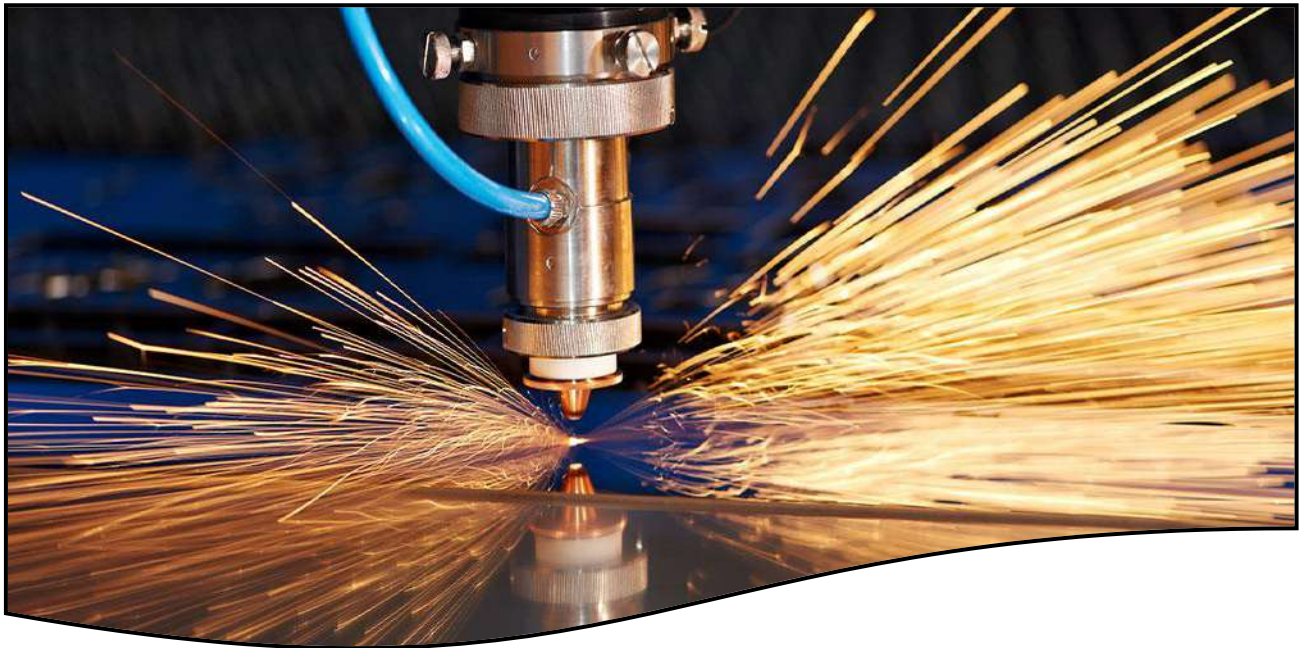




GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

Advanced Diploma (Vocational) in Welding Technology



Sector - Capital Goods & Manufacturing



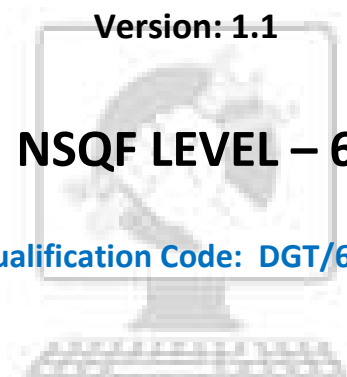
Advanced Diploma (Vocational) in **WELDING TECHNOLOGY**

(Designed in 2019)

Version: 1.1

NSQF LEVEL – 6

Qualification Code: **DGT/6004**



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कौशल भारत - कुशल भारत

Developed By

Government of India

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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1. COURSE INFORMATION

Introduction:

The Ministry of Skill Development and Entrepreneurship is an apex organization for the development and coordination of the vocational training in our country. The Ministry conducts the vocational training programmes through the Craftsmen Training Scheme (CTS), Apprenticeship Training Scheme (ATS), under the Skill Development Initiative (SDI) Scheme, and Craftsmen Instructor Training Scheme (CITS) to cater the needs of different segments of the Labour market. The Directorate General of Training (DGT) acts as a central agency to advise Government of India in framing the training policy and coordinating vocational training throughout India. The day-to-day administration of the ITIs rests with the State Governments/ Union Territories.

Skill Diploma Initiative:

In addition to that, the Ministry has planned to start Skill Diploma courses to cater the need of demand raised on a comprehensive workforce requirement, under DGT gamut. The proposed skill diploma holders will be trained more on practical competencies (70% Practical & 30% Theory) rather than more of theoretical knowledge offered in polytechnic/Diploma colleges.

The necessity of Advanced Diploma (Vocational) in Welding:

Welding is a process that most of the manufacturing industries depend upon and many automobile, aerospace, petrochemical and infrastructure industries need the help of welders and welding technology in their manufacturing. The fabrication Industries are having steady market growth as the steel usage is inevitable in the world.

Different types of welding have been used in the industries and in general, many industries use the few common welding process. When we consider the old technology of welding, it has many disadvantages and it is due to the lack in technological development. Later on the technology developed and many new welding methods have been introduced.

Hence the requirement of workforce is always exists in the arena. Welders, welding Supervisors, Welding Inspectors, Non destructive Testing Technicians are the category of workforces required in Industries

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Benefits:

Industry Advantage:

The Ministry of skill Development & Entrepreneurship will provide a pool of welding personnel at shop floor supervisor cum welder level, trained to international bench mark for industry. This will also enable industry to take challenges in the Fabrication product development and manufacturing.

Career for Welding Professionals:

Welding is a key technology and competency required for the fabrication and construction industries and requires qualified persons at various levels of skill and knowledge. The Advanced Diploma (Vocational) offers opportunity for upward career progression for the NTC (DGT) certificate holders. There is enormous scope to obtain national and overseas appointment for Advanced Diploma (Vocational) holders starting from the ground level welder to welding engineer.

Course Particulars:

In this Advanced Diploma (Vocational) in Welding Technology, the trainee is trained on **Five Core modules** each of 320 hours duration in first year. Each Core module contains professional skill & professional knowledge. In addition to this, the trainee is entrusted with the project work and extracurricular activities to build up confidence. In second year there are three electives where trainee has to select any of two elective modules, each module containing 320 hours duration with total duration of 640 hours. The trainee will be trained in Industry for 800 hours (as a part of on-the-job training). There will be a common subject for all courses on **Employability Skills** which will be for 160 hours in second year. The module wise course coverage is categorized as below:-

Core Module 1 (Welding Process & Power Source): On completion of this module, trainees should be able to work efficiently and perform different welding methods such as Shielded metal arc welding (SMAW), Gas tungsten arc welding (GTAW). Gas metal arc welding (GMAW), Flux-cored arc welding (FCAW) etc. During this course students will be taught on working principles, equipments, welding techniques, defects of various welding methods. Also knowledge about the welding power sources, construction features and maintenance aspects will be taught to the participants.

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Core Module 2 (Advanced Welding & Cutting Processes): On completion of this module, trainees should be able to understand working principles and work with Submerged arc welding machines, Resistance welding machines, Plasma welding & Cutting equipments. This module also covers basic principle of Laser Beam Welding, Electron Beam Welding, Laser cutting, under water welding, water jet cutting and Friction welding.

Core Module 3 (Welding Mechanisation, Automation & Standards): On completion of this course, trainees should be able to understand welding mechanization & automation and principles of Robots welding and CNC cutting operations. Theoretical knowledge and practical skills will also be imparted on automation Sensors, pneumatic and electronic controls etc. During this course students will be able to understand use of welding codes and standards (Indian and foreign standards). Also, they will get an exposure to the computer aided drafting & manufacturing (CAD/CAM) and also to read & interpret fabrication drawing.

Core Module 4 (Workshop Technology): On completion of this module, trainees should be able to operate the various tools, shop floor outfits and machines used in the production process like Lathe machine, Milling machine, Grinding machine and Drilling machine. They should be able to interpret technical drawings and machining safely using appropriate machine tools to do jobs to the desired level of accuracy. They should be able to use various measuring equipments.

Core Module 5 (Welding Inspection & Non destructive Testing): On completion of this module, trainees should be able to understand about different types Non Destructive Testing methods. They will be able to understand the basic principle and operating techniques behind important NDT methods including Visual Testing (VT), Penetrant Testing (PT), Magnetic Particle Testing (MPT), Ultrasonic Testing (UT), Radiographic Testing (RT) and Eddy current Testing (ET).

Elective Module 1 (Heat treatment & Material Testing): On completion of this module, trainees should be able to perform different types of heat treatment processes like hardening, normalising, stress relieving. During this course students will be taught on material testing methods using universal testing machine, impact testing machines and hardness testing machines.

Elective Module 2 (Repair & Maintenance Welding): On completion of this module, trainees should be able to understand about Welding Metallurgy and Weldability of commercial Alloys. Laboratory work consists of welding metallurgy investigation on the welded samples and weldability testing for specific applications. The course includes hard facing of metals, metal spraying and repair & reclamation processes.

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Elective Module 3 (High Pressure Pipe Welding): On completion of this module, trainees should be able to understand about on pipe welding procedure and to perform pipe welding using SMAW & GTAW process. They will be able to analyze joints using fundamental knowledge of various material strengths, design welded joints using basic weld design principles, and apply the fundamentals of welded joints structures.

On the Job Training: In this module the trainees will be working/training in the Industry for 800 hours. They work as apprentices/Personnel.

Employability Skills: This module is common for all Advanced Diploma (Vocational) courses and the total period is 160 hours. In this module the trainees will improve

- English literacy such as Pronunciation, functional grammar, reading, writing, speaking and spoken English
- Learn communication skills, listening skills, motivational training, Facing interviews and behavioural skills.
- Understand concepts of Entrepreneurship, Project preparation and marketing analysis, Institutions support and Investment Procurement.
- Understand on productivity, its benefits, affecting factors, comparison with developed countries, personal finance management.
- Understand Safety, Health and Environment Education - Safety & Health, Occupational Hazards, Accident & safety, First Aid, Basic Provisions, Ecosystem, Pollution, Energy Conservation, Global warming, Ground Water, Environment.
- Understand benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment of Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.
- Understand Quality Tools: Quality Consciousness, Quality Circles, Quality Management System, Housekeeping.

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of Vocational Training courses catering to the need of different sectors of economy/ Labour market. The Vocational Training Programmes are delivered under aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes of DGT for propagating vocational training. Recently DGT has started Advanced Diploma (Vocational) for different streams and primarily implemented at DGT field institutes such as NSTIs, FTIs and AHI and planned to expand to State Directorates in future.

Welding Technology course is very much essential in the current scenario due to a lot of demand in Capital Goods & Manufacturing Sector. The course is for two years duration. In the first year there are five core modules each module is credit base and employable. Each module is of 320 hours and is very much independent. In second year the trainee will be taking two elective modules out of three electives each of 320 hours and will be doing on the job training in Industry for 800 hours. In addition the trainees will pick up employability skills for 160 hours. After passing out the training programme, the trainee will be awarded Advanced Diploma (Vocational) by DGT which has worldwide recognition.

Candidates need broadly to demonstrate that they are able to:

- Read and interpret technical parameters/ documents, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge & employability skills while performing jobs.
- Document the technical parameters related to the task undertaken.

2.2 CAREER PROGRESSION PATHWAYS

- Can pursue higher technical education like BE/B. Tech.
- Can start their own enterprise on concerned trade.
- On successful completion of this course, the candidates shall be gainfully employed in the following industries:
 - Structural Fabrication like bridges, Roof structures, Building & construction.
 - Automobile and allied industries
 - Site construction activities for power stations, process industries and mining.
 - Service industries like road transportation and Railways.
 - Ship building and repair
 - Infrastructure and defense organizations
 - In public sector industries and private industries in India & abroad.
 - Petrochemical industries etc
 - Offshore oil exploration, processing and cross country pipe lines.

2.3 COURSE STRUCTURE

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

S No.	Module	Course Element	Notional Training Hours
1	For five Core Modules	Professional Skill (Trade Practical)	1000
		Professional Knowledge (Trade Theory)	600
2	For two Elective Module	Professional Skill (Trade Practical)	400
		Professional Knowledge (Trade Theory)	240
3	Employability Skills		160
4	On the job training		800
	Total		3200

Core Components (3200 Hrs) :-

Name		Teaching Hours		Total Hours
		Practical	Theory	
Core Subjects (All Compulsory)				
1	Welding Processes and Power Sources	224	96	1600
2	Advanced Welding & Cutting Processes	224	96	
3	Welding Mechanisation, Automation & standards	224	96	
4	Workshop Technology	224	96	
5	Welding inspection and NDT	224	96	

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Elective Subjects (any two)				
6	Heat treatment & Material Testing	224	96	640
7	Repair & Maintenance Welding	224	96	
9	High Pressure Pipe Welding	224	96	
Industrial Training				
10	On the Job Training	800		800
Common Subjects				
11	Employability Skills	160		160
Total Hours of Training				3200

Note: 1. The trainee must complete all the 5 core modules
2. The trainee must select any of two elective courses from the given three elective options

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course at each module and at the end of the training programme as notified by Govt of India from time to time.

- The **Internal assessment** during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the template (Annexure – II).
- The final assessment will be in the form of **summative assessment**. The All India Trade Test for awarding Advanced Diploma (Vocational) will be conducted by DGT on completion of training as per guideline of Govt of India. The pattern and marking structure is being notified by govt of India from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects is 40%.

