Syllabus for Hand Moulder

Course Name	**Hand Moulder**
Sector	Iron & Steel
Course Code	**STC-I&S/2025/2002**
Occupation	Hand Moulding Technician in Foundry.
Job Description	A Hand Moulder is responsible for preparing cores and complete sand moulds in sand casting processes. The work involves understanding, handling and proper use of various materials involved in sand moulding and core-making. The role requires performing and applying correct procedures for sand moulding, core-making and finishing in metal casting foundry operations. The focus is on producing accurate cast products by following proper techniques.
Course Duration	300 Hrs. (T- 100 Hrs. including ES-30 hrs., P- 140Hrs, OJT- 60Hrs.)
Trainees' Entry Level Qualification	Madhyamik (WBBSE) or Equivalent
Trainers' Qualification	BE / B.Tech / Diploma in Metallurgy / Mechanical Engg with 2 years of experience.

Course Structure:

Module No.	ModuleName	Outcome	Compulsory /Optional	Theory (Hrs)	Practical (Hrs)	OJT (Hrs)	Total (Hrs)
1	Workplace Safety	Apply safe working practice	Compulsory	10	20	--	30
2	Overview of Sand Casting	Demonstrate the procedure of sand casting	Compulsory	10	20	--	30
3	Patterns and Core Boxes	Apply patterns and core boxes in mould making and casting processes.	Compulsory	10	20	--	30
4	Sand mixture for moulding and core making	Prepare different types of sand mixture for moulding and core making in foundry operations.	Compulsory	20	40	--	60

Module No.	ModuleName	Outcome	Compulsory /Optional	Theory (Hrs)	Practical (Hrs)	OJT (Hrs)	Total (Hrs)
5	Moulding, Core Making and Finishing Processes.	Demonstrate the procedures of Moulding, Core Making and Finishing Processes	Compulsory	20	40	--	60
6	OJT	Work in real job situation with special emphasis on basic safety and hazards in this domain.	Compulsory	--	--	60	60
7	Employability Skill	As per guided curriculum	Compulsory	30	--	--	30
Grand Total				**100**	**140**	**60**	**300**

Module No. 1: Workplace Safety

Outcome: Apply safe working practice

Theory Content:

- Importance of safety and general precautions in industry/shop floor.
- Principles and importance of first aid in workplaces.
- Operation of electrical mains and electrical safety measures.
- Role and use of personal protective equipment (ppe).
- Outline emergency response procedures for power failure, fire and system failure.
- Importance of housekeeping and good shop floor practices.
- Occupational safety, health, and environment guidelines, legislations and regulations.
- Safe practices for hot work, confined space work and material handling equipment.

Practical Content:

- Safe use and handling of trade tools and equipment.
- Safety attitude development through proper use of ppe.
- First aid methods and basic emergency response training.
- Safe disposal methods for cotton waste, metal chips, and burrs.
- Hazard identification techniques and methods of accident avoidance.
- Safety signs for danger, warning, caution, and personal safety.
- Preventive measures for electrical accidents and emergency response steps.
- Types and proper use of fire extinguishers.

Module No. 2: Overview of Sand Casting

Outcome: Demonstrate the procedure of sand casting

Theory Content:

- Explain the casting process and its different steps.
- Discuss the common uses, benefits and limits of casting in industries
- Explain Sand mould casting process, it's advantages and limitations.
- Interpretation of casting drawings.
- Explain the product drawing with reference to pattern features and core requirements
- Describe parting line for pattern making
- Describe draft angle, taper and shrinkage allowance of a pattern.
- Explain cope-drag type with core, depending on design intricacy.
- Explain a pattern mounted on a match plate
- Explain the concept and use of core in casting.
- Methoding: Gating and risering system with the concept of feeding distance and directional solidification.
- Explain draft angle, taper and shrinkage allowance of a pattern
- Identify engraved part numbers then determine their position, font size and alignment before pattern manufacturing.

