SHORT TERM CURRICULUM

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BLACK SMITHING

March, 1999

Council for Technical Education and Vocational Training
(CTEVT) Sanothimi, Bhaktapur

PREFACE

This curriculum has been developed for Technical Schools under the Council for Technical Education & Vocation Training (CTEVT) in the form of short term competency based training package.

This is the first attempt of CTEVT to develop short course of this form. So, feedbacks and constructive suggestions from instructors/trainers are welcomed & gladly included while revising it in the coming days.

I would like to thank Mr. Jeeban Chandra Dahal, Curriculum expert, CTEVT, who played a pivotal role while developing this form of short course.

My sincere thank also go to the subject matter experts who helped a lot by giving valuable technical inputs while developing this short course.

I hope every success of this curriculum in the days to come.

Director
Curriculum Division
CTEVT

March, 1999

Acknowledgment

This curriculum has been developed specially for the Technical Schools running under CTEVT with a view to equip trainees with skills and knowledge in the related field of technology/vocation in the form of short term competency based curriculum package.

This is the first endeavor of CTEVT to develop short course in this form. It is hoped that this attempt will pour some drops in the ocean of competency based education provided by CTEVT throughout the country. Feed backs & constructive suggestions on behalf of related instructors/trainers/implementers are most welcome, gladly accepted, & included while revising this curriculum in the coming days.

I would like to extend my sincere thanks to curriculum division, CTEVT, who gave me a golden opportunity to bear responsibility of developing this form of short-term curriculum.

My sincere thanks also go to the subject matter experts who provided valuable technical inputs while developing this form of short course in one or the other way.

I hope every success in the implementation of this curriculum in the days to come.

March, 1999

Jeeban Chandra Dahal
Curriculum Expert
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Table of content

1. Aims and Objectives:

This short course for "Black smithing" is designed to provide trainees with basic skills and knowledge necessary for Black smithing work.

2. Course Description:

This training program provides task steps, terminal performance objective and related technical knowledge in all tasks necessary for Black smithing.

There will be both demonstrations of skills by the instructors and opportunity to practice the skills by the trainees.

Trainees successfully completing this training program will be able to prepare forge / workshop, prepare work piece, carryout heat treatment of work piece, carryout forge cutting of work piece, carry out forge shapping of hot work piece, join metal by forge welding and riviting and finish work piece.

3. Task structure

	Nature	Total hours
1. Prepare forge / workshop	P	33
2. Prepare work piece	P	35
3. Carryout heat treatment of work piece	P	48
4. Carryout forge cutting of work piece	P	42
5. Carry out forge shapping of hot work piece	P	56
6. Join metal by forge welding and riviting	P	49
7. Finish work piece	P	32
	Total hours	295

4. Target group :

Literate and interested community people willing to work as a black smith.

5. Group size :

Maximum of 16

6. Duration :

295 hours

7. Medium of instruction :

Nepali or English

8. Pattern of attendance :

Regular attendance in classes and practicals.

9. Entry criteria :

Able to read and write and having been interest in black smithing work.

10. Follow up suggestion :

First follow up : One month after the completion of the training
Second follow up : Two months after the first follow up

11. TASKS

11.1 Task : Prepare Forge / workshop

Task Steps	Terminal Performance Objective	Related Technical Knowledge
1. Select safety clothing. 2. Inspect / select hand tools. 3. Inspect / select marking / measuring tools. 4. Inspect / select forge tools. 5. Select forge fuel. 6. Prepare forge equipments 7. Position Anvil in relation to forge. 8. Position raw materials. 9. Select materials. 10. Clean work area. 11. Follow safety precautions.	**Condition (Given):-** • Safety clothings • Hand tools • Marking and measuring tools • Forge tools / fuel / equipment • Raw materials • Workshop **Task (What):-** • Prepare forge / workshop. **Standard (How well):-** • Safety clothings, hand tools, measuring tools, forge tools, forge fuel & equipment and raw materials identified, selected and inspected correctly. • Anvil and raw materials positioned correctly. • Work area well cleaned. • Followed All safety measured appropriately.	• Inspection of the condition of safety clothing. • Correct selection of safety clothing for forge use. • Identification, inspection & selection of hand tools, quality of hand tools, clamping workpiece. • Identification, Inspection and selection of marking and measuring tools, measuring hot metal, marking and measuring methods. • Identification, inspection and selection of forge tools, different forge work processes. • Types of forge fuel, inspection and selection of correct forge fuel, storage of the fuel. • Correct position and working height of forge, method of lightening forge and starting tinder. • Position of forge and Anvil in workplace, correct working height of Anvil, correct starting position when working with Anvil. • Storing metal of different lengths and cross sections. • Selection of correct materials. • Procedure of cleaning work area. • Correct behavior in workshop and forge, safety clothings and precautions.

