4nos. each)	10 Nos.
29.	Measuring tape	2500mm	7 Nos.
30.	Hand gloves Leather		25 Nos.
31.	Pliers	150mm	25 Nos.
32.	Screw driver	100mm	25 Nos.
33.	Tester		25 Nos.
B. Tools & Equipments for Production:			
34.	Jaw crusher		1 No.
35.	Roller crusher		1 No.
36.	Ball Mill/ Vibro mill		1 No.
37.	Sieves		7 Nos.
38.	Mixer machine		1 No.
39.	Press Machine		1 No.
40.	Dryer (Oven hot air)		1 No.

41.	Kiln		1 No.
42.	Moulds(Different shapes)		2 each
43.	Drying furnace (Lab scale) Int. Vol.Im3		1 No.
44.	Rammer		1 No.
45.	Air Compressor	5 bar	1 No.
C. Tools & Equipments for Application:			
46.	Brick cutting m/c with cutting wheel		7 Nos.
47.	Stirrer		2 Nos.
48.	Gunning machine		2 Nos.
49.	Models for electric arc furnace		1 No.
50.	Models for Basic Oxygen furnace		1 No.
51.	Models for Rotary kiln		1 No.
52.	Ladle		1 No.
53.	Tundish		1 No.
54.	Jack hammer with drill bits		1 No.
55.	Spirit level		5 Nos.
56.	Water level		5 Nos.
57.	Wooden/aluminiumrapter (optional)		2 Nos.
58.	Plumb		7 Nos.
59.	Masonry hammer		7 Nos.
60.	Slide caliper		7 Nos.
61.	Wooden hammer		7 Nos.
62.	GI Pipe	2" with clamps for scaffolding	As required
63.	Filler Gauge	Min 0.5 mm - 5 mm	1 No.

64.	Laser thermometer (Optional)		1 No.
65.	Pyrometer		1 No.
66.	Joint filler		1 No.
67.	Chisel flat	20X200mm	7 Nos.
68.	Pressure gauge		1 No.
69.	Screw jack		1 No.
70.	Weighing m/c	Min: 10 Kg	1 No.
71.	Wheel barrow		2 Nos.
72.	MS pan		2 Nos.
73.	Measuring flask		2 Nos.
74.	Litmus paper		As required
75.	Thermometer		1 No.
76.	Stop watch		1 No.
77.	Glass biker		1 No.
78.	Star Delta starter		1 No.
79.	Multimeter		2 Nos.
80.	Voltmeter		2 Nos.
81.	Flowmeter		2 Nos.
82.	Vicat apparatus		1 No.
83.	Piano wire/ Wire gauge pad (Optional)		2 nos.
84.	Auto CAD software		1 No.
85.	Hand saw		12 Nos.
86.	Electric hand drill		1 No.
87.	Micrometer	(0-25, 25-50,50-75mm)	1 set each

88.	Vernier callipers	(0-200mm) (.02 discount)	1 No.
89.	Welding transformer (Not required if welder trade exist)		1 No.
90.	C-Clamp	20 cm Perforated Hood	7 Nos.
91.	C-Clamp	30cm Light Duty Steel	7 Nos.
92.	Surface plate	300x300mm	2 Nos.
93.	Drill twist (metric)	3 mm to 12mm	1 sets
94.	Tapes and dies complete set in box BSW,BSF, Metric		2 sets each
95.	Oil Can V_2ft		3 Nos.
96.	Wire Brush		12 Nos.
97.	Double ended spanner	10mm to 25mm	7 Nos.
98.	Drill Chuck	0 to 12 morse taper	1 No.
99.	Drill machine to drill	upto 12mm dia	1 No.
100.	Digital multimeter		5 Nos.
101.	AC Motor	single Phase	1 No.
102.	AC Motor	three Phase	1 No.
E. List of additional tools for allied trade in welding			
103.	Transformer welding set	150 amps. - continuous welding current, with all accessories and electrode holder	1 Set
104.	Welder cable to carry 200 amps. With flexible rubber cover		24 Meter
105.	Lugs for cable		12 Nos.
106.	Earth clamps.		2 Nos.
107.	Arc welding table (all metal top) 122 cm X 12 cm X 60 cm with positioner.		1 No.

108.	Oxy - acetylene gas welding set equipment with hoses, regulator and other accessories.		1 Set.
109.	Gas welding table with positioner		1 No
110.	Welding torch tips of different sizes		1 Set
111.	Gas lighter.		2 Nos
112.	Trolley for gas cylinders.		1 No
113.	Chipping hammer.		2 Nos
114.	Gloves (Leather)		2 Pairs
115.	Leather apron.		2 Nos
116.	Spindle key for cylinder valve.		2 Nos.
117.	Welding torches	5 to 10 nozzles.	1 Set.
118.	Welding goggles		4 Pairs.
119.	Welding helmet with coloured glass		2 Nos.
120.	Tip cleaner		12 Sets.
F. Tools for Allied Trade- Sheet Metal Work			
121.	Trammel	30cm.	1 no.
122.	Prick punch		2 nos.
123.	Mallet.		2 nos.
124.	Snips straight	25 cm.	2 nos.
125.	Setting hammers with handle.		2 nos.
126.	Planishing hammer.		2 nos.
127.	Snip bent	25 cm.	2 nos.
128.	Stake hatchet.		2 nos.
129.	Stake grooving.		2 nos.

