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CONFIDENTIAL

SET B

UNIVERSITI KUALA LUMPUR

MALAYSIA FRANCE INSTITUTE

FINAL EXAMINATION

JULY 2010 SEMESTER

SUBJECT CODE	:	FTB32302
SUBJECT TITLE	:	WELDING METALLURGY 2
LEVEL	:	BACHELOR
DURATION	:	3.00pm – 5.30pm (2 ½ HOURS)
DATE / TIME	:	19 NOVEMBER 2010

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of TWO (2) sections. Section A and B. Answer ALL questions in Section A. For Section B, answer THREE (3) questions only.
6. Answer all questions in English.

THERE ARE 5 PRINTED PAGES OF QUESTIONS, AND 2 PAGES OF APPENDIX EXCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

Identify the needs of heat treatment in any of welding projects

(6 Marks)

Question 2

List **THREE (3)** advantages of temporary than permanent furnace.

(6 Marks)

Question 3

Explain the modification made by DeLong for improvement of Schaeffler's diagram.

(8 marks)

Question 4

Generally the coefficient of thermal conductivity of aluminum is six times that of steel. Discuss the welding behavior of aluminum compare to steel influence by this physical property.

(6 Marks)

Question 5

Discuss the location of weld decay and why it occurs at some distance from fusion line.

(6 Marks)

Question 6

Give **TWO (2)** reasons why Heat treatable nickel base alloys are often post weld heat treatment (PWHT).

(4 Marks)

Question 7

List **TWO (2)** typical problems in welding nickel base alloys.

(4 Marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer THREE (3) questions only.
Please use the answer booklet provided.

Question 1

Select the most suitable filler metal that able to obtain tough crack free welded for welding plate SA516 Gr. 60 and SS 304L. Assume 30% dilution was occurred and Nitrogen pickup was 0.1%

(a) Calculate the Ferrite Number (FN) for joining dissimilar metal by both of filler metals.
(12 Marks)

(b) Which filler metal is most suitable and give your reason for your selection.
(4 Marks)

(c) Discuss the main differences between DeLong and Schaeffler diagram.
(4 Marks)

(Note: Base and Filler metal compositions as in Table 1 and DeLong diagram attached in appendix 1)

Table 1: Base and Filler metals compositions

	Base metal (%)		Filler Metal (%)	
	SS304L	**SA516 Gr 60**	**ER310**	**ER308LMo**
Carbon	0.03	0.25	0.5	0.02
Manganese	2.0	1.0	2.00	1.5
Chromium	18.00	-	24	22
Silicon	1.0	0.30	1.5	0.75
Nickel	12.0	-	20	10.5
Molybdenum	-	-	-	2.5
Cooper	-	0.20	-	-
Sulphur	0.030	0.035	0.030	-
Phosphorus	0.045	0.035	0.030	-

Question 2

Preheat normally applied to avoid of weld cracking on heat affected zone (HAZ) by reduce a cooling rate.

(a) Briefly discuss how welding heat input and thickness of the plate will influence HAZ cracking.

(8 Marks)

(b) Determine preheating temperature by susceptibility grouping method for a 36 mm thickness steel plate of the following chemical composition.

C = 0.35%	P = 0.03%
Mn= 2.0%	S = 0.03%
Si = 1.0%	Cu = 0.1%
Ni = 0.2%	Cr = 0.2%

The plates are to be fillet welded by using basic coated electrode under high constrain

(6 Marks)

(c) Use Graville diagram (Figure 1) to predict HAZ condition that may obtain after welded for materials in question (b) and how to control.

