

**SYLLABUS OF SEMESTER SYSTEM**  
**FOR THE TRADE OF**

**REFRACTORY TECHNICIAN**

**SEMESTER PATTERN**

**Under**

**Craftsmen Training Scheme (CTS)**  
**(Two years/Four Semesters)**

**Revised in**  
**2014**

**By**  
**Government of India**  
**Ministry of Labour & Employment (DGE&T)**

## GENERAL INFORMATION

- 1. Name of the Trade** : **Refractory Technician**
- 2. N.C.O. Code**
- 3. Duration of Training** : Two years (Four semesters each of six months duration).
- 4. Power Norms** : 13.6 KW
- 5. Space Norms** : 130 Sq. mt. (Max L:B: :2:1)
- 6. Entry Qualification** : Passed 10<sup>th</sup> Class with Science and Mathematics under 10+2 system of Education or its equivalent
- 7. Trainees per unit** : 20
- 8a. Qualification for Instructors** : Degree in Mechanical/Ceramic/Metallurgy Engineering from recognized university with one year post qualification experience in the relevant field.  
OR  
Diploma in Mechanical /Ceramic/Metallurgy Engineering from a recognized board of technical education with two year post qualification experience in the relevant field.  
OR  
NTC/NAC passed in same or relevant trade with 3 years post qualification experience.
- 8b. Desirable Qualification** : Preference will be given to a candidate with Craft Instructor certificate (CIC) .

**Note:**

- (i) Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications.
- (ii) Instructor qualification for WCS and E.D, as per the training manual.

**9. For Employability Skills:-** One contract/part time / guest faculty for Generic module

i) MBA/ BBA with two years experience **OR** Graduate in Sociology / Social Welfare / Economics with Two years experience **OR** Graduate / Diploma with Two years experience and trained in Employability Skills from DGET institutes

AND

Must have studied English / Communication Skills and Basic Computer at 12<sup>th</sup> / Diploma level and above

OR

Existing Social Study Instructors duly trained in Employability Skills from DGET institutes

**Distribution of training on Hourly basis:**

Total hours /week	Trade practical	Trade theory	Work shop Cal. &Sc.	Engg. Drawing	Employability skills	Extra curricular activity
40 Hours	25 Hours	6 Hours	2 Hours	3 Hours	2 Hours	2 Hours

**COURSE INFORMATION****1. Introduction:**

- This course is meant for the candidates who aspire to become a professional Refractory Technician.

**2. Terminal Competency/Deliverables:**

After successful completion of this course the trainee shall be able to perform the following skills with proper sequence:

1. The trainees can work in the industry as semi-skilled Refractory Technician.
2. The trainee can work in the field of steel industry, Foundry observing safety precautions.
3. The trainees can work on Dismantle & assemble of Refractory liner.

**3. Employment opportunities:**

On successful completion of this course, the candidates shall be gainfully employed in the following industries:

1. Production & Manufacturing industries.
2. Service industries like Railways.
3. Defence organisations
4. In public sector industries like BHEL, BEML, SAIL, BFL, etc and private industries in India & abroad.

**4. Further learning pathways:**

- On successful completion of the course trainees can pursue Apprenticeship training in the reputed Industries / Organizations.
- On successful completion of the course trainees can opt for Diploma course (Lateral entry).

## SYLLABUS FOR THE TRADE OF REFRACTORY TECHNICIAN

### First Semester

**(Semester Code no. RFC - 01)**

**Duration : Six Month**

WEEK NO.	TRADE PRACTICAL	TRADE THEORY
1.	<p>Importance of trade training, List of tools &amp; Machinery used in the trade. Health &amp; Safety: Introduction to safety equipments and their uses. Introduction of first aid, operation of Electrical mains.</p> <p><b>Occupational Safety &amp; Health</b> <b>Importance of housekeeping &amp; good shop floor practices.</b> Health, Safety and Environment guidelines, legislations &amp; regulations as applicable. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Basic safety introduction, Personal protective Equipments(PPE):- Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution &amp; personal safety message. Preventive measures for electrical accidents &amp; steps to be taken in such accidents. Use of Fire extinguishers.</p>	<p>Importance of safety and general precautions observed in the in the industry/shop floor. All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. <b>Soft Skills: its importance and Job area after completion of training.</b> Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept &amp; its application. Response to emergencies eg; power failure, fire, and system failure.</p>
2&3	<p>Use of vice clamps, holding the job in the vice and practice of metal sawing with hacksaw and filing the edges maintaining squareness of all the faces. Marking practice using hermaphrodite caliper, surface gauge, engineers" try square, marking off table etc. Marking out lines, gripping suitably in the vice jaw, hacksawing to given dimensions, sawing different sections. Filing flat surface and checking the flatness and squareness with engineers" try square. Filing four edges, checking all dimensions with outside caliper and steel rule.</p>	<p>Description, construction and uses of different hand tools such as files, chisels, hacksaw &amp; hammer etc. Description, construction and uses of different marking tools such as steel rule, caliper, punches, v-block, scribing block etc. Description construction and uses of different job holding devices. Common hand tools, such as:- Steel rule, types of rules and their use. Divides, Calipers, Centre punch, Dot punch, Prick punch, their description and use. Different types of hammers and their use. "V" Block and marking off table Bench vice, types, use, care and maintenance, vice clamp, hacksaw frame and blade, their</p>