PracticalContent:

- Demonstrate various types of drawings, castings, patterns and core boxes (if required) in the workshop.
- Verify the casting dimensions according to the drawing specifications.
- Identify and illustrate the necessity of each pattern, core and other elements required for specific castings.
- Mark the Taper and Draft Angles on Patterns and Core Boxes.
- Identify the ingates and risers on specific casting.
- Compare surface finish of different type of casting.

Tools&EquipmentNeeded:

Patterns, Core Boxes, Vernier Calipers(6”and12”), Outside Calipers(3”and6”), Inside Calipers(2”and4”), Height Gauge(12”), Steel Scale(12”), Steel Measuring tape(3Mtr), V-Blocks4”to6”measuringheights, Angle Protractors, Fixed Right Angle Protractor.

Module 3: Pattern and core Boxes

Outcome: Apply patterns and core boxes in mould making and casting processes.

Theory Content:

- Define different types of pattern like One-piece, Split, Loose-piece, Match-plate, Cope & Drag, Gated, Sweep, Segmental, Skeleton etc.
- Selection of pattern based on casting design, different technical process parameters.
- Define a core as a sand shape to make hollow or recessed parts.
- Place cores in the mould to block metal flow where needed.
- Explain the process of making cores from sand, metal, plaster or ceramics.
- Explain the use of core boxes in making moulds
- Describe runners, gates and risers in patterns for metal flow.
- Define parting lines and surfaces using patterns.
- Select pattern material based on quantity, moulding process and accuracy needed.

- Commonly used pattern materials and their field of application considering the type of use, extent of use, and required surface finish.
- Importance of providing dimensional allowances to basic pattern geometry considering shrinkage, machining, draft angle, distortion control and shaking for withdrawal.
- Estimation of different pattern allowances.
- Integration of elements of gating and risering system with pattern.
- Incorporation of core in mould making.
- Method of core making using core box and arrangement of core setting in the mould using core print.
- Compare between drawing, pattern, and final casting
- Follow SOPs for mould making and production

Practical Content:

- Demonstrate all the features of pattern and their reflection in the respective casting.
- Mark the casting dimensions and features vis-à-vis pattern geometry with allowances and compliance with the drawing requirements.
- Demonstrate hollow or complex section in the casting by using a suitable core.
- Demonstrate the various patterns made of different materials, such as wood, metal, plastic and plaster.
- Demonstrate the various cores made of different materials, such as sand, metal, plaster and ceramic.
- Demonstrate the various cores of different shape and their respective core boxes and core prints.
- Demonstrate the procedure for cleaning and storing patterns and core boxes after use.
- Handling of the patterns and castings for better learning of shape, finish, and dimensional accuracy.

Tools&EquipmentNeeded:

Templates,Patterns, CoreBoxes, VernierCalipers (6”and12”), OutsideCalipers (3”and6”), InsideCalipers (2”and 4”), HeightGauge (12”), SteelScale (12”), Divider, SteelMeasuringtape (3Mtr.), V-Blocks4”to6”measuringheights, AngleProtractorsandTri square, FixedRightAngleProtractor.

Module 4: Sand mixture for moulding and core making

Outcome: Prepare different types of sand mixture for moulding and core making in foundry operations.

Theory Content:

