Syllabus for Junior Fettler

Course Name	JUNIOR FETTLER
Sector	CAPITAL GOODS
Course Code	STC-CGM/2025/0710
Occupation	Fettling & Grinding Technician in a Foundry.
Job Description	Junior Fettler cleans, shapes and finishes metal castings by removing excess material, burrs and surface imperfections. They operate grinding machines and hand tools safely to achieve the desired surface quality. They inspect castings for defects and ensure they meet specifications.
Course Duration	Total – 300 hrs. (T- 70 hrs. P- 140 hrs. OJT- 60 hrs. & ES-30 hrs.)
Trainees' Entry Qualification	Madhyamik (WBBSE) or Equivalent.
Trainers Qualification	BE / B.Tech. in Metallurgy / Mechanical Engineering with 2 years' experience in the relevant field OR Diploma in Metallurgy / Mechanical Engineering with 3 years' experience in the relevant field OR CTS/ATS in the trade of Molder / Foundryman with 5 years' experience in the relevant field

Structure of Course:

Module No.	Module name	Outcome	Theory (Hrs)	Practical (Hrs)	OJT (Hrs.)	Total (Hrs) [Multiple of 30]
1	Fettling in Foundry	Explain fettling and shake-out processes	10	20		30
2	Grinding Operation in Foundry	Carry out grinding to refine and finish castings within the fettling process	10	20		30
3	Equipment Required for Fettling, Grinding & Other Processes	Identify & apply of various Tools & Equipment of Fettling.	30	60		90
4	Inspection, Testing & Quality Control of Castings	Assess the nature of defects in a casting to determine the need and feasibility of repair	10	20		30
5	Repair and Restoration in Fettling Operations	Apply all relevant casting repair processes.	10	20		30
6	OJT	Work in real job situation with emphasis on basic safety and hazards			60	60
7	Employability Skill	Employability Skill	30	--		30
TOTAL			**100**	**140**	**60**	**300**

SYLLABUS:

Module No. 1: Fettling in Foundry

Outcome: Demonstrate fettling and shake-out processes.

Theory Content:

- Describe fettling in a foundry
- What is shake-out or knock out of a casting.
- Explain shake-out as the removal of solidified casting from the mold box.
- Describe different methods of shake-out: manual, breaking sand with tools and mechanical shake-out machines.
- Identify the steps of fettling:
  - Remove cores from castings using rods and tools.
  - Clean the surface by removing sand and oxide scales.
- Apply cleaning methods: hand tools, tumbling, air blasting, shot blasting, hydro blasting and chemical cleaning.
- Classify different abrasives used in blasting such as steel shots, grit, alumina and silicon carbide.
- Differentiate between sand blasting, shot blasting, hydro blasting and wheelabrator system.
- Summarize chemical cleaning processes.
- Evaluate the need for surface finishing depending on type of metal, size of casting and final requirement.

Practical Content:

- Observe the shake-out process in a foundry setup (manual and mechanical).
- Handle simple fettling tools like wire brush, file, crowbar and hammer.
- Demonstrate removal of sand and cores from castings using poking rods.
- Operate tumbling drum or mechanical equipment under supervision.
- Perform basic surface cleaning using sand blasting or shot blasting machine (faculty demonstration with safety).
- Illustrate trimming of fins and unwanted projections using grinding or cutting tools.
- Sketch diagrams of fettling equipment (when actual machines are not available).
- Participate in interactive discussions during class to clarify doubts.
- Practice identification of gates, risers, runners and fins in actual castings.
- Compare cleaned vs. uncleaned casting samples to understand improvement in finish.

Tools & Equipment Needed:

Max number of ready and available Rough Castings, Max number of ready and available Finished Castings, Drawings of these Castings, Appropriate Templates & Gauges of castings, Outside Calipers 3 and 6, Inside Calipers 2 and 4, Height Gauge 12, Steel Scale 12, Steel Measuring tape 3 Mtr, V-Blocks 4 to 6 measuring heights, Angle Protractors, Fixed Right Angle Protractor and Huge number of other operation-specific hardware gadgets are required which would be mentioned in subsequent

modules.