		types, uses. Method of sawing
4.	Marking of straight, arcs and parallel lines with odd leg calipers, scribing block and steel rule. Marking practice with divider. (Circles, arcs and parallel lines). Chipping flat surfaces along a marked line. Finding and marking centre line of cylindrical system, with the help of “spirit level and plumb”.	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.
5.	Drilling of various sizes of holes on a MS plate. Tapping of different sizes tapped holes on drilled job.	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.
6.	Measurement of different dimensions using Vernier height gauge, vernier caliper and micrometer.	Vernier height gauge, vernier caliper its least count, use, care and maintenance. Outside and inside micrometer. Its 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.
7.	Forging: - Preparation of hearth. Making of centre punch Making of flat chisel. 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.
8.	Practice on pneumatics tools like jack hammer, rammer & pressure gauge.	Basics of hydraulics & pneumatics.
9.	Sheet metal work: Cutting various types of Geometrical shapes. 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.
10.	Practice on all types of gauges.	Gauge and indication classification. Types of gauges and their use. Use of slip gauge. Ringing action. Working principle of dial gauge. Sine bar. Method of measuring with a sine bar.
11.	Practice on different types of fitting joints.	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 cutters.

12.	Welding (Arc), Striking straight beads left to right and right to left. Square butt joint. Lap Joint.	Arc welding process: Welding method, welding machines, electrode, coding, polarity, edge preparation, types of welding joints and beads.
13.	“T” Joint and Corner joint.	Arc welding process: Welding method, welding machines, electrode, coding, polarity, edge preparation, types of welding joints and beads.
14.	Gas cutting and Gas welding. Cutting of straight and curved metal pieces. Fusion runs on a M.S. Sheet. Left to Right and Right to Left.	Gas welding methods: Oxy-acetylene welding, Flames, Gas and Arc welding tools, Oxygen and Acetylene cylinder, Gas regulator, Gas welding equipments, back ward and right ward welding. Welding positions.
15.	Use of dies and making of external threads on various dia MS rods and fit the threaded rods on previous tapped holes.	Dies and dieing: Types of dies, die handle, method of using a die. Reamer parts, kinds of reamer, stud extraction
16.	Pipe fitting: Threading of pipes with the use of pipe die. Use of different types of pipe fittings.	Pipe and pipe fittings: Introduction. Different types of pipes, Pipe Accessories, G.I Pipe accessories, Tools and signs (symbols) of pipe fitting.
17.	Measurement of AC, DC by using multimeter. Measurement of AC voltage using step up & step down transformer. Measurement of 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.
18-19	Demonstration&Practice of various types of refractories.	<p>What is refractory. Classification of refractory. Properties of refractories.</p> <p>Bricks classification, chemical composition and its application area wise , insulation , Bricks expansion material ( ceramic fiber, Hysil block etc..),</p> <p><u>Different Shapes:</u></p> <ul style="list-style-type: none"> <li>➤ Regular Straight shapes.</li> <li>➤ Side Arch Shape.</li> <li>➤ End Arch Shape.</li> <li>➤ Key and Mini key Shape.</li> <li>➤ Semi Universal Shape.</li> <li>➤ Circular Bricks. Skewback Shape.</li> <li>➤ Checkers Bricks.</li> </ul> <p>Other refractory product like castable, mortar</p>

		etc.
20.	Practice on operation of water spray gun, vacuum sweepers, Dry fog nozzles, water sprinkler etc. Demonstration&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.
21.	Practice on handling various fuels. Operation & maintenance of Producer gas plant.	Types of fuel used in refractory industry: <ul style="list-style-type: none"> <li>• Coal</li> <li>• Coke</li> <li>• Producer Gas</li> <li>• Furnace oil</li> <li>• LPG</li> </ul> Safety & occupational hazard aspect in handling Producer gas plant.
23&24	Revision	
25	Examination	

**SYLLABUS FOR WORKSHOP SCIENCE AND CALCULATION**  
**SEMESTER-I**

<b>WEEK NO.</b>	<b>WORKSHOP CALCULATION AND SCIENCE</b>
1.	Arithmetic: Simple addition, subtraction, multiplication and division. Units and conversation (CGS, MKS, FPS & SI system)
2&3	Common fraction, addition, subtraction, multiplication. Decimal Fraction, Conversion of Fraction to Decimal and Decimal to fraction. Rounding of decimal values.
4.	Properties of engineering metal& non-metal. Physical properties and mechanical properties
5.	Ferrous metals : Blast furnace, copula furnace classification iron, types of cast iron and their use
6.	Non ferrous metals their type and use. Non ferrous alloys their type and uses. Different between ferrous and Non ferrous metals.
7.	Types of steels. Types of Alloy Steels
8-9	Density and relative Density : Mass, Unit of Mass, Density, Archimedes Principle. Relative Density bottle. Law of floatation, Equilibrium, Hydrometer, Nicholson Hydrometer, some examples of Floations
10-11	Graph. Rules for drawing graph, Reading of simple graph. Graph of simple equations. Problems on Graph.
12-13	Heat treatment, purpose, methods, critical temperature.
14.	Percentage, Introduction, examples. Problems on percentage.
15-16	Ratio and proportion. Problems on ratio and proportion.
17.	Different types of insulators used in Electrical industry Mass and Weight – Difference between mass and weight.
18-19	Weight & volume calculation.
20.	Workshop problem related on time and work.
21-22.	Friction- Types of friction and laws of limiting friction. Advantages and disadvantages of friction and Problems.
23-25	Revision
26	Examination



