SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE:	WELDING THEORY I		
CODE NO. :	MTF102	**SEMESTER:**	N/A
PROGRAM:	METAL FABRICATOR TECHNICIAN/WELDING TECHNIQUES		
AUTHOR:	STEVE WITTY		
DATE:	JAN 2010	**PREVIOUS OUTLINE DATED:**	JAN 2009
APPROVED:	"Corey Meunier" **CHAIR**		_____ **DATE**
TOTAL CREDITS:	THREE		
PREREQUISITE(S):	N/A		
HOURS/WEEK:	THREE		

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I. COURSE DESCRIPTION:

Describe the functions and controls of welding power sources in accordance with government safety regulations, manufacturer's recommendations and approved industry standards.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

- Define the functions of welding power sources.
- Describe the effects of power source controls on welding processes.
- Define the fundamentals of the Shielded Metal Arc Welding (SMAW) process.
- Describe the equipment requirements for the Shielded Metal Arc Welding (SMAW) process.
- Describe the construction and characteristics of the Shielded Metal Arc Welding (SMAW) electrodes.
- Describe the Shielded Metal Arc Welding (SMAW) procedure variables and their effects on quality and productivity
- Define the fundamentals of the Gas Metal Arc Welding (GMAW) process
- Explain safety concerns applicable to the Gas Metal Arc Welding (GMAW) process
- Explain the function of the components of the Gas Metal Arc Welding (GMAW) process
- Explain the selection and characteristics of consumables necessary for Gas Metal Arc Welding (GMAW) short-circuit transfer and spray-arc transfer
- Describe the procedure variables for Gas Metal Arc Welding (GMAW) and their effect on quality and productivity
- Define the fundamentals of the Flux Cored Arc Welding (FCAW) process and Metal Cored Arc Welding (MCAW) process
- Explain the function on the components of the Flux Cored Arc Welding (FCAW) process and Metal Cored Arc Welding (MCAW) process
- Describe the selection of welding parameters and consumables necessary for Flux Cored Arc Welding (FCAW) and Metal Cored Arc Welding (FCAW)
- Define the fundamentals of the Gas Tungsten Arc Welding (GTAW) process
- Explain the safety concerns applicable to the Gas Tungsten Arc Welding (GTAW) process
- Describe the required equipment and components for the Gas Tungsten Arc Welding (GTAW) process
- Explain the characteristics and selection considerations for consumables used for Gas Tungsten Arc Welding (GTAW) on steel
- Explain the set-up and control of the process variables for the Gas Tungsten Arc Welding process

1. Potential Elements of the Performance:

Define the functions of welding power sources

- Constant current, constant voltage, inverters, transformers, transformer rectifiers, generators, engine drives, amperage controls, principle of inductance, tapped control, saturable reactor, shunt, magnetic amplifier, and SCR

Describe the effects of power source controls on welding processes

- Amperage, voltage, voltage trim, remote controls, output characteristics, current type, polarity, slope control, inductance, square wave, high frequency, AC balance, transformer rectifier, inverter, welding current output frequency, inverter controls

2. Potential Elements of the Performance:

Define the fundamentals of the Shielded Metal Arc Welding (SMAW) process

- Development of arc welding
- Method of melting and freezing
- Fusion, arc characteristics, and arc length
- Effect on voltage
- Penetration and travel speed
- Optimum
- Effects of too fast or too slow
- Weld contamination protection

Describe the equipment requirements for the Shielded Metal Arc Welding (SMAW) process

- Power sources (transformers, rectifiers, inverters, generators, engine driven)
- Power source controls (amperage, duty cycle, voltage, current type, polarity)
- Welding cables (cable size and condition, connectors, relationship to required amperage, work lead, completion of welding circuit, clamps in good repair, work lead locations)

Describe the construction and characteristics of the Shielded Metal Arc Welding (SMAW) electrodes

- Basic construction features (core wire, flux covering, manufacturing methods of welding electrodes, electrode concentricity, functions of the flux coating, flux coating base material, chemical properties and alloying elements, shielding)

Describe the Shielded Metal Arc Welding (SMAW) procedure variables and their effect on quality and productivity

- Primary variables (conducted prior to welding) – joint design and fit-up, consumables, current type and polarity, amperage, pre-heat, electrode size)
- Secondary variables (conducted during welding) – travel speed, arc length, work angle, electrode angle, technique, whipping, weaving, stringer, multiple passes, and drag

