National Vocational & Technical Training Commission

(NAVTTC)

Curriculum for Certificate in

Mechanical Manufacturing Specialized in CNC

(NVQF Level 3, Duration: 2 Years)

December 2015

Contents

1 Introduction:

The Mechanical Manufacturing through Computer Numerical Control (CNC) Machining is one of the leading businesses in Pakistan as well as in Middle East and other part of the world. The industrial growth has created a demand of skilled manpower in Pakistan and abroad. Now a days, many manufacturing industries are inducting CNC machines for producing high quality and precise parts as per customer requirement and to meet the tight production deadlines. CNC machine operators with knowledge of mechanical manufacturing processes play a vital role in fulfilling the human resource demand of these industries.

The purpose of this training program evolves from the above prospective and the aim is to train individuals in mechanical manufacturing specialized in CNC machining operations who perform assigned tasks on CNC milling, CNC turning and EDM with basic demonstration of daily preventive maintenance of machines. The basic know-how of bench work and conventional machining operations also enable the individuals to perform CNC machining operations competently.

After this training program trainee shall be able to perform the selection of material and tools for machining operations, perform CNC machining operations, develop engineering drawing &CAD, perform manual programming, generate CAM program, planning and administering associated accessories according to the drawings standards and specifications in safe work environment. This has created an opportunity for skill training in the Mechanical Manufacturing Specialized in CNC operator to meet the ever-growing demand of industry. As a consequence, this vocational training course has been designed and developed to achieve the objectives of providing appropriate skills.

The graduates of this course will have a good balance of technical knowledge, skills, attitude and work experiences, which are the essential elements of any industry. Further, as CVT is simultaneously integrating work experience through on-the-job Training, the graduates will be able to use the latest technologies to achieve new levels of expertise. This course has been designed and developed to achieve its objectives of providing appropriate skills.

1.1 Overall course Objective:

The overall objective of this training program is to train individuals on mechanical manufacturing specialized in CNC machine operations to perform assigned tasks safely on CNC milling, CNC turning and EDM machines. The individual shall also be enabled with the knowledge of manufacturing processes, materials used in manufacturing, daily preventive maintenance of machines, bench work and conventional machining operations. The demonstrated skill on Engineering drawing and CAD software, perform manual programming and generate CAM program assists in developing a competent person which further inculcates by delivering knowledge and attitude demonstration on professionalism and communication skills.

1.2 Competencies gained after completion of the course

- Ensure personal and machine safety practices at work.
- Explain basic knowledge about conventional machining, bench work and manufacturing processes
- Understand the plan of mechanical manufacturing operations and operate CNC machine(s).
- Explain the principal operations of CNC machines and operate different CNC machines like CNC machining Centre, CNC Turing Centre, CNC Wire cut, CNC EDM etc.
- Perform manual CNC programming through G and M codes.
- Demonstrate basic skills on CAD and CAM software
- Prioritize job schedule, ensure good quality at each process stage and focus in reducing material wastages.
- Document work where necessary and consult with experts if demanded.
- Read & interpret technical documents, reports and drawing / data specific to the system and subsystems
- Work as a team-member and coordinate the activities with upstream and downstream operations
- Plan & perform routine preventive maintenance of selected CNC machines and basic housekeeping practices

1.3 Job Opportunities:

The pass out of this course would be able to:

- Work in home appliances manufacturing industry as Mechanical Manufacturing CNC machine operator
- Work in automotive industry as CNC machine operator
- Be self employed by having his own CNC machining workshop
- Work as CNC machine operator in Government and Semi-Govt. workshops & institutions

- Assist in mechanical manufacturing / tool & die development workshops of chemical, pharmaceutical, FMCG and packaging industries
- Work as CNC machining production operator of metal casting & forging industry

1.4 Trainee Entry Level:

Individuals who wish to enter in this course of study have to comply against the following criteria:

- Matric or middle pass with two years' experience in conventional machining OR G-II level
- Satisfactory completion of appropriate admission assessment test by the training institute considering comfort level of English language and mathematics

1.5 Minimum Qualification of Trainer/Instructor:

Trainers who wish to offer this program should meet one of the following requirements:

- B.E / B-Tech. in Mechanical, Industrial &Manufacturing Engineering along with minimum two years of relevant work experience **OR**
- DAE in Mechanical with minimum three years' experience in CNC machining **OR**
- G-II alongwith six years' experience in specialized CNC machining

Trainers offering this program must be computer literate and be conversant with the delivery of competency-based education and training (CBET).

1.6 Medium of Instructions:

Urdu, local languages and / or English

1.7 Teaching strategies in a competency-based environment

Training in a competency-based environment differs from the traditional method of training delivery. It is based on defined competency standards, which are industry oriented.

The traditional role of a trainer is changed and shifts towards the facilitation of training. A facilitator in CBET encourages and assists trainees to learn for themselves. Trainees are likely to work in groups (pairs) and all doing something different. Some are doing practical tasks in the workshop, some writing, some not even in the classroom or workshop but in another part of the building using specialist equipment, working on computers doing research on the Internet or the library. As trainees learn at different pace they might well be at different stages in their learning, thus learning must be tailored to suit individual needs.

The following facilitation methods (teaching strategies) are generally employed in CBET programs

- **Direct Instruction Method:** This might be effective when introducing a new topic to a larger group of trainees in a relative short amount of time. In most cases this method relies on one-way communication, hence there are limited opportunities to get feedback on the trainee's understanding.
- **Discussion Method:** This allows trainees to actively participate in sharing knowledge and ideas. It will help the trainer to determine whether trainees understand the content of the topic. On the other hand, there is a possibility of straying off topic under discussion and some trainees dominating others on their views.
- **Small Group Method:** Pairing trainees to help and learn from each other often results in faster knowledge/skill transfer than with the whole class. The physical arrangement of the classroom/workshop and individual assessment may be challenging. Analogy method should be incorporated.
- **Problem Solving Method:** This is a very popular teaching strategy for CBET. Trainees are challenged and are usually highly motivated when they gain new knowledge and skills by solving problems (Contingency skills). Trainees develop critical thinking skills and the ability to adapt to new learning situations (Transfer skills). It might be time consuming and because trainees sometimes work individually, they may not learn all the things that they are expected to learn.
- **Research Method:** This is used for workshops and laboratory tasks, field experiments, and case studies. It encourages trainees to investigate and find answers for themselves and to critically evaluate information. It however requires a lot of time and careful planning of research projects for the trainee.

1.8 National Vocational Qualifications Framework (NVQF) level:

The industrial and academic experts have reviewed the competency standard of "Mechanical Manufacturing Specialized in CNC" and based on identified Pakistan NVQF level descriptors, it has been declared as Level 3 qualification.

1.9 Division of modules

The "Mechanical Manufacturing Specialized in CNC" of NVQF level 3 has 13 modules which are divided as below;

1.1. Module A: Maintain Occupations Health and Safety

1.2. Module B: Applied Mathematics, Materials & Metrology

1.3. Module C: Life Skills & Professional Development

1.4. Module D: Allied & Secondary Skill

1.5. Module E: Perform Maintenance & Administrative Operations

1.6. Module F: Manufacturing Processes

1.7. Module G: Technical Drawing & CAD

1.8. Module H: Perform Bench Fitting &Conventional Machining

1.9. Module I: CNC Programming & CAM

1.10. Module J: Perform CNC machining Operations

1.11. Module K: Perform EDM Machining

1.12. Module L: Basic on Job Training

1.13. Module M: Advance on Job Training

Note: The period and time schedule of the OJT shall be adjusted with mutual understanding of Institute and Industry.

2 Sequence & Delivery of Modules

The industrial & academic experts have defined 13 competency module of Mechanical Manufacturing Specialized in CNC course. The sequence of these competency modules are comprises as below:

<table>
<tr><th colspan="2">Training in Training Center 12 Months
(or 6 month in institute and next 6 month in industry for OJT)</th><th colspan="2">On the Job Training (OJT) in a company 12 months (or 6 month in institute and next 6 month in industry for OJT)</th><th>Revision in Training Centre 2-3 Weeks</th></tr>
<tr><th>Phase-I; Basic Institutional Learning</th><th>Phase-III: Advanced Institutional Learning</th><th>Phase-II: Basic OJT</th><th>Phase-IV: advanced OJT</th><th></th></tr>
<tr><td colspan="2"></td><td>Company Orientation,
Personnel protective equipment, Preventive& regular Maintenance, Bench work and Conventional Machining</td><td>Training on CAD/CAM and advance manufacturing machine and operation like Wire cut EDM, EDM sinker, CNC Machining Centre, CNC Turing Centre, CNC grinder and also trainee completes one industrial project related to advance manufacturing process and complete summary reports.</td><td>Review
&
Preparation for
final Examination</td></tr>
</table>

3 Duration of the course

ACTIVITIES AND LOCATION	Contact Hours Allocation
At Training Institute (Including theory, Practical, and Secondary skills.)	1479
At OJT/Company (Practical training)	1600
Total Duration	**3079**
Total Credits	**308**

Percentage of **Theory** Hours 20% (620 Hours) and **Practical** Hours 80% (2469 Hours)

4 Overview about the Curriculum for Mechanical Manufacturing Specialized in CNC

Module Title & Aim	Learning Units	Theory (Hours)	Workplace (Hours)	Time Frame of The Modules (Hours)
Module A: Maintain Safety		16	24	40
Maintain Safety Aim: This module demonstrates skill and knowledge of personal safety, safe use of hand, power tools & equipment, first aid procedures, quality and environment related regulations in an industrial workplace.	Maintain work station safety	4	6	10
	Dispose off hazardous waste	4	6	10
	Perform waste management	4	6	10
	Check lifting equipment	2	3	5
	Report incidence to the superior	2	3	5
Module B: Applied Mathematics, Materials & Metrology		110	10	120
Part 1 : Applied Mathematics Aim: This module demonstrates knowledge in an individual to perform various calculations which are involved in practicing specified job.	Arithmetic (simple & fraction)	10	0	10
	Algebra	10	0	10
	Trigonometry	10	0	10
	Calculation of area & Volume	10	0	10
	Material weight calculation	10	0	10

Part 2 : Material Science Aim: This part of module demonstrates knowledge in an individual regarding different types of materials, their properties and processing. The basic knowledge of heat treatment also demonstrates to the trainee to assist in CNC machining operations.	Types of materials	9	0	9
	Material properties	9	0	9
	Processing of materials	9	0	9
	Heat treatment	8	0	8
Part 3 : Metrology Aim: This module demonstrates how to assist an individual to understand selection of appropriate measuring instruments, perform desired measurement accurately and convey the information efficiently with the methods of measurements based on agreed international standards and units.	Perform measurement through linear, adjustable and angular measuring tools	13	5	18
	Use of digital & precise measuring instruments	9	3	12
	Alignment and marking method	3	2	5
Module C: Life Skills & Professional Development		90	30	120
Part 1 : Life Skills Aim: This part of module demonstrates knowledge and attitude to add value in an individual through self-exploration, teamwork, goal-setting self-presentation and other essential life skills.	Exploring and Understanding Self	15	0	15
	Effective Communication	10	0	10
	Working with Teams	10	0	10
	Vision and Goal Setting	15	0	15
	Personal and Social Responsibility	10	0	10

Part 2 : Develop Professionalism Aim: This module identifies the competencies required to develop professionalism in an individual in accordance with requirement of profession. A competent individual will be expected to participate in training institute level mechanical manufacturer trainings, on Job training, perform communication with others, upgrade professional skills and work in a team. This underpinning knowledge regarding development of professionalism will be sufficient to provide the basis for quality working.	Participate in mechanical manufacturer training	7.5	7.5	15
	Participate in mechanical manufacturer training	7.5	7.5	15
	Participate in mechanical manufacturer training	7.5	7.5	15
	Participate in mechanical manufacturer training	7.5	7.5	15
Module D: Allied & Secondary Skills		60	190	250
Part 1: English Skills Listening Reading Writing Speaking Aim: To enhance students' listening comprehension of English language, enrich them with a passion of reading, improve students writing capacity and enable them to speak English language with fewer errors.	Introduction to Listening - Listening to match Information	10	5	15
	Introduction to Listening - Listening to Respond			
	Introduction to Listening - Following Conversations			
	Introduction to Listening - Listening for Key Information			
	Introduction to Reading - Reading to Understand the Sequence of a Text	10	5	15
	Introduction to Reading - Understanding the Text Structures			
	Introduction to Reading - Understanding the Purpose of Text			
	Introduction to Reading - Reading for Key Information			
	Introduction to Writing – Completing a form	10	5	15

	Introduction to Writing – Connecting errors			
	Introduction to Writing – Communicating Ideas and information			
	Introduction to Writing – Writing a text			
	Introduction to Speaking – Introduction to Language	10	5	15
	Introduction to Speaking – Social Situations			
	Introduction to Speaking – Exchanging information and opinions			
	Introduction to Speaking – Presenting a Topic			
Part 2 : Computer & IT Aim: This part of module assist an individual to learn how to use Computer and basic Computer software effectively.	Introduction to Computer	4	8	12
	Basics of Word Processing	4	8	12
	Basics of Spreadsheets	4	8	12
	Basics of Presentation development	4	8	12
	Basics of Internet and email usage	4	8	12
Part 3 : Secondary Skills	Monthly Test	0	36	36