**SYLLABUS FOR ENGINEERING DRAWING**  
**SEMESTER-I**

<b>WEEK NO.</b>	<b>ENGINEERING DRAWING</b>
1.	Introduction to engineering drawings.It's importance& uses in engineering fields.
2&3	Use of drawing instruments in the construction of geometrical drawings. Types of lines their meaning and use.Simple conventional symbols used in drawing. Geometrical drawing. Angle, Triangles, Rectangle, Square, Circles.
4.	Geometrical construction of polygon, ellipse parabola and hyperbola, oval and helix
5-7	Free hand sketches of common hand tools used in the trade.
8-11	Difference between the orthographic and oblique projection. Concept of planes of projection and quadrants. Convention of their rotation.
12-13	Concept of three views.
14.	Drawing of different joints.
15.	Drawing different types of flames.
16.	System of dimensioning and drawing of proper arrow mark.
17.	Dimensioning practice. Method of dimensioning according to B.I.S. specification.
18-20	Draw different shapes <ul style="list-style-type: none"> <li>➤ Regular Straight shapes.</li> <li>➤ Side Arch Shape.</li> <li>➤ End Arch Shape.</li> <li>➤ Key and Mini key Shape.</li> <li>➤ Semi Universal Shape.</li> <li>➤ Circular Bricks. Skewback Shape.</li> <li>➤ Checkers Bricks.</li> </ul>
21-22.	Orthographic views of simple objects by 1st angle projection.
23-25	Revision
26	Examination

## SYLLABUS FOR EMPLOYABILITY SKILLS

### SEMESTER-I

<b>1. I.T. Literacy</b>	
<b>Hours of Instruction : 20 Hrs.</b>	
<b>Marks Allotted : 20</b>	
Computer	- Introduction, Computer and its applications, Hardware and peripherals, Switching on and shutting down of computer.
WINDOWS	- Basics of Operating System, WINDOWS, The user interface of Windows OS, Customizing Windows Operating System, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.
MS office	- Basic operations of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creation and Editing of Text, Formatting the Text, Printing document, Insertion & creation of Tables. - Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets
INTERNET	- Basic of Computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Applications of Internet : Browsing, Searching, Emailing, Social Networking
WEB Browser	- Meaning of World Wide Web (WWW), Search Engines with examples, Web Browsing, Accessing the Internet using Web Browser, Downloading Web Pages, Printing Web Pages - Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT – ACT, Importance of information security and IT act, types of cyber crimes.
<b>2. English Literacy</b>	
<b>Hours of Instruction: 15 Hrs.</b>	
<b>Marks Allotted : 15</b>	
Pronunciation	- Phonetics and pronouncing simple words.
Listening	- Interpreting conversation and discussions related to everyday life, Responding to spoken instructions in order to carry out requests and commands.
Speaking	- Asking and answering simple questions in English to describe people, things, situations and events.
Reading	- Reading and interpreting simple sentences, forms, hoardings, sign boards and notices.
Writing	- Writing sentences with simple words, reply to everyday office correspondence, - Writing CV & simple application forms.
<b>3. Communication skill</b>	
<b>Hours of Instruction: 15 Hrs.</b>	
<b>Marks Allotted : 15</b>	
Communication Skills	- Definition, Effective communication, Verbal communication, Use of right words, Non verbal communication, Body Languages.
Motivation	- Self awareness, Goal setting, Career planning, Values and Ethics
Time management	- Managing time effectively through planning

Facing Interviews	- Appearance and behaviour in an interview, Do's and don'ts
Behavioural Skills	- Attitude, Problem Solving, Thinking Skills, Confidence building

**Second Semester**  
**(Semester Code no. RFC- 02)**  
**Duration: Six Month**

<b>WEEK NO.</b>	<b>TRADE PRACTICAL</b>	<b>TRADE THEORY</b>
1.	Demonstration&practice of different raw material & handling of same.	Different raw materials used in manufacturing refractory & their basic physical & chemical properties.
2.	Demonstration&practice on quality control.	Quality assurance, Definition & importance of Quality control, quality circle. Basic Concept of 5S, Kaizen, TPM, TQM & ISO 9000.
3-4.	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
5-7.	Demonstration&practice on Sieve Analysis of different grain size. Identification of parts of mixing machine & operation of mixing ma/c. Practice on changing /adjusting scrapper, Adjustment of roller height.. 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.
8-10.	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.(Manul/Hydraulic)	Moulding and pressing: Types of press & sequence of operation of press machine. Press capacity linked with bulk density. Different defects, identification & reporting.
11.	Segregation, Sizes, Edges & corner and any other physical defects.	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.
12-13.	Demonstration/practice on drying of bricks. Practice on dryers.	Drying of bricks. The objectives of drying Classification of dryers. The various dryers used in refractory industries and the process involved in these.
14.	Demonstration/practice of different temperature measuring instrument. Reading of temperature. 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.
15-17.	Observation and practice on loading/unloading, drying schedule, monitoring of firing schedule. Physical Inspection of finished product. Practice on loading/unloading of bricks.	Types of kilns for calcinations of raw materials. Different zones of kiln, Fuel used in the kiln
18-20.	Practice on operation & maintenance of kiln. Practice on firing schedule.	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.
21.	Practice on brick checking. Demonstration waste utilization.	Checking of bricks after firing: Sizes, lamination / Cracks, Spongy / Segregation and Edge and corner breakage and other physical defects.  <u>Waste Utilization:</u> 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.
22-23	<b>Implant training / Project work (work in a team)</b>	
24-25	<b>Revision</b>	
26	Examination	