3. Potential Elements of the Performance:

Define the fundamentals of the Gas Metal Arc Welding (GMAW) process

- Modes of metal transfer (short-circuiting transfer, spray arc transfer, globular, and pulsed)
- Gas shielding (purpose – types, Argon/Helium, CO2, mixed gases, triple mix gas

Explain safety concerns applicable to the Gas Metal Arc Welding (GMAW) process

- UV radiation (appropriate helmet and filer plate)
- Spatter and proper safety clothing
- Storage and handling of high pressure cylinders
- Flow meters, fumes and gases, and oxygen depletion

Explain the function of the components of the Gas Metal Arc (GMAW) process

- Fundamentals and characteristics of the Constant Voltage power source (self-correcting arc gap, application of Constant Current power sources, wire feeders – spool guns – push type – pull type – drive rolls, liners, metallic, non metallic – gas diffusers, contact tips/contact tubes, nozzles, water cooled guns, radiation, Ultra Violet, Infa Red, white light
- Noise
- Fall protection
- Falling objects

Explain the selection and characteristics of consumables necessary for Gas Metal Arc Welding (GMAW) short-circuit transfer and spray-arc transfer

- Optimal wire type and size (diameter)
- Filler metal classification system (low alloy, steels, stainless steels, aluminum, types and sizes, purpose of copper plating)
- Shielding gas (types, flow rate)

Describe the procedure variables for Gas Metal Arc Welding (GMAW) and their effect on quality and productivity.

- Primary variables (conducted prior to welding) – joint design and fit-up, consumables, shielding gas, current type and polarity, amperage, wire feed speed, wire diameter, voltage, preheat
- Secondary variables (conducted during welding) – travel speed, nozzle to work distance, work angle, gun angle to work distance, technique, stringer, multi-passes, weaving, forehand, and backhand

4. Potential Elements of the Performance:

Define the fundamentals of the Flux Cored Arc Welding (FCAW) process and Metal Cored Arc Welding (MCAW) process

- Metallic transfer
- Construction of tubular wire (wire types, flux types)
- Gas shielding (purpose and types)

Explain the function of the components of the Flux Cored Arc Welding (FCAW) process and Metal Cored Arv Welding (MCAW) process

- Fundamentals and characteristics of the Constant Current power source
- Fundamentals and characteristics of the Constant Voltage power source
- Electrode wire classification (types and sizes)
- Mechanical feeders (drive rolls, liners, contact tips, nozzles)
- Gas shielding (gas diffusers)

Describe the selection of welding parameters and consumables necessary for Flux Cored Arc Welding (FCAW) and Metal Cored Arv Welding (MCAW)

- Material thickness
- Position of welding
- Voltage
- Wire feed speed
- Wire type and size
- Drive rolls and contact tips
- Selection of shielding gas
- Types, flow rate, and gun angle
- Direction of travel

5. Potential Elements of the Performance:

Define the fundamentals of the Gas Tungsten Arc Welding (GTAW) process

- Non-consumable tungsten electrode
- Gags shielding of weld
- Advantages of the Gas Tungsten Arc Welding (GTAW) process – no spatter (all position capable, precision, weld light gauge materials, high quality welds, concentrated high-temperature arc, wide variety of applications and alloys)
- Limitations of the Gas Tungsten Arc Welding (GTAW) process (deposition rates and pre-cleaning required)

Explain the safety concerns applicable to the Gas Tungsten Arc Welding (GTAW) process

- Arc radiation, heat, air quality, fumes and gases, oxygen depletion, electrical, high frequency, thorium, high pressure cylinders

Describe the required equipment and components for the Gas Tungsten Arc Welding (GTAW) process

- Power source
- Fundamentals and characteristics of the constant current power source (equipment controls, welding currents, AC –
- DC electrode negative and positive
- High frequency (HF) circuit
- Contractor and current control methods (manual control, remote controls, foot controls, torch thumbwheel)
- Shielding gas supply system (cylinders or bulk systems, regulator, flow meter, hoses, torches, air and water cooled, amperage rating, coolant circulators, collet and body, nozzle, and gas lens)

Explain the characteristics and selection considerations for consumables used for Gas Tungsten Arc Welding (GTAW) on steel

- Shielding gas (type, flow rate – imperial and metric)
- Filler material (type/allow and classification, size, tungsten electrode, type and grade, size – conditioning and contamination control)

III. TOPICS:

1. Power Sources
2. Shielded Metal Arc Welding
3. Gas Metal Arc Welding
4. Flux Core/Metal Core Arc Welding
5. Gas Tungsten Arc Welding

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Modules: Course Pack MTF102

V. EVALUATION PROCESS/GRADING SYSTEM:

Part 1 NOTES:

1. Re-writes are NOT allowed for any written assignment, quiz or test.
2. Repeats are NOT allowed for any shop test
3. Course attendance is mandatory. One percent (1 %) per hour will be Deducted from the final course grade for apprentices with more than 4 hours of unexcused* absence.