Aim: This part of module add values in assessment and extra curriculum activities	Library	0	10	10
	Sports	0	10	10
	Events	0	14	14
	Students Projects	0	44	44
	Industrial visit	0	16	16
Module E: Perform Maintenance & Administrative Operations		60	73	133
	Maintain hydraulic & lubrication oil level	3	6	9
	Change Coolant	1	3	4
	Service coolant tank	2	6	8
	Replace worn tools	3	12	15
	Perform lockout /tag out procedures	4	12	16
	Apply Grease on machine	2	4	6
	Respond to machine failure	2	4	6
Part 2: Perform Administrative Operations	Prioritize job schedule	8	4	12

Aim: This part of module demonstrates skill and knowledge required to perform basic administrative operations in accordance with approved procedures. Competent individuals will be expected to prioritize job schedule, provide process improvement feedback, ensuring quality inspection and keep inventory.	Provide process improvement feedback	8	4	12
	Keep Tooling/ inventory	8	4	12
	Document in-process inspection	8	4	12
	Backup technical data	8	4	12

Module F: Manufacturing Processes		**60**	**20**	**80**
Manufacturing Processes **Aim:** This module demonstrates knowledge of mechanical manufacturing process introduction and types which are necessary to know by an individual performing CNC machining operation and working in this trade.	Define different types of manufacturing processes	6	0	6
	Understand casting processes	13	5	18
	Understand forming processes	15	5	20
	Understand joining processes	13	5	18
	Understand metal finishing processes	13	5	18

Module Title & Aim	**Learning Units**	**Workplace Hours**	**Time Frame of The Modules**
Module G: Technical Drawing & CAD		**90**	**120**
Part 1 : Technical Drawing	Read and extracting information from drawings	30	40

Aim: This part of module demonstrates skills needed to acquire by an individual for interpreting technical drawing and various technical symbols, develop free hand sketches to define technical requirements.	Freehand Sketches and drawing from physical measurements	20	25
Part 2: Computer Aided Design (CAD) **Aim:** This part of module demonstrates skills needed to acquire by an individual for interpreting developing two dimensional technical drawings and various technical symbols.	Demonstrate CAD system management techniques	5	10
	Demonstrate basic geometric entities on CAD	15	20
	Generate Drawing with CAD	20	25
Module H: Perform Bench Fitting & Conventional Machining		**109**	**138**
Part 1: Perform Bench work **Aim:** This part of module demonstrates skill and knowledge required to perform basic bench work operations using different tools and equipment in accordance with approved procedures which assist in performing successful completion of job on CNC machines. The competent individual will be expected to perform debarring (filing) marking, sawing tapping and reaming using hand tools.	Perform de-burring on metal	8	10
	Perform marking on job	8	12
	Perform manual sawing	8	10
	Perform reaming	6	8
	Perform manual taping	6	8
	Perform electric arc welding on job	9	12

Part 2: Perform conventional machining operations **Aim:** This part of module demonstrates skill and knowledge which assist an individual to perform conventional machining operations leading to CNC machining operations. The basic demonstration of milling, lathe, drilling & grinding machining operations in conventionally safe working environment will enable an individual to perform work on CNC machines more	Perform milling operation	20	24
	Perform lathe operation	20	24
	Perform drilling operation	16	20
	Perform grinding operation	8	10
Module I: CNC Programming & CAM		**80**	**135**
Part 1 : CNC Programming **Aim:** This part of module demonstrates skills, attitude and knowledge necessary to acquire the competencies to generate G & M codes, understand CNC control unit and understand the manual of CNC programs.	Demonstrate use of preparatory commands (G & M codes)	5	10
	Demonstrate function and application of codes	5	10
	Demonstrate use of codes to create contouring programs	5	10
	Generate CNC program	5	10
Part 2 : CAM **Aim:** This module demonstrates skills, attitude and knowledge necessary to acquire the competencies to generate tool path, setup and perform computer aided manufacturing operations.	Computer aided manufacturing (CAM) Applications and technology	5	20
	Features of CAM software	5	10
	Generate tool path geometry (2D)	15	20
	Generate tool path geometry (3D)	15	20
	Generate 2D and 3D CNC program with CAM software	20	25
Module J: Perform CNC machining Operations		**195**	**283**
Part 1: Perform CNC milling Operations	Perform vertical mill job setup	14	24

Aim: This part of module demonstrates skill, knowledge & attitude require performing job setting-up / setting-off, run simulation and making parts in safe working environment on CNC milling machine.	Run simulation of first part using CNC Machining Centre	14	24
	Make sample as per specifications	30	40
	Run production on CNC mill	10	14
	Tug out job from CNC milling Machine	6	10
Part 2: Perform CNC turning operations **Aim:** This part of module demonstrates skill, knowledge & attitude require to performing job setting-up / setting-off, run simulation and making parts in safe working environment on CNC lathe machine.	Perform turning Job setup	20	30
	Run turning simulation using CNC lathe	30	40
	Make sample as per specifications	30	40
	Run production using CNC lathe	20	28
	Tug out job from CNC lathe Machine	6	10
Part 3: Perform CNC grinding operations **Aim:** This part of module demonstrates skill, knowledge & attitude require to performing job setting-up / setting-off, run simulation and making parts in safe working environment on CNC grinding machine.	Perform grinding Job setup	4	6
	Run grinding simulation	4	6
	Grind job according to specifications	4	6
	Run production using CNC grinder	3	4
	Tug out job from grinding machine	0	1

Module Title & Aim	Learning Units	Theory Hours	Workplace Hours	Time Frame of The Modules
Module K: Perform EDM Machining		**22**	**38**	**60**
Part 1: Perform wire cut EDM operations **Aim:** This part of module demonstrates skill and knowledge required to perform operations on wire cut Electric Discharge Machine (EDM). It covers job setting up / setting off, running EDM wire cut related simulation & making parts from the machine.	Perform wire cut EDM job setup	2.5	5	7.5
	Run simulation on CAD and wire cut EDM	2.5	5	7.5
	Make sample as per specifications	2.5	5	7.5
	Run production on wire cut EDM	2.5	5	7.5
	Tug out job from wire cut EDM	2	3	5
Part 2: Perform EDM Sinker Operations **Aim:** This part of module demonstrates skill and knowledge required to perform operations on Electric Discharge Machine (EDM) Sinker. It covers mainly job setting up / setting off, running EDM Sinker & making parts from the machine.	Perform EDM Sinker job setup	3	3	6
	Make sample as per specifications	2.5	4	6.5
	Run production on EDM Sinker	2.5	4	6.5
	Tug out job from EDM Sinker	2	4	6

Module L: Basic on Job Training		**0**	**800**	**800**
Aim: **Practical basic hands on training of the trainee at selected company**	Company Orientation, Personnel protective equipment, Preventive & regular Maintenance, Bench work and Conventional Machining	0	800	800
Module M: Advance on Job Training		**0**	**800**	**800**
Aim: **Practical advance hands on training of the trainee at selected company**	Training on CAD/CAM and advance manufacturing machine and operation like Wire cut EDM, EDM sinker, CNC Machining Centre, CNC Turing Centre, CNC grinder and also trainee complete one industrial project related to advance manufacturing process and complete summery reports.	0	800	800

Total Contact Hours	Theory	Practical	Total
At the Training Institute	620	859	1479
At selected OJT company	0	1600	1600
Total	620	2459	3079
Percentage of contact hours	20%	80%	100%

5 Teaching and Learning Guide for "Mechanical Manufacturing Specialized in CNC"

5.1 Module A: Maintain Safety

Objective of the Module: This module includes knowledge, skills and attitude related personal safety, safe use of hand, power tools & equipment, first aid procedures, quality and environment related regulations in an industrial workplace.

Duration (Hours)	Theory (Hours)	Practical (Hours)
40	16	24

Learning Unit	Learning Outcomes	Learning Elements	Tools/ Equipment Material	Learning Place
LU-1 **Maintain work station safety**	**Trainee Should be able to:** • Demonstrate safe occupational habits, • Identify HSE risks around work station, • Perform routine work station cleaning according to standard, • Apply workstation cleanliness procedure as mentioned in HSE documents, • Carry out evacuation according to SOPs, • Perform basic fire-fighting according to SOPs,	• Describe company safety SOPs/policies • ISO safety standards • Personal safety risk & hazards • First aid • Safety equipment • Reporting procedures • Work permit • Best safety practices • Health Safety &Environment (HSE) related Risks • HSE Procedures • Evacuation SOPs • Tagging procedure • Safe work habits	First aid box SOPs Policy documents OEM manuals Brush Wiper Scraper Cotton Rug Floor Brush Vacuum Cleaner Scrap Bin Dust Pan Fire Fighting equipment all PPEs Ladder	Class room and Institute workshop Physical demonstration

Learning Unit	Learning Outcomes	Learning Elements	Tools/ Equipment Material	Learning Place
	• Give basic first aid as per SOPs, • Perform tagging on machine as per SOPs.	• Housekeeping principles		
LU-2 **Dispose-off hazardous waste**	**Trainee Should be able to:** • Apply safety hazard equipment according to type of hazardous waste disposal, • Handle hazardous waste according to SOPs, • Dispose-off Inflammable waste to ensure 0% fire cause, • Apply Personal and work place hygiene.	• Risk management procedure • Material safety data sheet (MSDS) • Different types of hazards in different workplace context, • Fire-fighting SOPS, • Importance of personal and workplace hygiene, • General handling and stacking procedures. • Procedure of dispose-off hazardous waste	PPE set Scrap Trolley, MSDS	Class room and Institute workshop and physical performance

Learning Unit	Learning Outcomes	Learning Elements	Tools/ Equipment Material	Learning Place
LU-3 **Perform waste management**	**Trainee Should be able to**: • Tag scrap bins according to pre-defined scrap management codes, • Collect scrap according to operational standard Separate scrap for proper disposing of, • Place scrap into appropriate bin,	• Waste reduction procedure • Scrap identification and handling • Differentiate between Scrape & Garbage, • Procedure of waste management	Standard Document Color Bins Plastic bags	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools/ Equipment Material	Learning Place
LU-4 **Check lifting equipment**	**Trainee Should be able to:** • Test manual lifting equipment for normal operation, • Perform adjustments on lifting equipment for normal operation.	• Safety precautions while handling any job • Operation of lifting equipment. • Lifting capacity of lifting equipment • Demonstrate usage of PPEs • Procedure of checking lifting equipment.	SOPs Lifting equipment	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools/ Equipment Material	Learning Place
LU-5 **Report incidence to the superior**	**Trainee Should be able to:** • Operate alarm on emergency situation, • Perform verbal communication for the incidence correctly, • Perform written communication for the incidence correctly.	• Different types of incidence & its severity • Locate emergency Alarm, • Maintain emergency contacts list, • Write incidence report, • Apply computer skills to perform verbal and written communication. • Procedure of incident report writing	Emergency Alarm Telecommunication instruments Stationary set Computer set with printer and internet	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools/ Equipment Material	Learning Place

5.1 Module B: Applied Mathematics, Materials & Metrology

Objective of the Module: This module includes knowledge, skills and attitude which are necessary for individuals enrolled in performing CNC machining operation and to assist in performing calculations, understanding material specifications and measurements.

Duration (Hours)	Theory (Hours)	Practical (Hours)
120	110	10

Part # 1 of Module B (Applied Mathematics, Materials & Metrology): Applied Mathematics

Objective of this part: This module includes knowledge, skills and attitude in an individual to perform various calculations which involve in practicing specified job.

Duration	Theory	Practical
50	50	0

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-1 **Arithmetic (simple & fraction)**	**Trainee Should be able to perform;** • BODMAS • Basic Arithmetic Calculations • Interpret formulae.	• Addition, • Subtraction, • Division • Multiplication • Average, • Percentage, • Proportion & Roots	Board Markers White board	Class room

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-2 **Basic Algebra**	**Trainee Should be able to perform** • Basic Algebraic calculation • Interpret formulas	• Algebraic identities • Interpreting algebraic formulas • Linear and Quadratic Equations	Board Markers White board	Class room

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-3 **Trigonometry**	**Trainee Should be able to:** **Interpret** • Types of Geometric Shapes Solve • Trigonometric Identities • Angles & Triangles	• Unit Conversion • Types of Shapes • Types of Angles & Triangles • Pythagoras Theorem	Board Markers White board	Class room

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-4 **Calculation of area & Volume**	**Trainee Should be able to:** • Identify different types of shapes. • Interpret formulae of Area of different shapes. • Interpret formulae of Volume different shapes	• Area of basic shape(Triangle, Square, Rectangle, Circle, Polygon) • Volume of regular shape solid (cube, rectangular prism, cylinder, triangular prism)	Board Markers White board	Classroom

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-5 **Material weight calculation**	**Trainee Should be able to:** • Define Density • Calculate Density	• Mass • Volume • Density • Units(Mass, Volume, Density)	Board Markers White board	Classroom

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place

Part # 2 of Module B (Applied Mathematics, Material Science& Metrology): Material Science

Objective of this part: This part of module includes knowledge, skills and attitude an individual required regarding different types of materials, their properties and processing. The basic knowledge of heat treatment also demonstrates to the trainee to assist in CNC machining operations.