**SYLLABUS FOR WORKSHOP SCIENCE AND CALCULATION**  
**SEMESTER-II**

<b>WEEK NO.</b>	<b>WORKSHOP CALCULATION AND SCIENCE</b>
1.	Friction- Types of friction and laws of limiting friction. Advantages and disadvantages of friction and Problems.
2-4	Definition and unit of terms related to motion-speed, displacement, velocity, acceleration and retardation.
5-7.	Parallelogram law of forces. Conditions of equilibrium, Kinds of equilibrium.
8-11.	Triangle and rectangular figures-their properties and problems concerning workshop practice.
12-13.	Relationship between efficiency, velocity ratio, and mechanical advantage. Pully Block, Inclined simple wheel and axle. Simple screw jack.
14.	Relationship between efficiency, velocity ratio, and mechanical advantage. PullyBlock, Inclined simple wheel and axle. Simple screw jack.
15-17.	Square root of perfect square, Square of whole number and decimal.
18-21.	Meaning of tenacity, elasticity, malleability brittleness, hardness, ductility.
22-23	<b>Implant training</b> / Project work (work in a team)
24-25	<b>Revision</b>
26	Examination

**SYLLABUS FOR ENGINEERING DRAWING**  
**SEMESTER-II**

<b>WEEK NO.</b>	<b>ENGINEERING DRAWING</b>
1-2	Orthographic views of simple objects by 1st angle projection.
3-7	Orthographic views of simple objects by 3rd angle projection.
8-11.	Simple exercise on interpretation of Orthographic projections.
12-13.	Exercises on orthographic view. View of simple solid and hollow object.
14.	Exercises on orthographic view. View of simple solid and hollow object.
15-21.	Free hand sketch of tools & tackles used in the trade.
22-23	<b>Implant training</b> / Project work (work in a team)
24-25	<b>Revision</b>
26	Examination

**SYLLABUS FOR EMPLOYABILITY SKILLS**  
**SEMESTER-II**

<b>1. Entrepreneurship skill</b>	
<b>Hours of Instruction : 10 Hrs.</b>	
<b>Marks Allotted : 10</b>	
Business & Consumer	Types of business in different trades and the importance of skill, Understanding the consumer, market through consumer behavior, market survey, Methods of Marketing, publicity and advertisement
Self Employment	Need and scope for self-employment, Qualities of a good Entrepreneur (values attitude, motive, etc.), SWOT and Risk Analysis
Govt Institutions	Role of various Schemes and Institutes for self-employment i.e. DIC, SIDBI, MSME, NSIC, Financial institutions and banks.
Initiation Formalities	Project Formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment Procedure - Loan Procurement - Agencies - banking Process
<b>2.Environment Education</b>	
<b>Hours of Instruction : 10 Hrs.</b>	
<b>Marks Allotted : 10</b>	
Ecosystem	Introduction to Environment, Relationship between Society and Environment, Ecosystem and Factors responsible for destruction.
Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.
Energy Conservation	Conservation of Energy, re-use and recycle.
Global warming	Global warming, climate change and Ozone layer depletion.
Ground water	Hydrological cycle, ground and surface water and treatment of water.
Environment	Right attitude towards environment, Maintenance of in-house environment.
<b>3.Occupational Safety, Health &amp; Environment</b>	
<b>Hours of Instruction : 10 Hrs.</b>	
<b>Marks Allotted : 10</b>	
Safety & Health	Introduction to Occupational Safety and Health and its importance at workplace
Occupational Hazards	Occupational health, Occupational hygiene, Occupational Diseases/ Disorders & its prevention
Accident & safety	Accident prevention techniques- control of accidents and safety measures
First Aid	Care of injured & Sick at the workplaces, First-aid & Transportation of sick person
Basic Provisions	Idea of basic provisions of safety, health, welfare under legislation of India
<b>4.Labour Welfare Legislation</b>	
<b>Hours of Instruction : 10 Hrs.</b>	
<b>Marks Allotted : 10</b>	
Welfare Acts	Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's Compensation Act
<b>5.Quality Tools</b>	
<b>Hours of Instruction : 10 Hrs.</b>	
<b>Marks Allotted : 10</b>	
Quality Consciousness	Meaning of quality, Quality Characteristic



