TMS Metallurgical and Materials Engineering Professional Engineer (PE) Licensing Review Course

August 20-22, 2015
TMS Headquarters
Warrendale, PA

Thursday, August 20

8:00 a.m.	Registration

8:15 a.m. Introductions and Exam Format Review
Charles White

8:30 a.m. Basics Crystal Structures, Chemistry, and Phase Diagrams
Dana Medlin
-*Atomic structure, atomic bonding*
-*Unit cells, crystal structures, directions, planes*
-*Imperfections, strengthening mechanisms, grain size*
-*Slip systems, recrystallization*
-*Phase diagram basics, lever rule, and equilibrium cooling*

10:30 a.m. Physical Metallurgy of Steel
George Krauss
-*The Fe-C diagram as a model phase diagram*
-*Crystal structures in steel (Austenite and Ferriite)*
-*Diffusion: effect of concentration gradients, atom type, and temperature*
-*Phase transformations and microstructures: diffusion- and shear-controlled*

12:30 p.m. Lunch

1:00 p.m. Physical Metallurgy of Steel
George Krauss
-*Hardness, strength, a function of carbon and alloy content*
-*Heat treatments for ductility and hardness*
-*Surface hardening: carburizing, induction*
-*Low toughness and embrittlements; fractography*

2:00 p.m. Mechanical/States of Stress
Indrajit Charit
-*Two-dimensional & three-dimensional states of stress*
-*Poisson's ratio & relationship between elastic constants*
-*Stress-strain relations & plane strain*

4:00 p.m.	Processing
	Charles White
	-Basic process (raw materials, mold making, melting)
	-Process characteristics (disposable and permanent molds)
	-Product characteristics (shrinkage, distortion, porosity, allowances)
	-Cold work (recovery, recrystallization, grain growth, property changes, in process control)

| 5:00 p.m. | Questions |

Friday, August 21

8:00 a.m.	Chemical Analysis Techniques, Metallography Nondestructive Testing
	Dana Medlin
	-X-ray basics, XRF, OES, mass spec, EDS, XRD, etc.
	-Flaw, leak, liquid penetrant, mag particle, eddy current
	-Strain gage, ultrasonic, radiographic, etc.
	-Metallographic, microstructural characterization
	-Alloying and hardenability calculations

10:00 a.m.	Performance
	Erik Mueller
	-Arrhenius behavior and predicting transformation times
	-Creep and high temperature flow
	-Ductile to brittle transition
	-Using standards and specifications

| 12:00 p.m. | Lunch |

12:30 p.m.	Mechanical Behavior of Composites & Heterogeneous Material and High Temperature Degradation
	Indrajit Charit
	-Various composite forms of materials
	-Elastic models in fiber-reinforced composites
	-Composite strengthening
	-High-temperature oxidation, corrosion mechanisms (including metal dusting)
	-Creep-fracture and stress rupture
	-Radiation-induced degradation

2:30 p.m.	Fitness for Service & Life Prediction
	Alphonse Hegger
	-Fitness for service
	-Life prediction and modeling
	-Life extension
	-Application of techniques to assess remaining life for local thinning, brittle fracture, plastic collapse, and time dependent damage

| 4:30 p.m. | Questions |

Saturday, August 22

8:00 a.m.	Testing and Analysis
	Erik Mueller
	-Failure analysis (including overstress, fatigue, corrosion, embrittlement, deformation,

and polymers/composites)
-Wear mechanisms
-Interpreting testing data

10:00 a.m.	**Corrosion Mechanisms & Environmental Compatibility**

Alphonse Hegger
-General, galvanic, pitting, intergranular, erosion, and microbiologically induced corrosion
-Selective leaching
-Environment assisted cracking
-Hydrogen damage
-Electrochemistry
-Environmental testing methods
-Environmentally assisted cracking

12:00 p.m.   Lunch

12:30 p.m.   **Polymers and Strengthening Mechanisms for Polymers**
Steven Sopher
-Polymers and strengthening mechanisms for polymers & reinforced polymers
-Plastics and polymer processing, standards, and specifications

1:30 p.m.   Statistics
Steven Sopher
-Statistical quality control methods
-Industrial safety practice

2:30 p.m.   Joining Processes/Coatings
Charles White
-Welding, soldering, brazing, bonding processes
-Coatings (corrosion & wear resist, cosmetic)
-Application method (diffusion, dipping, spray, flow, chemical conversion)

4:00 p.m.   Wrap-up/Evaluation