Module No. 2: Grinding Operation in Foundry

Outcome: Carry out grinding to refine and finish castings within the fettling process

Theory Content:

- Define grinding as the process of removing unwanted material from hard surfaces using a machine or by hand.
- Explain that rough grinding is mainly used for cleaning casting surfaces.
- List different types of grinding machines:
  - Portable grinders
  - Swing frame grinders
  - Floor-stand grinders
  - Abrasive belt grinders
- Describe portable grinders:
  - Use them for castings that cannot be ground on larger machines.
  - Mount grinding wheels of different shapes (cup, cone, disk, cylindrical).
  - Distinguish between straight grinders (axial mounting) and angle grinders (angled mounting like AG4, AG7
- Describe swing frame grinders:
  - Mount the grinding machine on a swing frame.
  - Keep the casting fixed and move the grinder over the surface.
  - Balance the frame using an overhead jib crane for smooth movement.
- Describe floor-stand grinders:
  - Use double-ended machines with rough and fine wheels on either side.
  - Rotate wheels at 2000–3000 RPM.
  - Hold small castings by hand or use fixtures for accuracy and speed.
- Describe abrasive belt grinders:
  - Use two rollers with an endless abrasive belt running at high speed.
  - Achieve fast stock removal and smooth surface finish.

Practical Content:

- Observe grinding demonstrations in the workshop for different machines.
- Identify parts and uses of portable, swing frame, floor-stand and abrasive belt grinders.
- Handle simple portable grinders safely under supervision.
- Practice cleaning small castings with floor-stand grinders.
- Demonstrate how to avoid grinding areas marked as “as-cast surface” in drawings.
- Compare surfaces before and after grinding to evaluate improvement.
- Sketch basic diagrams of grinding machines when actual equipment is not available.
- Participate in class discussions and ask questions about grinding operations.

Tools & Equipment Needed:

Available templates, if any, Max number of ready and available Rough Castings, Finished Castings of the same type, Drawings of those castings, All types of Grinding Machines, if available, All types of Grinding Disks, if available, All types of Grinding / Polishing Belts (both Paper & Canvas Types), Repairing kits of hand machines, namely the Carbon Brush of Armatures, Magnifying Glass, All types of suitable Personal Protective Equipment's (PPEs).

Module No.3: Equipment Required for Fettling, Grinding & Other Processes

Outcome: Identify & apply of various Tools & Equipment of Fettling.

Theory Content:

- Explain shake-out as the first step of fettling, where the casting is released from the mold box or flask.
- Identify different shake-out equipment such as vibrating decks, rotating drum separators, punch-out machines, conveyors and robotic manipulators.
- Describe methods for removing gates, runners and risers:
  - Use chipping hammers to cut brass, bronze, copper, SG iron and steels.
  - Apply flogging (knocking off) for brittle materials like gray cast iron and white cast iron.
  - Operate shearing machines for small castings.
  - Perform sawing using band, hack or circular saws.
  - Use abrasive cut-off wheels for hard alloys.
  - Carry out machining when removal can be combined with other machining operations.
  - Apply flame cutting with oxy-acetylene torches for large steel castings.
  - Employ plasma cutting for stainless steel and non-ferrous alloys.
- Explain final finishing processes after removal of unwanted projections:
  - Perform grinding with wheels or abrasive belts.
  - Apply rotary filing for soft metals like aluminum, brass and bronze.
  - Carry out heat treatment such as stress relieving, normalizing or annealing.
  - Deliver machining as per customer requirements.
  - Use chemical treatments like molten salt baths or acid pickling.
  - Perform polishing with abrasive belts of fine grit.
  - Apply brushing using rotary wire or fiber brushes
  - Carry out buffing for high luster using buff wheels.
  - Demonstrate blast-cleaning for smooth finish using sand or fine shot grits.
  - Apply painting for appearance and rust protection.
- Identify other treatments such as enameling, electroplating, galvanizing, anodizing, carburizing, hard facing, shot peening, flame and induction hardening.
- Describe uncleaned and cleaned castings for improvement in finish.

Practical Content:

- Observe shake-out and fettling operations in the workshop or through models if real castings are not available.