Quality Circles	Definition, Advantage of small group activity, objectives of Quality Circle, Roles and Functions of Quality Circles in organisation, Operation of Quality Circle, Approaches to Starting Quality Circles, Steps for Continuation Quality Circles
Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
House Keeping	Purpose of Housekeeping, Practice of good Housekeeping.5S Principles of Housekeeping: SEIRI – Segregation, SEITON – Arrangement, SEISO – Cleaning, SEIKETSU – maintenance of Standards, SHITSUKE - Discipline

**Third Semester**  
**(Semester Code no. RFC- 03)**

**Duration: Six Month**

<b>WEEK NO.</b>	<b>TRADE PRACTICAL</b>	<b>TRADE THEORY</b>
1-2.	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 monolithics 14. Curing 15. Dry out 16. Criteria for acceptance Cracks 17. Defects and acceptance criteria 18. Inspection
3-4.	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
5.	Practice on fitting scaffolding.	Scaffolding. Purpose of scaffolding. Materials used in scaffolding & safety aspect in it.
6-8.	Practice with gunning machine, ramming, patching..	Gunning, Ramming, Shot crating, Patching, Coating, hot repair
9.	Demonstration on energy conservation. Practice on 5S.	Energy conservation. Concerns for energy conservation. Energy conservation drive. Areas of improvement. Best practices to be adopted for energy conservation.
10- 11.	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.
12-13.	Familiarization & Identification of computer parts. Practice on computer for MS word, MS power point, MS Excel.	<b>Introduction to computer basics:</b> Basics of computer, MS word, MS power point, MS Excel. Report writing as per Proforma.
14 - 16.	Practice on packaging.	<u>Packaging of refractory :</u> 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.
17 - 21.	Operation of brick cutting m/c , checking perpendicularity of lining using plumb, Mortar preparation , Monitoring thickness of mortar during installation, Demolition of existing/used lining. Use of leveling tool, Sprit level, water level. Use of wooden hammer for adjusting brick level. Measuring, cutting & Installation of Key brick. Practice on hand grinding. Use of brick holder & brick. Use of skew brick & Arch making, use of screw jack	<b>Sorting tools</b> <ul style="list-style-type: none"> <li>• Hand tools to remove packing materials</li> </ul> <b>Survey tools</b> <ul style="list-style-type: none"> <li>• Levelling tools</li> <li>• Length level 2 ml</li> <li>• Marking paint red</li> </ul> <b>Carpenter tools</b> <ul style="list-style-type: none"> <li>• Hammer; nails; wood; electric/handsaw</li> </ul> <b>Demolishing / wrecking</b> <ul style="list-style-type: none"> <li>• Wrecking Machine, wrecking hammers</li> </ul> <b>Brickwork tools</b> <ul style="list-style-type: none"> <li>-- Marking Pen</li> <li>-- Hammer; (metallic / rubber /wood)</li> <li>-- Buckets</li> <li>-- Rigging chisels</li> <li>-- Trowel for applying mortar</li> <li>-- Measuring tools (meter; stick; level; brick layer string</li> <li>-- Profiles; brick-layer string;</li> <li>-- Brick Cutting machine, (diamond saw)</li> <li>-- Level instrument;</li> </ul>

		-- Paddle mixer for mixing mortar, -- Brick Laying Machine, /screw jack.
22-23	<b>Implant training</b> / Project work (work in a team)	
24-25	<b>Revision</b>	
26	Examination	

**SYLLABUS FOR WORKSHOP SCIENCE AND CALCULATION**  
**SEMESTER-III**

<b>WEEK NO.</b>	<b>WORKSHOP CALCULATION AND SCIENCE</b>
1-2.	Metric system of weight and measurement unit and conversion factors- problems.
3-5.	Electrical Power and energy & their units, related calculations.
6-8.	<b>METALS.</b> Properties and use of cast iron, wrought iron Plain carbon steel, Alloy steel.
9.	Effect of Alloying elements and properties of metals
10- 11.	Trigonometry: Definition, Trigonometrically formula, Measurement of angles, use of trigonometrically tables. Trigonometric values of certain diagram.
12-13.	Computer Lab
14 - 21.	Division method Factorization method,
22-23	<b>Implant training</b> / Project work (work in a team)
24-25	<b>Revision</b>
26	Examination

**SYLLABUS FOR ENGINEERING DRAWING**  
**SEMESTER-III**

<b>WEEK NO.</b>	<b>ENGINEERING DRAWING</b>
1-2.	Revision and more exercises on orthographic views of machine parts such as bearing brackets etc.
3-4.	Free hand sketching of various moulds.
5.	Free hand sketching of various moulds.
6-9.	Free hand sketching of various parts of gunning m/c..
10- 13.	Free hand sketching of various parts of dryers.
14 - 16.	Free hand sketching of various parts of kiln.
17 - 21.	Free hand sketching of various parts of kiln.
22-23	<b>Implant training</b> / Project work (work in a team)
24-25	<b>Revision</b>
26	Examination