2.4.2 ASSESSMENT GUIDELINE

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

Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work



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

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Performance Level	Evidence
(a) Weightage in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	<ul style="list-style-type: none"> • Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b)Weightage in the range of above 75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	<ul style="list-style-type: none"> • Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Weightage in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	<ul style="list-style-type: none"> • High skill levels in the use of hand tools, machine tools and workshop equipment • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

Brief description of Job roles:

- i) **Supervisor and Foreman, Welding and Flame Cutting:** Supervisor and Foreman, Welding and Flame Cutting supervises welding and flame cutting operation in workshop and ensures correct working. Studies drawings and other details regarding welding or cuttings to be done and arranges for jigs and fixtures, if required. Explains joints to be made, precautions necessary to retain form or avoid cracking and burning, type of welding to be done, electrodes or welding rods to be used, flux to be applied, etc., to workers to ensure correct welding. Supervises work, enforces adaptation of prescribed precautionary measures regarding placement of gas cylinders, use of rubber gloves, welding shields, etc., and guides workers as necessary to achieve desired finish, size strengths, shape and other factors as specified. Checks welded or cut part with appropriate testing and measuring instruments and gets defects removed or rectified, if possible. Ensures maintenance of welding sets, torches, gas cylinders etc., and maintains scheduled production and discipline in section. May maintain production and material records and registers.
- ii) **Welder while doing Arc welding,** fuses metals using arc-welding power source and electrodes. Examines parts to be welded, cleans them and sets joints together with clamps or any other suitable device. Starts welding power source and regulates current according to material and thickness of welding. Connect one lead to part to be welded, selects required type of electrode and clamps other lead to electrode holder. Establish arc between electrode and joint and maintain it throughout the length of the joint.
- iii) **Welder, operates spot welding machine** to joint metal sheet by resistance welding method. Feeds metal sheets to be welded according to type of machine and welds them by pressing paddle, or by automatic arrangements.
- iv) **Welder while doing gas brazing,** joints metal parts by heating using flux and filler rods. Cleans and fastens parts to be joined face to face by wire brush. Apply flux on the joint and heats by torch to melt filler rods into joint. Allows it to cool down. Clean and examines the joint.
- v) **Welder while doing Gas Tungsten Arc welding** reads fabrication drawing, examines parts to be welded, cleans them and sets joints with clamps or any other suitable device. Selects suitable tungsten electrode, grinds the edges and fit in to the GTA welding torch. Selects gas nozzle and fit in to the GTA welding torch. Selects suitable filler rods and cleans them. Establish arc through across a column of highly ionized inert gas between work piece and Tungsten electrode. Melts the metal and deposit weld beads on metal surfaces by passing

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the suitable filler rod in to the weld puddle. Joins metal pieces such as Steel, Stainless steel and Aluminum metals.

- vi) **Welder while doing Gas Metal Arc welding** reads fabrication drawing, examines parts to be welded, cleans them and sets joints with clamps or any other suitable device. Connects work piece with earth cable. Connects the machine with suitable gas Cylinder, regulator and flow meter. Connects pre-heater when CO₂ is used as shielding gas. Selects suitable wire electrode, feed it to welding GMA Welding torch through wire feeder. Selects contact tip gas nozzle and fit in to the GMA welding torch. Preheats joints as required. Starts the Constant Voltage GMA welding machine, sets suitable welding voltage & wire feed speed and shielding gas flow, produces arc between work piece and continuously fed wire electrode. Melts the metal and deposit weld beads on the surface of metals or joins metal pieces such as Steel, and Stainless-steel metals.

Reference NCO-2015:

- i) 3122.4200 - Supervisor and Foreman, Welding and Flame Cutting
- ii) 7212.0200-Welder, Electric
- iii) 7212.0700-Welder, Resistance
- iv) 7212.0500-Brazer
- v) 7212.0105-Tungsten Inert Gas Welder
- vi) 7212.0303 -Gas Metal Arc Welder (MIG/MAG/GMAW)

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4. GENERAL INFORMATION

Name of the Course	Advanced Diploma (Vocational)in Welding Technology
NCO – 2015	3122.4200, 7212.0200, 7212.0700, 7212.0500, 7212.0105, 7212.0303
NSQF Level	Level 6
Duration	2 Years (3200 Hours)
Entry Qualification	NTC/NAC (Welder) or Diploma in Mechanical / Related Engineering Field.
Minimum Age	17 years as on first day of academic session.
Unit Strength (No. Of Student)	20
Space Norms	300 Sq. m
Power Norms	50 KW
Instructor’s Qualification for	
	<p>B.Voc /Degree in Mechanical / Metallurgy / Production Engineering/ Mechatronics from AICTE/ UGC recognized Universitywith two-year industrial experience in relevant field.OR Diploma in Mechanical or allied branch or relevant Advanced Diploma (Vocational) from DGT with five years industrial experience in relevant field.OR NTC/NAC in the Trade of “Welder or other similar trades”with seven years industrial experience in the relevant field.</p> <p>Essential Qualification: National Craft Instructor Certificate (NCIC) in related trade, in any of the variants under DGT.</p>
(iv) Employability Skill	<p>MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years’ experience with short term ToT Course in Employability Skills from DGT institutes. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills from DGT institutes.</p>
Minimum Age for Instructor	21 Years

5. NSQF LEVEL COMPLIANCE

NSQF level for **Advanced Diploma (Vocational) in Welding Technology**: Level 6

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

- a. Process
- b. Professional Knowledge
- c. Professional Skill
- d. Core Skill
- e. Responsibility

The Broad Learning outcome of **Advanced Diploma (Vocational) in Welding Technology** mostly matches with the Level descriptor at Level- 6.

The NSQF level-6 descriptor is given below:

Level	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
Level 6	Demands wide range of specialized technical skill, clarity of knowledge and practice in broad range of activity involving standard non standard practices.	Factual and theoretical knowledge in broad contexts within a field of work or study.	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study.	Reasonably good in mathematical calculation, understanding of social, political and reasonably good in data collecting organizing information and logical communication.	Responsibility for own work and learning and full responsibility for other`s works and learning.

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

6.1 LEARNING OUTCOMES (TRADE SPECIFIC)

1. Demonstrate welding of Mild steel in 1G/1F, 2G/2F, 3G/3F and 4G/4F positions by Shielded Metal Arc Welding process. (SMAW)
2. Plan and perform welding of Mild steel Plate and sheets by Gas Metal Arc Welding process. (GMAW)
3. Demonstrate welding of Mild steel Plate by FCAW process.
4. Plan and perform welding on of Mild steel Stainless steel & Aluminium sheets & pipes by Gas Tungsten Arc Welding. (GTAW)
5. Plan & operate Submerged Arc Welding machine to do weld joints.
6. Plan & operate Spot and Seam welding machines to do weld joints.
7. Cut & check metals using Plasma cutting system.
8. Demonstrate Friction and Ultrasonic welding to do weld joints.
9. Cut & check metals using laser cutting system.
10. Demonstrate welding of joints using Welding Robots.
11. Draft engineering drawings using 2D CAD software and plot CAD drawings.
12. Demonstrate cutting of metals using CNC Plasma cutting machine.
13. Plan & prepare WPS (Welding procedure specification) & PQR (Procedure Qualification Records).
14. Interpret ASME, ISO & IBR codes/standard/regulations.
15. Check functions of various pneumatic and electronic controls used in welding automation Industries.
16. Plan & operate lathe observing standard procedure and check for accuracy.
17. Plan & operate Milling machines involving different operations.
18. Plan & operate Drilling machine involving different hole machining operations.
19. Plan & operate different Grinding machines.
20. Plan & perform sheet metal fabrication works.
21. Demonstrate Visual Inspection Testing method.
22. Plan & perform Dye Penetrant Testing method.
23. Demonstrate Magnetic Particle Testing method.
24. Plan & perform Ultrasonic Testing method.
25. Demonstrate Radiographic Film Interpretation.
26. Demonstrate Eddy current testing method.

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27. Plan & measure the Rockwell hardness, Brinell, Vickers and Micro hardness on heat treated components.
28. Demonstrate annealing, normalizing, tempering, hardening, stress relieving and surface hardening processes.
29. Demonstrate preheating and post heat treatment on welds.
30. Plan & operate Universal Testing Machine to measure stress, strain, elongation, modulus of given metals & Carry out bend tests on UTM.
31. Plan & measure the impact energy of given material.
32. Plan & repair welding on ferrous & nonferrous metals.
33. Demonstrate welding of cast iron.
34. Demonstrate dissimilar metal welding.
35. Plan & perform hard facing of metal surfaces using SMAW processes.
36. Demonstrate Metal Spraying techniques.
37. Plan & perform pressure pipe welding in 5G & 6G positions.
38. Design simple welding Fixtures used in Fabrication Industries.
39. Fabricate and use welding fixtures.

6.2 LEARNING OUTCOMES (EMPLOYABILITY SKILLS)

1. Exhibit leadership qualities and entrepreneurship skills.
2. Apply organisational principles and practices using creative abilities and digital skills.
3. Organize work efficiently by self-management and effective communication.
4. Implement Continuous Professional Development (CPD) using emotional intelligence.

7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

LEARNING OUTCOMES (TRADE SPECIFIC)		
CORE MODULE 1: WELDING PROCESS & POWER SOURCE		
S No.	Learning Outcomes	Assessment Criteria
1	Demonstrate welding of Mild steel in 1G/1F, 2G/2F, 3G/3F and 4G/4F positions by Shielded Metal Arc Welding process. (SMAW).	1.1 Plan and select the type & diameter of electrode, welding Current type and polarity.
		1.2 Prepare weld metal edges as per drawing requirement
		1.3 Check and set Shielded metal arc welding power source and tack the pieces as per drawing requirement.
		1.4 Set up the tacked pieces in specific position.
		1.5 Deposit the weld maintaining appropriate arc length, electrode angle, welding speed, weaving technique and maintain safety aspects.
		1.6 Carryout cleaning the welded joint thoroughly.
		1.7 Inspect visually for soundness of the weld joint & check dimensions using weld gauges.
2	Plan and perform welding of Mild steel Plate and sheets by Gas Metal Arc Welding process. (GMAW).	2.1 Plan and select the type & diameter of electrode wire, contact tip, nozzle, and liner.
		2.2 Ensure proper functioning of wire feeder and set wire feed speed.
		2.3 Adjust shielding gas pressure according to the nozzle size
		2.4 Prepare weld metal edges as per drawing requirement
		2.5 Check and set welding power source and tack the pieces as per drawing requirement.
		2.6 Set up the tacked pieces in specific position.
		2.7 Deposit the weld maintaining appropriate arc length, electrode angle, welding speed, weaving technique and maintain safety precautions.
		2.8 Carryout cleaning the welded joint thoroughly.
		2.9 Inspect the weld joint using visual and Dye penetration Technique & check dimensions using weld gauges.
3	Demonstrate welding of Mild steel Plate by FCAW process. (FCAW).	3.1 Plan and select the FCAW diameter of electrode wire, contact tip and nozzle.
		3.2 Ensure proper functioning of wire feeder and set wire feed speed
		3.3 Adjust shielding gas pressure according to the nozzle size
		3.4 Prepare weld metal edges as per drawing requirement
		3.5 Check and set welding power source and tack the pieces as

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		per drawing requirement.
		3.6 Deposit the weld maintaining appropriate arc length, electrode angle, welding speed, weaving technique and maintain safety precautions.
		3.7 Carry out cleaning the welded joint thoroughly.
		3.8 Inspect the weld joint using visual and dye penetration technique & check dimensions using weld gauges.
4	Plan and perform welding on of Mild steel Stainless steel & Aluminium sheets & pipes by Gas Tungsten Arc Welding.(GTAW).	4.1 Plan and select the type & diameter of tungsten electrode, and proper nozzle size.
		4.2 Adjust shielding gas pressure according to the nozzle size
		4.3 Prepare weld metal as per drawing requirement
		4.4 Check and set welding power source and tack the pieces as per requirement.
		4.5 Deposit the weld maintaining appropriate arc length, Torch angle, welding speed, and maintain safety precautions.
		4.6 Inspect the weld joint using visually for the soundness of the weld.

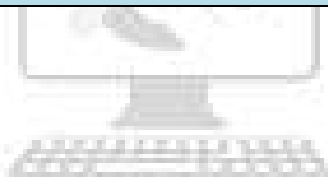

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CORE MODULE 2: ADVANCED WELDING & CUTTING PROCESSES		
S No.	Learning Outcomes	Assessment Criteria
1	Plan & operate Submerged Arc Welding machine to do weld joints.	1.1 Plan and select the diameter of electrode wire and Shielding flux
		1.2 Ensure proper functioning of wire feeder and set wire feed speed, travel speed and current.
		1.3 Prepare weld metal edges as per drawing requirement by grinding or machining process.
		1.4 Check and set welding power source
		1.5 Set up the welding plates with proper fixing.
		1.6 Start the welding by maintaining appropriate welding speed, flux delivery and maintain safety precautions.
		1.7 Carryout cleaning the welded joint thoroughly.
		1.8 Inspect the weld joint using visual and Dye penetration technique & check dimensions using weld gauges.
2	Plan & operate Spot and Seam welding machines to do weld joints.	2.1 Plan & select spot and seam welding electrode size.
		2.2 Cut the sheet metal to required size.
		2.3 Check and set welding power source
		2.4 Set and maintain appropriate water and air pressure.
		2.5 Plan & set spot welding parameters according to type of metal and thickness
		2.6 Operate the Spot welding machine either manually or pneumatically.
		2.7 Inspect the weld for defects.
		2.8 Repeat the process for different types of metals by adjusting the welding variables.
3	Cut & check metals using Plasma cutting system.	3.1 Plan and mark on Ferrous/Non ferrous metal plates surface for plasma cutting
		3.2 Select the torch/nozzle size, current and working pressure of gas as per requirement
		3.3 Set the marked plate properly on cutting table.
		3.4 Set the plasma cutting machine and perform the cutting operation by adapting proper techniques and safety aspects.
		3.5 Examine the cutting surface finish.
4	Demonstrate Friction and Ultrasonic welding to do	4.1 Plan & Prepare samples for Friction welding.
		4.2 Set the welding parameter for Friction welding.