11.2 Task : Prepare work piece

Task Steps	Terminal Performance Objective	Related Technical Knowledge

1. Interpret workshop drawing.
 	
2. Calculate materials.
 	
3. Make material requisition.
 	
4. Select safety equipment.
 	
5. Select the followings:-
- Marking/measuring tools.
- Hand tools
- Materials
.
6. Measure / markout work piece.
7. Cut materials..
8. Check dimensions.
9. Clean work area.
10.Clean / store tools
11.Follow safety measures
	Condition (Given):-
	• workshop drawing
	• Safety clothings
	• Marking and measuring tools
	• Cutting tools / hand tools
	• Raw materials
	• workshop
	Task (What):-
	• Prepare work piece.
	Standard (How well):-
	• Required materials calculated correctly; all tools, materials and equipment obtained in time, and put on the safety cloths.
	• Workpiece measured and marked out not producing any unnecessary marks and lines.
	• Material cut to an accuracy of ± 2 mm.
	• Dimension of material checked based on the drawing.
	• work area cleaned; tools cleaned and stored properly.
	• All safety measures well followed.
		• Interpretation of workshop drawing.
		• Methods of calculation.
		• Material requisition list.
		• Safety equipment and their condition.
		• Inspection and selection of :
		  • Marking / measuring tools
		  • Hand tools
		  • Materials.
		• Measuring and marking methods for workpiece preparation.
		• Procedure of metal cutting, handling cutting tools, and different cutting methods.
		• How to check dimensions, workshop drawing and method of checking.
		• Procedure of cleaning work area.
		• Cleaning and storing tools.
		• Safety measures to be followed.

11.3 Task : Carryout heat treatment of workpiece

Task Steps	Terminal Performance Objective	Related Technical Knowledge
1. Interpret workshop drawing. 2. Select safety clothings. 3. Select safety equipment for heat treatment. 4. Select hardening tools. 5. Prepare forge. 6. Heat workpiece using forge. 7. Harden workpiece. 8. Quench workpiece. 9. Check hardness of workpiece. 10.Temper workpiece. 11.Check / test workpiece (edges)for brittleness. 12.Clean work area. 13.Store tools. 14.Follow safety measures.	**Condition (Given):-** • Workshop drawing • Forge & forge fuels • Heat treatment colour chart • Quenching bocket • Quenching medium, oil/water • Tongs • Workpiece • Safety cloths & equipment **Task (What):-** • Carryout heat treatment of workpiece. **Standard (How well):-** • Safety cloths and equipment well used. • Heat treatment of workpiece properly carried out. • Hardness colour correctly identified. • Hardened and tempered the workpiece according to the given instruction. • The workpiece did not break or blunt while undergoing testing.	• Reading workshop drawing. • Safety cloths for Forge work and their selection. • Safety equipment for heat treatment and their use. • Identification, selection, inspection and handling hardening tools. • Preparation and maintenance of Forge. • Heating temperature selection, colours for heat treatment and heating procedure. • Methods / process of hardening workpiece. • Purpose and methods of quenching workpiece, selection of quenching medium. • Methods of testing hardness of work piece. • Purpose and method of tempering. • Methods of testing brittleness of workpiece. • Purpose and method of cleaning workareas. • cleaning and storing tools • Safety measured to be following during heat treatment.

11.4 Task : Carryout Forge cutting of hot workpiece

Task Steps	Terminal Performance Objective	Related Technical Knowledge
1. Interpret workshop drawing. 2. Select hand tools. 3. Select forge cutting forge. 4. Prepare Forge. 5. Select correct working temperature. 6. Heat workpiece. 7. Hot cut workpiece in length. 8. Puncture hole in workpiece. 9. Split metals. 10.Check dimension. 11.Clean work area. 12.Store tools. 13.Follow safety measures.	**Condition (Given):-** • Work shop drawing • Marking/measuring tools • Safety clothings • Forge cutting equipment • Hand tools • Metal **Task (What):-** • Carryout forge cutting of hot workpiece. **Standard (How well):-** • All task steps followed in sequence in a patience, honest and safe manner. • The product produced as per drawing to a tolerance of ± 2mm. • Confidence shown in the operation of forge, selection of cutting tools and operation of cutting tools. • Workplace cleaned, tools cleaned, and the cleaned tools stored • All safety precautions well followed.	• Interpretation of drawing. • Clamping & cutting methods, selection of clamping & cutting tools. • Hot metal cutting methods, identification and selection of forge cutting tools. • Preparation & maintenance of forge. • Selection of working temperature and application of forge colours. • Methods of heating small & large workpieces, tapered workpiece; use of localized heating, scale removal, heat distribution, effects of over/under heating, and flow of grain in workpiece. • Cutting tools, correct working temperature & methods of cutting hot metals. • Methods of puncturing a hole in hot metal, changing shape of the hole, hole cutting & shaping tools, working temperature and upsetting workpiece. • Metal splitting methods, related tools and working temperature. • Checking dimensions. • Cleaning work area. • Cleaning & storing tools • Safety measures.