Duration	Theory	Practical
35	35	0

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-1 **Types of materials**	**Trainee Should be able to:** **Identify** • Ferrous metal • Non-Ferrous metals and its alloys • Most common heavy metal alloys • Most common non – Ferrous light metals • plastic material as per manufacturing requirement	• **Ferrous metals**: carbon-, alloy-, stainless-, tool-and-die steels • **Non-ferrous metals**: aluminum, magnesium, copper, nickel, titanium, super alloys, refractory metals, beryllium, zirconium, low-melting alloys, • **Tool & Die materials** • Effect of Carbon in iron • K100, D2 • **Plastics**: thermoplastics (acrylic, nylon, polyethylene, ABS) • Thermostats (Epoxies, Polyimides, Phenolic) • Elastomers (rubbers, silicones, polyurethanes) • **Other materials:** Ceramics, Glass,	Material sheet Manual Periodic table Board Markers White board or Multimedia	Class room

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
		Graphite, Composites		
LU-2 **Material properties**	**Trainee Should be able to define:** • Physical properties of materials • Mechanical properties of materials • Chemical properties of materials • Structure of material	Physical Properties: • Color of materials • Specific heat • Density • Thermal conductivity • Melting point • Electrical conductivity • Coefficient of thermal expansion Mechanical Properties • tensile strength • ductility • malleability • brittleness • elasticity • plasticity • toughness • hardness • machinability • Oxidation,	Material sheet Manual Periodic table Board Markers	Classroom

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
		• Corrosion, • Flammability, • Toxicity • Carbon ratio link to iron • Different types of material structures		
LU-3 **Material selection as per manufacturing requirement**	**Trainee Should be able to**: **Identify** • Dies & Mold material • Casting Material	Describe: • Dies & Mold material • Casting Material • Carbon Ratio • Manufacturing capability • Material Uses	Material sheet Manual Periodic table Board Markers	Class room

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-4 **Heat treatment**	**Trainee Should be able to**: • Interpret different types of Heat treatment. • Interpret effects of different types of heat Treatment. • Increase strength, harness and wear resistance • Increase ductility and softness • Increase toughness • Improve machinability • Improve cutting properties of tool steels • Demonstrate Quenching, inhaling, hardening	• Definition and objective of hat treatment • Types of heat treatment • bulk hardening, surface hardening • tempering, recrystallization annealing • recrystallization annealing, full annealing, normalizing • stress relief annealing • full annealing and normalizing • hardening and tempering	Material sheet Manual Periodic table Board Markers	Class room

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place

Part # 3 of Module B (Applied Mathematics, Materials & Metrology): Metrology

Objective of this part: This module demonstrates knowledge, skills and attitude an individual requires necessary to assist an individual to understand selection of appropriate measuring instruments perform desired measurement accurately and convey the information efficiently with the methods of measurements based on agreed International standards and units.

Duration	Theory	Practical
35	25	10

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-1 **Perform measurement through linear, adjustable and angular measuring tools**	**Trainee Should be able to:** • Use appropriate measuring instrument/ tools as per the requirement of provided job • Use linear measurement supporting tools as per SOPs • Use adjustable linear measurement tools as per SOPs • Use angular measurement tools as per SOPs • Communicate performed measurement in effective manner and document it • Calculate least count of selected measuring instruments • Perform zero error calculations of selected measuring instruments	• Learn about SI Units, standards, tolerances, geometric limits and allowances • Procedure of basic metrology elements • the selection criteria of appropriate measuring instrument / tools for assigned job as per work instructions • Procedure to use different types of linear measuring tools • Procedure to use different types of adjustable measuring tools ▪ Vernier Caliper ▪ Micrometer ▪ Dial indicator • Procedure to use different types of angular measuring tools	Vernier Caliper Screw Gauge Surface plate Digital Venire Caliper Digital screw Gauge Bevel Protector Dial indicator SI Unit Manual Digital instruments Thread measuring instrument Height gauge Feeler gauge	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
		• Procedure to define least count of selected measuring instruments • Procedure to perform calculation process of zero error prevention		
LU-2 **Use of digital & precise measuring instruments**	**Trainee Should be able to:** • Use precise measuring instrument/ tools as per the requirement of provided job • Perform accurate measurement by selecting appropriate digital measuring instrument as per SOPs	• Procedure to perform selection criteria of appropriate measuring instrument / tools for assigned job as per work instructions • Procedure to define least count of selected digital measuring instruments • interpret touching probe	Surface plate Digital Venire Caliper Digital screw Gauge Digital height gauge Lever gauge Bevel protector Dial indicator Touching probe SI Unit Manual Microscope Digital instruments Thread measuring instrument	Class room and Institute workshop lab

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-3 Alignment & marking method	**Trainee Should be able to:** • describe different marking tools • Alignment of job as per specifications	• Procedure of marking on the job by selected tools • Procedure of job alignment,	Scriber Marking Ink French curve Geometric drawing Accessories Center punch Steel Scale	

5.2 Module C: Life Skills & Professional Development

Objective of the Module: This module demonstrates knowledge, skills and attitude an individual requires to add value through professional development skills, attitude development and life skills additions which mainly demonstrate self-exploration, teamwork, goal-setting self-presentation and other essential life skills.

Duration (Hours)	Theory (Hours)	Practical (Hours)
120	90	30

Part # 1 of Module C (Life Skills & Professional Development): Life Skills

Objective of this part: This part of module includes knowledge, skills and attitude an individual requires to add value through self-exploration, teamwork, goal-setting self-presentation and other essential life skills.

Duration	Theory	Practical
60	60	0

Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools /	Learning Place
LU-1 **Exploring and Understanding Self**	**Trainee Should be able to:** • Demonstrate the importance and acquire skills for self-awareness • Perform emotional intelligence for a solid foundation in personal effectiveness	Self-Awareness • Self-Discovery • Self-Knowing • Self esteem • Self-Concept • Developing self Emotions Management • Knowing emotions • Exploring intense emotions • Emotions Management Emotional Intelligence • Dealing with own emotions • Dealing with others emotions	Total 15 Theory 15 Practical 0	Multimedia White Board Markers Speakers Internet TLR ILO Life Skills Manu	Training Room

Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools /	Learning Place
		• Leading via emotional intelligence		al	
LU-2 **Effective Communication**	**Trainee Should be able to:** • Demonstrate the importance of communication in life • interpret about different elements of effective communication • Demonstrate Attitude building for effective communication	Communication Skills • Persuasive Communication • Verbal and Non-verbal • Attitude building	Total 10 Theory 10 Practical 0	Multimedia White Board Markers	Training Room
LU-3 **Working with Teams**	**Trainee Should be able to:** • Comprehend how to work with people / groups • Manage the conflicts	• Teambuilding • Knowing diversity • Team building techniques • Teamwork • Managing diversity • Conflict management techniques	Total 10 Theory 10 Practical 0	Multimedia White Board Markers Speakers Internet TLR ILO Life Skills Manua	Training Room

Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools / Equipment	Learning Place
				l	
LU-4 **Vision and Goal Setting**	**Trainee Should be able to:** • Develop personal vision • Develop personal goals for fulfilling one's dreams for a successful life	• Personal Vision and Goal Setting methodology • Personal Development Plan	Total 15 Theory 15 Practical 0	Multimedia White Board Markers Speakers Internet TLR ILO Life Skills Ma	Training Room

Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools / Equipment	Learning Place
				nual	
LU-5 **Personal and Social Responsibility**	**Trainee Should be able to:** • Understanding &responding impact of gender disparity • Demonstrate gender respect in culture on individuals / groups	• Gender Sensitivity • Difference between sex &gender • Division of labor • Power &decision making • Practical gender need • Rights &Responsibilities • Healthy Families • Sexual Harassment • Workplace	Total 10 Theory 10 Practical 0	Videos Stories Case studies	Training Room

Part # 2 of Module C (Life Skills & Professional Development): Professional Development

Objective of this part: This part of module demonstrates includes knowledge, skills and attitude an individual requires through professional development ethics, communications with others and participate effectively in technical trainings. This assist teacher / instructor to make the requisite measures accordingly.

Duration	Theory	Practical
60	30	30

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-1 **Participate in mechanical manufacturer training**	Trainee Should be able to • Develop CNC training needs according to recent industrial demands. • Get enroll in mechanical manufacturer training course • Follow training providing organizational policies for professional development • Perform training task mentioned in TLM • Follow instructions of training providers • Demonstrate good team work skills where applicable • Adopt dress code as per training providing organization regulations. Show comfort and tolerance.	• Keep in touch with mechanical training providers • Apply workshop mathematical skills during training. • Apply technical English skills during training, • Describe the importance of being a good team player, • Identify TLM / curriculum.	Mechanical manufacturing training workshop tools and equipment Training provider's prospectus TLM	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-2 **Participate in On Job Training**	Trainee Should be able to • Demonstrate manufacturing skills, industrial production units, • Promote Kaizen of manufacturing industry, • Implement 5's on Job place, • Maintain skill matrix according to organizational policies, • Develop time management plan, • Provide logistic support for workshop machinery according to Job requirement.	• Describe importance of Industrial Kaizen, • Identify shop KPIs, • Time and motion knowledge for target setting, • Awareness of time, • Describe Housekeeping through check sheet.	Tool and equipment available on job place Kaizen suggestion format Skill matrix format 5's check sheet Simple PDCA tool	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-3 **Develop communication skills**	Trainee Should be able to • Perform verbal communication with: ✓ Colleagues ✓ Clients ✓ Venders ✓ Supervisors ✓ Employee ✓ Juniors adopting correct procedures • Perform written communication with: ✓ Colleagues	• Identify factors required to communicate effectively and precisely within organization. • Justify the appropriate use of electronic and relative media as per need • Describe types of communications • Enlist record keeping methods • Determine communication styles	Pen Computer, equipped with internet and printer. Magazines, books, codes and standards, 5S methodology	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
	✓ Clients ✓ Venders ✓ Supervisors ✓ Employee ✓ Juniors adopting correct procedures • Maintain communication log / record			
LU-4 **Participate in workshops and seminars**	Trainee Should be able to • Adopt upcoming market trends in Machinist trade by attending workshop and seminar, • Participate in Skill test for professional development with consecration, • Participate in skill up gradation courses with consecration, • Participate in professional seminars with consecration to acquire first hand industrial knowledge,	• Describe the benefits of latest machining techniques and developments, • Identify the need of skill sets by getting involved in seminars, • Identify internet browsing/search engine, • Describe browsing techniques to find appropriate web site, • Read books/magazines related with mechanical manufacturing trade.	Computer with internet Telephone Journals Books Magazines Survey templates Research papers	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
	• Perform industrial visits on schedule, • Consult senior experts to get advised, • Participate in skill competitions for targeted win, • Watch videos/documentaries related with mechanical manufacturing trade, • Perform internet browsing related with mechanical manufacturing trade, • Conduct related surveys with concerned people to acquire first hand industrial knowledge, • Review research papers related with mechanical manufacturing trade.			

5.3 Module D: Allied Skills

Objective of the Module: This module includes knowledge, skills and attitude an individual requires necessary to perform basic functions and assist in clear understanding of assigned tasks / work order in efficient manner.

Duration (Hours)	Theory (Hours)	Practical (Hours)
250	60	190

Part # 1 of Module D (Allied Skills): English

Objective of this part: This part of module includes knowledge, skills and attitude an individual requires for listening comprehension of English language, enrich them with a passion of reading, improve students writing capacity and enable them to speak English language with fewer errors.

Duration	Theory	Practical
60	40	20

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-1 **Introduction to Listening - Listening to Match Information**	Trainee must be able to • Listen and match information • Practice effective and active listening.	Listening to Match information Body parts Daily routine How do I spend mayday? People and profession All over the world My visits	Hand-out and Audio CD	Class Room

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-12 **Introduction to Listening – Listening to Respond**	Trainee must be able to • Achieve an elementary level of listening skills to respond accordingly.	Listening to Respond Introduction and meeting A day at school At hotel Inquiry Uncle Fester	Hand-out and Audio CD	Class Room
LU-3 **Introduction to Listening - Following Conversations**	Trainee must be able to • Improve English language • Listening comprehension • participate more effectively in • communicative skills to follow • Conversations.	Following Conversations At a restaurant Birthday invitation Birthday party At a party At a bank	Handbook and Audio CD	Class Room
LU-4 **Introduction to Listening - Listening for Key Information**	Trainee must be able to • Expand English language listening comprehension skills to focus on particular key information.	Listening for Key Information Being busy Hello, may I help you? Robbery A trip to London Job opportunity A medical advice	Handbook and Audio CD	Class Room

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
LU-5 **Introduction to Reading - Reading to Understand the Sequence of a Text**	Trainee must be able to • Achieve an acceptable level of reading skills and follow meaning sequences as well.	Reading to Understand the Sequence of a Text Words in my life My puzzled world of words Senseless! Let's give sentences a sense Let's make a story Reading comprehension	Hand-out and Audio CD	Class Room
LU-6 **Introduction to Reading - Understanding the Text Structures**	Trainee must be able to • Acquire an adequate level of reading skills and be able to understand different types of reading structures.	Understanding the Text Structures Turn on the meaning Making a decision on opinions Read a picture Reading between the lines Build a reading bridge Read and answer	Hand-out and Audio CD	Class Room
LU-7 **Introduction to Reading understanding the**	Trainee must be able to • Read and fully comprehend the	Understanding the Purpose of Text Finding essence	Handbook and Audio CD	Class Room