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	weld joints.	4.3	Demonstrate operation of Friction welding machine.
		4.4	Inspect the weld for defects.
		4.5	Plan & Prepare samples for Ultrasonic welding.
		4.6	Plan & set the welding parameter for Ultrasonic welding.
		4.7	Demonstrate operation of Ultrasonic welding machine.
		4.8	Inspect the weld for defects.
5	Cut & check metals using laser cutting system.	5.1	Plan and mark on Ferrous/Non ferrous metal plate surface for laser cutting
		5.2	Select the torch/nozzle size, current and working pressure of gas as per requirement
		5.3	Set the marked plate properly on cutting table.
		5.4	Set the laser cutting machine and perform the cutting operation by adapting proper techniques and safety aspects.
		5.5	Examine the cutting surface finish.



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CORE MODULE 3: WELDING MECHANISATION, AUTOMATION& STANDARDS		
SNo.	Learning Outcomes	Assessment Criteria
1	Demonstrate welding of joints using Welding Robots.	1.1 Check Robot cell components and axis for performance.
		1.2 Program and Move robot in World coordinate system.
		1.3 Program and Move robot in axis coordinate system.
		1.4 Demonstrate Robot program to move in linear path.
		1.5 Demonstrate Robot program to move in circular path.
		1.6 Create point to point program.
		1.7 Set up welding plate on the welding manipulator with clamps.
		1.8 Select welding parameters and Gas flow rates.
		1.9 Execute Robot welding program to weld plates.
		1.10 Inspect the weld quality for defects.
2	Draft engineering drawings using 2D CAD software and plot CAD drawings.	2.1 Draft simple welding structures using Draw comments.
		2.2 Demonstrate changes using Modify comments.
		2.3 Demonstrate dimensioning the drawing.
		2.4 Plan & insert appropriate welding symbols for easy interpretation.
		2.5 Plot the drawing.
		2.6 Covert 2D drawing in the machine codes using CAM software.
3	Demonstrate cutting of metals using CNC Plasma cutting machine.	3.1 Check the CNC controller Keys and its function.
		3.2 Retrieve the standard cutting profiles and dimension the profiles.
		3.3 Set the cutting machine parameters.
		3.4 Demonstrate operation of the machine.
		3.5 Plan & draw the non standard cutting profile in CAD.
		3.6 Convert the CAD drawing in to CNC control program using CAM software.
		3.7 Plan & transfer the program in to the controller.
		3.8 Demonstrate dry run the program.
		3.9 Execute the CNC cutting machine with required setting.
		3.10 Inspect the cut piece for dimension and finish.
4	Plan & prepare WPS (Welding procedure specification) & PQR (Procedure Qualification)	4.1 Write a welding procedure specification for given job (WPS).
		4.2 Plan to fabricate sample piece as per the guide lines of WPS.
		4.3 Record the parameters used.
		4.4 Test the specimen as per Inspection requirement.

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	Records).	4.5 Plan & Prepare the Procedure Qualification record (PQR).
5	Interpret ASME, ISO & IBR codes/standard/regulations.	5.1 Interpret Structural welding code for given drawing 5.2 Apply Structural code requirements on a Fabrication drawing 5.3 Interpret pressure vassal welding code for given drawing 5.4 Apply pressure vassal code requirements on a Fabrication drawing
6	Check functions of various pneumatic and electronic controls used in welding automation Industries.	6.1 Check solenoid valves symbolically. 6.2 Demonstrate the functionality of solenoid valves. 6.3 Check the functions of proximity sensors. 6.4 Demonstrate the functionality of different types of sensors. 6.5 Assemble and demonstrate pneumatic circuits using the valves and sensors



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CORE MODULE 4: WORKSHOP TECHNOLOGY		
S No.	Learning Outcomes	Assessment Criteria
1	Plan & operate lathe observing standard procedure and check for accuracy.	1.1 Select tools for Plain turning operation.
		1.2 Calculate and select parameters.
		1.3 Demonstrate plain turning operation.
		1.4 Measure the dimensions and record the values
		1.5 Plan and perform profile turning.
		1.6 Plan and perform Knurling operation on different materials.
		1.7 Plan and perform taper turning-External and Internal.
		1.8 Plan and perform boring and counter boring.
		1.9 Plan and perform blind Hole boring.
		1.10 Plan and perform threading operation.
2	Plan & operate Milling machines involving different operations.	2.1 Select tools for face milling operation.
		2.2 Calculate and select parameters.
		2.3 Demonstrate face milling operation.
		2.4 Measure the dimensions and record the values
		2.5 Plan and perform end milling operations
		2.6 Plan and perform milling a right angled block with surface finish.
		2.7 Plan and perform Milling a slot and angular milling.
3	Plan & operate Drilling machine involving different hole machining operations.	3.1 Select tools for drilling operation.
		3.2 Calculate and select parameters.
		3.3 Demonstrate drilling operation.
		3.4 Measure the dimensions and record the values
		3.5 Plan and perform reaming
		3.6 Plan and perform counter boring.
		3.7 Plan and perform counter sinking.
		3.8 Plan and perform Spot facing.
		3.9 Plan and perform Machine tapping.
4	Plan & operate different Grinding machines.	4.1 Select tools for surface grinding operation.
		4.2 Calculate and select parameters.
		4.3 Demonstrate Surface grinding.
		4.4 Measure the dimensions and record the values
		4.5 Plan and perform Bench grinding.

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		4.6 Plan and perform pedestal grinding.
5	Plan &perform sheet metal fabrication works.	5.1 Select sheet metal for fabrication.
		5.2 Calculate the sheet metal requirement.
		5.3 Develop pattern on sheets using parallel line method.
		5.4 Fabricate the job using appropriate sheet metal technique.
		5.5 Plan and develop pattern on sheets using radial line method.
		5.6 Plan and develop pattern on sheets using triangular line method.
		5.7 Plan and perform rolling works on flat sheets.
		5.8 Plan and perform Forming works on flat sections.
		5.9 Plan and perform bending works.
		5.10 Fabricate a riveted joint.



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CORE MODULE 5: WELDING INSPECTION & NON-DESTRUCTIVE TESTING		
S No.	Learning Outcomes	Assessment Criteria
1	Demonstrate Visual Inspection Testing method.	1.1 Check defects noticed on the outside of the given specimen.
		1.2 Demonstrate dimensional inspection using welding gauges.
		1.3 Plan & Prepare the Visual Inspection report considering reference standard.
2	Plan & perform Dye Penetrant Testing method.	2.1 Plan & Perform Dye penetrant test on the given specimen using Red dye.
		2.2 Plan & Perform Dye penetrant test on the given specimen using fluorescent dye.
		2.3 Evaluate the test pieces.
		2.4 Plan & Prepare Inspection report.
3	Demonstrate Magnetic Particle Testing method.	3.1 Plan & Perform Magnetic Particle test on the given specimen using Electromagnetic principles: Headshot techniques.
		3.2 Plan & Perform Magnetic Particle test on the given specimen using Electromagnetic principles: Coil techniques.
		3.3 Plan & Perform Magnetic Particle test on the given specimen using Electromagnetic principles: Central conductor techniques.
		3.4 Plan & Perform Magnetic Particle test on the given specimen using Electromagnetic principles: Prod type techniques.
		3.5 Plan & Perform Magnetic Particle test on the given specimen using permanent magnet principles.
		3.6 Evaluate the test pieces.
		3.7 Plan & Prepare Inspection report.
		3.8 Demagnetise the samples after test.
4	Plan & perform Ultrasonic Testing method.	4.1 Calibrate the normal probe using test block.
		4.2 Plan Ultrasonic Test using normal probe for detecting the defects in the given sample and perform.
		4.3 Evaluate the test pieces.
		4.4 Plan & Draw a DAC curve using the test specimen.
		4.5 Plan & Draw DGS curves.
		4.6 Calibrate angle beam probe.
		4.7 Inspect a weld specimen.
		4.8 Evaluate the result.
		4.9 Plan & Prepare Inspection report.
5	Demonstrate Radiographic	5.1 Identify welding defects the radiographic reference standard

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	Film Interpretation.	for various defects.
		5.2 Evaluate the given radiographic film.
		5.3 Plan & Prepare Inspection report.
6	Demonstrate Eddy current testing method.	6.1 Calibrate the equipment using standard block.
		6.2 Plan & Perform eddy current testing on a given specimen.
		6.3 Evaluate the result.
		6.4 Plan & Prepare inspection report.



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Elective 1: Heat Treatment & Material Testing		
S No.	Learning Outcomes	Assessment Criteria
1	Plan & measure the Rockwell hardness, Brinell, Vickers and Micro hardness on heat treated components.	1.1 Prepare specimen for doing Rockwell hardness test
		1.2 Test the Specimen using Rockwell hardness tester.
		1.3 Plan & Prepare Inspection report.
		1.4 Prepare specimen for doing Brinell hardness test on a given material.
		1.5 Test the Specimen using Vickers hardness tester
		1.6 Plan & Prepare Inspection report.
		1.7 Prepare specimen for doing Micro hardness test on a given material.
		1.8 Test the Specimen using Micro hardness tester
		1.9 Plan & Prepare Inspection report.
2	Demonstrate annealing, normalizing, tempering, hardening, stress relieving and surface hardening processes.	2.1 Select temperature for hardening of a given material.
		2.2 Plan and perform Hardening of a given material on different quenching medium.
		2.3 Measure hardness value using harness tester
		2.4 Plan and perform Annealing method of heat treatment on a sample and evaluate the result.
		2.5 Plan and perform Normalising method of heat treatment on a sample and evaluate the result.
		2.6 Plan and perform Tempering method of heat treatment on a sample and evaluate the result.
		2.7 Plan and perform Stress relieving method of heat treatment on a sample and evaluate the result
		2.8 Plan and perform Surface hardening method of heat treatment on a sample and evaluate the result
3	Demonstrate preheating and post heat treatment on welds.	3.1 Examine the material for requirement of preheating and post heating.
		3.2 Select the method for heat treatment.
		3.3 Calculate the temperature and duration.
		3.4 Plan and perform preheating and post heating.
		3.5 Record the temperature and duration.
4	Plan & operate Universal Testing Machine to measure stress, strain, elongation, modulus of given metals & Carry out bend	4.1 Prepare sample for tensile test.
		4.2 Calculate the required properties of material as per standard procedure.
		4.3 Plan & prepare the tensile test reports.
		4.4 Prepare the sample for Bend test.

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	tests on UTM.	4.5 Calculate the required properties of material as per standard procedure.
		4.6 Plan &prepare the bend test report
		4.7 Perform an impact test and calculate the required properties of material as per standard procedure.
5	Plan and measure Impact energy of a given material.	5.1 Prepare sample for Izod impact test.
		5.2 Calculate the required properties of material as per standard procedure.
		5.3 Plan &prepare the Izod impact test reports
		5.4 Prepare sample for Charpy impact test.
		5.5 Calculate the required properties of material as per standard procedure.
		5.6 Plan &prepare the Charpy impact test reports



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Elective 2: Repair & Maintenance Welding		
S No.	Learning Outcomes	Assessment Criteria
1	Demonstrate welding of cast iron.	1.1 Plan a repair procedure for Cast Iron components by CI filler rod using Oxy acetylene flame.
		1.2 Demonstrate Cast Iron repair welding by CI filler rod using Oxy acetylene flame.
		1.3 Inspect the welded item for acceptability.
		1.4 Plan a repair procedure for Cast Iron components by Bronze welding using Oxy acetylene flame.
		1.5 Demonstrate Cast Iron repair welding by Bronze welding using Oxy acetylene flame.
		1.6 Inspect the welded item for acceptability.
		1.7 Plan a repair procedure Cast Iron component by Arc welding using Nickel & Nickel alloy electrodes.
		1.8 Demonstrate Cast repair welding by Arc welding using Nickel & Nickel alloy electrodes.
		1.9 Inspect the joint for acceptability.
2	Plan & repair welding non ferrous metals.	2.1 Plan a repair procedure for Aluminium alloy components.
		2.2 Demonstrate Aluminium repair welding using appropriate welding technique.
		2.3 Inspect the repaired joint for acceptability
3	Demonstrate dissimilar metal welding.	3.1 Plan a repair procedure for dissimilar metal welding using silver brazing technique.
		3.2 Demonstrate dissimilar metal welding using silver brazing technique.
		3.3 Inspect the repaired joint for acceptability.
		3.4 Plan a repair procedure for dissimilar metal using Nickel electrode welding.
		3.5 Demonstrate dissimilar metal welding using Nickel electrode welding.
		3.6 Inspect the repaired joint for acceptability.
4	Plan & perform hard facing of metal surfaces using SMAW process.	4.1 Plan a hard facing procedure on metals to increase hardness properties of steel.
		4.2 Perform hard facing procedure on metals to increase hardness properties of steel using hard facing electrode
		4.3 Inspect the hardness value of the job.
5	Demonstrate Metal	5.1 Plan a cold spraying process using oxy-acetylene flame.