- Handle and identify tools like chipping hammers, saws and abrasive wheels.
- Practice safe use of portable grinders and observe flame or plasma cutting under supervision.
- Demonstrate removal of gates, risers and runners on sample castings.
- Identify common symbols used in drawing of molding and casting.
- Identify areas marked “as cast surface” in drawings and avoid grinding in those areas.
- Sketch tools, machines or fettling arrangements on board when real equipment is not available.
- Participate in interactive discussions and ask questions during theory and practical demonstrations.

Tools & Equipment Needed:

Product Drawings, Magnifying Glass, Available templates, if any, Max number of ready and available Rough Castings, Finished Castings of the same type, Drawings of those castings, All types of Equipment’s & Grinding Machines, if available.

Module No. 4: Inspection, Testing & Quality Control of Castings

Outcome: Assess the nature of defects in a casting to determine the need and feasibility of repair.

Theory Content:

- Explain that the quality of castings is essential for the foundry industry and inspection ensures that imperfections are within the allowable limits.
- Describe how rejection criteria may vary depending on agreements between the casting supplier and the customer.
- State that after castings are cleaned, they must be inspected to check if they will function properly in service.
- List the purposes of inspection:
  - Separate good castings from defective ones.
  - Locate defects in raw materials or at different production stages.
  - Check conformity with design requirements.
  - Provide data for quality control in the foundry.
- Differentiate inspection from testing:
  - Inspection involves observing processes and products to ensure desired qualities.
  - Testing checks physical performance and related properties.
  - Focus on external appearance and surface defects that can be corrected by re-fettling.
  - Explain that inspection covers both surface (external) and sub-surface (internal) defects, leading to acceptance or rejection.
- Classify inspection procedures as:
  - Visual inspection of surfaces.
  - Dimensional inspection for shape and size.
  - Physical, metallurgical and chemical tests.
  - Mechanical property testing (destructive and semi-destructive).
  - Non-destructive testing (NDT).
- Describe visual inspection:
  - Detect surface defects such as cracks, tears, blow holes, metal penetration, rattails, buckles, swells, shifts, shrinkage and roughness.

  - Use the naked eye or magnifying glass.
  - Correct many defects by fettling.
- Describe dimensional inspection:
  - Check critical dimensions and geometry.
  - Ensure machining allowance is available and patterns are correct.
  - Use templates, micrometers, calipers, gauges, CMMs and 3D inspection stations.
  - Correct dimensional defects through re-fettling, grinding or blasting.
- List other inspection and testing methods (without detailed discussion):
  - Physical, metallurgical and chemical tests.
  - Tensile, hardness, impact, fatigue and creep testing.
  - Pressure and leak testing for valves, pipes and fitting.
  - Non-destructive tests like dye penetrant testing, magnetic particle inspection, ultrasonic testing and radiographic testing.
  - Emphasize that NDT findings may require salvaging operations, which include gouging defective zones, repairing with welding and re-grinding or blasting.

Practical Content:

- Demonstrate real inspection methods in the workshop using instruments when available.
- Show visual inspection of castings and identify surface defects.
- Use measuring instruments to check dimensions and geometry of castings.
- Explain drawings where areas marked “as cast surface” must not be ground.
- Demonstrate safe use of fettling and re-fettling techniques to correct defects.
- Compare defective and acceptable castings to highlight quality differences.
- Conduct interactive sessions where learners ask questions during demonstrations.
- Use sketches on the board, downloaded images or videos when equipment is not available.
- Move at a slow pace to ensure full understanding, linking theory classes directly to workshop demonstrations.
- Encourage active observation and practice of inspection procedures to build practical skills.

Tools & Equipment Needed:

Product Drawings, Available Templates, Gauges, if any, Max number of ready and available Rough Castings, Finished Castings of the same type, All types of Testing Instruments & Machines, if available, Soft copies or videos of the Testing Equipment’s may be shared with the target group of students, DP Test kit and Magnifying Glass.

Module No. 5: Repair and Restoration in Fettling Operations

Outcome: Apply all relevant casting repair processes.

Theory Content:

- State that inspection ensures castings meet quality requirements by classifying them into:
  - Acceptable immediately.
  - Acceptable after rework/salvaging.
  - Outright rejection.
  - Explain that salvaging focuses only on castings that can be reworked to acceptable quality.