- Overview of the mould preparation process using moulding sand mixture.
- Types of sand mould: Green sand mould, Dry sand mould, No-bake sand mould, skin dried sand mould.
- Category of moulding sand mixture based on use and function: Green sand, Dry sand, Loam sand, Resin sand, Facing sand, Backing sand, Parting sand, Core sand, System sand etc.
- Ingredients of green and drysand mixture - Base sand, Binders and Additives and their functions.
- Type of base sand:silica, zircon, olivine and chromite
- Critical characteristics of base sand:Refractoriness, Grain size, Grain shape.
- Common binders - Bentonite, fire clay, kaolinite,illite, limonite etc. and their characteristics.
- Explain the process of moulding sand by using clay binders.
- Describe other moulding materials like coal dust, wood flour, graphite, soda ash, Boric acid,Dyethyl glycol.Alkaline phenolic resin.Catalyst,Gas catalyst and resins.
- Common additives-sea coal, graphite, coal dust, silica floor, wood floor, cellulose, organic floors, lime powder, soda ash, Sodium Silicate,Boric acid, Dyethyl Glycol, Alkaline Phenolic Resin, Catalyst, Gas catalyst resins etc. and their functions.
- Ingredients of no-bake/resin sand mixture- Base sand, Binders, hardener and catalyst. Functions of each ingredient. Examples of commonly used such ingredients and their characteristics.
- Various types of Core: Green Sand Cores, Dry Sand Cores, Oil Bonded Cores, Resin-Bonded Cores, $Na_2SiO_2 – CO_2$ Cores, Shell Cores.
- Important properties of sand mould mixtures that influence casting quality like – Flowability, Green Strength, Dry Strength, Hot Strength, Permeability or Porousness, moisture content, Refractoriness,

Adhesiveness,
- Collapsibility, Bench Life, Coefficient of Expansion and Durability.

Practical Content:

- Demonstration of base sand sources: silica, chromite, zircon and olivine.
- Grain size analysis of base sand grains using sieves.
- Examination of sand grain shapes under magnifier or microscope.
- Identification natural, synthetic and loam sands.
- Measurement and mixing of sand, binder, water and additives to prepare green sand mixfor at least 3 different sand mixes.
- Preparation of resin sand mixes: 2-part and 3-part compositions.
- Application of loam sand on brick moulds for large castings.
- Testing of sand properties: refractoriness, permeability or porousness, flowability, Green Strength, Dry Strength, Hot Strength, Adhesiveness, Collapsibility, Bench Life, Coefficient of Expansion and Durability.
- Comparison of casting quality using different sand types.
- Demonstration of common casting defects like sand wash, scabs, and cracks
- Collect silica sand, clay, coal dust, wood flour, water and other additives.
- Measure correct proportions for at least 3 different sand mixes
- Demonstrate all Properties of Moulding Sand: Flowability, Green Strength, Dry Strength, Hot Strength, Permeability or Porousness, Refractoriness, Adhesiveness, Collapsibility, Bench Life, Coefficient of Expansion and Durabilit.
- Measure coefficient of expansion to ensure dimensional accuracy
- Demonstration of sand reclamation by removing lumps, foreign material and reclaiming sand.
- Performing dry, wet, thermal, and combined sand reclamation processes.
- Application of mould and core paints for better surface finish.
- Compare differences in properties (strength, flowability, collapsibility) between different sand mixes).

Tools&EquipmentNeeded:

CleanWhite papers, DifferenttypesofsandwithalltypesofGrain-Shape, MagnifyingGlass,SandMuller Machine, Spatul, WeighingScales/Machines, WeighingPots/ Containers, Mould Boxes, Patterns, CoreBoxes, SteelMeasuringtape(3Mtr), SteelScale(12”), DepthGauge(3”).

Module No. 5: Moulding, Core Making and Finishing Processes

Outcome: Demonstrate the procedures of Moulding, Core Making and Finishing Processes

Theory Content:

- Describe Core Making Procedure step by step.
- Explain Core Print, chaplets and Core Venting.
- Describe two basic Mould Making Procedures step by step: (i) Hand Moulding (ii) Machine Moulding.
- Describe different Methods of Manual Ramming in Hand-Moulding.
- Explain the Advantages and disadvantages of Hand Ramming
- Describe different Methods of Machine Ramming/ compacting in Hand-Moulding:Squeezing, Jolting, Sand Slinging, vacuum moulding.
- Explain the Vent Holes and its importance.
- Step by step process of preparing various types of Moulds: Green sand Mould, Dry sand Mould, Skin-dried

Mould, Loam Mould, Shell Mould, Investment Mould, Sodium Silicate-CO_2 Mould and otherResin mould.