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Spraying techniques.	5.2	Perform cold spraying process using oxy-acetylene flame
	5.3	Inspect the dimension for correctness.
	5.4	Plan a hot spraying process using oxy-acetylene
	5.5	Perform hot spraying process using oxy-acetylene flame and Perform.
	5.6	Inspect the dimensions for correctness.



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Elective 3: High Pressure Pipe Welding		
S No.	Learning Outcomes	Assessment Criteria
1	Plan & perform pressure pipe welding in 5G & 6G positions.	1.1 Plan and weld root pass on pipes using cellulosic pipe welding electrodes by SMAW on down hand position.
		1.2 Plan and weld intermediate and cover pass on pipes using Low hydrogen electrode on down hand position.
		1.3 Inspect welded pipe Visually and Test by LPT.
		1.4 Plan and weld pipes in Horizontal position using positioner by SMAW.
		1.5 Inspect welded pipe Visual Inspection and Test by LPT.
		1.6 Plan and weld Root pass, Intermediate and cover pass welding of pipes in horizontal fixed position by SMAW.
		1.7 Inspect welded pipe visually and Test by LPT.
		1.8 Plan and weld Root pass, Intermediate and cover pass welding of pipes in inclined position by SMAW.
		1.9 Inspect welded pipe visually and Test by LPT.
		1.10 Plan and weld Root pass welding of pipes in inclined position by TIG.
		1.11 Plan and weld Intermediate and cover pass in inclined position by SMAW.
		1.12 Inspect welded pipe Visually and Test by LPT.
		1.13 Plan welding procedure for welding of pipes in by GMAW.
		1.14 Perform welding of pipes in by GMAW in fixed and Inclined position.
		1.15 Inspect welded pipe visually and Test by LPT.
		1.16 Fabricate simple welding fixture.
		1.17 Plan, weld and check Pipe & Plate Flange joint by GMAW.
		1.18 Plan & weld T & Y pipe joint welding by GMAW.
2	Design simple welding Fixtures used in Fabrication Industries.	2.1 Identify welding fixture requirement problem
		2.2 Design and draft a fixture to ease and save time for welding cycle
		2.3 Select suitable material for fabrication
3	Fabricate and use welding fixtures.	3.1 Plan and prepare the material for fabricating welding fixture
		3.2 Fabricate the welding fixture components including all machining activities
		3.3 Assemble the fixture
		3.4 Adopt and evaluate the usefulness

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LEARNING OUTCOME (EMPLOYABILITY SKILLS)	
Learning Outcomes	Assessment criteria
1 Exhibit leadership qualities and entrepreneurship skills.	1.1 Interact with varied individuals and convince them by resolving differences.
	1.2 Assess risk with risk analysis tools and take initiatives.
	1.3 Contemplate differently with an innovative mindset.
	1.4 Persevere under pressure with stress management.
	1.5 Develop healthy relationship with client.
	1.6 Choose opportunities, for entrepreneurship development, not obvious to others.
	1.7 Assess the competitive advantage of ideas.
	1.8 Identify customer or client requirements.
	1.9 Determine the commercial viability of ideas.
	1.10 Demonstrate sensitivities (political, commercial, environmental, cultural, and so on).
	1.11 Identify opportunities for setting up business.
2 Apply organisational principles and practices using creative abilities and digital skills.	2.1 Evaluate productivity for projecting deadlines.
	2.2 Work under pressure and tight deadlines.
	2.3 Organize the workload to meet with the timelines.
	2.4 Prioritize the tasks.
	2.5 Visualize a business idea end-to-end.
	2.6 Conceptualize an idea.
	2.7 Transform notions into business ideas.
	2.8 Write strong and effective emails for communication.
	2.9 Use digital tools like laptops, palmtops, mobiles, fax machines, printers, projectors, conferencing tools effectively.
	2.10 Strong understanding of emerging technologies.
	2.11 Good understanding of information security aspects.
	2.12 Convert textual content into graphs, images, charts, diagrams and flow charts.
3 Organize work efficiently by self-management and effective communication.	3.1 Exhibit personal vision and goals.
	3.2 Evaluate and monitor his/her own performance.
	3.3 Exhibit knowledge and confidence in your own ideas and vision.

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	3.4	Articulate your own ideas and vision.	
	3.5	Exhibit responsibility.	
	3.6	Evaluate documents, drawings and recognize hazards in the work site.	
	3.7	Plan workplace/ assembly location with due consideration to the operational stipulation.	
	3.8	Communicate effectively with others and plan project tasks.	
	3.9	Assign roles and responsibilities of the co-trainees for execution of the task effectively and monitor the same.	
	3.10	Interact with stakeholders, whether it is internal in an organization or external with partners or clients, is fraught with opportunities for misunderstanding.	
	3.11	Exhibit formal presentations and informal presentations during meetings.	
4	Implement Continuous Professional Development (CPD) using emotional intelligence.	4.1	Exhibit professional development plan to enhance professional capabilities and interact successfully with colleagues and clients.
		4.2	Implement CPD to connect with people from different cultural backgrounds.


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Syllabus for Advanced Diploma (Vocational) in “Welding Technology”			
Core Module 1: Welding Process & Power Source: 320 Hrs			
Hour No.	Reference Learning outcome	Professional Skills (Trade Practical) (224 Hrs)	Professional Knowledge (Trade Theory) (96Hrs)
		(with indicative Hours)	
1-73	Demonstrate welding of Mild steel in 1G/1F, 2G/2F, 3G/3F and 4G/4F positions by Shielded Metal Arc Welding process. (SMAW).	Skills on SMAW Process (49 hrs) <ul style="list-style-type: none"> • Weld Fillet “T” joint on M.S. plate in Flat position.(3 Hrs) • Weld Fillet Lap joint on M.S. plate in Flat position.(3 Hrs) • Weld Fillet Corner joint on M.S. plate in Flat position.(3 Hrs) • Weld Single “V” on M.S. plate in Flat position.(5 Hrs) • Weld Fillet “T” joint on M.S. plate in Horizontal position.(3 Hrs) • Weld Fillet Corner joint on M.S. plate in Horizontal position.(3 Hrs) • Weld Single “V” butt joint on M.S. plate in Horizontal position. (5 Hrs) • Weld Fillet “T” joint on M.S. plate in Vertical position. (3 Hrs) • Weld Fillet Corner joint on M.S. plate in Vertical position. (3 Hrs) • Weld Single “V” butt joint on M.S. plate in Vertical position. (5 Hrs) • Weld Fillet “T” joint on M.S. 	Arc physics, Arc welding Power Sources etc. (24 Hrs) <ul style="list-style-type: none"> • Arc physics: Electric Discharge phenomena, arc discharge, Arc temperature distribution, Arc characteristics, Forces acting on metal transfer, Arc starting methods. • Arc welding Power sources: Characteristics, Working principles of Transformers, Rectifiers - Diode & Thyristor control, Generators, Inverters, Selection factors, Maintenance. • Shielded metal arc welding (SMAW): Principles, Process capabilities and limitations, power source, Electrodes & Classifications, welding procedures, defects, causes and remedy. Welding positions as per ISO and ASME. Safety practices. • Safety on welding • Autonomous maintenance of welding equipments

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		<p>plate in overhead position. (3 Hrs)</p> <ul style="list-style-type: none"> • Weld Single “V” butt joint on M.S. plate in overhead position. (5 Hrs) • Weld Structural pipe flange joint. (5 Hrs) 	
74-179	Plan and perform welding of Mild steel Plate and sheets by Gas Metal Arc Welding process (GMAW).	<p>Skills on GMAW Process(82 hrs)</p> <ul style="list-style-type: none"> • Weld Fillet “T” joint on M.S. Plate in Flat position.(3 Hrs) • Weld Fillet Lap joint on M.S. Plate in Flat Weld position. (3 Hrs) • Weld Fillet Corner joint on M.S. plate in Flat position.(3 Hrs) • Weld Single “V” joint on M.S. plate in Flat position.(5 Hrs) • Weld Fillet “T” joint on M.S. Plate in Horizontal position.(3 Hrs) • Weld Fillet Corner joint on M.S. Plate in Horizontal position.(3 Hrs) • Weld Single “V” butt joint on M.S. Plate in Horizontal position.(5 Hrs) • Weld Fillet “T” joint on M.S. Plate in Vertical position.(3 Hrs) • Weld Fillet Corner joint on M.S. Plate in Vertical position.(3 Hrs) • Weld Single “V” butt joint on M.S. Plate in Vertical position.(5 Hrs) • Weld Fillet “T” joint on M.S. Plate in overhead position.(3 	<p>Gas Metal Arc welding (GMAW) (24 Hrs)</p> <p>Principles, Process capabilities and limitations, applications, power source, Wire feeders, Welding torch types and configuration, Electrodes & Classifications, Modes of metal transfer, Shielding gases, welding procedures, defects, causes and remedy, and latest developments</p>

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		<p>Hrs)</p> <ul style="list-style-type: none"> • Weld Fillet Corner joint on M.S. plate in overhead position.(3 Hrs) • Weld Single “V” butt joint on M.S. plate in overhead position.(5 Hrs) • Weld Fillet “T” joint on S.S. Sheet in Flat position.(3 Hrs) • Weld Fillet Lap joint on S.S. Sheet in Flat position.(3 Hrs) • Weld Fillet Corner joint on S.S. Sheet in Flat position.(3 Hrs) • Weld Square butt joint on S.S. Sheet in Flat position.(3 Hrs) • Weld Fillet “T” joint on Aluminium Sheet in Flat position.(4 Hrs) • Weld Fillet Lap joint on Aluminium sheet in Flat position.(4 Hrs) • Weld Square butt joint on Aluminium sheet in Flat position.(4 Hrs) • Weld Single “V” butt joint on Aluminium plate in Flat position.(5 Hrs) • Weld of sheet metal by GMAW brazing process.(6 Hrs) 	
180-219	Demonstrate welding of Mild steel Plate by FCAW process (FCAW).	<p>Skills on FCAW Process(16 Hrs)</p> <ul style="list-style-type: none"> • Weld Fillet “T” joint on M.S.Plate in Flat position.(4 Hrs) • Weld Fillet Lap joint on M.S.Plate in Flat position.(4 Hrs) • Weld Fillet Corner joint on 	<p>Flux cored Arc welding (FCAW) (24 Hrs)</p> <p>Principles, Process capabilities and limitations, power source, Wire feeders, Welding torch types and configuration, Electrodes & Classifications, Metal transfer, Shieding gases,</p>

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		<p>M.S.plate in Flat position.(4 Hrs)</p> <ul style="list-style-type: none"> • Weld Single “V” butt joint on M.S.plate in Flat position.(4 Hrs) 	<p>welding procedures, defects, causes and remedy.</p>
220-320	<p>Plan and perform welding of Mild steel Stainless steel &Aluminium sheets & pipes by Gas Tungsten Arc Welding(GTAW).</p>	<p>Skills on GTAW Process(77 Hrs)</p> <ul style="list-style-type: none"> • Weld Square butt joint on M.S.Sheet in Flat position.(3 Hrs) • Weld Fillet “T” joint on M.S.Sheet in Flat position.(3 Hrs) • Weld Fillet Lap joint on M.S.Sheet in Flat position. (3 Hrs) • Weld Fillet Corner joint on M.S.Sheet in Flat position.(3 Hrs) • Weld root run on Single “V” butt joint on M.S. plate in Flat position.(5 Hrs) • WeldSquare but joint on M.S. plate in horizontal position. (3 Hrs) • WeldFillet “T” joint on M.S. Sheet in horizontal position.(3 Hrs) • Weld Fillet Corner joint on M.S. Sheet in horizontal position.(3 Hrs) • WeldSquare butt joint on M.S. Plate in vertical position.(3 Hrs) • Weld Fillet “T” joint on M.S. Sheet in vertical position.(3 Hrs) • Weld Fillet Corner joint on M.S.Sheet in vertical 	<p>Gas Tungsten Arc welding(GTAW)(24 Hrs)</p> <p>Principles, Process capabilities and limitations, applications, power source and polarity effects, Welding torch types and configuration, Tungsten electrodes & Classifications, Shielding gases, welding procedures, developments, defects, causes and remedy.</p>

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		<p>position.(3 Hrs)</p> <ul style="list-style-type: none"> • Weld Square butt joint on Aluminium Sheet in Flat position(4 Hrs) • Weld Fillet “T” joint on Aluminium sheet in down hand position.(5 Hrs) • Weld Fillet Lap joint on Aluminium Sheet in down hand position.(5 Hrs) • Weld Fillet Corner joint on Aluminium Sheet in down hand position.(5 Hrs) • Weld Single ‘V’ butt joint on Aluminium plate in down hand position.(5 Hrs) • Weld Square butt joint on Aluminium Sheet in horizontal position.(5 Hrs) • Weld Square butt joint on Aluminium Sheet in Vertical position.(5 Hrs) • Weld Titanium metal by GTAW.(8 Hrs) 	
		<p>Project Work/ Industrial Visit:</p> <ul style="list-style-type: none"> • A miniature model of wind Turbine or any other involving all the above process welding in it. 	
Revision			