- Identify categories of defects in salvageable castings:
  - Surface defects visible by eye or measurement.
  - Sub-surface defects revealed by DPT, MPI, machining or radiography.
  - Material defects found by mechanical tests like tensile, bend or impact.
  - Define salvaging as the process of saving defective castings by restoring their service properties to the level of defect-free castings.
- List factors affecting salvaging:
  - Size and shape of casting.
  - Alloy composition.
  - Difficulty of repair.
  - Availability of tools, methods, materials and manpower.
  - Customer's quality requirements.
  - Agreement between manufacturer and customer.
- Describe salvaging techniques:
  - Welding (most common).
  - Brazing, braze welding, soldering.
  - Burning-on (for large castings).
  - Patches and plugs (drilling out defective zone and inserting patch/plug).
  - Caulking and impregnation (for small valves and reservoirs).
- Explain welding repair:
  - Apply to steel, cast iron and high-alloy castings.
  - Achieve metallurgical union between casting and filler metal.
  - Use SMAW, TIG, MIG or gas welding depending on material.
  - Remove all blow holes, cracks, scabs and under-filling before repair.
  - Elect filler metals with similar properties to casting material.
- Explain brazing, braze welding and soldering:
  - Use non-ferrous filler metals.
  - Brazing and braze welding operate above 800°F.
  - Soldering operates below 800°F.
  - Suitable for joining dissimilar metals and repair gray iron castings.
  - Produce lower stress and lower cost repairs, though solder joints are weaker.
- Explain finishing after salvaging:
  - Allow castings to cool after metal filling or welding.
  - Carry out grinding, polishing, buffing or blasting for appearance and surface finish.
  - Complete all final steps as part of the fettling process.

Practical Content:

- Demonstrate chipping, gouging, drilling, plugging, patching, welding repairs, brazing and soldering using actual equipment where available.
- Show how to identify defective zones and prepare them for repair.
- Demonstrate welding techniques with correct filler materials.
- Guide learners to practice safe handling of tools during salvage operations.
- Highlight drawings where "as cast surface" must be kept intact and grinding avoided.
- Compare defective castings before and after salvage to show improvements.
- Conduct interactive discussions during demonstrations to clarify doubts.

- Take students to the workshop after theory sessions (or during) for hands-on practice.
- Use sketches, charts or videos where equipment is unavailable to explain salvage methods.
- Move step by step to match the learners' pace and ensure clear understanding.

Tools & Equipment Needed:

Product Drawings, Magnifying Glass, Max number of ready and available Rough Castings, Finished Castings of the same type, Defective Castings of the same type, Drawings of those castings, All types of Equipment's & Grinding Machines, if available, Welding units are a must, Portable Drilling and Pneumatic or power chipping machines, Plug-fixing or Insert-fixing.

Module No 7: OJT

Outcome: Work in real job situation with special emphasis on basic safety and hazards in this domain.

Practical Content:

Assessor will check report prepared for this component of Practical training of the course and assess whether competency has been developed to work in the real job situation with special emphasis on basic safety and hazards in this domain. (The trainee is expected to undertake work in actual workplace under any supervisor / contractor for 60 Hours.)

Module 7: Employability Skills

Detail of Employability Skills Syllabus: 30 hours

Key Learning Outcomes:

Introduction to Employability Skills Duration: 1 Hour

After completing this programme, participants will be able to:

1. Discuss the importance of Employability Skills in meeting the job requirements

Constitutional values - Citizenship Duration: 1 Hour

2. Explain constitutional values, civic rights, duties, citizenship, responsibility towards society etc. that are required to be followed to become a responsible citizen.
3. Show how to practice different environmentally sustainable practices

Becoming a Professional in the 21st Century Duration: 1 Hours

4. Discuss 21st century skills.
5. Display positive attitude, self -motivation, problem solving, time management skills and continuous learning mindset in different situations.