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
Purpose of Text	purpose of written materials.	Give me a title Recognizing patterns Vocabulary Skimming Scanning Dictionaries		
LU-8 **Introduction to Reading - Reading for Key Information**	Trainee must be able to • Read independently to look for the key information.	Reading for key Information Summarizing KWL Learning log Visualizing Crossword Taking notes Reading – silent and aloud	Handbook and Audio CD	Class Room
LU-9 **Introduction to Writing- Completing a form**	Trainee must be able to Improve basic English Language writing skills.	Completing form All about you What do me lookalike? Where am I from? Likes and dislikes What about you?	Hand book	Class Room
LU-10 **Introduction to Writing - Correcting errors**	Trainee must be able to • Improve English language writing skills, focusing on basic writing errors.	Correcting errors Capital Letters Full stops Other Punctuations We all make Mistakes	Hand book	Class Room
LU-11	Trainee must be able to	Communicating ideas and information	Hand book	Class Room

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
Introduction to Writing - Communicating ideas and information	• Improve English language writing skills concerning their immediate surroundings.	Where do you live? My family What's his job? What can you do?		
LU-12 **Introduction to Writing - Writing a text**	Trainee must be able to • Improve English language formal and informal writing skills	Writing text Replying to a letter Suggestions in a letter Having a great time Writing a form response Making suggestions Explaining why?	Hand book	Class Room
LU-13 **Introduction to Speaking - Introduction to language**	Trainee must be able to • Improve English language speaking skills by discussing basic and general information.	Introduction to language Sounds interesting Patterns and shapes Numbers and dates Family Hobbies and interests Home and hometown Occupations Languages	Hand-out and Audio CD	Class Room

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
		Weather		
LU-14 **Introduction to Speaking - Social situations**	**Trainee must be able to:** • Improve English language speaking skills by sharing information on higher level.	Social situations Greeting& exclaiming Asking and answering questions Describing people, things, and places Expressing likes, dislikes and preferences Apologizing and forgiving Accepting and refusing offers Suggesting and proposing Responding to invitations	Hand-out and Audio CD	Class Room
LU-15 **Introduction to Speaking - Exchanging information and opinion**	**Trainee must be able to:** • Improve English language speaking skills by sharing information on higher level.	Exchanging information and opinion Same and different people and things Same and different actions What's in your picture? Asking for and giving directions Making plans How do you commute to work? Are you in a rut? How to report people? I have done it! Is tourism appreciated?	Handbook and Audio CD	Class Room
LU-16 **Introduction to Speaking -**	**Trainee must be able to:** • Improve English	Presenting a topic People	Handbook and Audio CD	Class Room

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment Material	Learning Place
Presenting a topic	language speaking skills by expressing and presenting opinions and experiences.	Personalities Clothes Books, music and film Places Food and drink How was your dinner? Machines and technology Travelling Where would you stay?		

Part # 2 of Module D (Allied Skills): Computer & IT

Objective of this part: This module includes knowledge and skill required to perform basic computer operation and usage of MS office to work efficiently in assigned tasks.

Duration	Practical
60	40

Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools / Equipm
LU-1 **Introduction to Computer**	**Trainee must be able to:** • Differentiate between software and Hardware. • Identify parts of computer.	• Computer (Definition) • Information Processing Cycle • Components of the Computer • Data Representation • Software • Some Abbreviations	Total 12 Theory 4 Practical 8	Desktop Computer Latest office processing Handout for students Multimedia
LU-2. **Basics of Word Processing**	Trainee must be able to • Develop skills for using word processing for office work	• Understand the Basics • Work with Text and Paragraph • Format the Text • Format the page • Insert Art and Object • Add references in the document • Use document review	Total 12 Theory 4 Practical 8	Desktop Computer Word processing softwa Handout for students Multimedia

Duration		Practical		
		options • Develop labels and envelop editing • Print the document		
LU-3 **Basics of Spreadsheets**	**Trainee must be able to:** • Use Excel for official purposes	• Understand Spreadsheet • Work with Spreadsheet • Create Graphs and Charts • Work with Multiple Worksheets • Import Spreadsheet into Word and Power point • Print Spreadsheet document	Total 12 Theory 4 Practical 8	Desktop Computer Office software Handout for students Multimedia
LU-4. **Basics of Power Point**	**Trainee must be able to:** • acquire skills for using PowerPoint software	• Understand the purpose and use of Power point • Work with slides • Create simple presentations • Use insert options • Apply and customize Animation • Print the document	Total 12 Theory 4 Practical 8	Desktop Computer Office software Handout for students Multimedia

Duration		Practical		
LU-5. **Basics of Internet and email usage**	**Trainee must be able to:** • acquire skills for using emails and Internet effectively	• Use Internet effectively • Set-up email accounts and use emails as a communication tool • Ethics of emailing	Total 12 Theory 4 Practical 8	Desktop Computer MS-0ffice 2010 Handout for students Multimedia

Part # 3 of Module D (Allied Skills): Secondary Skills

Objective of this part: This module add values in assessment and extra curriculum activities (It demonstrate teachers / instructors to make necessary arrangements to assist the trainees accordingly)

Duration	Theory	Practical
130	0	130

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-1 **Monthly Test**	**Trainee must be able to:** • Check if the Learning Objectives have been achieved. • Identify the learning gaps.	• It is based on the desired competencies necessary in an individual and modules available in the curriculum	Multimedia Projector Answer Sheets Test papers	Class rooms

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	• Monitor the progress • Preparation for final examination.			
LU-2 **Library**	**Trainee must be able to:** • Develop reading habits • Study reference books and machine manuals. • Providing opportunity to get more details on	• It is based on the desired competencies necessary in an individual and modules available in the curriculum	Fully equipped library	Library

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	any topics.			
LU-3 **Sports**	**Trainee must be able to:** • Providing an opportunity of healthy and physical activities. • Improve team work and fitness by playing		Sports goods	Play Area

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	indoor and outdoor games.			
LU-4 **Events**	**Trainee must be able to:** • Getting extra curricula knowledge and information. • Broadening the vision and thinking.	• It is based on the desired competencies necessary in an individual and modules available in the curriculum	Multimedia Projector	At Institute or outside

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-5 **Students Projects**	**Trainee must be able to:** • Enhancement of technical skills and knowledge. • Understanding technical drawings (Detail Drawings and Assembly Drawing) • Project planning • Improving problem-	• It is based on the desired competencies necessary in an individual and modules of OJT available in the curriculum	Machines Hand Tools	Workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	solving skills, creative thinking, and teamwork.			
LU-6 **Industrial visit**	**Trainee must be able to:** • Giving exposure to local industries • Observing industrial procedures and operations. • Getting awareness of industrial environment	• It is based on the desired competencies necessary in an individual and modules available in the curriculum which necessitate industrial exposure	N/A	Industry

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place

5.4 Module E: Perform Maintenance & Administrative Operations

Objective of the Module: This module demonstrates knowledge, skills and attitude required to perform routine maintenance and specified administrative operations which assist an individual to perform planning their work, smooth functioning & operations of CNC machines.

Duration (Hours)	Theory (Hours)	Practical (Hours)
133	60	73

Part # 1 of Module E (Perform Maintenance & Administrative Operations): Perform routine maintenance of CNC machines

Objective of this part: This part of module demonstrates knowledge, skills and attitude required to perform maintenance functions by an individual in accordance with the organization's approved guidelines and procedures. The competent person will be expected to perform routine maintenance of machines and tools as well as general housekeeping. The underpinning knowledge regarding maintenance of tools and machinery will be sufficient to provide the worker with the basis for maintenance work.

Duration	Theory	Practical
73	20	53

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-1 **Clean CNC machine**	**Trainee must be able to:** • Turn off the machine as per SOPs • Empty chips trolley according to SOPs, • Remove dust particles from exterior of machine according to SOPs, • Perform exterior-Interior cleaning of machine using cleaning tools	• Describe necessary starting activities to perform machining operations on CNC machine, • Describe necessary ending activities to perform machining operations on CNC machine, • Enlist safety measures for CNC machine cleaning, • Procedure to perform 5S practices	Cotton Rug Fork lifter Waste Trolley Scrape Pan Gloves Dust Mask Floor Brush	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	recommended in OEM manual.	• Enlist material required to perform exterior & Interior cleaning of CNC machine, • Identify chips trolley, • Procedure of cleaning	Standard cleaning fluids SOPs	
LU-2 **Maintain Hydraulic and lubrication oil level**	**Trainee must be able to:** • Perform fluid condition test as per OEM Manual, • Remove used oil as per recommendations of OEM manual of machine • Top up oil level as per OEM recommendations.	• Identify different eye level • Give reasons for maintaining fluid level in machine • Identify machine oil • Interpret oil removal method • Interpret oil top up method • Interpret oil change records • Basic definitions of viscosity, pressure, mass, volume etc. necessary for knowing better quality oil / lubricants • Procedure to maintain hydraulic and lubrication oil level	Oil can Funnel spanners set Waste cloths Oil / hydraulic Operation manual	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-3 **Change coolant**	**Trainee must be able to:** • Check working condition of coolant as per SOPs, • Top up the coolant up to level recommended in OEM manual.	• Identify different gauge level • Identify coolant • Select recommended fluid for machine • Identify coolant reservoir • Interpret coolant removal method • Interpret coolant top up method • Procedure to change coolant	Mechanical workshop machine Oil can Funnel Spanners set Waste cloths OEM Manual	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-4 **Service coolant tank**	**Trainee must be able to:** • Perform coolant tank cleaning according to SOPs • Refill recommended coolant in recommended quantity.	• Follow Company SOP's • Coolant top up method • Procedure to perform service of coolant tank.	SOPs Spanners set Specified seals	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-5 **Replace worn tools**	**Trainee must be able to:** • Perform inspection of tool to decide its operational condition. • Remove worn out tool from machine according to OEM recommendations, • Update tool library with correct indexing. • Replace tool from library	• Describe Physically discarded tool, • Describe causes of tool wear, • Define disadvantages of using worn tool, • Index tool Library. • Procedure to replace worn tools	Machine equipped with cutting tools Tool Library Spanners Allen keys set	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-6 **Perform lockout /tag out procedures**	**Trainee must be able to:** • Maintain daily maintenance check list • shut down operating panel • Mount tags on appropriate locations • Remove electrical connections	• Interpret daily check list, • Interpret tags • Tagging procedure	Standard check sheet Identification tags Star set	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-7 **Apply Grease on machine**	**Trainee must be able to:** • Remove expired grease according to SOPs • Apply recommended quality & quantity grease on machine as per OEM manual	• Purpose of performing greasing • Describe grease specifications • Differentiate between oil and grease • Procedure to apply greasing	PPEs Specified grease Grease gun Maintenance manual	Class room and Institute workshop
LU-8 **Respond to machine failure**	**Trainee must be able to:** • Stop the machine / Emergency Stop, • Switch off related electrical supply,	• Knowledge about Emergency Stop • All panel connection locations • Reporting format • Read maintenance schedule	Safety equipment Fire extinguisher Fire buckets Alarm switch	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	• Submit Report to concerned authority • Keep maintenance record as per company policy, • Keep all the tools and material in proper place to ensure safe work. • Identify electrical and electronics faults and consult with superior	• Describe method of keeping record of maintenance schedule. • Machine operations • Emergency contact numbers • Electrical faults and types • Describe pressure units • Describe electric units like Volt, Watt and Ampere	Reporting format	

Part # 2 of Module E (Perform Maintenance & Administrative Operations): Perform Administrative Operations

Objective of this part: This part of module demonstrates skill and knowledge required to perform basic administrative operations in accordance with approved procedures. Competent individual will be expected to prioritize job schedule, provide process improvement feedback, ensuring quality inspection and keep inventory.

Duration	Theory	Practical
40	20	60

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-1 **Prioritize job schedule**	**Trainee must be able to:** • Create schedule according to priority with respect to production plan • Comprehend material priorities for hindrance less production, • Develop list of required tools for hindrance less production , • Calculate time required for production • Determine sequence of activities, • Report delays to superior in prescribed manners.	• Interpret production plan, • Describe measure to meet time lines, • Describe optimization of own time/activities, • Describe manufacturing process	Computer set Stationary (assorted) Stop watch Job Card Standard format in hard and soft copy	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-2 **Provide process improvement feedback**	**Trainee must be able to:** • Observe areas for process improvement correctly, • Evaluate individual activities criticality, • Evaluate process flow critically, • Maintain flow process chart • Meet supervisor to discuss about process improvement	• Interpret manufacturing process flow diagram/chart, • Define concepts of integrated manufacturing , • Describe benefits of integrated manufacturing • Interpret Kaizen and 5S methodology	Board Markers Sticky notes Stationary etc. Flow chart	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-3 **Keep material inventory**	**Trainee must be able to:** • Verify consumables availability through inventory and maintain check sheet • Verify availability of desired tools through stock inventory, • Report stock condition consumption according to job, • Request for material on prescribed indent format, • Carryout consumed items disposal.	• Interpret indent book, • Interpret check sheet, • Interpret record keeping methods.	Computer set with printer Pen File Racks Indent book Check sheet Bin Cards	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-4 **Document in-process inspection**	**Trainee must be able to:** • Maintain check sheet of process inspection • Apply outcomes of process inspection by segregating nonconformance parts by following SOPs • Keep record and suggest improvement if any	• Describe necessity of in process inspection documentation, • Describe method of in-process documentation, • Quality and process inspection check points	Go - not Go gauges Stationary Process check sheets/ flow charts	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-5 **Back-up technical data**	**Trainee must be able to:** • Generate CAD data file back-up in specified location • Generate CAM data file back-up in specified location • Generate Numeric Control data file back-up in specified location	• Different safe storage medium • Describe process of PC storage • Frequency of back-up and master medium of storage • Procedure to backup technical data	Computer DVD Storage Hard drives	Class room and Institute workshop

5.5 Module F: Manufacturing Processes

Objective of the Module: This module demonstrates knowledge of mechanical manufacturing process, introduction and types manufacturing processes which are necessary to know by an individual performing CNC machining operations and working in this trade.