Note : 1) Following weld joint preparation skills are common for all types of exercises mentioned above:

- a) Cut metal to size& straighten it
- b) Grind the edges as per drawing requirement
- c) Clean the joint edges
- d) Set the plate /sheet
- e) Perform tack weld at appropriate places
- f) Inspect the weld joint visually

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Syllabus for Advanced Diploma (Vocational) in “Welding Technology”			
Core Module 2 :Advanced Welding &Cutting Processes: 320 Hrs			
Hour No.	Reference Learning outcome	Professional Skills (Trade Practical) (224 Hrs)	Professional Knowledge (Trade Theory) (96 Hrs)
		(with indicative Hours)	
1-72	Plan & operate Submerged Arc Welding machine to do weld joints.	Skills on SAW Process (40hrs) <ul style="list-style-type: none"> • Cut M.S. Plate to required size as per drawing. (2 Hrs) • Prepare the edges as per the Single “V” butt joint dimensions. (2 Hrs) • Clean the edges. (2 Hrs) • Fit up on the machine with appropriate clamping. (2 Hrs) • Set copper backing bar.(2 Hrs) • Set welding parameters and weld with voltage variation (32V/35V/40v, 0.5m/min and 550A). (4 Hrs) • Prepare sample for Weld macro analysis. (4 Hrs) • Compare the bead pattern with voltage variation.(2 Hrs) • Set welding parameters and weld with current variation (32V, 0.5m/min and 350A/500A/650A). (4 Hrs) • Prepare Weld macro analysis sample. (4 Hrs) • Compare the bead pattern with current variation. (2 Hrs) • Set welding parameters and weld with welding speed 	Submerged Arc welding (SAW),Welding Metallurgy(32hrs) Submerged Arc welding (SAW): Principles, Process capabilities and limitations, applications, power source, Wire feeding system, Flux feeding and recovery systems, Electrodes & Classifications, Types of fluxes, welding procedures, developments, defects, causes and remedy. Welding Metallurgy: Metallurgical effect of welding, Weld metal solidification, Fe-C Diagram, TTT diagram, Metallurgical phases, Thermal effects of welding on parent metals, Heat affected zone(HAZ), Hydrogen embrittlement, Cold & Hot cracking phenomena, Weld decay.

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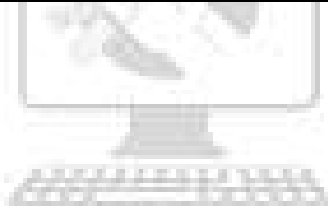
		<p>variation (32V, 0.5/1/1,5 m/min and 500A). (4 Hrs)</p> <ul style="list-style-type: none"> • Prepare Weld macro analysis sample. (4 Hrs) • Compare the bead pattern with welding speed variation. (2 Hrs) 	
73-130	Plan & operate Spot and Seam welding machines to do weld joints.	<p>Skills on Spot & Seam Welding Process (40hrs)</p> <ul style="list-style-type: none"> • Cut M.S. Sheet to required size. (2 Hrs) • File and clean the edges. (2 Hrs) • Set spot welding parameters for 1mm sheet. (2 Hrs) • Maintain water and air pressure. (2 Hrs) • Operate the Spot welding machine. (3 Hrs) • Inspect the weld for defects. (2 Hrs) • Perform Spot welding of 1.5mm thick M.S. Sheet by varying the parameters. (3 Hrs) • Perform Spot welding of 2mm thick M.S. sheet by varying the parameters. (3 Hrs) • Perform Spot welding of 1mm Stainless steel sheet by varying the parameters. (3 Hrs) • Set seam welding parameters for 0.5mm M.S sheet seam welding. (2 Hrs) • Maintain water and air pressure. (2 Hrs) • Operate the Seam welding 	<p>Resistance welding (RW):(18hrs)</p> <p>Principles, Process capabilities and limitations, applications, Classifications, welding techniques, power source, Electrode tip selection, surface preparation, welding parameters, developments, defects, causes and remedy</p>

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		<p>machine. (3 Hrs)</p> <ul style="list-style-type: none"> • Weld by adjusting the welding variables for 1mm M.S sheet.(3 Hrs) • Inspect the weld for defects. (2 Hrs) • Operate Stud welding gun to weld studs. (3 Hrs) • Operate Flash butt welding to weld metals. (3 Hrs) 	
131-180	<p>Cut & check metals using Plasma cutting system.</p>	<p>Skills on Plasma Cutting(40hrs)</p> <ul style="list-style-type: none"> • Set the cutting parameters. (2 Hrs) • Ensure the plasma gas pressure. (4 Hrs) • Cut the metal (SS or aluminium) to required size. (30 Hrs) • Examine the cutting surface finish. (4 Hrs) 	<p>Plasma Cutting (10hrs)</p> <p>Principles, advantages, Equipments, process variables, safety precautions</p>
181-320	<p>Demonstrate Friction and Ultrasonic welding to do weld joints.</p> <p>Cut & checkmetals using laser cutting system.</p>	<p>Skills on Special Welding systems(104hrs)</p> <p>Friction Welding</p> <ul style="list-style-type: none"> • Prepare samples for Friction welding. (4 Hrs) • Set the welding parameter for Friction welding. (4 Hrs) • Operate Friction welding machine. (12 Hrs) • Inspect the weld for defects. (4 Hrs) • Prepare samples for Ultrasonic welding. (4 Hrs) • Set the welding parameter for Ultrasonic welding. (4 Hrs) • Operate Ultrasonic welding machine. (8 Hrs) • Inspect the weld for defects. 	<p>Working and welding (36hrs)</p> <p>Principles& applications of</p> <ul style="list-style-type: none"> - Friction welding - Friction stir welding - Electro gas welding - Electro slag welding - Narrow gap welding - Laser welding - Ultrasonic welding - Under water welding - Electron beam welding - Laser cutting

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		(4 Hrs) Laser Cutting <ul style="list-style-type: none">• Set samples for Laser cutting. (20 Hrs)• Set the parameter for Laser cutting. (10 Hrs)• Operate Laser cutting machine. (20 Hrs)• Inspect the weld surface. (10 Hrs)	
Project Work/ Industrial Visit: <ul style="list-style-type: none">• A model of SS bellows or any other object involving all the above process cutting & special welding in it.			
Revision			



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Syllabus for Advanced Diploma (Vocational) in “Welding Technology”			
Core Module 3 :Welding Mechanization, Automation & Standards: 320 Hrs			
HOUR No.	Reference Learning outcome	Professional Skills (Trade Practical) (224 Hrs)	Professional Knowledge (Trade Theory) (96 Hrs)
		(with indicative Hours)	
1-104	Demonstrate welding joints using Welding Robots.	Skills on Robot Welding - (80 Hrs) <ul style="list-style-type: none"> • Check of Robot cell components and axis. (8 Hrs) • Move robot in World coordinate system. (6 Hrs) • Move robot in axis coordinate system. (6 Hrs) • Perform Robot program to move in linear path. (10 Hrs) • Perform Robot program to move in circular path. (10 Hrs) • Create point to point program. (10 Hrs) • Cut M.S. Plate to required size as per drawing. (4 Hrs) • Clean the edges. (2 Hrs) • Fit on the welding manipulator. (4 Hrs) • Set welding parameters and Gas flow rates. (4 Hrs) • Execute Robot welding program. (16 Hrs) 	Concept and types of welding mechanization& automation-(24Hrs) Major categorisation of mechanisation: Partially mechanised welding, Fully mechanised welding and Automatic welding. Moving head system, Moving work systems, Industrial welding robots: Anatomy, Programming and operation. Orbital welding.
105-208	Draft engineering drawings using 2D CAD software and plot CAD drawings.	Skill on CAD - (80Hrs) <ul style="list-style-type: none"> • Draw simple welding structures using “Draw” comments. (24 Hrs) • Perform changes Using 	CAD - (24Hrs) Use of Draw & Edit comments in fabrication drawing. Use of Dimensioning commands in detailing the drawings. Plot

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		<p>Modify comments. (24 Hrs)</p> <ul style="list-style-type: none"> • Perform dimensioning the drawing. (12 Hrs) • Insert appropriate welding symbols for easy interpretation. (6 Hrs) • Plot the drawing. (2 Hrs) • Covert 2D drawing in the machine codes using CAM software. (4 Hrs) • Read and interpret engineering/fabrication drawings. (8 Hrs) 	<p>commands usage in printing the drawing.</p>
209-246	Demonstrate cutting of metals using CNC Plasma cutting machine.	<p>Skills on CNC Gas/Plasma cutting (26Hrs)</p> <ul style="list-style-type: none"> • Check the CNC controller Keys and its function. (4 Hrs) • Retrieve the standard cutting profiles and dimension the profiles. (4 Hrs) • Set the cutting machine parameters. (2 Hrs) • Operate the machine. (2 Hrs) • Draw the non standard cutting profile in CAD. (4 Hrs) • Convert the CAD drawing in to CNC control program using CAM software. (2 Hrs) • Transfer the program in to the controller. (2 Hrs) • Perform dry run the program. (2 Hrs) • Operate the CNC cutting machine with required setting. (2 Hrs) • Check the cut piece for dimension and finish. (2 Hrs) 	<p>CAM software usage (12Hrs)</p> <p>CAM software usage in converting CAD drawings in machine codes</p>

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247-272	<p>Plan & prepare WPS (Welding procedure specification) &PQR(Procedure Qualification Records).</p> <p>Interpret ASME, ISO & IBR codes/standards/regulations.</p>	<p>Skill on Use of Codes (14 Hrs.)</p> <ul style="list-style-type: none"> • Write a Welding procedure specification for given job (WPS). (2 Hrs) • Prepare the sample piece as per the guide lines of WPS. (4 Hrs) • Record the parameters used. (2 Hrs) • Test the specimen. (4 Hrs) • Prepare the Procedure Qualification record (PQR). (2 Hrs) 	<p>Codes and standards etc. (12 Hrs.)</p> <p>Codes and standards used in welding.</p> <p>Awareness about ASME,IBR & ISO codes/standard/regulations</p> <p>Welding procedure specification</p> <p>Procedure qualification records</p> <p>Welding symbols: basic and Supplementary symbols, examples</p>
273-320	<p>Check functions of various pneumatic and electronic controls used in welding automation Industries.</p>	<p>Skill on Electronic & Pneumatic controls(24 hrs.)</p> <ul style="list-style-type: none"> • Check solenoid valves symbolically. (6 Hrs) • Check the functionality of solenoid valves.(6 Hrs) • Check the functions of proximity sensors.(4 Hrs) • Check the functionality of different types of sensors. (8 Hrs) 	<p>Electronic & Pneumatic controls(24 Hrs.)</p> <p>Principle and operation of pneumatic control valves (Direction control and solenoid valves)</p> <p>Principle and operation of electronic pneumatic controls (Proximity Sensors& types)</p> <p>Introduction to PLC and its application</p>
<p><u>Project work/Industrial visit:</u></p> <ul style="list-style-type: none"> • A suitable mass production component involving robot programming & operation in it. 			
<p>Revision</p>			

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Syllabus for Advanced Diploma (Vocational) in "Welding Technology"			
Core Module 4 : Workshop Technology: 320 Hrs			
HOUR No.	Reference Learning outcome	Professional Skills (Trade Practical) (224 Hrs)	Professional Knowledge (Trade Theory) (96 Hrs)
		(with indicative Hours)	
1-104	Plan & operate lathe observing standard procedure and check for accuracy.	Introduction workshop and Metals: 80 hrs. <ul style="list-style-type: none"> • Perform Plain turning. (8 Hrs) • Perform Step turning with. (12Hrs) corner radius and fillet. • Perform profile turning. (12 Hrs) • Practice Knurling operation on different materials. (8 Hrs) • Practice taper turning-External and Internal. (14 Hrs) • Perform boring and counter boring. (6 Hrs) • Perform blind Hole boring. (6Hrs) • Perform threading operation. (14 Hrs.) 	Related theory:24 hrs. General machine shop awareness. Tool designation as per ISO. Introduction to Lathe, functions and types. Introduction to Tool materials and tool selection. Different tool nomenclatures. Feed and thread cutting mechanisms. Lathe accessories and attachments. Lathe operations. Cutting tool signature. Calculations related to cutting speed, feed, taper turning and thread cutting, speed, feed, taper turning and thread cutting.
105-188	Plan & operate Milling machines involving different operations.	Skills on Milling machine operation:60hrs. <ul style="list-style-type: none"> • Perform face milling operation. (10 Hrs) • Perform end milling operations. (10 Hrs) • Perform milling a right angled block with surface finish. (20 Hrs) • Perform Milling a slot and angular milling. (20 Hrs.) 	Theory duration: 24 hrs. Introduction to Milling machines, types and mechanisms. Types of cutters. Importance of coolant and its preparation. Accessories and attachments used. Cutter holding devices. Milling process, Milling operations. Calculations related to spindle speed, feed, depth of cut and machining time.