Basic English Skills Duration: 2 Hours

6. Use appropriate basic English sentences/phrases while speaking

Communication Skills Duration: 4 Hour

7. Demonstrate how to communicate in a well -mannered way with others.

8. Demonstrate working with others in a team

Diversity & Inclusion Duration: 1 Hour

9. Show how to conduct oneself appropriately with all genders and PwD
10. Discuss the significance of reporting sexual harassment issues in time

Financial and Legal Literacy Duration: 4 Hours

11. Discuss the significance of using financial products and services safely and securely.
12. Explain the importance of managing expenses, income, and savings.
13. Explain the significance of approaching the concerned authorities in time for any exploitation as per legal rights and laws

Essential Digital Skills Duration: 3 Hours

14. Show how to operate digital devices and use the associated applications and features, safely and securely
15. Discuss the significance of using internet for browsing, accessing social media platforms, safely and securely

Entrepreneurship Duration: 7 Hours

16. Discuss the need for identifying opportunities for potential business, sources for arranging money and potential legal and financial challenges

Customer Service Duration: 4 Hours

17. Differentiate between types of customers
18. Explain the significance of identifying customer needs and addressing them
19. Discuss the significance of maintaining hygiene and dressing appropriately

Getting ready for apprenticeship & Jobs Duration: 2 Hours

20. Create a bio-data
21. Use various sources to search and apply for jobs
22. Discuss the significance of dressing up neatly and maintaining hygiene for an interview
23. Discuss how to search and register for apprenticeship opportunities.

Learning Outcome – Assessment Criteria

Module No.	Outcome	Assessment Criteria
1	Demonstrate fettling and shake-out processes	**After completion of this module students will be able to:** 1.1 Explain the concepts of fettling and shake-out. 1.2 Identify and describe the steps, tools and cleaning methods used in fettling operations. 1.3 Differentiate between blasting methods. 1.4 Demonstrate safe handling of fettling tools and equipment. 1.5 Learn to study the Drawings of castings &

Module No.	Outcome	Assessment Criteria
		understand the fit and finish requirements.
2	Carry out grinding to refine and finish castings within the fettling process	**After completion of this module students will be able to:** 2.1 Explain the grinding process. 2.2 Identify different grinding machines (portable, swing frame, floor-stand, abrasive belt) and their applications. 2.3 Perform at least two Types of Grinding Operation. 2.4 Demonstrate safe handling and operation of grinders while cleaning casting surfaces.
3	Identify & apply of various Tools & Equipment of Fettling	**After completion of this module students will be able to:** 3.1 Identify equipment used for shake-out operations. 3.2 Describe methods and tools for removing gates, runners and risers in different casting materials. 3.3 Identify and explain final finishing processes such as grinding, surface treatments etc. 3.4 Perform a good number of activities in a fettling shop.
4	Assess the nature of defects in a casting to determine the need and feasibility of repair	**After completion of this module students will be able to:** 4.1 Explain the importance of inspection, testing and quality control in castings. 4.2 Differentiate between inspection and testing. 4.3 Identify and detect common casting defects through visual and dimensional inspection. 4.4 Demonstrate safe use of measuring instruments and fettling/re-fettling techniques to correct minor defects. 4.5 Identify kind of inspection is required for which casting DT or NDT based on normal practice of that fettling area.
5	Apply all relevant casting repair processes	**After completion of this module students will be able to:** 5.1 Classify castings into acceptable, salvageable or rejected categories after inspection. 5.2 Follow the exact sequence of operations in defect removal techniques. 5.3 Identify surface, sub-surface and material defects suitable for salvaging using

Module No.	Outcome	Assessment Criteria
		appropriate inspection methods. 5.4 Explain the method for removing material from defective zone of the casting. 5.5 Evaluate the effectiveness of repair by comparing castings before and after salvage, ensuring proper finishing operations.
6	OJT	Assessor will check report prepared for this component of Practical training of the course and assess whether competency has been developed to work in the real job situation with special emphasis on basic safety and hazards in this domain. (The trainee is expected to undertake work in actual workplace under any supervisor / contractor for 60 Hours.)
7	Employability Skill	As per guided curriculum

List of Tools, Equipment & materials needed for 30 Trainees (Practical)