130.	Gauge imperial sheet.		1 no.
G. General Furniture:			
131.	Almirah	as per required size	2 Nos.
132.	Steel Rack	5'x4'x2'	2 Nos.
133.	Fire Extinguisher	Arrange all proper NOCs and equipment from Municipal/Competent authorities.	
134.	First aid Box		1 No.

Note: -

1. Internet facility is desired to be provided in the class room.

ANNEXURE-II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts, trainers of ITIs, NSTIs, faculties from universities and all others who contributed in revising the curriculum.

Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

List of Expert members participated/ contributed for finalizing the course curriculum of Refractory Technician Trade.

S No.	Name & Designation Sh./Mr./Ms.	Organization	Remarks
1.	A. D. Shahane, Vice-President, (Corporate Trg.)	Larsen & Tourbo Ltd., Mumbai 400001	Chairman
2.	Dr. P.K.Jain, Professor	IIT, Roorkee, Roorkee-247667, Uttarakhand	Member
3.	N. Ramakrishnan, Professor	IIT Gandhinagar, Gujarat-382424	Member
4.	Dr. P.V.Rao, Professor	IIT Delhi, New Delhi-110016	Member
5.	Dr. Debdas Roy, Asstt. Professor	NIFFT, Hatia, Ranchi-834003, Jharkhand	Member
6.	Dr. Anil Kumar Singh, Professor	NIFFT, Hatia, Ranchi-834003, Jharkhand	Member
7.	Dr. P. P. Bandyopadhyay Professor	IIT Kharagpur, Kharagpur-721302, West Bengal	Member
8.	Dr. P.K.Ray, Professor	IIT Kharagpur, Kharagpur-721302, West Bengal	Member
9.	S. S. Maity, MD	Central Tool Room & Training Centre (CTTC), Bhubaneswar	Member
10.	Dr. Ramesh Babu N, Professor	IIT Madras, Chennai Member	Member
11.	R.K. Sridharan, Manager/HRDC	Bharat Heavy Electricals Ltd, Ranipet, Tamil Nadu	Member
12.	N. Krishna Murthy Principal Scientific Officer	CQA(Heavy Vehicles), DGQA, Chennai, Tamil Nadu	Member
13.	Sunil Khodke Training Manager	Bobst India Pvt. Ltd., Pune	Member
14.	Ajay Dhuri	TATA Motors, Pune	Member
15.	UdayApte	TATA Motors, Pune	Member
16.	H B Jagadeesh, Sr. Manager	HMT, Bengaluru	Member
17.	K Venugopal Director & COO	NTTF, Peenya, Bengaluru	Member
18.	B. A. Damahe, Principal L&T Institute of Technology	L&T Institute of Technology, Mumbai	Member

19.	Lakshmanan. R, Senior Manager	BOSCH Ltd., Bengaluru	Member
20.	R C Agnihotri, Principal	Indo- Swiss Training Centre Chandigarh, 160030	Member
MEMBERS OF SECTOR MENTOR COUNCIL			
Mentor			
1.	Sunil Kumar Gupta (Director)	DGT, MOLE, New Delhi	Mentor
Members of Core Group			
2.	Sukhdev Singh (JDT)	ATI Kanpur	TEAM LEADER
3.	N. Nath. (ADT)	CSTARI, Kolkata	Coordinator
4.	H. Charles (TO)	NIMI, Chennai.	Member
5.	Ravi Pandey (V.I)	ATI Kanpur	Member
6.	A.K. Nasakar (T.O)	ATI Kolkata	Member
7.	Samir Sarkar (T.O)	ATI Kolkata	Member
8.	J. Ram Eswara Rao (T.O)	RDAT Hyderabad	Member
9.	T.G. Kadam (T.O)	ATI Mumbai	Member
10.	K. Mahendar (DDT)	ATI Chennai	Member
11.	Shrikant S Sonnavane (T.O)	ATI Mumbai	Member
12.	K. Nagasrinivas (DDT)	ATI Hyderabad	Member
13.	G.N. Eswarappa (DDT)	FTI Bangalore	
14.	G. Govindan, Sr. Draughtsman	ATI Chennai	Member
15.	M. N. Renukaradhya,	Govt. ITI, Tumkur Road,	Member
16.	B. V. Venkatesh Reddy. JTO	Govt. ITI, Tumkur Road,	Member
17.	N. M. Kajale, Principal,	Govt. ITI Velhe, Distt: Pune,	Member
18.	Subrata Polley, Instructor	ITI Howrah Homes, West Bengal	Member
19.	Vinod Kumar R, Sr. Instructor	Govt. ITI Dhanuvachapuram Trivendrum, Dist., Kerala	Member
20.	M. Anbalagan, B.E., Assistant Training Officer	Govt. ITI Coimbatore, Tamil Nadu	Member
21.	K. Lakshmi Narayanan, T.O.	DET, Tamil Nadu	Member
Other Industry Representatives			
22.	Venugopal Parvatikar	Skill Sonics, Bangalore	Member
23.	Venkata Dasari	Skill Sonics, Bangalore	Member
24.	Srihari, D	CADEM Tech. Pvt. Ltd., Bengaluru	Member
25.	Dasarathi. G. V.	CADEM Tech. Pvt. Ltd., Bengaluru	Member
26.	L. R. S. Mani	Ohm Shakti Industries, Bengaluru	Member

ABBREVIATIONS:

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्