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189-240	Plan & operate Drilling machine involving different hole machining operations.	Skills on Drilling machine operations:32hrs. <ul style="list-style-type: none"> • Perform drilling and Reaming operation.(8 Hrs.) • Perform counter boring. (4 Hrs.) • Perform counter sinking. (4 Hrs.) • Perform Spot facing. (8 Hrs.) • Perform Machine tapping. (8 Hrs.) 	Theory duration:20 hrs. Introduction function of drilling machine. Types of drilling machines and parts. Work holding devices.Tool holding devices. Different drilling operations. Speed, Depth of cut and time.
241-280	Plan & operate Grinding machines involving different operations.	Skills on Grinding machine operations:20 hrs. <ul style="list-style-type: none"> • Perform Surface grinding.(10 Hrs.) • Perform Bench grinding. (5 Hrs.) • Perform pedestal grinding. (5 Hrs.) 	Theory duration: 20hrs. Introduction to Grinding, Types and Mechanisms.Applications of Grinding.Work holding devices and attachments.Selection of Grinding wheel.Abrasives. Calculations on speed, feed, depth of cut and machining time.
281-320	Plan & perform sheet metal fabrication works	Skills on sheet Metal works:32 hrs. <ul style="list-style-type: none"> • Develop pattern on sheets using parallel line method. (4 Hrs.) • Develop pattern on sheets using radial line method. (5 Hrs.) • Develop pattern on sheets using triangular line method. (5 Hrs.) • Perform rolling works on flat sheets. (3 Hrs.) • Perform Forming works on flat sections. (3 Hrs.) • Perform bending works on frames. (6 Hrs.) • Make a riveted joint (6 Hrs.) 	Theory duration:08 hrs. Sheet metal works measuring and marking tools. Basic sheet metal process: cutting, shearing, seaming, folding, hemming. Development of pattern: Parallel line development, Radial line development, Triangular line development. Bending, Rolling and Forming operations. Riveted joints.

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Project work / Industrial visit:			
<ul style="list-style-type: none"> • A suitable component involving all the above machining operation involved in it. 			
Revision			
Syllabus for Advanced Diploma (Vocational) in “Welding Technology”			
Core Module 5 : Welding inspection and NDT: 320 Hrs			
Hour No.	Reference Learning outcome	Professional Skills (Trade Practical) (224 Hrs)	Professional Knowledge (Trade Theory) (96 Hrs)
		(with indicative Hours)	
1-27	Demonstrate Visual Inspection Testing method.	Skills on Visual Inspection: (15 Hrs) <ul style="list-style-type: none"> • Check defects noticed on the outside of the given specimen. (4 Hrs.) • Perform dimensional inspection using welding gauges. (4 Hrs.) • Prepare the Visual Inspection report considering reference standard. (4 Hrs.) • Perform fitup inspection. (3 Hrs.) 	(12 Hrs of Theory) Weld defects classifications, Types of defects and identification Visual Inspection procedure. Visual Inspection Tools, Weld Dimensional Inspection Tools. Acceptance criteria.
28-60	Plan & perform Dye Penetrant Testing method.	Skills on Dye Penetrant Test: (21 Hrs) <ul style="list-style-type: none"> • Perform Dye penetrant test on the given specimen using Red dye. (6 Hrs.) • Perform Dye penetrant test on the given specimen using fluorescent dye. (6 Hrs.) • Evaluate the test pieces. (2 Hrs.) • Prepare Inspection report. (5 Hrs.) • Clean the job after test. (2 Hrs.) 	(12 Hrs of Theory) Principles and operating procedure of Dye Penetrant Inspection, Advantages and limitations. Applications, Consumables used in this method. Acceptance criteria.
61-112	Demonstrate Magnetic Particle Testing method.	Skills on Magnetic Particle test: (40 Hrs) <ul style="list-style-type: none"> • Perform Magnetic Particle test on the given specimen using 	(12 Hrs of Theory) Principles and operating procedure of Magnetic particle

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		<p>Electromagnetic principles : Headshot techniques. (6 Hrs.)</p> <ul style="list-style-type: none"> • Perform Magnetic Particle test on the given specimen using Electromagnetic principles: Coil shot, techniques. (6 Hrs.) • Perform Magnetic Particle test on the given specimen using Electromagnetic principles: Central conductor techniques. (6 Hrs.) • Perform Magnetic Particle test on the given specimen using Electromagnetic principles: Prod type techniques. (6 Hrs.) • Perform Magnetic Particle test on the given specimen using permanent magnet principles. (6 Hrs.) • Evaluate the test pieces. (2 Hrs.) • Prepare Inspection report. (4 Hrs.) • Demagnetise the samples after test. (4 Hrs.) 	<p>inspection, Advantages and limitations, Applications, Types of magnetization techniques. Consumables used in this method. Acceptance criteria.</p>
113-228	Plan & perform Ultrasonic Testing method.	<p>Skills on Ultrasonic test: (80 Hrs)</p> <ul style="list-style-type: none"> • Calibrate the normal probe before testing. (10 Hrs.) • Perform UT using normal probe for detecting the defects on the given sample. (10 Hrs.) • Evaluate the test pieces. (10 Hrs.) • Draw a DAC curve using the test specimen. (10 Hrs.) • Draw DGS curves. (10 Hrs.) • Calibrate angle beam probe. (10 Hrs.) • Inspect a weld specimen. (10 	<p>(36 Hrs of Theory)</p> <p>Principles and operating procedure of Ultrasonic Inspection, Advantages and limitations, Equipment calibration, Probe calibration, DAC/DGS curve plotting methods, welding plate testing methods, Phased array technique, TOFD, UT applications, calibration blocks.</p>

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		<p>Hrs.)</p> <ul style="list-style-type: none"> Evaluate the result. (4 Hrs.) Prepare Inspection report. (6 Hrs.) 	
229-280	Demonstrate Radiographic Film Interpretation.	<p>Skills on Radiographic Interpretation: (40 Hrs)</p> <ul style="list-style-type: none"> Identify welding defects the radiographic reference standard for various defects. (16 Hrs.) Evaluate the given radiographic film. (16 Hrs.) Prepare Inspection report. (8 Hrs.) 	<p>(12 Hrs of Theory)</p> <p>Principles of Radiographic inspection, Advantages and limitations. X-rays, Gamma Rays methods, Study of radiographic reference standard, Radiographic Interpretation of weld samples. Digital radiography, Acceptance criteria.</p>
281-320	Demonstrate Eddy current testing method.	<p>Skills on Eddy current Testing: (24 Hrs)</p> <ul style="list-style-type: none"> Calibrate the equipment using standard block. (8 Hrs.) Perform eddy current testing on a given specimen. (8 Hrs.) Evaluate the result. (6 Hrs.) Prepare inspection report. (6 Hrs.) 	<p>(12 Hrs of Theory)</p> <p>Principles and operating procedure of Eddy current inspection, Advantages and limitations. Applications.</p>
<p><u>Project work / Industrial visit:</u></p> <ul style="list-style-type: none"> A suitable inspection of components involving all the above inspection techniques. 			
Revision			

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Syllabus for Advanced Diploma (Vocational) in “Welding Technology”			
Elective Subject 1: Heat Treatment and Material Testing : 320 Hrs.			
Hour No.	Reference Learning outcome	Professional Skills (Trade Practical) (224 Hrs)	Professional Knowledge (Trade Theory) (96 Hrs)
		(with indicative Hours)	
1-58	Plan & measure the Rockwell hardness, Brinell, Vickers and Micro hardness on heat treated components.	Skills on Hardness testing: (26Hrs) <ul style="list-style-type: none"> • Perform Rockwell hardness test HRC on a given material. (5 Hrs.) • Perform Rockwell hardness test- HRB on a given material. (5 Hrs.) • Perform Brinell hardness test on a given material. (5 Hrs.) • Perform Vickers hardness test on a given material. (5 Hrs.) • Perform hardness test on a given material using Poldi hardness test. (6 Hrs.) 	(32Hrs of Theory) Metals & alloys, Classification of steels, alloying elements Atomic bonding, solidification structure, crystal structure of metals Phase transformation, Solubility, Iron/carbon phase diagram, Time temperature transformation, CCT curves Hardness test: Brinell hardness test, Vickers hardness test, Rockwell hardness test.
59-204	Demonstrate annealing, normalizing, tempering, hardening, stress relieving and surface hardening processes. Demonstrate preheating and post heat treatment on welds.	Skills on Heat treatment of metals: (114Hrs) <ul style="list-style-type: none"> • Select hardening temperature of a given material. (18 Hrs.) • Perform Hardening of a given material on different quenching media. (8 Hrs.) • Perform low tempering of a hardened material. (8 Hrs.) • Perform medium tempering of a hardened material. (8 Hrs.) • Perform High tempering of a hardened material. (8 Hrs.) • Perform stress relieving of a given material. (8 Hrs.) • Perform pre weld heat 	(32Hrs of Theory) Heat treatment methods,- Annealing, Normalizing, Hardening & tempering and surface hardening methods. Stress relieving Heat treatment of welds-PWHT Temperature measurements.

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		<p>treatment of a welded component. (8 Hrs.)</p> <ul style="list-style-type: none"> • Perform post weld heat treatment of a welded component. (12 Hrs.) • Perform an annealing of work hardened material. (12Hrs.) • Perform a normalizing of a forged components. (12Hrs.) • Perform a flame hardening of a given material. (12Hrs.) 	
205-320	<p>Plan & operate Universal Testing Machine to measure stress, strain, elongation, modulus of given metals & Carry out bend tests on UTM.</p> <p>Plan & measure the impact energy of given material.</p>	<p>Skill on Mechanical testing of Metals: (84 Hrs)</p> <ul style="list-style-type: none"> • Perform tensile test and calculate the required properties of material as per standard procedure. (25Hrs.) • Perform a Bend test and calculate the required properties of material as per standard procedure. (17Hrs.) • Perform an impact test and calculate the required properties of material as per standard procedure. (25Hrs.) • Perform weld macro analysis. (17Hrs.) 	<p>(32Hrs of Theory)</p> <p>Mechanical Testing of Metals: Tensile test, Bend test, Weld tensile test: All weld metal test, Transverse weld test, Longitudinal butt weld test</p> <p>Impact test,</p> <p>Metallographic examination: Macro examination, Micro examination.</p> <p>Pressure testing</p> <p>Ferrite testing</p> <p>Positive metal identification (PMI).</p>
<p><u>Project Work/ Industrial Visit:</u></p> <p>A suitable Heat Treatment & Testing of components involving all the above techniques.</p>			
<p>Revision</p>			

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Syllabus for Advanced Diploma (Vocational) in “Welding Technology”			
Elective Subject 2 : Repair & Maintenance Welding: 320 Hrs.			
Hour No.	Learning outcome	Professional Skills (Trade Practical) (224 Hrs)	Professional Knowledge (Trade Theory) (96 Hrs)
		(with indicative Hours)	
1-136	<p>Plan & repair welding on ferrous & non ferrous metals.</p> <p>Demonstrate welding of cast iron.</p> <p>Demonstrate dissimilar metal welding.</p>	<p>Skills on Repair welding: (100Hrs)</p> <ul style="list-style-type: none"> • Repair Cast Iron components by using Cast iron filler rod using Oxy acetylene flame. (16 Hrs.) • Inspect the joint for acceptability. (4 Hrs.) • Repair Cast Iron components by Bronze welding using Oxy acetylene flame. (16 Hrs.) • Inspect the joint for acceptability. (4 Hrs.) • Repair Cast Iron components by Arc welding using Nickel & Nickel alloy electrodes. (16 Hrs.) • Inspect the joint for acceptability. (4 Hrs.) • Repair Aluminium alloy components. (8 Hrs.) • Inspect the joint for acceptability. (2 Hrs.) • Repair Carbon steel components. (8 Hrs.) • Inspect the joint for acceptability. (2 Hrs.) • Repair stainless steel components. (8 Hrs.) • Inspect the joint for acceptability. (2 Hrs.) • Weld dissimilar metals by silver brazing. (5 Hrs.) • Weld dissimilar metal by arc welding using Nickel electrodes. (5 Hrs.) 	<p>(36Hrs of Theory)</p> <p>Weldability of metals: Effects of alloying elements on weldability, Carbon equivalent, weldability testing, Welding characteristics of cast Iron and welding procedure, Welding procedure for Low carbon, medium carbon and high carbon steels. Welding procedure for Austenitic, Ferritic and Martensitic stainless steels, Welding procedure for aluminium and its alloys, Welding procedure for dissimilar metals, Welding procedure for titanium. Welding copper, Brazing & soldering.</p>

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137-220	Plan & perform hard facing of metal surfaces using SMAW processes.	Skills on Surfacing process: (60 Hrs) <ul style="list-style-type: none"> • Perform hard facing on metals to increase hardness properties of steel. (16 Hrs.) • Check the hardness value. (4 Hrs.) • Perform cold spraying process using oxy-acetylene flame. (16 Hrs.) • Check the dimension. (4 Hrs.) • Perform hot spraying process using oxy-acetylene flame. (16 Hrs.) • Check the dimensions. (4 Hrs.) 	(24Hrs of Theory) Hard facing of metals: Definition and concept, Objectives, Types of wear, Wear factors, Operation and steps involved in hard facing, hard facing alloys, Surfacing methods.
221-320	Demonstrate Metal Spraying techniques.	Skills on Thermal spraying process: (64 Hrs) <ul style="list-style-type: none"> • Perform oxy-acetylene flame spraying process for Surface coating.(28 Hrs.) • Inspect the surface quality.(6 Hrs.) • Perform arc spraying process for Surface coating by(24 Hrs.) • Inspect the surface quality. (6 Hrs.) 	(36Hrs of Theory) Metal spraying process: Classifications of thermal spraying, Advantages & Disadvantages, Flame spraying process, Electric arc spraying, Plasma arc spraying. Estimation of welding costs: Main components, Factors involved, Costing procedure.
Project Work/ Industrial Visit: <ul style="list-style-type: none"> • A shaft to be powder coated to 0.5mm or any other object involving all the above process powder spraying or hard facing. 			
Revision			