LIST OF TOOLS AND EQUIPMENT			
(For batch of 30 candidates)			
S No	**Name of the Tool &Equipment**	**Specification**	**Quantity**
1.	Varieties of Product Drawings.	NA	As required
2.	Varieties of Rough Casting.	NA	As required
3.	Varieties of Finished Castings.	NA	As required
4.	Vernier Calipers 12”	12”	3 nos.
5.	Outside Calipers 6”	6”	3 nos.
6.	Inside Calipers 4”	4”	3 nos.
7.	Height Gauge 12”	12”	1 no.
8.	Stainless Steel Scale 6”	Standard	3 nos.
9.	Stainless Steel Scale 12”	Standard	3 nos.
10.	Steel Measuring Tape 3 Mtr	3 mtr	3 nos.
11.	V-Blocks 4” to 6” measuring heights.	Standard	1 Set
12.	Angle Protractors and Tri Square	NA	3 nos.
13.	Fixed Right Angle Protractor.	NA	3 nos.
14.	Divider	3”	3 nos.
15.	Depth Gauge 3”	3”	3 nos.
16.	Spirit Level	6”	3 nos.
17.	Hard Wire Brush for Sand cleaning from casting surface.	6” x 2”	10 nos.
18.	Magnifying Glass	Standard	3 nos.

19.	Angle Grinding Machine AG4 with sufficient Number of Spare Grinding Wheels and required tools.	4"	3 nos.
20.	Angle Grinding Machine AG7 with sufficient Number of Spare Grinding Wheels	7"	3 nos.
21.	Swing Frame Grinding Unit with JIB Crane	12" Wheel	1 Unit
22.	Gas Cutting Set complete with Regulators, Hoses, Cutting Torch, Cutting Nozzle, Cylinders etc.		1 Unit + 1 Spare Set
23.	Hose Clips	½", 1", 1½", 2"	10 nos. each
24.	Spark Lighter	Standard	1 unit
25.	Arc Welding Complete Set with adequate number of spare electrodes	Standard	1 unit
26.	MIG Welding Unit complete set.	0.8 mm & 2.18 mm Wire Spool	1 unit
27.	Gas Welding Set complete with Regulators, Hoses, Welding Torch with 2 mm & 5 mm Nozzle-Tips, Cylinders etc.	Standard	1 unit + 1 spare Set
28.	Welding Helmet, Leather Sleeves, Leather Safety Gloves, Leather Aprons, Safety Glasses with Side Shields, Ear Plug, Safety Shoes etc.	Standard	3 sets
29.	Tip Cleaner, Wire Brush (MS), Cleaning Agents, Cleaning Cloth, Waste Container, Dust Pan and Brush Set, Liquid Soap etc.	Standard	3 sets
30.	Compressor	Standard	1 no
31.	Pneumatic Chipping Machine with chisels	Standard	1 no
32.	Electric Chipping Machine with chisels	Standard	1 no
33.	Jigs & Fixtures, Fibre Ropes, Wire Ropes, Manual Lifts, Blocks & Tables, Straps, Bolts, Clamps.	Standard	3 sets
34.	Cutting Tools, Hacksaws + Spare Blades, Hammers, Punches	Standard	3 sets
35.	Screwdrivers, Sockets, Wrenches, Spanners, Scrapers etc.	Standard	3 sets
36.	Welder's Peening Hammer	2"	3 nos.
37.	Welder's Screen, Goggles, Gloves etc.	Standard	6 sets
38.	Belt Grinding Unit with belts of various Grits	Standard	1 set
39.	Straight Grinding Machine with cylindrical & cone-shaped grinding wheels	Standard	1 set
40.	Buffing Machine with Buffing Wheel	Standard	1 set

Marks Distribution

Outcome	Outcome Code	Type	Total Th marks	Total Pr marks	Total OJT marks
Explain fettling and shake-out processes	CGM/0710/OC1	Compulsory	20	120	0
Carry out grinding to refine and finish castings within the fettling process	CGM/0710/OC2	Compulsory	30	120	0
Identify & apply of various Tools & Equipment of Fettling.	CGM/0710/OC3	Compulsory	40	170	0
Assess the nature of defects in a casting to determine the need and feasibility of repair	CGM/0710/OC4	Compulsory	30	120	0
Apply all relevant casting repair processes.	CGM/0710/OC5	Compulsory	30	120	0
Work in real job situation with emphasis on basic safety and hazards	CGM/0710/OC6	Compulsory	0	0	150
Employability Skill-30 Hrs	DGT/VSQ/N0101	Compulsory	50	0	0
Full Marks: 1000 **Theory: 200 including ES** **Practical: 800 including OJT**					