**Fourth Semester**  
**(Semester Code no. RFC- 04)**  
**Duration: Six Month**

<b>WK NO.</b>	<b>TRADE PRACTICAL</b>	<b>TRADE THEORY</b>
1- 4.	<p>Opening &amp; repair of vibrator needle, rammer, pneumatic breaker, replacement of chisel.</p> <p>Testing of water quality using litmus paper. Water temperature, quantity of mixing water, time of mixing, Lead time/measurement, Mixer operation, adjustment of scrapper &amp; Cleaning mixer after use &amp; preventive maintenance.</p> <p>Preparation &amp; Fixing of shuttering, Checking Vibrator for capability, vibration time, Height of Castable for vibration, Roding practice.</p> <p>Sprinkling water on casted segment for natural/wet curing.</p> <p>Identifying &amp; reporting physical defects after Dry out.</p>	<p>1 Storage</p> <p>2 Worksite</p> <p>3 Equipment</p> <p>4 Installation</p> <ul style="list-style-type: none"> <li>- Steel surface</li> <li>- Anchoring</li> <li>- Formwork / shuttering</li> <li>- Water quality</li> <li>- Mixing</li> <li>- Sampling</li> <li>- Vibrating / Rodding</li> <li>- Application</li> <li>- Joints in monolithics</li> </ul> <p>5 Curing</p> <p>6 Dry out</p> <p>7 Criteria for acceptance</p> <ul style="list-style-type: none"> <li>- Cracks</li> <li>- Defects and acceptance criteria</li> </ul> <p>8 Inspection</p>
5.	<p>Demonstration on different parts of the furnaces.</p>	<p><u>Application of refractory:</u></p> <p>Nomenclature of different parts of the furnaces. The industries of application of refractory:</p> <ul style="list-style-type: none"> <li>• Iron &amp; Steel</li> <li>• Aluminium &amp; non-ferrous</li> <li>• Foundry</li> <li>• Cement</li> <li>• Thermal Power/Inclinator</li> <li>• Petrochemical/Refinery</li> <li>• Chemical/Fertilizer</li> <li>• Glass</li> </ul>
6 - 7.	<p>Practical training in the model workshop / fields.</p>	<p>Iron &amp; steel:-</p> <p>Hot metal transfer Ladle, Torpedo Ladles, Sponge iron kilns. Video/Visual display(audio visual display)</p> <p>Induction furnace, Electric Arc furnace, LD converter, Ladles, Tundish.</p>

8- 9.	Preparation of heating chart & report making.	Curing, Preheating/Dry out, tempering schedule/cycle of furnaces after refractory installation.
10-12.	Refractory lining practices.	Study of the refractory lining drawings.
13 - 14.	Refractory lining practices. Construction of vertical wall, brick laying, gunning, anchor welding, fixing of shuttering & formers, vibro casting, Ramming, Patching/Troweling, fettling(Construction/expansion joints)	Shaped & Unshaped refractory lining. Anchor types, Construction joints, Expansion joints.
15 - 16.	Practical training in the model workshop / fields.	Iron & steel: Slide gate fixing, Porous plug fixing, Fixing of CC refractories.
17.	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
18-20.	Demonstration & practice Tools, Tackles and Operation.	<u>Tools, Tackles and Operation:</u> 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.
21.	-Do-	<u>Maintenance of Refractory lining. : Different types of refractory practices like LD converter, Laddle, Tundishes, Slide gate refractory, rotary kiln,Mills, Reheating furnace.</u> <u>Occupational Health Hazards and its control.</u> 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).
22-23	<b>Implant training</b> / Project work (work in a team)	
24-25	<b>Revision</b>	
26	Examination	

**SYLLABUS FOR WORKSHOP SCIENCE AND CALCULATION**  
**SEMESTER-IV**

<b>WK NO.</b>	<b>WORKSHOP CALCULATION AND SCIENCE</b>
1- 4.	Heat and Temperature, Measurement of Temperature, Boiling and melting points.
5.	Different Temperature scales. Types of Thermometers and Properties of Mercury. Mutual Conversions. Absolute Temperature.
6 - 7.	Quantity of Heat and its different units and their mutual relations. Related problems.
8- 12.	Heat transfer conduction, Convection, Radiation. Thermal conductivity and Insulations.
13 - 14.	Critical pressures and temperatures.
15 - 17.	Interchange of heat, (Principle of calorimetry) Concept of linear expansion.
18- 20.	Specific heat, sensible Heat, Latent heat, super heat. Percentage & its application.
21.	Practice NCVT test paper.
22- 23	<b>In-plant training</b> / Project work (work in a team)
24	Revision
25	Examination



**SYLLABUS FOR ENGINEERING DRAWING**  
**SEMESTER-IV**

<b>WK NO.</b>	<b>ENGINEERING DRAWING</b>
1- 4.	Free hand sketching of various parts of kiln.
5.	Free hand sketching of various parts of kiln.
6 - 7.	Free hand sketching of various pallets.
8- 9.	Free hand sketching of various pallets.
10- 12.	Free hand sketching of various parts of furnace.
13 - 14.	Side view & top view of engineering drawing.
15 - 17.	Free hand sketching of ladle, Tundish, etc..
18- 20.	Free hand sketching of various tools, tackles, etc..
21.	Free hand sketching of various tools, tackles, etc..
22- 23	<b>In-plant training</b> / Project work (work in a team)
24	Revision
25	Examination