Note: 1) Following weld joint preparation skills are common for all types of exercises mentioned above:

- a) Perform the spark test on metals
- b) Remove metal from the defective place by Gouging (Carbon arc and oxy-acetylene flame) or Grinding method Clean the joint edges
- c) Prepare bevel the edges to required angle
- d) Clean the joint surface
- e) Select proper welding process & Select proper electrode

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Syllabus for Advanced Diploma (Vocational) in "Welding Technology"			
Elective Subject 3 :High Pressure Pipe Welding: 320 Hrs.			
Hour No.	Reference Learning outcome	Professional Skills (Trade Practical) (224 Hrs)	Professional Knowledge (Trade Theory) (96 Hrs)
		(with indicative Hours)	
1-320	<p>Plan & perform pressure pipe welding in 5G & 6G positions.</p> <p>Design simple welding Fixtures used in Fabrication Industries.</p> <p>Fabricate and use welding fixtures.</p>	<p>Skills on Pipe welding (224Hrs)</p> <ul style="list-style-type: none"> • Weld root pass on pipes using cellulosic pipe welding electrodes by SMAW. (8 Hrs.) • Weld intermediate and cover pass on pipes using Low hydrogen electrode. (8 Hrs.) • Weld pipes in 1G position using positioner by SMAW. (16 Hrs.) • Perform Visual Inspection of pipe. (4 Hrs.) • Inspect and clear using LPI test. (4 Hrs.) • Weld pipes in 2G position using positioner by SMAW. (16 Hrs.) • Inspect clear by LPI test. (4 Hrs.) • Weld Root pass welding of pipes in 5G position by SMAW. (16 Hrs.) • Weld Intermediate and cover pass on pipes in 5G position by SMAW. (16 Hrs.) • Inspect and clear by LPI. (4 Hrs.) • Weld Root pass welding of pipes in 6G position by SMAW. (16 Hrs.) • Weld Intermediate and cover 	<p>(96 Hours Theory)</p> <p>Pipe Welding procedure: Pipe schedule, Types, Edge preparation, joint nomenclature, Fit up procedure, Tack welding method, Root pas welding procedure by SMAW, Root pas welding procedure by GTAW, Intermediate and cover pass welding procedure, Cellulosic & Low hydrogen electrodes. Testing methods,</p> <p>Welding design: Principles of sound welding, Joint Design, Allowable stress for weld metal, Allowable fatigue strengths, Design of weld subjected to combined stresses, Computer aided welding design and analysis.</p> <p>Distortion and residual stress: Residual stresses, Concept of distortion, types of distortion, Controlling techniques.</p> <p>Welding Jigs & Fixtures: Consideration of fixture selection, Principles governing design of good fixture.</p>

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		<p>pass on pipes in 6G position by SMAW. (16 Hrs.)</p> <ul style="list-style-type: none"> • Inspect and clear by LPI. (4 Hrs.) • Weld Root pass welding of pipes in 6G position by GTAW. (8 Hrs.) • Weld Intermediate and cover pass in 6G position by SMAW. (8 Hrs.) • Inspect and clear by LPI. (4 Hrs.) • Weld root pass on pipes in 5G position by GMAW. (8 Hrs.) • Weld root pass welding of pipes in 5G position by GMAW. (8 Hrs.) • Weld Root pass on pipes in 6G position by GMAW. (8 Hrs.) • Weld Intermediate and cover pass on pipes in 6G position by GMAW. (8 Hrs.) • Inspect and clear by LPI. (4 Hrs.) • Fabricate simple welding fixture. (16 Hrs.) • Weld Pipe & Plate Flange joint by GMAW. (10 Hrs.) • Weld T & Y pipe joint welding by GMAW. (10 Hrs.) 	
	<p><u>Project Work/ Industrial Visit:</u></p> <ul style="list-style-type: none"> • GTAW welding fixture for welding SS sheet metal 1mm thick involving purging. 		
	Revision		

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Note : 1) Following weld joint preparation skills are common for all types of exercises mentioned above:

- a) Cut the pipe to required length
- b) Bevel of pipe edges to required angle
- c) Clean the joint surfaces
- d) Set the pipe with spacers
- e) Perform Tack weld pipes at 90 degree apart at 4 places by SMAW
- f) Inspect for fit up for uniform root gap



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9. SYLLABUS – EMPLOYABILITY SKILL

Reference Learning Outcome	1. Leadership Skills Duration : 20 Hrs.
1. Exhibit leadership qualities and entrepreneurship skills.	Leadership - Define leadership, types of leadership, leadership Traits, Functions of leadership, styles of leadership. Resolving Individual differences among people.
	Risk Analysis tools; estimate the risks that you could face in your role. In turn, this helps you manage these risks and minimize their impact on your plans. Break-even point analysis. Risk Value = Probability of Event x Cost of Event.
	Success stories / Best Practices – Inspection, inspect Demo displacement. Innovation has become one of the most popular buzz words of the Digital Age. Re-evaluate the true meaning of a concept than when it is being touted by individuals and companies around the world. Spark innovation, maximize productivity, and increase profitability as a result of implementing the Big Five behaviors.
	Stress management - Define Management, Type of stress Management, How to improve stress in workplace, Team leader in workplace.
	Manage relationships with client who may be confused with the services requirements. Build healthy client relationships and use customer centric approach.
	2. Entrepreneurship Skills Duration : 20 Hrs.
	Self Employment as a Career path - Define Entrepreneurship, Strategy of entrepreneurship, Market Research. Implementation of self Employment in workplace Ps, Mange self employment in workplace. Quality consciousness – its relevance.
	Study of Competitive Advantage Model. PEST factors for external changes and implement VRIO resources for getting an edge over the competitors.
	Ensure that environmental conditions are suitable for the client and the services to be carried. Deal with clients lacking the technical background to solve the problem on

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	their own.
	Immediate or temporary solutions to resolve delays.
	5 Strategies of handling sensitive issues (political, commercial, environmental, cultural, and so on) at workplace – 1. Define the issues, 2. Develop Policies Adhering to Company Goals, 3. Communicate Policies, 4. Hold People Accountable and 5. Continue to Evolve.
	Define marketing; Tools of marketing, 7 Ps define market strategy, important of market strategy, use of strategy in trade theory (Labour Market Information).
	3. Organizational Skills Duration : 20 Hrs.
2. Apply organisational principles and practices using creative abilities and digital skills.	Training & Managerial responsibilities Introduction & discussion on managerial responsibilities.
	Basic quality Concept & 5'S Colour Dynamics
	Follow the organisation's policies and procedures for working with colleagues.
	Time management - Workplace time Management, maintain Time management, Benefits of Time Management in workplace, Time management schedule.
	4. Creative Abilities Duration :20 Hrs.
	Boosting Morale - Boosting ethics & Development work environment, ethics theory, Development of work environment & training process, knowledge of presentation & self motivation.
	Five Dimensions to conceptualize your idea to make it a successful innovation. When conceptualizing an idea, it is essential to ask questions like what is the problem that the idea solves, who is the consumer for the idea, does the idea solve the consumer's problems and how will the

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	<p>solution be delivered to the consumer. It is very important to direct the thinking to specific dimensions and search answers to certain questions that help in evolving the idea from the initial thought through the various stages of innovation.</p>
	<p>The single most effective way to come up with a business idea is to solve a problem. Next step, you bring the idea to life. Whether it's code, carpentry, or culinary, a project is a created idea. When the project is nearly complete and it's time to begin putting the project into the hands of real people. Once your project is perfected through testing, it's time to come up with a way to make money from it. Growth - Get the word out about the thing.</p>
	<p>5. Digital Skills Duration : 20 Hrs.</p>
	<p>Write memos and e-mail to customers, co-workers, and vendors to provide them with work updates and to request appropriate information.</p>
	<p>Operate all types of digital tools like laptops, palmtops, mobiles, fax machines, printers, projectors, conferencing tools effectively.</p>
	<p>Attributes that feature in the emergence of novel technologies are: (i) radical novelty, (ii) relatively fast growth, (iii) coherence, (iv) prominent impact, and (v) uncertainty and ambiguity. The framework for operationalising emerging technologies is then elaborated on the basis of the proposed attributes.</p>
	<p>Understanding and adhering to the Information security aspects of the organization based on ISP.</p> <p>Information Security Policy (ISP) is a set of rules enacted by an organization to ensure that all users or networks of the IT structure within the organization's domain abide by the prescriptions regarding the security of data stored digitally within the boundaries the organization stretches its authority.</p>
	<p>Create or convert textual contents into graphical representation, charts, diagrams and flow charts. Learn to</p>

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	make graphs and charts in MS excel. Use of digital camera and other imaging tools. Use of MS-Powerpoint for developing diagrams and flowcharts.
	6. Self-Management Duration : 20 Hrs.
3. Organize work efficiently by self-management and effective communication.	Decision making pertaining to the concerned area of work. Decision making process.
	Identifying the strengths - SWOT Analysis. Define Swot analysis, Important of swot analysis, characteristics of swot analysis, Example of swot analysis related with Trade development in detail
	Apply, analyze, and evaluate the information gathered from observation, experience, reasoning, or communication, as a guide to thought and action.
	Use of multi-model strategies of articulation such as audio visual tools, kinaesthetic learning tools, etc.
	7 thoughts on taking responsibility at workplace-
	1. There is always a price to pay. 2. Build your self-esteem.3. Give yourself the permission to work as you want.4. Taking actions 5. Understand the limits of your responsibility. 6. Don't forget to take responsibility in everyday work life. 7. Aim to be your best self.
	7. Plan and organize the work related to the occupation Duration : 20Hrs.
	Prepare and organize service feedback files/documents.
The best way is to plan for workplace/ assembly location is to think of any emergency situation before it happens. Think clearly and logically in a crisis, so it is important to do so in advance with due consideration of the operational stipulation.	
Guidelines for delegating roles and responsibilities to co-trainees: 1. Identify key opportunities for delegation, 2. Establish a clear set of objectives for each task, 3. Play to your coworker's strengths, 4. Construct a timeline, 5. Use follow-up tasks to keep your workers on point, 6. Establish authority and respect, 7. Use a feedback loop to	

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	make future delegation easier.
	<p>8. Effective communication (written and verbal) Duration : 10 Hrs.</p>
	<p>Communication process & elements of communication.</p> <p>Maintain clear communication with colleagues (by all means including face-to-face, telephonic as well as written). Pass on information to stakeholders in line with organisational requirements both through verbal as well as non-verbal means. Principles of effective communication, body language, handling nervousness/ discomfort and dealing with barriers.</p>
	<p>Different Types of Communication Aids: Projected/ Non Projected using different types of board in a class room session. Black board, White board, Flannel board, Magnetic board etc.</p> <p>Application, use & maintenance of OHP, Digital Camera, LCD projector and Smart board. Preparation of slides in MS-Powerpoint and presentation of the slides.</p> <p>Handle FAQ session during meetings.</p>
	<p>9. Emotional intelligence Duration : 10 Hrs.</p>
4. Implement Continuous Professional Development (CPD) using emotional intelligence.	Work with colleagues to integrate work. Work in ways that show respect for colleagues.
	Getting it right from the very beginning, you'll most likely see things flourish. Spending ample time collecting information, allow client to share their knowledge and participate in the project.
	Adopt a flexible attitude, learn about the culture beforehand, expect differences, understand hierarchies, be upfront about difficulties in communication, be respectful & tolerant and be patient.