11.5 Task : Carryout forge shapping of hot workpiece

Task Steps	Terminal Performance Objective	Related Technical Knowledge
1. Interpret drawing. 2. Select safety clothings. 3. Select marking / measuring tools. 4. Select hand tools. 5. Select forge tools. 6. Prepare forge. 7. Upset / form head on bar. 8. Draw down / change cross-sectional shape of bar. 9. Carryout twisting / flaring of workpiece. 10. Carryout off set / circular bending. 11. Carryout angle bending of bar. 12. Carryout edgeway bending of bar. 13 Bend in angle iron.	**Condition (Given):-** • Drawing • Measuring & marking tools • Hand tools • Forge tools • Raw materials **Task (What):-** • Carryout Forge shapping of hot workpiece. **Standard (How well):-** • All task steps followed in a sequence in a patience, honest and safe manner. • Confidence shown in the selection and operation of forge and forming tools. • The workpieces shapped and bended as per drawing to a tolerance of $\pm$ 2 mm linear and $\pm 0.5^0$ angular. • work place cleaned; and tools cleaned and stored properly. • All safety precautions well followed.	• Interpretation of drawing. • Safety clothings. • Marking and measuring tools selection. • Hand tools selection for the task. • Forge tools, shaping tools. • Preparation and maintenance of forge. • Upsetting methods, methods of producing heads (rounded & square), work temperature and method of checking head. • Methods and process of drawing down square bar; methods of chamfering; changing cross-sectional shape and neckingin. • Methods of twisting and flaring of workpiece, and handling related tools. • Method of offset and circular bending; handlings related tools.

11.5 Task : Carryout forge shapping of hot workpiece

Task Steps	Terminal Performance Objective	Related Technical Knowledge
14. Carryout cold metal bending. 15. Check dimension. 16. Clean work area. 17. Store tools. 18. Follow precautions.		• Concept & method of angle bending of bar and handling related tools. • Concept & method of edge way bending and handling related tools. • Process of bending 90^0 + 360^0 in angle iron. • Methods and limitation of cold metal bending, reaction of metal at bends and handling related tools. • Method or process of checking dimension. • cleaning work area & its need. • Cleaning & storing tools. • Precautions while carrying out forge shapping of hot workpiece.

11.6 Task : Join metal by forge welding / riviting

Task Steps	Terminal Performance Objective	Related Technical Knowledge
1. Interpret workshop drawing. 2. Select safety clothings. 3 .Measure / markout the workpiece. 4. Prepare workpiece. 5. Select flux. 6. Prepare forge. 7. Check work piece temperature. 8. Forge weld the workpiece. 9. Inspect joints. 10. Mark out / cut rivit holes. 11. Select type of rivit. 12. Rivit workpiece. 13. Check rivit. 14. Clean work area. 15. Store tools. 16. Follow safety measures.	**Condition (Given):-** • Workshop drawing • Safety clothing • Measuring m marking tools • Forge tools • Hand tools • Riviting tools • Metal **Task (What):-** • Join metals. • Carryout forge welding & riviting processes. **Standard (How well):-** • All task steps carried out in a sequencial order being patient, honest and confident. • Prepared and joined metals using forge welding and riviting process. • Neat and uniform rivits are produced. • Neat welds are produced with 75% penetration along its length. • Fules and flux efficiently used to produce good quality welds. • All safety measures & precautions well followed.	• Interpretation of drawing. • Selection of Safety clothings and their uses. • Measuring and marking out workpieces. • Preparation of workpiece, methods of cutting to length & need for scale removal. • Concept, types and uses of flux; flux selection. • Preparation and maintenance of forge. • Method of checking temperature of workpiece. • Welding process, types of welding joints, working temperature, use of flux and forge welding process. • Method of checking weld penetration (destructive testing). • Drilling holes, correct hole position & need for oversize holes. • Round and counter sunk rivits, size and shape of rivits. • How to rivit workpiece. • Cleaning work area. • Cleaning & storing tools. • Applying safety measures.