**TRADE: REFRACTORY TECHNICIAN**  
**LIST OF TOOLS & EQUIPMENTS FOR 20 TRAINEES**

**A : Trainee's Tool Kit:**

Sl. No.	Name	Quantity
1	Steel Rule 12"	21 Nos.
2	Hammer Ball Pin 0.45 Kg	21 Nos.
3	Hammer Flat	21 Nos.
4	Chisel Cold Flat 2cmX22Cm	21 Nos.
5	File Flat 30cm Bastered	21 Nos.
6	File Flat 30cm Se3cond Cut	21 Nos.
7	File Half Round Bastard	21 Nos.
8	Safety goggles	21 Nos.
9	Googles Furness, Antigua Around Heat Proof	21 Nos.
10	Head wear anticoncusion Furness	21 Nos.
14	Pliers 20cm	21 Nos.
15	Vice bench 12cm Jaw	21 Nos.
16	Sledge Hammer 5kg	21 Nos.
17	Buckets 10 Ltr. Capacity	21 Nos.
18	Sprit level 150 mm	21 Nos.
19	Pocket steel Tape 1800mm long	21 Nos.
20	Crow Bar 1500mm	21 Nos.
21	Screw Driver 300mm	21 Nos.
22	Bench Grinder	21 Nos.
23	Hacksaw 30cm adjustable	21 Nos.
24	Work Bench 15x10x6cm	21 Nos.
25	Shovel	21 Nos.
26	Trammel	21 Nos.
27	Scriber	21 Nos.
28	Calipers Odd leg	21 Nos.
29	Caliper inside 15cm	21 Nos.
30	Centre Punch 15 cm	21 Nos.
31	Trowels(Suare& triangle)	21 Nos.
32	Measuring tape	21 Nos.
34	Hand gloves	21 Nos.
35	Pliers	21 Nos.
36	Screw driver	21 Nos.
37	Tester	21 Nos.

**B. Tools & equipments for Production:**

Sl No.	NAME	Quantity
1*	Jaw	1 No.

2*	Roller	1 No.
3*	Ball Mill/Vibro mill	1 No.
4	Sieves	5 Nos.
5	Mixer machine	1 No.
6	Press Machine	1 No.
7*	Dryer	1 No.
8*	Kiln	1 No.
9	Moulds(Different shapes)	2 each
10	Drying furnace(Lab scale) Int. Vol.Im3	1 No.
11	Rammer	1 No.
12	Air Compressor(5bar)	1 No.

### C. Tools & equipments for Application:

Sl.No.	Name	Quantity
1	Brick cutting m/c with cutting wheel	5 Nos.
2	Stirrer	2 Nos.
3	Gunning machine	2 Nos.
4	Models for electric arc furnace	1 No.
5	Models for Basic Oxygen furnace	1 No.
6	Models for Rotary kiln	1 No.
7*	Ladle	1 No.
8*	Tundish	1 No.
9	Jack hammer with drill bits	1 No.
10	Vibrator with needle	2 Nos.
11	Spraying machine	2 Nos.

**Note:- For the items marked “\*” MOU with a refractory manufacturing company may be done for imparting training to the trainees.**

### D. General Tools & Equipments:

Sl.No.	Name	Quantity
1	Spirit level	4 Nos.
2	Water level	4 Nos.
3	Wooden/aluminium rafter	2 Nos.
4	Plumb	5 Nos.
5	Masonry hammer	5 Nos.
6	Slide caliper	5 Nos.
8	Wooden hammer	5 Nos.
9	GI Pipe(2”) with clamps for scaffolding	As required
10	Filler Gauge(Min 0.5mm – 5mm)	1 No.
11	Laser thermometer	1 No.
12	Pyrometer	1 No.

13	Joint filler	1 No.
14	Chisel	5 Nos.
15	Pressure gauge	1 No.
17	Screw jack	1 No.
17	Weighing m/c(Min: 10 Kg)	1 No.
18	Wheel barrow	2 Nos.
19	MS pan	2 Nos.
20	Measuring flask	2 Nos.
21	Litmus paper	As required
22	Thermometer	1 No.
23	Stop watch	1 No.
24	Glass biker	1 No.
25	Tester	5 Nos.
26	Multimeter	2 Nos.
27	Voltmeter	2 Nos.
28	Flowmeter	2 Nos.
29	Vicat apparatus	1 No.
30	Piano wire	2 mtr.
31	Auto CAD software	1 No.
32	Hand saw	10 Nos.
33	Electric hand drill	1 No.
34	Micrometer (0-25, 25-50,50-75mm)	1 set each
35	Vernier calipers(0-200mm)(.02 discount)	1 No.
36	Welding transformer	1 No.
37	C-Clamp 20 cm Perforated Hood	5 Nos.
38	C-Clamp 30cm Light Duty Steel	5 Nos.
39	Surface plate 300x300mm	2 Nos.
40	Drill twist (metric) 3mm to 12mm	1 sets
41	Tapes and dies complete set in box BSW,BSF, Metric	2 sets each
42	Oil Can ½ ft	3 Nos.
43	Wire Brush	10 nos.
44	Double ended spanner 10mm to 25mm	5 Nos.
45	Drill Chuck 0 to 12 morse taper	1 No.
46	Drill machine to drill upto 12mm dia	1 No.
47	Digital multimeter	4 Nos.
48	AC Motor single Phase	1 No.
49	AC Motor three Phase	1 No.
50	Star Delta starter	1 No.

