

NEEP -423

Nuclear Engineering Materials

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Office Hours 2:25-4:00 PM Monday

NEEP 423 Grading Procedure

- **Exams - 80 %**
 - 2 one hour exams @ 25 % ea**
 - Final Exam - 30 %**
- **Problems - 10 %**
 - Periodic assignments**
 - Possible Writing Assignment**
- **Class Participation -10 %**
 - Attendance**
 - Interest**
 - Questions**

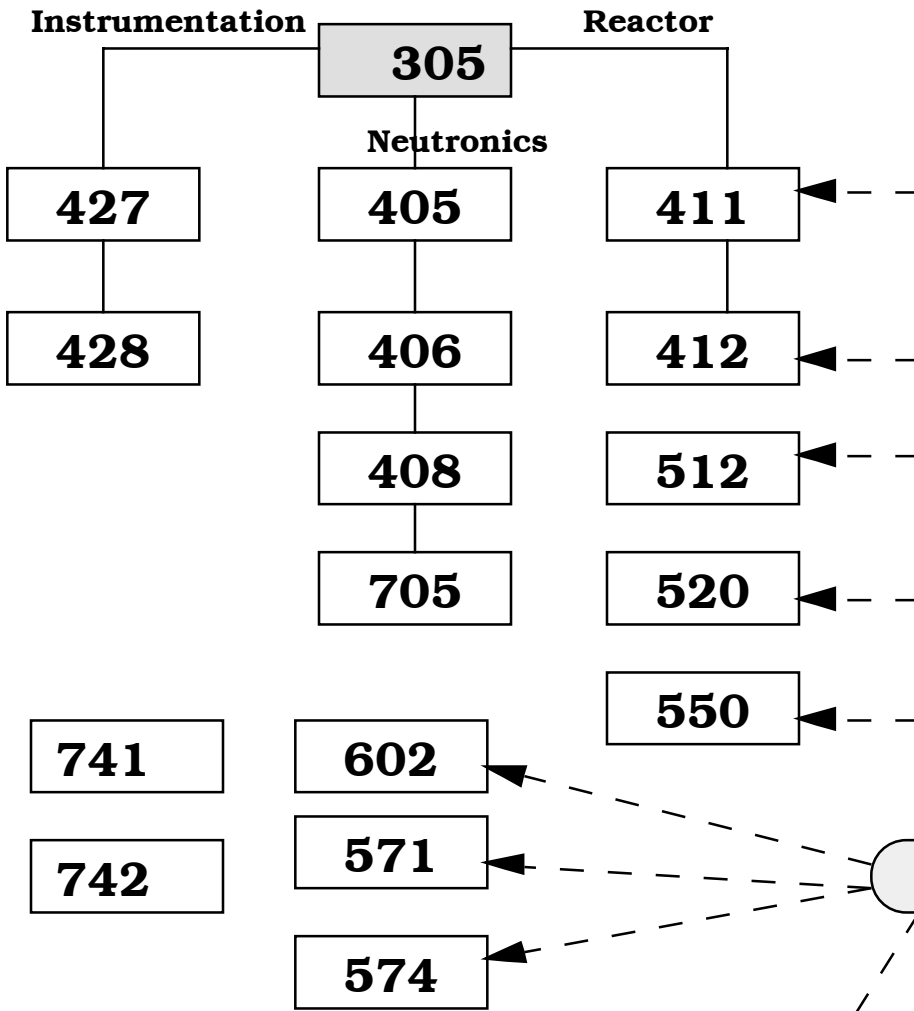
1-Sep-98				
Tentative Syllabus For NEEP 423-Fall 1998				
Nuclear Engineering Materials*				
Room 236 Materials Science				
11:00-11:50 AM, MWF				
Date	#	Day	Topic	Reference
2-Sep	1	W	Introduction	notes
4-Sep	2	F	Materials for Fission Reactors	notes
9-Sep	3	W	Metallic Fuels	notes/Ref Book
11-Sep	4	F	Metallic Fuels	notes/Ref Book
14-Sep	5	M	No Class	
16-Sep	6	W	LMR Fuels	notes/Ref Book
18-Sep	7	F	LMR Fuels	notes/Ref Book
21-Sep	8	M	Enrichment of Nuclear Fuels	Notes
23-Sep	9	W	Enrichment of Nuclear Fuels	Notes
25-Sep	10	F	Zircalloy	notes/Ref Book
28-Sep	11	M	Zircalloy	notes/Ref Book
30-Sep	12	W	Failure of Fuel Elements	Garzarolli Article
2-Oct	13	F	Failure of Fuel Elements	Garzarolli Article
5-Oct	14	M	Exam	
7-Oct	15	W	Chapter 10 Fuel Element Performance	Olander
9-Oct	16	F	Review Exam	
12-Oct	17	M	Chapter 10 Fuel Element Performance	Olander
14-Oct	18	W	Chapter 10 Fuel Element Performance	Olander
16-Oct	19	F	Chapter 10 Fuel Element Performance	Olander