[Any absence without a written, valid reason will be deemed unexcused.]

Valid reasons would include:

- Doctor's note
- Apprenticeship Ministry note
- Family Death or Serious Illness supported by a written note.

Part 2 Final Course Grades:

The final course grade will be determined by means of the following list of weighted factors:

Factor	***Value***
Theory Quiz & Test	100 %
Attendance	-1% per Unexcused Hour

The following semester grades will be assigned to students:

Grade	**Definition**	*Grade Point Equivalent*
A+	90 – 100%	4.00
A	80 – 89%	

B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 – 59%	1.00
F (Fail)	49% and below	0.00

CR (Credit)	Credit for diploma requirements has been awarded.
S	Satisfactory achievement in field /clinical placement or non-graded subject area.
U	Unsatisfactory achievement in field/clinical placement or non-graded subject area.
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.
NR	Grade not reported to Registrar's office.
W	Student has withdrawn from the course without academic penalty.

VI. SPECIAL NOTES:

Course Outline Amendments:
The professor reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

Retention of Course Outlines:
It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

Prior Learning Assessment**:**
Students who wish to apply for advance credit transfer (advanced standing) should obtain an Application for Advance Credit from the program coordinator (or the course coordinator regarding a general education transfer request) or academic assistant. Students will be required to provide an unofficial transcript and course outline related to the course in question. Please refer to the Student Academic Calendar of Events for the deadline date by which application must be made for advance standing.

Credit for prior learning will also be given upon successful completion of a challenge exam or portfolio.

Substitute course information is available in the Registrar's office.

Disability Services:
If you are a student with a disability (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your professor and/or the Disability Services office. Visit Room E1101 or call Extension 2703 so that support services can be arranged for you.

Communication:
The College considers ***WebCT/LMS*** as the primary channel of communication for each course. Regularly checking this software platform is critical as it will keep you directly connected with faculty and current course information. Success in this course may be directly related to your willingness to take advantage of the ***Learning Management System*** communication tool.

Plagiarism:
Students should refer to the definition of "academic dishonesty" in *Student Code of Conduct*. A professor/instructor may assign a sanction as defined below, or make recommendations to the Academic Chair for disposition of the matter. The professor/instructor may (i) issue a verbal reprimand, (ii) make an assignment of a lower grade with explanation, (iii) require additional academic assignments and issue a lower grade upon completion to the maximum grade "C", (iv) make an automatic assignment of a failing grade, (v) recommend to the Chair dismissal from the course with the assignment of a failing grade. In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

Student Portal:
The Sault College portal allows you to view all your student information in one place. **mysaultcollege** gives you personalized access to online resources seven days a week from your home or school computer. Single log-in access allows you to see your personal and financial information, timetable, grades, records of achievement, unofficial transcript, and outstanding obligations. Announcements, news, the academic calendar of events, class cancellations, your learning management system (LMS), and much more are also accessible through the student portal. Go to https://my.saultcollege.ca.

Electronic Devices in the Classroom:
Students who wish to use electronic devices in the classroom will seek permission of the faculty member before proceeding to record instruction. With the exception of issues related to accommodations of disability, the decision to approve or refuse the request is the responsibility of the faculty member. Recorded classroom instruction will be used only for personal use and will not be used for any other purpose. Recorded classroom instruction will be destroyed at the end of the course. To ensure this, the student is required to return all copies of recorded material to the faculty member by the last day of class in the semester. Where the use of an electronic device has been approved, the student agrees that materials recorded are for his/her use only, are not for distribution, and are the sole property of the College.

Attendance:
Sault College is committed to student success. There is a direct correlation between academic performance and class attendance; therefore, for the benefit of all its constituents, all students are encouraged to attend all of their scheduled learning and evaluation sessions. This implies arriving on time and remaining for the duration of the scheduled session.