### E. List of additional tools for allied trade in welding

Sl. No.	Name & Description of Machines	Quantity
1.	Transformer welding set 150 amps. – continuous welding current, with all accessories and electrode holder	1 Set
2.	Welder cable to carry 200 amps. With flexible rubber cover	20 Meter
3.	Lugs for cable	12 Nos.
4.	Earth clamps.	2 Nos.
5.	Arc welding table (all metal top) 122 cm X 12 cm X 60 cm with positioner.	1 No.
6.	Oxy – acetylene gas welding set equipment with hoses, regulator and other accessories.	1 Set.
7.	Gas welding table with positioner	1 No
8.	Welding torch tips of different sizes	1 Set
9.	Gas lighter.	2 Nos
10.	Trolley for gas cylinders.	1 No
11.	Chipping hammer.	2 Nos
12.	Gloves (Leather)	2 Pairs
13.	Leather apron.	2 Nos
14.	Spindle key for cylinder valve.	2 Nos.
15.	Welding torches 5 to 10 nozzles.	1 Set.
16.	Welding goggles	4 Pairs.
17.	Welding helmet with coloured glass	2 Nos.
18.	Tip cleaner	10 Sets.

**Note:** -The above items are to be provided for Training where the Welding trade does not exist.

### F. Tools for Allied Trade- Sheet Metal Work

Sl. No.	Name of the items	Qty
1	Trammel 30cm.	1 no.
2	Prick punch	2 nos.
3	Mallet.	2 nos.
4	Snips straight 25 cm.	2 nos.
5	Setting hammers with handle.	2 nos.
6	Planishing hammer.	2 nos.
7	Snip bent 25 cm.	2 nos.
8	Stake hatchet.	2 nos.
9	Stake grooving.	2 nos.

10	Gauge imperial sheet.	1 no.
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**Note:** -The above items are to be provided for Training where the Sheet Metal trade does not exist.

**G. General Furniture:**

1	Almirah (as per required size)	2 Nos.
2	Steel Rack (5'x4'x2')	2 Nos.
3	Fire Extinguisher	2 Nos.
4	First aid Box	1 No.

**LIST OF TRADE COMMITTEE MEMBERS**

Sl. No.	Name & Designation Sh/Mr/Ms.	Organization	Mentor Council Designation
<b>Members of Sector Mentor council</b>			
1.	A. D. Shahane, Vice-President, (Corporate Trg.)	Larsen & Turbo 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
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.	Uday Apte	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

<b>Mentor</b>			
21.	Sunil Kumar Gupta (Director)	DGET HQ, New Delhi.	Mentor
<b>Members of Core Group</b>			
22.	N. Nath. (ADT)	CSTARI, Kolkata	Co-ordinator
23.	H.Charles (TO)	NIMI, Chennai.	Member
24.	Sukhdev Singh (JDT)	ATI Kanpur	Team Leader
25.	Ravi Pandey (V.I)	ATI Kanpur	Member
26.	A.K. Nasakar (T.O)	ATI Kolkata	Member
27.	Samir Sarkar (T.O)	ATI Kolkata	Member
28.	J. Ram Eswara Rao (T.O)	RDAT Hyderabad	Member
29.	T.G. Kadam (T.O)	ATI Mumbai	Member
30.	K. Mahendar (DDT)	ATI Chennai	Member
31.	Shrikant S Sonnavane (T.O)	ATI Mumbai	Member
32.	K. Nagasrinivas (DDT)	ATI Hyderabad	Member
33.	G.N. Eswarappa (DDT)	FTI Bangalore	Member
34.	G. Govindan, Sr. Draughtsman	ATI Chennai	Member
35.	M.N.Renukaradhya, Dy.Director/Principal Grade I.,	Govt. ITI, Tumkur Road, Banglore, Karnataka	Member
36.	B.V.Venkatesh Reddy. JTO	Govt. ITI, Tumkur Road, Banglore, Karnataka	Member
37.	N.M.Kajale, Principal,	Govt. ITI Velhe, Distt: Pune, Maharashtra	Member
38.	Subrata Polley, Instructor	ITI Howrah Homes, West Bengal	Member
39.	VINOD KUMAR.R Sr.Instructor	Govt.ITI Dhanuvachapuram Trivendrum, Dist., Kerala	Member
40.	M. Anbalagan, B.E., Assistant Training Officer	Govt. ITI Coimbatore, Tamil Nadu	Member
41.	K. Lakshmi Narayanan, T.O.	DET, Tamil Nadu	Member
<b>Other industry representatives</b>			
42.	Venugopal Parvatikar	Skill Sonics, Bangalore	Member
43.	Venkata Dasari	Skill Sonics, Bangalore	Member
44.	Srihari, D	CADEM Tech. Pvt. Ltd., Bengaluru	Member
45.	Dasarathi.G.V.	CADEM Tech. Pvt. Ltd., Bengaluru	Member
46.	L.R.S.Mani	Ohm Shakti Industries, Bengaluru	Member