(6 Marks)

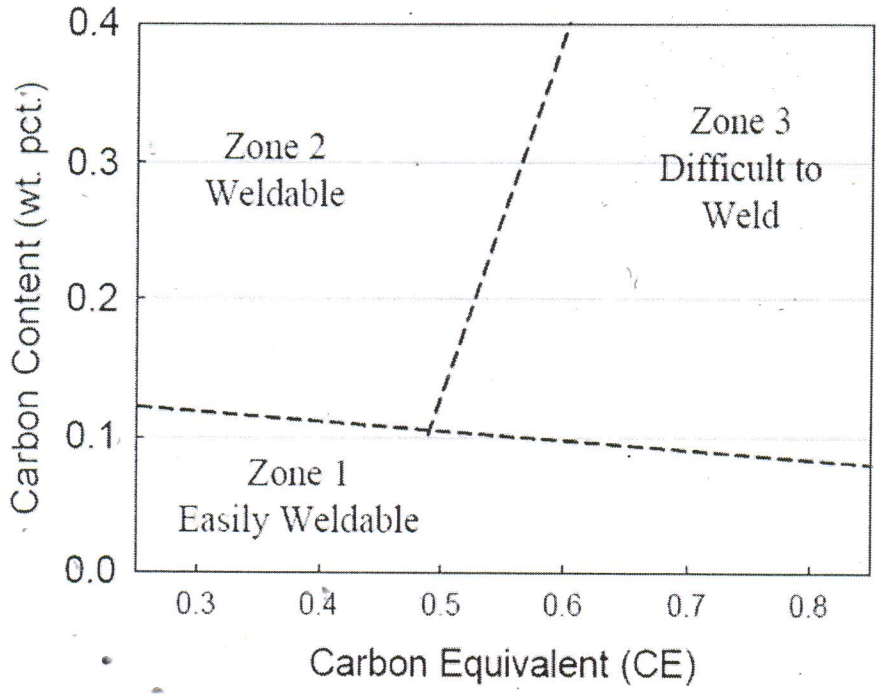

Figure 1: Graville Diagram

Question 3

(a) Explain the effect of Lithium and Magnesium to aluminum alloys.

(4 Marks)

(b) Discuss generally the effect of welding to aluminum 3000 series.

(8 Marks)

(c) Give your proposal to reduce the porosity in aluminum welding that cause by hydrogen.

(8 Marks)

Question 4

Welding may produce metallurgical modifications that can be increased susceptibility to corrosion attack. Welding stabilize austenitic stainless steel may cause metallurgical modification toward susceptible to knife line attack if not proper control.

(a) Explain why chromium carbide ($Cr_{23}C_6$) can be form in stabilize austenitic stainless steels.

(8 Marks)

(b) State **TWO (2)** prevention methods to avoid knife line attack.

(4 Marks)

(c) Discuss both your answer in question (b).

(8 Marks)