Duration (Hours)	Theory (Hours)	Practi
80	60	

	Learning Outcomes	Learning Elements	Duration
LU-1 **Define different types of manufacturing processes**	**Trainee Should be able to:** • Describe mechanical manufacturing • describe different types of manufacturing process • Develop process flow	• Definition of manufacturing • Types & categories of manufacturing processes • Process flow diagram	Total 6 Theory 6 Practical 0
LU-2 **Describe casting & molding processes**	**Trainee Should be able to:** • Differentiate between types of metal casting processes • describe Types of molding processes	• Die casting • Sand casting • Plastics Injection molding • Compression molding • Extrusion • Blow molding • Vacuum molding	Total 18 Theory 13 Practical 5
LU- Describe forming processes	**Trainee Should be able to:** • Describe different types of Sheet metal forming processes • Forging (Hot & cold)	• Forging process (Hot & cold) • Rolling process (Hot & cold) • Extrusion process	Total 20 Theory 15 Practical 5

Duration (Hours)	Theory (Hours)		Practi
	• Rolling (Hot & cold) • Extrusion Pressing Other metal and non-metal forming processes	• Sheet Metal processes ✓ Blanking ✓ Drawing (manufacturing) ✓ Deep drawing (sinks, auto body) ✓ Bending & Hemming ✓ Embossing ✓ Stretch forming ✓ Shearing ✓ Piercing ✓ Trimming ✓ Shaving ✓ Notching ✓ Perforating ✓ Nibbling ✓ Dinking operation ✓ Lancing ✓ Cut-off • Stamping of Metal, non-metal	
LU- describe joining processes	**Trainee Should be able to:** • Describe different types of joining processes • Describe types of Permanent Joining Processes	Types of welding Procedure of; • Brazing • Soldering	Total 18 Theory 13 Practical 5

Duration (Hours)	Theory (Hours)		Practi
	• Describe Types of Temporary Joining Process	• Fastening	
LU-5 **Describe polishing and finishing processes**	**Trainee Should be able to:** • Describe finishing & industrial finishing processes	Describe Finishing & industrial finishing Procedure of; • Abrasive blasting (sand blasting) • Buffing • Electroplating • Electro polishing • Etching	Total 18 Theory 13 Practical 5

5.6 Module G: Technical Drawing & CAD

Objective of the Module: This module demonstrates skills, knowledge and attitude to acquire competencies to read and understand technical drawing, demonstrate understanding via free hand sketches and develop two dimensional drawing on Computer Aided Design software.

Duration (Hours)	Theory (Hours)	Practical (Hours)
120	30	90

Part # 1 of Module G (Technical Drawing & CAD): Technical Drawing

Objective of this part: This part of module demonstrates skills needed to acquire by an individual for interpreting technical drawing and various technical symbols, develop free hand sketches to define technical requirements.

Duration	Theory	Practical
65	15	50

Learning Unit	Learning Outcome	Learning Elements	Duration	Tools / Equipment	Learning Place
LU-1 **Read and extracting information from drawings**	**Trainee Should be able to:** • Demonstrate knowledge of basic engineering drawings and their applications • Demonstrate line, arc, circle, angles, ellipse, dimensions and others main drawing generation tools • Interpret and	• Interpret terminology associated with drawings. 1. nominal size 2. limits 3. tolerance 4. allowance 5. scale • Procedure to perform line, arc, circle, angle,	Total 40 Theory 10 Practical 30	Drawing Board Basic Engineering Drawing Book Drawing instrument	Class room and Institute lab

Learning Unit	Learning Outcome	Learning Elements	Duration	Tools / Equipment	Learning Place
	extract information from drawings necessary to perform required functions on the job	ellipse, dimensions and others main drawing generation tools • Identify types of basic drawings and sketches and describe their purpose. • Interpret and extract information from drawings. 1. Lines, arc, angles 2. projections 3. dimensions 4. views 5. notes 6. finish symbols • Explain the principles of isometric, orthographic & oblige projection.			

Learning Unit	Learning Outcome	Learning Elements	Duration	Tools / Equipment	Learning Place
LU-2 **Freehand Sketches and drawing from physical** **Measurements.**	**Trainee Should be able to:** • Demonstrate his understanding by basic freehand sketches • Draw an accurate drawing from physical measurements.	• Procedure to perform basic sketching techniques. • Describe the procedures used to perform accurate reading and transfer of sizes. • Describe the procedures used to transfer information to the drawing Paper	Total 25 Theory 5 Practical 20	Drawing Board Basic Engineering Drawing Book Drawing instrument	Class room and Institute lab

Part # 2 of Module G (Technical Drawing & CAD): Computer Aided Designing (CAD)

Objective of this part: This part of module demonstrates skills needed to acquire by an individual for interpreting developing two dimensional technical drawings and various technical symbols.

Duration	Theory	
55	15	

Learning Unit	Learning Outcome	Learning Elements	Duration	Tools / Equipmen

LU-1
Demonstrate CAD system management techniques
	Trainee Should be able to:
	• Demonstrate a CAD system Operations:
	  ○ CAD functions
	  ○ Capabilities of a CAD system
	• Demonstrate Auto CAD environment
		• Describe basic CAD functions
		• Describe basic Capabilities of a CAD system
		• Describe basics of CAD Environment
		• Apply procedure of CAD operation, function, environment and capabilities
			Total 10
			Theory 5
			Practical 5
				Computer Set
				CAD system
				Auto CAD software
				Lecture
				Video
				Paper based material
				Internet On-Line

LU-2 **Demonstrate basic geometric entities on CAD**	**Trainee Should be able to:** • Demonstrate basic geometric entities: • Demonstrate basic drawing entities • Demonstrate entities by entering coordinates • Modify drawing entities using editing commands	Procedure to Create basic drawing entities 1. **File:** New, Open, Save, Save As, Printer Set, Printer Preview And Print 2. **Edit:** Undo, Redo, Cut And Copy 3. **View:** Zoom Pan, Aerial View, Model Space, Paper Space, Hide Shade And Render. 1. **Format:** Layer Color, Text Style Unit 2. **Draw**: Line Ray, Construction Line, Multi Line, Poly Line Polygon Rectangle, Arc, Circle, Ellipse Block, Hatch, Region, Text Surface And	Total 20 Theory 5 Practical 15	Computer Set CAD system Auto CAD software Lecture Video Paper based material Internet On-Line

		Solids. 3. **Tool:** UCS, Inquiry, Object Snap Setting And Drawing Aids 4. **Dimension**: Line, Aligned, Ordinate Radius, Diameter, Angular Baseline, Continue, Oblique Aligned Text And Style. 5. **Insert:** Block. 6. **Modify**: Erase, Copy, Mirror, Offset, Array, Move Rotate, Scale, Stretch, Trim Extent, Brake, Chamfer, Fillet and Explode. 7. **Coordinate**: Absolute, Incremental, Relative, Polar		
LU-3 **Generate Drawing with CAD**	**Trainee Should be able to:** • Demonstrate drawings basic functions with Auto CAD commands • Generate drawing through Auto CAD software	• Procedure to create layers/levels and layers/ level properties • Procedure to Organize drawing elements • Procedure to perform Detail drawing dimensions: • Procedure to create hatch patterns: • Procedure to Import standard symbols.	Total 25 Theory 5 Practical 20	

		• Procedure to Verify size conformity		

5.7 Module H: Perform Bench Fitting & Conventional Machining

Objective of the Module: This module demonstrates skills, attitude and knowledge to perform conventional operations which assist an individual in basic understanding and to perform operations of CNC machines. This module is combination of conventional machining operations and bench work operation. To demonstrate competencies in each, it has been divided into 2 parts to cover required learning elements and outcomes separately for each conventional operation.

Duration (Hours)	Theory (Hours)	Practical (Hours)
138	29	109

Part # 1 of Module H (Perform Bench Fitting &Conventional Machining): Perform Bench work

Objective of this part: This part of module demonstrates skill and knowledge required to perform basic bench work operations using different tools and equipment in accordance with approved procedures which assist in performing successful completion of job on CNC machines. The competent individual will be expected to perform debarring (filing) marking, sawing tapping and reaming using hand tools.

Duration	Theory			Practical
60	15			
Learning Unit	**Learning Outcome**	**Learning Elements**	**Duration**	**Tools / Equipmer**
LU-1 **Perform de-burring on metal**	Trainee Should be able to • Collect job from store to perform operation as per job requirement. • Clamp the job in vice as per work instructions • Perform de-burring to get required finish.	• Describe purpose of bench vice • Describe correct posture for performing de-burring • Describe hand filing methodology • Interpret parts and types of file • Differentiate files	Total 10 Theory 2 Practical 8	PPEs File set Emery paper Hand Grinder

Duration	Theory			Practical
		according to cutting teeth • Describe file handling rules • Select file according to the. activity • Procedure of de-burring on metal		
LU-2 **Perform marking on metallic job**	Trainee Should be able to • Paste color on job according to drawing • Rest job on surface plate according specified angle • Set measuring instruments for error less measurements. • Perform marking on the job with- in tolerances as specified in SOPs.	• Define importance of accurate job marking • Interpret appropriate measuring and marking tools • Describe job marking steps • Describe job setting method • Describe application of height gauge • Interpret drawing for job marking • Basic Engineering drawing • Basics of measurement and tolerances • Procedure of marking on the metallic job	Total 12 Theory 4 Practical 8	Height gauge Surface plate Color marker Tri square Scriber Centre punch Hammer
LU-3 **Perform manual sawing on metal**	Trainee Should be able to • Fix Job on vice according	• Define importance of accurate job sawing,	Total 10	Saw/blade

Duration	Theory			Practical
	to SOPs , • Perform saw adjustment for required sawing operation, • Perform sawing on job as per mark/drawing, • Select appropriate blade according to job requirement,	• Describe job sawing steps, • Interpret drawing for job sawing, • Interpret saw setting method, • Procedure to perform manual sawing on metal	Theory 2 Practical 8	Saw frame Bench Vice
LU-4 **Perform Reaming On metallic job**	Trainee Should be able to • Fix Job on vice according to SOPs, • Set reamer in the handle correctly, • Apply lubricants during reaming on appropriate intervals.	• Interpret appropriate reaming tools, • Procedure to perform reaming. , • Interpret drawing for reaming job, • Describe types of reamers, • Define importance of using oil/lubricants during reaming,	Total 8 Theory 2 Practical 6	Bench vice Hand reamer Handle of reamer Oil/Lubricant Plug Gauges
LU-5 **Perform manual taping**	Trainee Should be able to • Mount job on vice as per SOPs, • Perform tapping according to job specification,	• Describe thread standards. • Interpret thread gauge Interpret drawing to determine thread specification	Total 8 Theory 2 Practical 6	ANSI thread size charts Conversion table Thread gauge Tap Tap handle

Duration	Theory			Practical
		• Procedure to perform manual taping.		Vice Drill Centre punch Magnifying glass
LU-6 **Perform electric arc welding on job**	Trainee Should be able to • Perform welding job setup according to SOPs, • Control welding machine power source correctly, • Fix electrode in welding holder correctly, • Perform welding on job as per required length • Verify welded joint as per welding SOPs.	• Interpret welding process, • Describe types of electrodes, • Describe safety requirements, • Describe welding plant capacity, • Interpret electrode according to material specifications. • Procedure to perform electric arc welding	Total 12 Theory 3 Practical 9	Welder's PPEs Welding transformer Electrodes Chipping hammer Wire brush

Part # 2 of Module H (Perform Bench Fitting & Conventional Machining): Perform Conventional Machining Operations

Objective of this part: This part of module demonstrates skill and knowledge which assist an individual to perform conventional machining operations leading to CNC machining operations. The basic demonstration of milling, lathe, drilling & grinding machining operations in conventionally safe working environment will enable an individual to perform work on CNC machines more appropriately.