Practical Content:

- Demonstratethe procedure of Core Making
- Preparation of core from different types of sand mixtures.
- Demonstrate of the two basic mould making procedures: (i) Hand Moulding (ii) Machine Moulding.
- Demonstrate of methods of hand ramming using a rammer.
- Demonstrate of different methods of machine ramming in hand-moulding such asJolting, Squeezing, Sand Slinging, VacuumMoulding.
- Step by step process of preparing, assembling of moulds and cores.
- Demonstrate of the procedure for finishing, cleaning of loose particles and storing the mould and core after making.
- Prepare green sand mould, dry sand mould, skin-dried mould, loam mould, shell mould, investment mould, Sodium Silicate-CO_2 mould and other resin bonded mould by Hand-Moulding.
- Visual inspection and checking of Mould-Hardness variation throughout the mould.
- Casting of samples from each category of mould with any low melting metal such as Aluminium and evaluation of the casting.

Tools & Equipment Needed :

Bellow(SandBlower), Brush, Lifter, Cleaner, DustBag, Gaggers, Heart&Square, PeenRammer, HandRammer, FloorRammer, HandRiddle, SpruePin&SprueCutter, SprayGun, SpiritLevel, Springs&Nails, Shovel, VentWire, GateCutter, InsideSquare.

Module No 6: On Job Training

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 biodata
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	AssessmentCriteria
1	Apply safe working practice	**Aftercompletionofthismodulestudentswillbeableto:** 1.1 Explain the importance of safety and general precautions in the industry 1.2 Describe the role and use of Personal Protective Equipment (PPE). 1.3 Identify hazards and apply methods of accident avoidance. 1.4 Explain the principles and importance of first aid in workplaces. 1.5 Differentiate between types of fire extinguishers and demonstrate their proper use.

Module No.	Outcome	AssessmentCriteria
2	Demonstrate the procedure of sand casting	**Aftercompletionofthismodulestudentswillbeableto:** 2.1 Demonstrate different types of casting processes and their applications. 2.2 Interpret drawings for patterns and cores. 2.3 Select appropriate sand type, casting method and heat treatment for a given casting. 2.4 Explain parting lines, draft angles, taper and shrinkage allowances on patterns. 2.5 Use cope-drag patterns, core boxes and match plates correctly. 2.6 Verify casting dimensions and core placements according to drawing specifications.
3	Apply patterns and core boxes in mould making and casting processes	**Aftercompletionofthismodulestudentswillbeableto:** 3.1 Explain the various types of patterns and their uses in mould making. 3.2 Prepare mould cavities with patterns and core prints. 3.3 Create hollow or complex sections by correctly placing cores in the mould. 3.4 Illustrate the function of runners, gates and risers for proper metal flow. 3.5 Apply allowances, draft angles and material selection principles to ensure accurate casting. 3.6 Demonstrate proper handling, cleaning and storage of patterns, core boxes and castings.
4	Prepare different types of sand mixture for moulding and core making in foundry operations.	**Aftercompletionofthismodulestudentswillbeableto:** 4.1 Identify different sources of moulding and core-making sand. 4.2 Distinguish between natural, synthetic and loam sands. 4.3 Measure and mix sand with binders, water and additives correctly. 4.4 Prepare green sand and resin sand mixes accurately. 4.5 Describe sand properties like refractoriness, permeability, strength and flowability. 4.6 Explain casting defects caused by improper sand use. 4.7 Measure the correct proportions of sand, clay and additives for different mixes. 4.8 Prepare moulding sand thoroughly by mixing sand, clay, additives and water. 4.9 Describe the properties of moulding sand, such as strength, flowability and permeability. 4.10 Perform sand reclamation using dry, wet, thermal, and combined methods 4.11 Apply mould and core coatings to improve surface finish and dimensional accuracy