11.7 Task : Finish workpiece

Task Steps	Terminal Performance Objective	Related Technical Knowledge
1. Interpret workshop drawing. 2. Select hand tools. 3. Select grinding equipment. 4. Prepare grinding equipment. 5. Shape workpiece to final dimension. 6. Check dimensions. 7. Remove burrs. 8. Shape edges 9. Clean workshop 10. Store tools. 11. Apply safety measures.	**Condition (Given):-** • Workshop drawing • Safety clothing • Marking / measuring tools • Hand tools • Forge tools • Grainding equipment **Task (What):-** • Finish workpiece. **Standard (How well):-** • All task steps conducted in sequence in a patient honest and safe manner. • Grinding equipment operated safely, safety clothings used and correctly selected the grade of wheel to finish workpiece as per the drawing. • Finished tool or workpiece have dimensions and angles as per drawing. • Finished workpiece (tool) cut M/S plate without blunting and breaking. • Finished the workpiece by grinding to given workshop drawing to an accuracy of $\pm$ 0.5 mm. • All safety measures and precautions well followed.	• Interpretation of the drawing.. • Selecting hand tools. • Grinding machine and wheels; grinding process selection. • Method of preparation of grinding equipment and how to dress a wheel. • Shapping workpiece to final dimension, application of grinding machine. • Process of checking dimensions. • Removing burrs and its need. • How to shape edges and its need. • Process of cleaning and maintaining workshop. • Cleaning & storing tools. • Safety measures to be applied while finishing workpiece.

12. Certificate requirement

In order to get the certificate of completion of this training, trainees should master all the tasks and knowledge included in this curriculum.

13. Facilities

1. Well equipped class rooms.
2. Well equipped blacksmith's workshop.

14. Trainers' qualification

1. Having training on "Black smithing"
2. Good communicative / instructions skills
3. Job Experience in the related field

15. Trainees' evaluation

1. Regular evaluation of trainees' performance by their related trainers
2. Written evaluation regarding the related technical knowledge
3. Final practical test by the related institute

16. Tools / materials / equipment

1. Apron
2. Goggles
3. Boots
4. Gloves
5. Shields
6. Screens
7. Hammers
8. Crosspine hammer
9. Bench hammer
10. Rod testing hammer
11. Hand hammer
12. Hammer heads
13. Hacksaw
14. Hacksaw blade grade
15. Erect hacksaw blade
16. Saw blades / various blades
17. Cold chisel
18. Hot chisel
19. Chisel angle
20. Vice
21. Bench vice
22. Leg vice
23. G-clamps
24. Anvil
25. Swage block
26. Topand bottom swage
27. 30 mm rule / 30mm steel rule
28. Folding rule
29. Forge rule
30. Tape
31. Try square
32. Sliding Bevel
33. Scriber
34. Straight edge scriber
35. Punch
36. Center Punch
37. Hole punch
38. Dividers
39. External calipers
40. Vernier calipers
41. Blacksmith guage
42. Forge
43. Round peak forge
44. Forge fuel
45. Char coal
46. Pam nut shells
47. Coconut shells
48. Wood savings
49. Paper
50. Cleaning oil
51. Flux
52. Sand
53. Borax
54. Hcl water solution (50/50)
55. Water
56. Oil
57. Brine
58. Raw materials
59. Pieces of metal
60. Tool steel
61. Spring steel
62. Bars
63. Materials of different carbon content, length and cross sectional shape.
64. Different types of carbon steel
65. Work shop drawing
66. Floor drawing
67. Drawing board
68. Pencils
69. T-square
70 Set- square
71. Compass
72. Ruler
73. Combination set
74. Protractors
75. Test piece
76. Depth guage
77. Colour chart
78. Heat treatment color chart
79. Quenching bocket
80. Quenching medium (oil/water)
81. Tongs
82. Pliers

83. Tinder
84. Hardened tools
85. Non-hardened tools
86. M/S plate
87. 3mm M/S plate
88. 6mm M/S plate
89. Hot set
90. Hardie
91. Drift
92. Floor chalk
93. Head forming tool
94. Twisting bar
95. Tube
96. Calculator
97. Electric drill
98. Drill bits
99. Snap & set
100. Rivit
101. Round & counter sung rivits
102. Angle guage
103. Oil store
104. Grinding machine / wheels
105 Other materials and supplies.