Duration	Theory			
78	14			
Learning Unit	**Learning Outcomes**	**Learning Elements**	**Duration**	**Tools / Equipmer**
LU-1 **Perform milling operation**	Trainee Should be able to • Select milling tools according to job requirement. • Mount and set the required work-holding devices, work piece and cutting tools according to SOPs • Set the operating parameters (e.g. speed and feed) of machine tool to achieve the work specification. • Obtain and follow work specifications, drawings or sketches to accomplish the job • Perform milling as per prescribed procedure / work instructions • Perform tool sharpening	• Interpret safety precautions and PPEs • Methods and techniques of mounting and setting of work-piece. • Methods and techniques of adjusting operating parameters of machine tool. • Procedure to perform milling machine operations. • Calculate speed and feed. • Identify cutting tools. • Work specifications, drawings and sketches. • Interpret techniques to check quality of component produced. • Basic machine operations • Use safety precautions and	Total 24 Theory 4 Practical 20	Milling Machine Milling / Cutting Tools Vernier Calliper Personal Protective Equip Angular vice Arbor Dividing / indexing head Studs Rotary table Tool Sharpener

Duration	Theory			
	operation based on the requirement as specified in work instructions	procedures need to be observed during work. • Interpret basic Engineering drawing • Basic manufacturing processes • Describe tool sharpening procedure		
LU-2 **Perform lathe operation**	Trainee Should be able to • Set speed & feed of lathe machine according to SOPs • Select tools according to job requirement. • Mount Work piece in chuck • Mount cutting tool in tool post • Perform turning operation according to drawing / instructions. • Perform tool sharpening operation	• Methods and techniques of mounting and setting of work-piece. • Installation methods of cutting tool • Adjustment of feed &speed according to material specification • Basic material properties • Identify cutting tool • Procedure to perform lathe machine operations • Interpret work specifications, drawings and sketches. • Techniques to check quality of component produced. • Procedure of shutting	Total 24 Theory 4 Practical 20	Lathe Machine Cutting Tools Vernier Calliper Personal Protective Equip Tool sharpener

Duration	Theory			
		down of machine and equipment after closure of activities. • Use safety precautions and procedures need to be observed during work. • Interpret Basic engineering drawing • Describe tool sharpening		
LU-3 **Perform drilling operation**	Trainee Should be able to • Select drill bits according to drawing. • Mount and set the required work-holding devices, work piece and cutting tools. • Adjust the RPM of machine according to the job. • Perform drilling operation according to the drawing. • Check quality of the component produced at different intervals. • Observe personal and workplace safety. • Perform tool sharpening operation	• Identify types of drill bits • Define procedure of mounting and setting up of work-holding devices, work piece and cutting tools. • Procedure to perform drilling • Understand method and technique of adjusting RPM of drill machine. • Use safe drilling procedures. • Use safety precautions and procedures. • Understand basic engineering drawing • Describe tool sharpening	Total 20 Theory 4 Practical 16	Drill machine & bits Drill chuck with key Vernier caliper Personal Protective Equip Marking Tools Drill Sleeve and Socket Scriber Center punch Clamping vice Scale Tool sharpener

Duration	Theory			
LU-4 **Perform Grinding Machine Operations**	Trainee Should be able to • Select appropriate grinding wheel according to material specification of job • Hold the work piece firmly by placing it on the tool rest. • Use coolant as specified in work instructions / SOPs for selected job • Identify reference points on work piece before grinding. • Adjust depth of cut according to speed of machine table. • Observe safety while performing grinding job	• Types of different grinding machines. • Understand type, size, grade of wheels and abrasive. • Procedure to perform grinding • Define technique of holding work piece • Importance of using coolant. • Use specific safety precautions and guidelines. •	Total 10 Theory 2 Practical 8	D-type bevel protector Grinding Machine Personal Protective Equip Coolant Wheel Dresser Surface grinder Cylindrical grinder Vice for grinding machine

5.8 Module I: CNC Programming &Computer Aided Manufacturing (CAM)

Objective of the Module: This module demonstrates skills, attitude and knowledge necessary to acquire the competencies to generate G & M codes, understand manual CNC program, generate tool path and perform computer aided manufacturing operations.

Duration (Hours)	Theory (Hours)	Practical (Hours)
135	55	80

Part # 1 of Module I (CNC Programming & CAM): Manual CNC Programming

Objective of this part: This part of module demonstrates skills, attitude and knowledge necessary to acquire the competencies to generate G & M codes, understand CNC control unit and understand manual CNC program.

Duration	Theory	Practical
40	20	20

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-1 **Demonstrate use of preparatory commands (G &M codes)**	**Trainee Should be able to:** • Demonstrate use of G-codes in a block: • Demonstrate use of M-codes.	• Procedure to apply G & M-codes and uses • Describe Modality • Describe Conflicting commands • Procedure to create Order	CNC manual programming hand book	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-2 **Demonstrate function and application of codes**	**Trainee Should be able to:** • Demonstrate use of codes to specify dimensions: • Demonstrate use of codes to specify speeds and feeds • Demonstrate use of codes to specify tool function: • Demonstrate use of codes to set and assign reference points: • Demonstrate use of codes for rapid positioning	Procedure to perform complete programming exercise with using G & M Codes Describe: • Metric/inch selection • Absolute data input • Incremental data input • Combination in the same block • Diameter programming • Radius programming • Leading and trailing zeros	Computer Set Lecture Video Paper based material Internet On-Line	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
		input Describe: • Spindle rotation direction • Spindle stop • Spindle speed (RPM) • Feed rate function • Constant surface speed Describe: • Machine reference point • Work piece reference point • Tool reference point Describe: • Linear interpolation • Circular interpolation • Helical interpolation • Ramping		
LU-3 **Demonstrate use of codes to create contouring programs**	**Trainee Should be able to:** • Demonstrate use of codes to create contouring programs	Procedure to perform: : • fixed cycles • drilling • tapping		Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
		• turning • boring • threading • roughing • finishing		
LU-4 **Generate CNC program**	**Trainee Should be able to:** • Demonstrate use of G & M Codes in specific dimension. • Generate CNC program for assigned job	• Procedure to perform complete programming exercise using G & M Codes • Procedure to create CNC programming for assigned job		Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place

Part # 2 of Module I (CNC Programming & CAM): Computer Aided Manufacturing (CAM)

Objective of this part: This module demonstrates skills, knowledge and attitude necessary to acquire the competencies to generate tool path, setup and perform computer aided manufacturing operations.

Duration	Theory	Practical
95	35	60

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-1 **Computer aided manufacturing (CAM) Applications and technology**	**Trainee Should be able to:** • Demonstrate the use of computer aided manufacturing (CAM) applications and technology.	• Describe the capabilities and applications of CAM technologies • Procedure of different types of CNC machining code creation and capabilities of CAM software packages: • 2-D machining • 2 1/2-D machining • 3-D machining • Lathe • Mill • EDM • Plasma • Laser • Water Jet • Punches •	Computer set CAM software	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-2 **Features of CAM software**	**Trainee Should be able to:** • Demonstrate features of CAM software:	• Describe Interface with the user (menu driven) • Geometry module • Post processor (machine-code generator) • Cycle time calculations • Speed and feed calculations • Curve generation • File size • Tool library • Material library • Comment section of the program • Post-processor support • Tool path simulation	Computer set CAM software	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-3 **Generate tool path geometry(2D)**	**Trainee Should be able to:** • Demonstrate start and end points for cutting tool locations. • Demonstrate use of 2-D geometry to create cutter paths. • Demonstrate use of 2-D geometry to create chamfers and radii. • Demonstrate use of transformation functions: • Determine the axis support on the CNC machine tool and software. • Demonstrate List and select cutting tools. • Demonstrate chaining techniques for 2-D geometry • Demonstrate contours for chaining by identifying: • Demonstrate the special features of CAM software: • Demonstrate pocketing Tool paths:	• Describe start and end points for cutting tool locations. • Procedure to use 2-D geometry to create cutter paths. • Procedure to use of transformation functions: • mirroring function • rotating function • moving function • translating function • copying function • offset function • grouping elements • scaling elements • Procedure to perform the axis support on the CNC machine tool and software • Procedure to List and select cutting tools. • Procedure of chaining techniques for 2-D geometry • Procedure to contours for chaining by identifying:	Computer set CAM software	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
		• start position • direction • path • end position • z-level change • Procedure to make special features on CAM software: • Lettering • Tool path editing • Tool path merging • Tool path deleting • Procedure of pocketing Tool paths: • Associative tool path • pocket size • window • start point • direction of cut • pocket machining routine • spiral inside in &out • zig-zag • finish allowance		

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
		• number of pocket supports • number of island supports • overcut avoidance between islands • pocket roughing		
LU-4 **Generate tool path geometry (3D)**	**Trainee Should be able to:** • Demonstrate 3-D software features and applications • Demonstrate the application of construction and graphic planes • Demonstrate tool path generation methods • Demonstrate Simulation • Demonstrate Post processer • Demonstrate NC file generation and modification method	• Describe 3-D software features and applications • Cutter radius compensation • Surfaces capabilities • Projections • Roughing capabilities • Sami Finishing capabilities • Finishing capabilities • Describe the application of construction and graphic planes. • Procedure of tool path generation methods in 3D: • Volume • Surfacing • Trajectory • Pocketing • Procedure of Simulation and use error remove techniques	Computer set CAM software	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
		• Procedure of Post processer and selection • Procedure of NC file generation and modification method		
LU-5 **Generate 2D and 3D CNC program with CAM software**	**Trainee Should be able to:** • Demonstrate Pregame with use of CAM software in specific dimension. • Demonstrate tool path generation methods • Demonstrate Simulation • Demonstrate Post processer • Demonstrate NC file generation and modification method	• Procedure of complete programming exercise with using CAM software. Describe tool path generation methods: • Volume • Surfacing • Trajectory • Pocketing • Procedure of Simulation and use error remove techniques • Procedure of Post processer and selection • Procedure of NC file generation and modification method	Computer set CAM software	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place

5.9 Module J: Perform CNC Machining Operations

Objective of the Module: This module demonstrates skills and knowledge in an individual to perform CNC machining operations comprising of CNC milling, CNC turning and CNC grinding. To demonstrate competencies in each machining operations in the module it has been divided into 3 parts, each part cover each machining operation separately with the required learning elements and outcomes.

Duration (Hours)	Theory (Hours)	Practical (Hours)
283	88	195

Part # 1 of Module J (Perform CNC Machining Operations): Perform CNC Milling Operations

Objective of this part: This part of module demonstrates skill, knowledge & attitude require to performing job setting-up / setting-off, run simulation and making parts in safe working environment on CNC milling machine.

Duration	Theory	Practical
112	38	74

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-1 **Perform CNC mill job setup**	**Trainee Should be able to:** • Collect Material from store as per job requirement • Perform pre operation CNC machine cleaning • Home machine for proper references according to SOPs • Operate machine manually to bring machine table in desired position • Clamp Job according to work	• Interpret safety precaution mentioned in milling Machine manual • Cutting material properties • Functions & operations of milling machine • Enlist main parts of milling machine • Define measuring method of parts • Procedure to perform Job setup in CNC Milling machine • Enlist milling machine Tools&	CNC Milling machine Spanner (assorted) Cutting tools Machine vice Steel ruler Vernier Caliper Step Clamps Set	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	instruction • Perform dialling on the job according to operation manual • Evaluate centering of job value with reference point • Put desired values in machine control panel according to work instructions	understand their operation • Interpret mill job drawings and NC file. • Procedure to perform material collection method from store • Procedure to perform machine cleaning before job setup.		
LU-2 **Run simulation of first part using CNC mill**	**Trainee Should be able to:** • Perform initial settings according to operating system manual, • Down load milling simulation on computer from storage media, • Run CAM software for milling operation on computer, • Initiate simulation to verify parameters setting according to job requirements.	• Interpret Manual program of provided CNC job • Downloading process of milling simulation from storage media • CAD & CAM data download procedure • Procedure of running simulation	Computer set equipped with milling simulation 3D CAM software	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-3 **Make sample as per specifications**	**Trainee Should be able to:** • Operate milling machine through control panel as prescribed in operation manual, • Inspect in process quality of finished job as per defined standard, • Interrupt mill machine operation on abnormal situations.	• Describe function of control penal on mill, • Interpret milling machine panel display, • Define tolerance for a work piece. • Define cleaning standard& frequency of routine cleaning of mill according to Work Instruction Sheet, • Explain abnormal situation in which machine need to stop	CNC Milling machine Spanner Cutting tools Machine vice Steel ruler Micrometer	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
		• Procedure to make sample as per specification		
LU-4 **Run production using CNC mill**	**Trainee Should be able to:** • Acquire approval of competent authority on OK sample to start quantity production on CNC mill, • Arrange production material to complete production(max. three pieces) with in assigned timelines, • Stack finished products as per SOPs, • Sort out finished products according to pre-set quality	• Describe Manufacturing process, • Enlist hindrances and their remedies to speed up production, • Describe cycle time of milling job, • Interpret milling work order, • Calculate quantity of material required for bulk production. • Understand Computer Aided Manufacturing drawing	CNC Milling machine Spanner (assorted) Cutting tools Machine vice Steel ruler Micrometer	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	standards.	• Procedure of running production on CNC milling		
LU-5 **Tug out Job from CNC milling Machine**	**Trainee Should be able to:** • Stop machine operation according to work instructions manual, • Un-clamp part from the machine according to SOPs, • Place part on appropriate place according to SOPs, • Perform post work routine cleaning according to work instruction sheet	• Procedure to Job Tug out • Procedure to perform machine cleaning • Explain use of spanner set	CNC Milling machine Spanners set Cotton rags Nylon Brush	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place

Part # 2 of Module J (Perform CNC Machining Operations): Perform CNC Turning Operations

Objective of this part: This part of module demonstrates skill, knowledge & attitude require to performing job setting-up / setting-off, run simulation and making parts in safe working environment on CNC lathe machine.