Module No.	Outcome	AssessmentCriteria
5	Demonstrate the procedures of Moulding, Core Making and Finishing Processes.	**Aftercompletionofthismodulestudentswillbeableto:** 5.1 Identify different types of cores and moulds used in foundry processes. 5.2 Demonstrate the procedures for core making and mould preparation. 5.3 Demonstrate manual and machine ramming methods during hand moulding. 5.4 Prepare core sand by mixing base sand with appropriate binders and additives. 5.5 Demonstrate the proper techniques for finishing moulds and cores after making. 5.6 Illustrate the importance of core prints, core venting and vent holes in moulds.
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

ListofTools,Equipment&Materialsneededfor30Trainees(Practical):

Sl No	ItemsName	Specification	Qty
1	MaxnumberandvarietiesofPatterns.	NA	Any
2	Maxnumber ofready Core Boxes.	NA	Any
3	Guidepins,DowelPins	NA	Any
4	VernierCalipers6”	6”	3
5	VernierCalipers12”	12”	3
6	OutsideCalipers3”	3”	3
7	OutsideCalipers6”	6”	3
8	InsideCalipers2”	2”	3
9	InsideCalipers4”	4”	3
10	HeightGauge12”	12”	1
11	StainlessSteelScale6”		3 Nos
12	StainlessSteelScale12”		3 Nos
13	SteelMeasuringTape3Mtr	3mtr	3
14	V-Blocks4”to6”measuringheights.		1Set
15	AngleProtractorsandTri Square	NA	3
16	FixedRightAngleProtractor.	NA	3
17	Divider	3”	3
18	DepthGauge3”	3”	3
19	WeighingScales/ Machines	5kg&50kg	1Each
20	Mould Boxes	12”&18”	3Sets Each
21	Spatula(AllShapes:asshowninthe equipment list above)	AlldifferentShapesas shown in Equipment List	Alltypesatleast6 Eachfor3 groups.

Sl No	ItemsName	Specification	Qty
22	Peen Rammer, Hand Rammer, Floor Rammer	NA	10
23	SpiritLevel	6”	3
24	Springs&Nails	½” to 2”	200Pcs Each
25	Shovel	Standard	3 Nos
26	VentWire	4mmØx 7” Long	20 Nos
27	GateCutter	1”x3” (L-Shaped)	20 Nos
28	InsideSquare(RefPics)	2”	8 Nos
29	Gaggers(Mouldreinforcers)	Bentononeendor both ends.	100NosofEach Types.
30	DustBag	100gmcapacity	8 Nos
31	Cleaner	L-Shaped,3”Long	10 Nos
32	Lifter	L-Shaped,2”Wx4” Long	10 Nos
33	Brush	1”	10 Nos
34	MagnifyingGlass	Standard	3 Nos
35	C-Clamp	12”	6 Nos
36	ClampingbarswithThreadedClamping Rods with Lock-Nuts & Suitable Washers.	Suitable for the availableMouldBoxes	12 sets

Marks Distribution

Outcome	Outcome Code	Type	Total Th marks	Total Pr marks	Total OJT marks
Apply safe working practice	I&S/2002/OC1	Compulsory	10	110	0
Demonstrate the procedure of sand casting	I&S/2002/OC2	Compulsory	20	110	0
Apply patterns and core boxes in mould making and casting processes.	I&S/2002/OC3	Compulsory	20	110	0
Prepare different types of sand mixture for moulding and core making in foundry operations.	I&S/2002/OC4	Compulsory	50	160	0
Demonstrate the procedures of Moulding, Core Making and Finishing Processes	I&S/2002/OC5	Compulsory	50	160	0
Work in real job situation with emphasis on basic safety and hazards	I&S/2002/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**					