19-Oct	20	M	Chapter 11 Fuel Element Chemistry	Olander
21-Oct	21	W	Chapter 11 Fuel Element Chemistry	Olander
23-Oct	22	F	Chapter 11 Fuel Element Chemistry	Olander
26-Oct	23	M	Chapter 11 Fuel Element Chemistry	Olander
28-Oct	24	W	Chapter 12 Behaviour of Fission Products	Olander
30-Oct	25	F	Chapter 12 Behaviour of Fission Products	Olander
2-Nov	26	M	Chapter 13 Swelling Due to Fission Products	Olander
4-Nov	27	W	Chapter 13 Swelling Due to Fission Products	Olander
6-Nov	28	F	Chapter 13 Swelling Due to Fission Products	Olander
9-Nov	29	M	Chapter 13 Swelling Due to Fission Products	Olander
11-Nov	30	W	Exam	
13-Nov	31	F	Chapter 14 Pore Migration and Restructuring	Olander
16-Nov	32	M	Chapter 14 Pore Migration and Restructuring	Olander
18-Nov	33	W	Review Exam	
20-Nov	34	F	Chapter 14 Pore Migration and Restructuring	Olander
23-Nov	35	M	Chapter 15-Fission Gas Release	Olander
25-Nov	36	W	Chapter 15-Fission Gas Release/Corrosion	Olander/notes
27-Nov			Thanksgiving Break	
30-Nov	37	M	Embrittlement of Pressure Vessels	Shah Article
2-Dec	38	W	Embrittlement of Pressure Vessels	Shah Article
4-Dec	39	F	Embrittlement of Pressure Vessels	Shah Article
6-Dec	40	M	Embrittlement of Pressure Vessels	Shah Article
9-Dec	41	W	Fusion Materials-Tritium	notes
11-Dec	42	F	Fusion Materials-Structural	notes
13-Dec	43	M	Fusion Materials-Radioactive Waste	notes
22-Dec		T	Final Exam-12:25	
* Web Site http://elvis.neep.wisc.edu/~neep423/FALL98/neep423.html				