Duration	Theory	Practical
148	42	106

Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools / Equipment	Learning Place
LU-1	**Trainee Should be able to:**	• Describe metal characteristics			

Learning Unit	Learning Outcomes	Learning Elements		Duration	Tools / Equipment	Learning Place
Perform turning Job setup	• Collect data according to turning assignment, • Collect material from store as per job requirement, • Assess suitability of material for desire job according to SOP, • Clamp Job on CNC lathe according to CNC lathe operation manual, • Align the job within allowed tolerance in performing setup • Setup tool for required operation as per work instructions	knowledge, • Convert allowed tolerance into size. • Describe mechanical turning process, • Select tools for performing turning operations • Enumerate sequence of job setting up on CNC lathe, • Select coolant according to the job requirement, • Verify machining tool condition, • Enumerate tool setting method, • Describe turning job measurements. • Procedure to perform turning job setup		Total 30 Theory 10 Practical 20	CNC lathe Machine Tool and Inserts Turning Tool Facing Tool Parting Tool Boring Tool Reaming Tool Drilling Tool Centre Tool Dial Indicator Vernier Caliper micro Meter	Class room and Institute workshop
LU-2 **Run turning simulation using CNC lathe**	Trainee Should be able to • Feed CAM program for simulation verification according to work instructions • Initiate simulation to verify parameters setting according to Job requirements, • Remove errors from the program with respect to assigned values.	• Down Load turning simulation on computer from storage media, • Identify errors in assigned values, • Interpret CAM Commands, • Run CAM software, • Interpret Manual turning program.	Total 40 Theory 10 Practical 30	Computer set equipped with CAD &CAM software and turning simulation	Storage media	Class room and Institute workshop and lab

Learning Unit	Learning Outcomes	Learning Elements		Duration	Tools / Equipment	Learning Place
		• Interpret basic engineering drawing • Procedure of turning simulation using CNC lathe				
LU-3 **Make sample as per specification**	Trainee Should be able to • Apply appropriate safety guards during machine operation, • Operate CNC lathe through control panel for turning selected part as per work instructions • Demonstrate work order and job quality verification procedure • Prepare sample turning job according to work order • Inspect finished products according to pre-set quality standards.	• Verify initial turning operations, • Describe dimensional specifications, • Describe function of control penal on CNC turning center • Interpret CNC Lathe panel display screen. • Define dimensional tolerances • Describe work order and job quality verification procedure • Procedure to make sample as per specification	Total 40 Theory 10 Practical 30	PPEs CNC lathe machine Tool and inserts Turning tool Facing tool Parting tool Boring tool Reaming tool Drilling tool Center tool Dial Indicator Vernier Caliper Micro Meter		Class room and Institute workshop
LU-4 **Run production using CNC lathe**	**Trainee Should be able to:** • Acquire approval of competent authority on OK sample to start quantity production on CNC lathe	• Describe operation of machine • Interpret process	Total 28 Theory 8	PPEs CNC lathe machine Tool and inserts		Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements		Duration	Tools / Equipment	Learning Place
	• Arrange production material according to SOPs to complete production within assigned time • Arrange production material to complete production(max. three pieces) with in assigned timelines,	flow chart • Interpret turning work order • Describe job cycle time • Learn material selection for selected job production • Procedure to perform production on CNC lathe	Practical 20	Turning tool Facing tool Parting tool Boring tool Reaming tool Drilling tool Center tool Dial Indicator Vernier Calipers Micro Meter Inspection gauges Jigs & Fixtures Trolley and racks		
LU-5 **Tug out Job from CNC lathe Machine**	**Trainee Should be able to:** • Stop machine operation according to OEM manual, • Turn off machine applying SOPs. • Un-clamp part from the machine according to SOPs, • Place part on appropriate place according to SOPs, • Perform after work procedures according to OEM manual.	• Procedure to perform Job Tug out • Procedure to perform machine cleaning	Total 10 Theory 4 Practical 6	CNC turning machine Spanners set Cotton rags Nylon Brush		Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements		Duration	Tools / Equipment	Learning Place
	• Perform post work routine cleaning according to work instruction sheet					

Part # 3 of Module J (Perform CNC Machining Operations): Perform CNC Grinding Operations

Objective of this part: This part of module demonstrates skill, knowledge & attitude require to performing job setting-up / setting-off, run simulation and making parts in safe working environment on CNC grinding machine.

Duration	Theory	Practical
23	8	15

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-1 **Perform grinding Job setup**	**Trainee Should be able to:** • Collect data according to grinding assignment, • Collect Material from store as per job requirement, • Perform wheel balancing of machine according to SOP, • Clamp Job on Machine according to SOP, • Verify Job surface for proper placement, • Perform wheel dressing/crushing as per work instructions manual • Assess suitability of material for desire job according to SOP, • Align grinding Job within allowed tolerance,	• Describe metal grinding techniques, • Describe characteristics of grinding wheel, • Measuring Instruments for grinding job, • Appropriate grinding wheel, • Enlist parts of grinding machine with their functions, • Define magnetic Bed strength of clamping, • Calculate cutting Feed & Grinding wheel RPM, • Enumerate safety precaution recommended for Grinding Machine. • Procedure to perform grinding job setup	Grinding machine Digital caliper Gauges Magnetic Vice Clamping Kit. Spanner set Surface finish tester	Class room and Industry visit

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	• Setup grinding wheel according to surface finish			
LU-2 **Run grinding simulation**	**Trainee Should be able to:** • Down load grinding simulation on computer from storage media according to work instructions, • Load CAM software as defined in machine manual, • Initiate simulation to verify parameters setting is meeting Job requirements.	• Remove Errors from fed program, • Interpret CAM Commands, • Run CAM software on computer, • Interpret simulation Operating software On Screen Buttons, • Interpret Manual grinding program. • Procedure to perform CAM • Procedure to perform simulation	Computer set equipped with CAD & CAM software and grinding simulation Storage media	Class room and Industry visit
LU-3 **Grind job according to specifications**	**Trainee Should be able to:** • Operate machine through dry	• Describe operation of grinding machine, • Identify of abnormalities in grinding	PPEs Surface Grinding machine	Class room and Industry visit

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	run as specified in manual • Bring to Home Position through control panel, • Operate grinding machine through control panel for grinding assigned part as prescribed in operation manual , • Determine difference between assigned and product tolerance, • Intercept grinding operation due to abnormalities.	Machine performance, • Interpret Grinding machine OEM Manual, • Describe safety gears for grinding operation. • Define abnormalities in the operations • Procedure to Grind job according to specifications	Digital caliper Surface tester Manual	
LU-4 **Run production using CNC grinder**	**Trainee Should be able to:** • Prepare sample grinding job according to work order, • Get approval of sample on work order from authority for quantity production on grinder, • Arrange production material to complete production within	• Describe measuring method for surface finish • Interpret process flow chart for grinding operation. • Understand stacking SOPs • Understand inspection criteria	PPEs Surface Grinding machine Digital caliper Surface tester	Class room and Industry visit

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	assigned time, • Stack finished products as per SOPs, • Inspect finished products according to pre-set quality standards.	• Procedure to run production on CNC grinder		
LU-5 **Tug out Job from grinding machine**	**Trainee Should be able to:** • Stop machine operation according to OEM manual, • Turn off machine applying SOPs. • Un-clamp part from the machine according to SOPs, • Place part on appropriate place according to SOPs, • Perform post work routine	• Procedure to perform Job Tug out • Procedure to perform machine cleaning	CNC grinding machine Spanners set Cotton rags Nylon Brush	Class room

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	cleaning according to work instruction sheet			

5.10 Module K: Perform EDM Machining Operations

Objective of the Module: This module demonstrates skills and knowledge in an individual to perform Electric Discharge Machining (EDM) operations comprising of EDM wire cut & EDM Sinker operations. To demonstrate competencies in each machining operations in this module it has been divided into 2 parts, each part cover each machining operation separately with the required learning elements and outcomes.

Duration (Hours)	Theory (Hours)	Practical (Hours)
60	22	38

Part # 1 of Module K (Perform EDM Machining Operations): Perform EDM Wire Cut Operations

Objective of this part: This part of module demonstrates skill and knowledge required to perform operations on wire cut Electric Discharge Machine (EDM). It covers job setting up / setting off, running EDM wire cut related simulation & making parts from the machine.

Duration	Theory	Practical
35	12	23

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-1 **Perform wire cut EDM job setup**	**Trainee Should be able to:** • Perform Control panel setting correctly according to SOPs • Home EDM for predetermined references, • Position EDM table according to job specification, • Load pre quality inspected job on the machine according to operational requirements, • Dial job according to	• Enlist safe practice precautions for EDM wire cut, • Describe operating Principals of EDM wire cut, • Identify main parts of EDM wire cut, • Give reasons of fluids used in EDM wire cut, • Describes machine referencing procedure, with limit switches, • Describe machine operating,	Wire cut EDM Spanner set Measuring Instruments Step Clamps Set Wire	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	specification, • Check wire according to specification • Put values in machine control panel according to work instructions • Demonstrate checking in control panel of program size and orientation for clamping job	• Describe work order importance, • Describe measure instruments, • Knowledge about wire setting • check the machine capacity according to job • Orientation of clamping job • Procedure to perform EDM wire cut job setup		
LU-2 **Run simulation on wire cut EDM**	**Trainee Should be able to:** • Load CAD Drawing on computer and machine panel from storage media • Perform CAD Data Verification for normal condition on computer / machine panel • Initiate simulation to verify parameters setting is meeting Job requirements	• Describe operating procedure of Machine panel, • Describes machine reference procedure, • Describe measuring instruments, • Interpret work order, • Describe measure instruments • Procedure to Perform Simulation in CAD software	Computer set equipped with CAD &CAM software Data Storage device	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
		• Interpret basic engineering drawing • Procedure to perform simulation on wire cut EDM panel		
LU-3 **Make sample as per specifications**	**Trainee Should be able to:** • Run EDM according to methods prescribed in OEM manual, • Interrupt EDM operation on necessary causes as per prescribed method mentioned in OEM manual,	• Verify initial job setup on EDM, • Describe dimensional specifications, • Describe function of control penal on EDM, • Interpret EDM display. • Procedure to make sample as per specification	Wire Cut EDM Vernier Caliper Micrometer Measuring Instruments	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-4 **Run production wire cut EDM**	**Trainee Should be able to:** • Prepare sample wire cut job according to work order, • Get approval of sample on work order from authority for quantity production on grinder, • Arrange production material to	• Describe lubricate requirement for wire cut EDM, • Describe operating procedure of wire cut EDM panel, • Required Wire for wire cut EDM,	Wire cut EDM Measuring Instruments	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	complete production within assigned time, • Stack finished jobs as per SOP, • Inspect finished jobs according to pre-set quality standards.	• Measure wire cut EDM job, • Describe function of wire gauge, • Interpret CAD Drawing, • Describe safety precaution for continue operation of wire cut EDM machine, • Describe time management measures to chive target, • Interpret wire cut process flow chart. • Procedure to perform production on wire cut EDM		
LU-5 **Tug out Job from wire cut EDM**	**Trainee Should be able to:** • Stop machine operation according to OEM manual, • Un-clamp part from the machine according to SOPs,	• Procedure to perform Job Tug out Procedure to perform machine cleaning	Wire EDM machine Spanners set Cotton rags Nylon Brush Clamping set	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	• Place part on appropriate place according to SOPs, • Turn off machine applying SOPs • Perform post work routine cleaning according to work instruction sheet			

Part # 2 of Module K (Perform EDM Machining Operations): Perform EDM Sinker Operations

Objective of this part: This part of module demonstrates skill and knowledge required to perform operations on Electric Discharge Machine (EDM) Sinker. It covers mainly job setting up / setting off, running EDM Sinker & making parts from the machine.

Duration	Theory	Practical
25	10	15

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-1 **Perform EDM Sinker job setup**	**Trainee Should be able to:** • Perform Control Panel setting correctly, • Home EDM for predetermined references according to SOP • Position EDM table according to job specification, • Mount pre quality inspected electrode on swivel head according to operational requirements, • Clamp job according to job requirement • Dial job according to specification, • Put values in machine control unit • Move electrode in X &Y axis position for sink position as per	• Enlist safe practice precautions for EDM Sinker, • Describe operating Principals of EDM Sinker, • Identify main parts of EDM Sinker, • Give reasons of dielectric used in EDM Sinker, • Describes machine referencing procedure, with limit switches, • Describe machine operating, • Describe work order importance, • Describe measure instruments, • Knowledge about electrode • EDM sinker functions • Describe electric units like Watt, Volt and Ampere • Procedure to perform EDM sinker job	EDM Sinker Spanner set Measuring Instruments Step Clamps Set Electrode Machine manual	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
	work order • Set dielectric flesh position according to machine manual	setup		
LU-2 **Make sample as per specifications**	**Trainee Should be able to:** • Run EDM Sinker according to methods prescribed in OEM manual, • Intercept EDM Sinker operation on necessary causes as per prescribed method mentioned in OEM manual,	• Verify initial job setup on EDM Sinker • Describe dimensional specifications, • Describe function of control on EDM Sinker, • Interpret EDM Sinker display. • Procedure to make sample as per specification	EDM Sinker Spanner set Machine vice Measuring Instruments Step Clamps Set Magnifying glass	Class room and Institute workshop

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment	Learning Place
LU-4 **Tug out Job from EDM Sinker**	**Trainee Should be able to:** • Stop machine operation according to OEM manual, • Turn off machine applying SOPs. • Un-clamp part from the machine according to SOPs, • Place part on appropriate place according to SOPs, • Perform post work routine cleaning according to work instruction sheet	• Procedure to perform Job Tug out • Procedure to perform machine cleaning. • Emergency stop for the job tugging and cleaning • Display placement area of part	EDM Sinker machine Spanners set Cotton rags Nylon Brush	Class room and Institute workshop

5.11 Module L: Basic on Job Training

Objective of the Module: The basic on the job training is to give an overall orientation of company, health, safety and quality policy, its overall operations and to gain the real work place understanding skills by practicing the competencies as acquired in the training institute.