END OF QUESTION

Appendix1

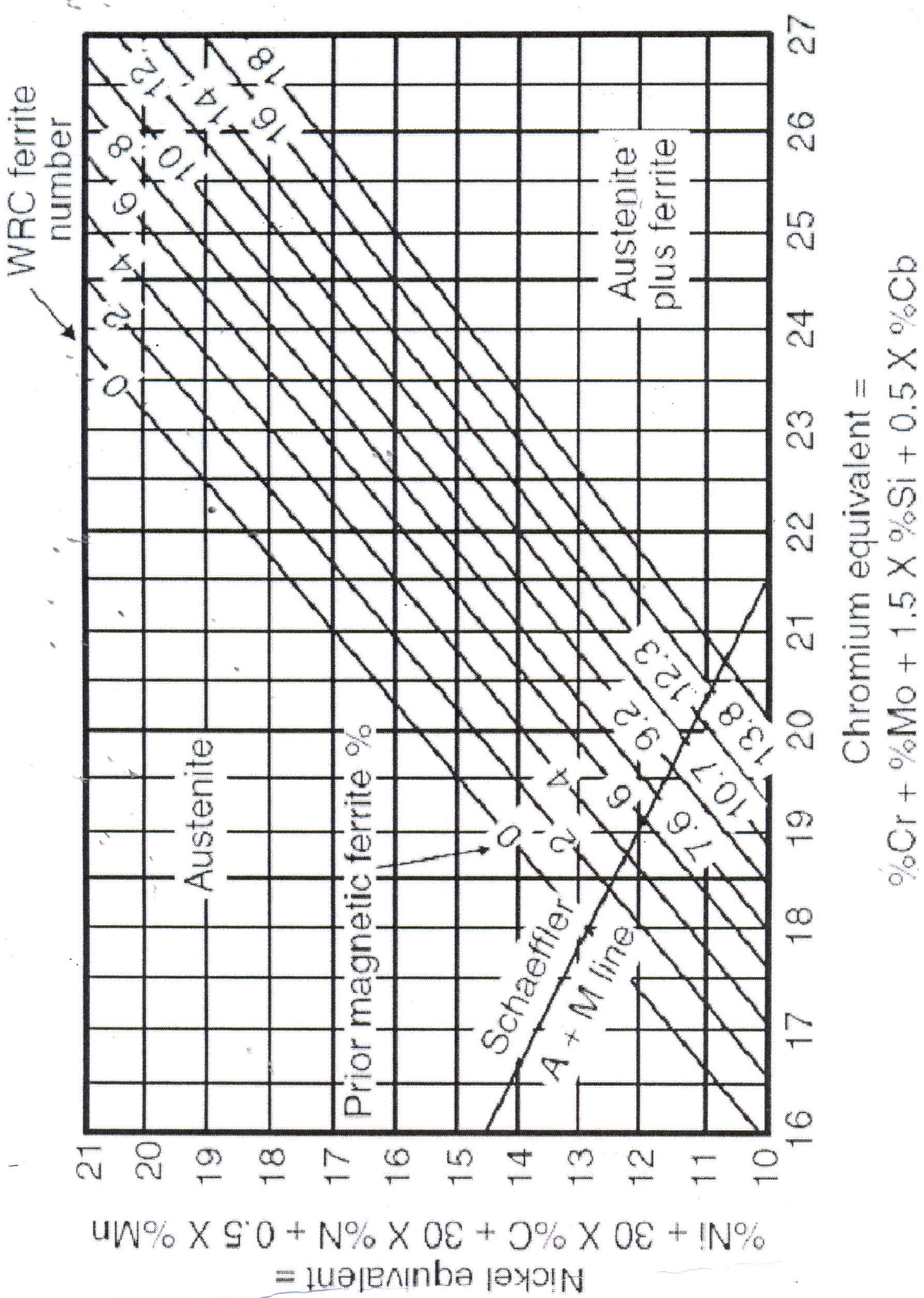
WRC ferrite number
Austenite
Austenite plus ferrite
Prior magnetic ferrite %
Schaeffler
A + M line
Nickel equivalent =
%Ni + 30 X %C + 30 X %N + 0.5 X %Mn
Chromium equivalent =
%Cr + %Mo + 1.5 X %Si + 0.5 X %Cb

Table 2: Susceptibility Index grouping

Hydrogen Level (H)	*Pcm*				
	< 0.18	< 0.23	< 0.28	< 0.33	< 0.38
H_1	A	B	C	D	E
H_2	B	C	D	E	F
H_3	C	D	E	F	G

Where, H_1 = 5 ml/100g of weld metal
H_2 = 10 ml/100g of weld metal
H_3 = 30 ml/100g of weld metal

Table 3: Minimum Preheat and Interpass Temperature (Above the Ambient) for the Fillet and Butt Welds for Three Level of Restraint (°C)

Level of Restraint	*Thickness* (mm)*	*Susceptibility Index Grouping*						
		A	*B*	*C*	*D*	*E*	*F*	*G*
Low	10	< 20	< 20	< 20	< 20	60	140	150
	10–19	< 20	< 20	20	60	100	140	150
	19–38	< 20	< 20	20	80	110	140	150
	38–75	20	20	40	95	120	140	150
	> 75	20	20	40	95	120	140	150
Medium	10	< 20	< 20	< 20	< 20	70	140	160
	10–19	< 20	< 20	20	80	115	145	160
	19–38	< 20	20	75	110	140	150	160
	38–75	20	80	110	130	150	150	160
	> 75	95	120	140	150	160	160	160
High	10	< 20	< 20	< 20	40	110	150	160
	10–19	< 20	20	65	105	140	160	160
	19–38	20	85	115	140	150	160	160
	38–75	115	130	150	150	160	160	160
	> 75	115	130	150	150	160	160	160

* Thickness refers to thicker part.

Formula

$$P_{cm} = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Cu}{20} + \frac{Ni}{60} + \frac{Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B$$

$$S.I = 12P_{cm} + \log_{10} H$$