Reference List for Course NEEP-423

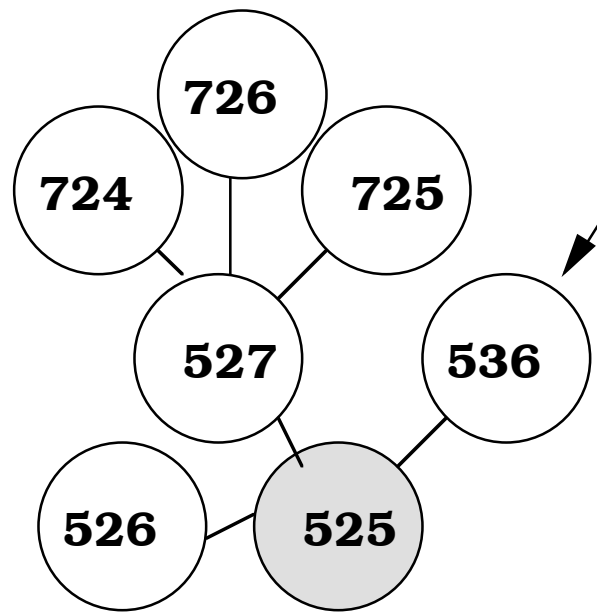
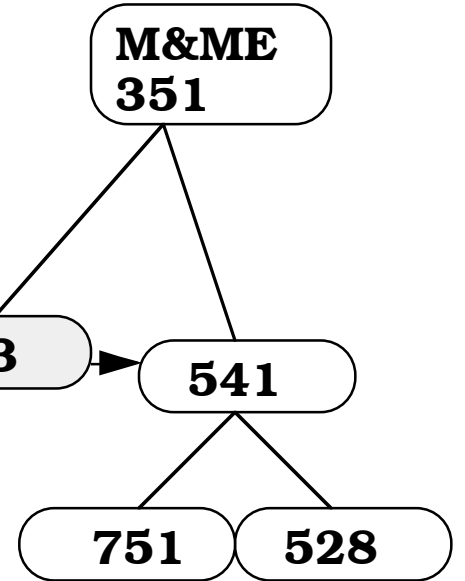
1. Wilkinson, W.D. and Murphy, W.F., "Nuclear Reactor Metallurgy," Van Nostrand Co., New York, NY, 1958.
2. Garzaolli, F., R. von Jan, and H. Stehle, "The Main Causes of Fuel Failure in Water Cooled Power Reactors", Atomic Energy Review, Vol. 17, No. 1, p. 31 (1979)
3. Wymer, Raymond G. and Vondra, Benedict L., "Light Water Reactor Nuclear Fuel Cycle," CRC Press, Inc., Boca Raton, FL, 1981.
4. Roberts, J.T. Adrian, "Structural Materials in Nuclear Power Systems," Plenum Press, New York, NY, 1981.
5. Frost, Brian R.T., "Nuclear Fuel Elements," Pergamon Press, Elmsford, NY, 1982.
6. Ma, Benjamin M., "Nuclear Reactor Materials and Applications," Van Nostrand Reinhold Company, New York, NY, 1983.
7. Olander, Donald R., "Fundamental Aspects of Nuclear Reactor Fuel Elements," TID-26711-P1, Technical Information Center, Springfield, Virginia, March 1985.
8. Shah, V. N., and P. E. MacDonald, "Aging and Life Extension of Major Light Water Reactor Components", Elsevier Publishers, Amsterdam, 1993
9. "Materials Science and Technology", Edited by R. W. Cahn, P. Haasen, E. J. Kramer, Volume 10A & 10B, VCH Publishers, New York, 1994
10. "Proceedings of the 1997 International Topical Meeting on Light Water Reactor Fuel Performance", Portland, OR, March 2-6, 1997

Relationship of NEEP to Other NEEP Courses

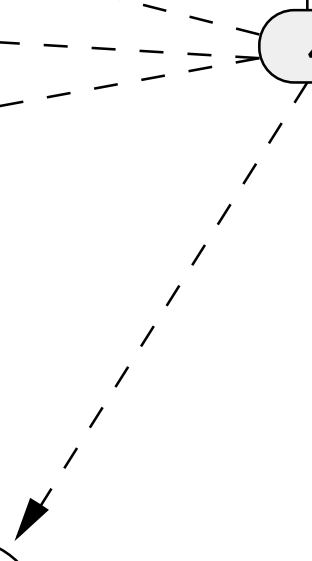
Fission



Materials



Fusion



Scope of Materials Problems for Nuclear Energy

Fission

Fuel
Cladding
Core Struc.
Control Rods
Reflector
Pressure Vessel

Fusion

First Wall
Blanket Struc.
Breeder
Reflector
Shield
Direct Conv.
Electrical Insul.

S/C Magnets
Lasers
Optics
Accelerators
RF or Particle
Beams

Piping ----->
Pumps ----->
Heat Exchangers----->
Turbines----->
Generators----->
Transmission----->

Materials used in the Construction of Fission Reactors

U, Pu, Th	Fissionable and fertile elements, generally used as an alloy, ceramic, or cermet
Al, Mg, Zr, Be, C	Elements with low thermal neutron capture cross sections. Could be used for cladding for thermal reactors. Carbon and Be can also be used for moderators and reflectors.
Nb, Mo, Ta, V, W	Refractory metals with capture cross sections suitable for fast reactors.
Na, Na-K, Li-7, Bi, Pb, Cs	Liquid metals for use as heat transfer media. Bi has also been considered as a solvent for U in a LMR
Construct. Steels (Fe, Ni, Cr, Mn)	Range from mild steels for pressure vessels to fully austenitic or ferritic steels for core structure.
B, Hf, Cd, Ag, Gd	Elements with extremely high absorption cross sections for control rods.
Organic coolants	Used where high temperature is required without high pressure