Duration	Theory	Practical
800 Hrs	0 hrs	800 Hrs

Month	Week	Recommended rotation plan	Applied Knowledge and skills Related to
1	1	**Company Orientation (Department wise)**	Awareness of chain of command on the plant site, process unit wise orientation and Understanding
		HSE Procedures and regulations of local authority and the company	Health, Safety and Environment manuals and policies; Equipment specifications, study of company's safe working procedures
	2	Types of Materials used and their selection	Importance and use of warehouse; Supply and demand concept, international codes and standards of materials
	3	**Personnel protective equipment (PPE)**	Use and importance of PPE; Maintain the best and safe working practices; Healthy and incident free work place, implementation of accident reporting culture
		Health, Safety and Environment overview of work place as well as equipment	Safety at Work, Understanding Emergency procedures, Fire Fighting, Waste product management, Identifying hazards, define escaping route, material Identification, Surface Protection Methods (Ensure safety at workplace)
	4		

	Monthly report Writing	MS- Office or computerized logging or reporting system	
2	5-6	**Perform Preventive and regular Maintenance Operations**	Perform Preventive and regular maintenance operations in safe mode as per company SOP like, 1. Clean CNC machine 2. Maintain hydraulic & lubrication oil level, 3. Change Coolant 4. Service coolant tank 5. Replace worn tools 6. Perform lockout /tag out procedures 7. Apply Grease on machine
	7		Perform assistance to existing maintenance team as well as operation personnel, learn and use the Equipment, machines and system cleaning and maintenance procedure.
	8		Perform and aware maintenance documentation, control sections its importance and methods of record keeping.
	8	Monthly report Writing	MS- Office or computerized logging or reporting system

3	**Bench work**	Perform Bench work in safe mode with workshop or maintenance team and perform following main process on small size of job. 1. Perform de-burring on metal 2. Perform marking on metallic job 3. Perform manual sawing on metal 4. Perform Reaming On metallic job 5. Perform manual taping 6. Perform electric arc welding on job
		Check work as per given drawing and write report on error and discuss supervisor for its solution.

	Monthly report Writing	MS- Office or computerized logging or reporting system

4	13 14 15 16	**Perform Conventional Machining**	Perform conventional machining in safe mode as per company SOP with the help of technical team, Perform Milling machine operation as per given drawing and trainee doing any job related to following operation with the help of technical team. **Perform Milling Machine operations** 1. Job setup techniques 2. Facing 3. Pocketing 4. Profile cutting 5. Tool Sharpening techniques Check work as per given drawing and write report on error and discuss supervisor for its solutions.

Month	Week	Recommended rotation plan	Applied Knowledge and skills Related to
5	**17** **18** **19** **20**		Perform Lathe machine operation as per given drawing and trainee doing any job related to following operation with the help of technical team. **Perform Lathe Machine operations** 1. Job setup techniques 2. Facing 3. Threading 4. Profile cutting 5. turning 6. Drilling 7. Boring 8. Tool Sharpening techniques Check work as per given drawing and write report on error and discuss with supervisor about its solutions.

Month	Week	Recommended rotation plan	Applied Knowledge and skills Related to
6	**21** **22**		Perform drilling machine operation as per given drawing and doing any job related to following operation with the help of technical team. **Perform drilling Machine operations** 1. Job setup techniques 2. Indentation/Marking 3. Drilling 4. Drill bit Grinding Techniques. Check work as per given drawing and write report on error and discuss with supervisor about its solutions. Perform grinding machine operation as per given drawing and trainee doing any job related to following operation with the help of technical team.
Month	**Week**	**Recommended rotation plan**	**Applied Knowledge and skills Related to**
6	**23**		**Perform grinding Machine operations** 1. Job setup techniques 2. Grinding 3. Grinding Wheel balancing and dressing techniques Check work as per given drawing and write report on error and discuss supervisor for its solutions. Perform and aware documentation, control sections its importance and methods of record keeping.
	24	Monthly report Writing	MS- Office or computerized logging or reporting system

5.12 Module M: Advance on Job Training

Objective of the Module: The advance on the job training is to give exposure and practice of CNC machines and it operations in real working environment. It also comprises the project that competent individual will be completing at the time of completion of OJT.

Duration	Theory	Practical
800 Hrs	0 hrs	800 Hrs

Month	Week	Recommended rotation plan	Applied Knowledge and skills Related to
1	**1** **2**	**Perform wire cut EDM operations**	Perform Wire cut machining in safe mode as per company SOP with the help of technical team, Perform wire cut machine operation as per given drawing and trainee doing any job related to following operation with the help of technical team. **Perform Wire cut Machine operations** • **CAD Part** 1. Create CAD drawing as per given dimension 2. Create Program as per drawing 3. Run and check simulation 4. Remove error if any

Month	Week	Recommended rotation plan	Applied Knowledge and skills Related to
1	**3** **4**		• **CAM Part** 1. Program download on controller 2. Check simulation on machine panel and put reference value on controller 3. Job setup techniques 4. Wire setting 5. Coolant checking 6. Machine operate and cutting as per drawing Check work as per given drawing and write report on error and discuss with supervisor about its solutions. Perform and aware CAM documentation, control sections its importance and methods of record keeping.
		Monthly report Writing	MS- Office or computerized logging or reporting system

Month	Week	Recommended rotation plan	Applied Knowledge and skills Related to
2	**5** **6** **7**	**Perform CNC Milling operations**	Perform CNC milling operation in safe mode as per company SOP with the help of technical team, Perform CNC milling machine operation as per given drawing and doing any job related to following operation with the help of technical team. • **CAM Part** 1. Check 3D CAD data on Software 2. CAM setup on software as per machine and job requirement 3. Tool selection as per required tool in CAM software 4. Design volume, and surface mill as per job requirement 5. Tool path setting and generating 6. Check simulation and verify all process 7. Generate NC file with selection of verified Postprocessor from CNC supervisor
2	**8** **9**	**Perform CNC Milling operations**	• **CNC Milling operational Part** 1. Program download on controller 2. Check simulation on machine panel and put reference value on controller 3. Job setup techniques 4. Tool selection and Setup 5. Coolant checking 6. Machine operation and cutting as per NC data Check work as per given drawing and write report on error and discuss with supervisor about its solutions.
			Perform and aware CAM documentation, control sections its importance and methods of record keeping.

Month	Week	Recommended rotation plan	Applied Knowledge and skills Related to
		Monthly report Writing	MS- Office or computerized logging or reporting system
3	**10**	**Perform CNC Lathe Operations**	Perform CNC Lathe operation in safe mode as per company SOP with the help of technical team, Perform CNC Turing machine operation as per given drawing and doing any job related to following operation with the help of technical team. • **CAM Part** 1. Check 3D CAD data on Software 2. CAM setup on software as per machine and job requirement 3. Tool selection as per required tool in CAM software 4. Design volume, and roughing as per job requirement 5. Tool path setting and generating 6. Check simulation and verify all process 7. Generate NC file with selection of verified Postprocessor from CNC supervisor

Month	Week	Recommended rotation plan	Applied Knowledge and skills Related to
3	**11** **12**	**Perform CNC Lathe Operations**	• **CNC Lathe operational Part** 7. Program download on controller 8. Check simulation on machine panel and put reference value on controller 9. Job setup techniques 10. Tool selection and Setup 11. Coolant checking 12. Machine operation and cutting as per NC data Check work as per given drawing and write report on error and discuss with supervisor about its solutions. Perform and aware CAM documentation, control sections its importance and methods of record keeping.
		Monthly report Writing	MS- Office or computerized logging or reporting system

Month	Week	Recommended rotation plan	Applied Knowledge and skills Related to
4	**13** **14**	**Perform CNC Grinding Operations**	Perform CNC Grinding operation in safe mode as per company SOP with the help of technical team, Perform CNC Grinding machine operation as per given drawing and doing any job related to following operation with the help of technical team. • **CAM Part** 1. Check 3D CAD data on Software 2. CAM setup on software as per machine and job requirement 3. Tool selection as per required tool in CAM software 4. Design grinding CAM as per job requirement 5. Tool path setting and generating 6. Check simulation and verify all process 7. Generate NC file with selection of verified Postprocessor from CNC supervisor
4	**15** **16**	**Perform CNC Grinding Operations**	• **CNC Grinding operational Part** 1. Program download on controller 2. Check simulation on machine panel and put reference value on controller 3. Job setup techniques 4. Grinding Wheel Selection, balancing and Dressing 5. Coolant checking 6. Machine operate and cutting as per NC data Check work as per given drawing and write report on error and discuss supervisor for its solutions.
			Perform and aware CAM documentation, control sections its importance and methods of record keeping.

Month	Week	Recommended rotation plan	Applied Knowledge and skills Related to
		Monthly report Writing	MS- Office or computerized logging or reporting system
5	**17** **18**	**Perform EDM Sinker Operations**	Perform EDM sinker operation in safe mode as per company SOP with the help of technical team, Perform EDM sinker machine operation as per given drawing and doing any job related to following operation with the help of technical team. • **CAM Part** 1. Check 3D CAD data on Software 2. CAM setup on software as per machine and job requirement 3. electrode selection as per available electrode in CAM software
5	**19** **20**	**Perform EDM Sinker Operations**	• **EDM Sinker operational Part** 1. Input electrode coordinate on controller 2. Job setup techniques 3. electrode selection and electrode making 4. oil check 5. Machine operate and cutting as per NC data and drawing Check work as per given drawing and write report on error and discuss with supervisor about its solutions. Perform and aware CAM documentation, control sections its importance and methods of record keeping.
		Monthly report Writing	MS- Office or computerized logging or reporting system

Month	Week	Recommended rotation plan	Applied Knowledge and skills Related to
6	21 22 23 24	**Project**	Perform any industrial project with apply safety rules and company SOP Including following work • Design work (Manual engineering drawing/sketching and CAD drawing) • Bench work • Conventional machining work • Different CNC Machining work • CAM Work • Checking method of project with checking instrument • Report writing of project detail like development time, including process sequence, Quality result, summary
		Monthly report Writing	MS- Office or computerized logging or reporting system

6 List of Machinery, Equipment &Tools

(For A Class of 25 Students)

Name of Trade: Mechanical Manufacturing Specialized in CNC

Duration of Course: 01 – years

List of Machines			
1	Power Saw	11	Electric Arc welding complete set
2	CNC Machining Center	12	Wire cut EDM
3	CNC Turning Centre	13	Lifting equipment
4	Computer set	14	Pedestal grinder
5	Surface Grinder	15	Tool & cutter grinder
6	Hardness testing machine	16	EDM Sinker
7	Hand Grinder	17	Cylindrical grinding
8	Lathe Machine	18	
9	Universal Milling machine	19	
10	Drilling Machine	20	

List of Tools & Equipment			
1	V Blocks	**21**	Tri-Square
2	Parallels blocks	**22**	Surface plate
3	Allen key set	**23**	Dial indicator
4	Bevel protector	**24**	Thread gauge
5	Angular plate	**25**	Tool box
6	Vernier Calipers	**26**	Feeler Gauges
7	Chucks (universal, four jaws)	**27**	Files set
8	Step Clamps	**28**	Dial stand
9	Cleaning equipment (including sandblasters)	**29**	Hand tools common (e.g., screw driver)
10	Compasses	**30**	Height gauge
11	Grease gun/oil cane	**31**	magnetic blocks
12	Depth Gauge	**32**	Torque wrench with sockets
13	Assorted micrometers	**33**	Radius gauges
14	Honing tool	**34**	Saw (& wet saw), Band saw Scale
15	Cutting tools	**35**	Scientific calculator
16	touching probe	**36**	Scriber
17	Hammer	**37**	DVD & Master Storage medium

18	Magnetic stand	**38**	CAD Software
19	Vice (Bench)	**39**	CAM Software
20	Side bar	**40**	MS Office
41	Lever gauge	**42**	Slip gauge set

List of consumables 7

Sr. No.	Description	Qty.	Sr. No	Description	Qty.
1.	Saw dust	12 packs	15	Cotton waste /cotton rags	5 Kg
2.	Duster	12 Nos.	16	Sprit	3 Liter
3.	Emery paper	50 Nos.	17	Thinner	3 Liter
4.	Ferrous and non-ferrous metals	10 Kg block (25)	18	Disposable polyethin bags	1Kg
5.	Materials like plastic and Tafton and PVC etc.	2 Kg (25)	19	Rust cleaner	1 Liter
6.	Grease (assorted)	2 Kg	20	First aid box articles/medicines	2 Box
7.	Stationary	As per need	21	Floor Brush	5 Nos.
8.	Marking ink	As per need	22	Latex gloves set	25 Nos.
9.	lubrication oil/ hydraulic oil	25 Liters	23	Face/nose mask	25 Nos.
10.	Coolant fluid	25 Liters	24	Ear plug set	25 Nos.
11.	Kerosene oil	25 Liters	25	Emery paste	10 Nos.

12.	Hand wash /soap	As per need	26	Welding rod	10 Pack
13.	Cutting tool	25 Nos.	27	PPEs	25 set
14.	EDM wire Brass / tungsten / Molybdenum	2 packets	28	Fire Extinguisher	5 set