List of Tools& Equipment			
General Installation:(For a batch of 20 Candidates)			
Module 1: Welding Processes& Power Sources:			
S No.	Item Description	Specification	Qty
1.	Inverter based DC welding machine with accessories for MMAW application	400A at 60% duty cycle, OCV 60 – 80 V, IGBT Control, IP23 Enclosure Conformity to IEC 60974 & CE	10 sets
2.	MIG/MAG welding machine with accessories (Air cooled torch, Gas pre-heater, Nozzle and contact tips)	350A at 60% duty cycle, IGBT controlled digital welding system Degree of protection: IP23 Synergic Wire feeder Wire Feed mechanism: 4 roll	8sets
3.	Pulsed MIG welding machine	400 A, IGBT controlled digital welding system, Synergic Wire feeder Wire Feed mechanism: 4 roll	2 Sets
4.	AC/DC GTAW welding machine with accessories (water cooled torch 300 A, Argon regulator, Gas hose, water circulating system)	300 A at 60% duty cycle, IGBT Inverter control, In built HT unit Pre flow & post flow control, pulse control & Remote control	10 Sets
5.	Welding Simulators for GTAW/GMAW	Virtual Arc type, 230V, AC, 1Ph, 50Hz, GTAW/GMAW, Green learning with no real arc & smoke. Display, LED/LCD Monitor.	5 sets
Module 2: Advanced Welding & Cutting Processes:			
1.	Submerged Arc welding	1200 A, IGBT Inverter control, Digital display control, Wire feeder, Tractor mounted type and other accessories.	2 sets
2.	Micro Plasma welding System with welding fixtures	Capable of welding 0.5mm below foils, Welding current 0.5 to 25 Amps	1 set
3.	Friction Welding Machine	Capacity 10 to 50mm Chuck: 3jaw, Rpm :2000, Clamp: Hydraulic, Slide:400mm	1 no.
4.	Ultrasonic welding machine	Frequency: 20HZ, Max.Force:3000N, Drive: Pneumatic, Stroke:100mm	1 no.
5.	Spot welding machine	15 KVA, Throat depth 400mm, Gap 200mm, Electrode Tip dia. 16mm	2 sets

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6.	Seam Welding machine	Longitudinal, 75 KVA Welding Capacity : M.S : 2 + 2 mm and S.S 1.2 mm Electrode Dia : 200mm Stoke : 75 mm	1 Set
7.	Stud welding equipment	Capacitor Discharge type, Capacity up to 8mm Thin sheet welding	2 nos.
8.	Flash butt welding machine	OD 30 to 40mm Thickness 2 – 20mm	1 no.
9.	Oxy Acetylene cutting system	Gas Cutting torch Oxy-acetylene, Double Stage pressure regulator, Flashback Arresters, Hose pipes	2 nos.
10.	Laser cutting system	Laser power:3500W Laser Source: CO2 Axis speed:170m/min Working Range:3000x1500x100 Thickness: MS-20, SS -10	1 no.
11.	Air Plasma cutting equipment with all accessories with compressor	Capacity to cut 12 mm clear cut, IGBT Inverter based, Out put current 20-80A, OCV: 330VDC	2 sets
12.	Laser welding system	Laser power: 400W Wave length: 1064nm Welding depth:4mm Frequency:100Hz Pulse width: 20ms Power consumption: 14KW	1 no.
13.	Complete set of Weld Macro Analysers with accessories	Stereo Microscope range from 0.62X to 5X, Digital Camera, Software for measuring (2D) of lines, circles, areas, angles, etc	1 set
Module 3: Welding Mechanisation, Automation& Standards:			
1.	MIG/MAG Robotic welding system	Welding Robot & controller: 6 axis articulated Robot with hollow arm type, Reach: 1420 mm, Payload: 10 Kg. welding Power source digital Inverter type (350Amps) with wire feeder & Torch.	1 no.
2.	CNC Plasma cutting system	Display Minimum 5 Inch, Standard Shape in CNC 24 and above, Effective Cutting Length& Width: 2000MM x 1500MM with plasma cutting system	1 no.
3.	Computers with latest	I8 processor, 21 inch LED monitor,	25 nos.

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	configuration	Graphic card, or latest version.	
4.	CAD software	Mechanical drafting software for cutting Shape preparation	25 user license
5.	CAM software for CNC cutting	Nesting software for CAD drawing Conversion	25 user license
6.	AWS structural welding code D1.1	American welding Society Publication CD/Book	2 nos.
7.	ASME section IX Boiler Pressure vassal code	American Society of Mechanical Engineering Publication CD/Book	2 nos.
8.	Code of practice for Boiler & pressure vassal by IBR	Indian Boiler Regulation act Publication CD/Book	2 nos.
9.	Pneumatic Trainer Kit with accessories	3/2,5/2, Solenoid valves, Profile plate, 5HP Compressor, Sensors, Relays, DA Cylinders, Limit switches etc.	4 sets
Module 4: Workshop Technology:			
1.	Universal Milling Machine	Overall table size (L x W):(1500- 1600)x(300-350) Longitudinal movement:830 – 930 mm, Traverse movement:250 – 300 mm Vertical movement:400 – 450 mm, Spindle motor power:5.5 KW, No of speeds:12, Head tilt:45 degree	2 nos.
2.	Pillar type Drilling machine	Capacity in steel:M16, Size of working table:270/270 mm, Electric motor ;1 HP, No of spindle speeds :8, Range of spindle peed:86 - 3360	2 nos.
3.	Radial Drilling Machine	Drilling Radius: 2250mm Drill Head Traverse: 1800 Axis & column distance: 300	1 no.
4.	D.E. Pedestal Grinder	Wheel size ODxWxD, 300x38x25.4 mm, Centre distance:625 mm, Centre height :910 mm, Spindle motor :2 KW RPM:1500 Drilling capacity in steel/CI :19/22 mm	1 no.
5.	Lathe machine	Between centre:750-1000mm, Centre height:200 – 225 mm, Swing over the bed:400 – 450 mm, Swing over the carriage:335 – 400 mm, Between centre:750 – 1000mm, Main motor power:4 KW: Speed range:40 – 2800 rpm	6 nos.
6.	Vertical Milling Machine.	Overall table size (L x W):(1500-	4 nos.

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		1600)x(300-350) Longitudinal movement:830 – 930 mm, Traverse movement:250 – 300 mm Vertical movement:400 – 450 mm, Spindle motor power:5.5 KW, No of speed:12	
7.	Surface Grinding Machine	Table clamping area: 600x200 mm Max work height: 330 mm Max job weight on table:180 kg Size of the magnetic chuck:600x200 Grinding wheel size (ODxWxD):250x20x76.2 Grinding wheel motor: 2.2 KW Max traverse- long/cross/vertical:630/230/360	2 nos.
Module 5: Welding Inspection & Non-Destructive Testing:			
1.	Die penetrant testing kit	Red, Fluorescent penetrant, Cleaners, Wet, Solvent based developed.	5 set
2.	Yoke type Magnetic particle testing Kit with accessories	Current delivery: C/HWDC Pole Distance: 50 to 300 mm, Max. yoke weight : 4 kg , Lifting capacity : Min. 5 kg, Controls: Solid state control	5 sets
3.	Prod type Magnetic particle testing Kit with accessories	Max. Current: 1500 Amps, AC and HWDC output Thyristorised current control	5 sets
4.	Stationary coil type Magnetic particle machine	Coil Dia: 300mm, Capacity 5000Amps, AC/FWDC changeover	1 set
5.	Stationary headshot type Magnetic particle machine	Capacity : 2000 AC/HWAC Maximum length:1000mm	1 set
6.	Digital Ultrasonic Flaw detector with accessories	Display: TFT Colour LCD. Pixel : 640x480,Auto calibration, Gain : 0-120dB variable in 0.1dB Units: Millimeters Range: 5mm to 5 mtrs. Or latest	5 sets
7.	Phased array UT with TOFD	Channels: 16 Actives, 128 Multi-plexed Pulse width:40 to 1000ns Pulser delay:0 to 10.2 ns Operating Temp: 10 to 40 deg.	1 set
8.	Ultrasonic Thickness gauge	Measuring Range: 0.5 to 25mm TFT Colour screen 5.0 MHz Transducer	5 sets
9.	Reference radiographic film	ASTM Steel Fusion welds	2 sets

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10.	Weld Gauges (Fillet & Universal)	Leaf type, Fillet Gauge, Multi purpose, Radius Gauge, Bridge Cam, HI-Lo Welding Gauge	20 nos.
11.	Eddy current testing machine	Base unit, Flaw resolution – 20 μ m ,Dynamic range - 20 dB in steps of 0.5 dB, Flaw indication – Visual on LCD, acoustic on speaker LCD – 128 x 128 pixel or above, Power – 220 v AC Housing – ABS plastic Dust & water proof – IP 54 Maximum test speed – 0.1 to 0.15 m/sec.	2 nos.
Module 6: Heat Treatment & Material Testing			
1.	Rockwell Hardness testing machine	Test Loads: 60,100,150Kgf Initial Load:10 Testing Height: 230 Depth of throat:125	1 no.
2.	Brinell Hardness Testing Machine	Load: 500 to 3000 Testing Height: 250 Depth of throat:150	1 no.
3.	Vickers Hardness Testing Machine	Test Loads: 5,10,20,30,50Kgf Magnification:70X Testing Height: 200 Depth of throat:125	1 no.
4.	Muffle furnace – up to 1200 deg C	Max temp 1200 deg c, Size: 375*175*125mm Electric muffle with energy regulator, Type of thermo couple – Cr/Al	2 no.
5.	Metallurgical Microscope	Magnification: 50-1000x Head: Inclined 30 degrees Interpupillary distance: 50-75mm Illumination: 6V/30W Halogen Lamp	1 no.
6.	Portable hardness tester	Testing Height: 110mm Depth of throat:55mm	1 no.
7.	Universal Tensile Testing Machine (Tensile, Bend, compression)-200KN	Measuring Capacity: 1000kN Least Count : 0.1kN, Testing speed:80mm/min	1 no.
8.	Impact Testing Machine – Izod and Charpy	Maximum capacity: 300J/170J Minimum Scale: 1J	1 no.
9.	Fatigue Testing machine	Load capacity:+/-:250kN Dynamic load: 250kN Static load:150kN Displacement:4m	1 no.
Module 7: Repair & Maintenance Welding:			

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1.	Oxy acetylene manual powder spray equipment (Hot)	Hot Powder spray Torch and accessories	2 set
2.	Oxy acetylene manual powder spray equipment (Cold)	Cold Powder spray Torch and accessories	2 sets
3.	Metalizing Equipment with accessories (wire & Powder) for oxy acetylene use	Spraying Gun & Oxy acetylene welding system	1 set
4.	Metalizing Equipment with accessories (wire & Powder) for Arc use	Spraying Gun & arc welding power source	1 set
5.	Software for weld design and analysis	Welding design software.	10 Licenses
Module 8: High Pressure Pipe Welding:			
1.	Portable gas cutting machine	Capable of cutting Straight(50mm) & Circular cut 1000mm), cutting speed 200 - 500mm,min. Track length 1.8M	1 set
2.	Air Carbon arc Gouging Torch	Compressor, Carbon electrode, Transformer 300Amps	2 sets
3.	Pipe cutting machine to part thin and thick wall pipes	Mechanical/ Pneumatic type Capacity 6 Inches dia	2 nos.
4.	Pipe beveling machine to bevel thin and thick wall pipes	Mechanical/ Pneumatic type Capacity 6 Inches dia	2 nos.
5.	Hand Grinder	Angle Grinder 4" wheel dia	5 nos.
6.	Hand Grinder	Angle Grinder 7" wheel dia	5 nos.
7.	Oven, electrode drying	0 to 400°C, 50 kg capacity	1 no.
8.	Holding oven	0 to 150°C, 10 kg capacity	2 nos.
Common equipment/Accessories required for all modules:			
1.	Auto Darkening Welding Helmet	Five selectable dark shades 9,10,11, 12 and 13. Switching time between the light-dark shades should not be more than 0.1 millisecond.	25 nos.
2.	Welding Air jackets	Heavy duty split cowhide leather chest and sleeves Flame Retardant Cotton back	2 nos.
3.	Welding booths with universal welding positioner suitable to weld in all positions and Centralised Fume extractors& curtains	As per the work station, to be custom designed	As required
4.	Down draft welding table	Fume Extractor cum welding table with inbuilt prefilter and main filter:down draft type. Supply voltage : 400V/3 phase/50Hz. Fan Type : Radial, Blowing Capacity : 2500m ³ /h Sound level 74 dB	10 nos.

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		Welding table Size : Length 1200 , Width 1000 Height 920	
5.	Power saw machine	18" Blade length	2 nos.
6.	Portable abrasive cut-off machine	14" High speed Cut off machine	2 nos.
7.	Weld measurement software	Software for measuring (2D) of lines, circles, areas, angles, etc of weld profiles	2 nos.
8.	Stereo zoom microscope with camera	Stereo Microscope range from 0.62X to 5X, Digital Camera,	2 nos.
9.	Trainees tool kit set	Hammer , Screw driver, Wire brush, Nozzle cleaner, Center punches etc,	21 set
10.	Trainees PPE items	Apron, Gloves, Leg Guards, Helmets, Hand shields etc.	21 set and as & when required
11.	Welding accessories and Gas cylinders	Gas Cutting torch Oxy-acetylene, Gas welding blow pipe Oxy-acetylene, Double Stage pressure regulator, Flashback Arresters,	As required
12.	Gas Manifold system	As per the work station, to be custom designed	As required
13.	Welding Table with positioner	As per the work station, to be custom designed	As required
Smart Class Room items for all modules:			
1.	LED/LCD projector	Latest version	3 nos.
2.	Interactive Smart board	Width - 2016 mm, Height _165 mm, Board Aspect Ratio - 16:10, Number of touch points - 6 Nos.projector and white board both, Response time: 1000milli seconds	3 nos.
3.	Magnetic board	6x4 feet	03 nos.
4.	Computer/ workstation with multimedia and accessories.	I7 processor, 19" TFT Monitor, 2GB Graphic card or latest version	10 nos.
5.	Printer (Colour and Black & White)	Lase jet , 30PPM	Each one
6.	Chairs or Dual desk type	Dual Desk type	25 nos. + 25 nos.
7.	Trainees tables or Dual desk type	Dual Desk type	12 nos. + 12 nos.
8.	Faculty chair	Revolving Type	04 nos.
9.	Faculty table	6x4 feet	04 nos.
10.	Lab stools	SS stand type	25 nos.
11.	Laptop with OS	Latest version	10 nos.
12.	Scanner	Latest version	2 nos.

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13.	LED TV for class rooms	48" LED	2 nos.
14.	Document camera/Visual presenter	Technology – CMOS, Resolution - Full HD (1920 x 1080) Pixels, Optical Zoom – 13, Layout - Landscape 5 Mega Pixel or latest	2 nos.
15.	Welding /Inspection educational DVDs/CDs	Interactive type, Welding process and Inspected related.	2 each
16.	Computer table	3 X 4 ft.	10 nos.
17.	Computer Chairs	Revolving type	10 nos.



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