

NEEP -423

Nuclear Engineering Materials

Professor Gerald L. Kulcinski
Office -439 Engineering Research Building
Telephone -263-2308
email-kulcinski@engr.wisc.edu
Office Hours 2:25-4:00 PM

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**

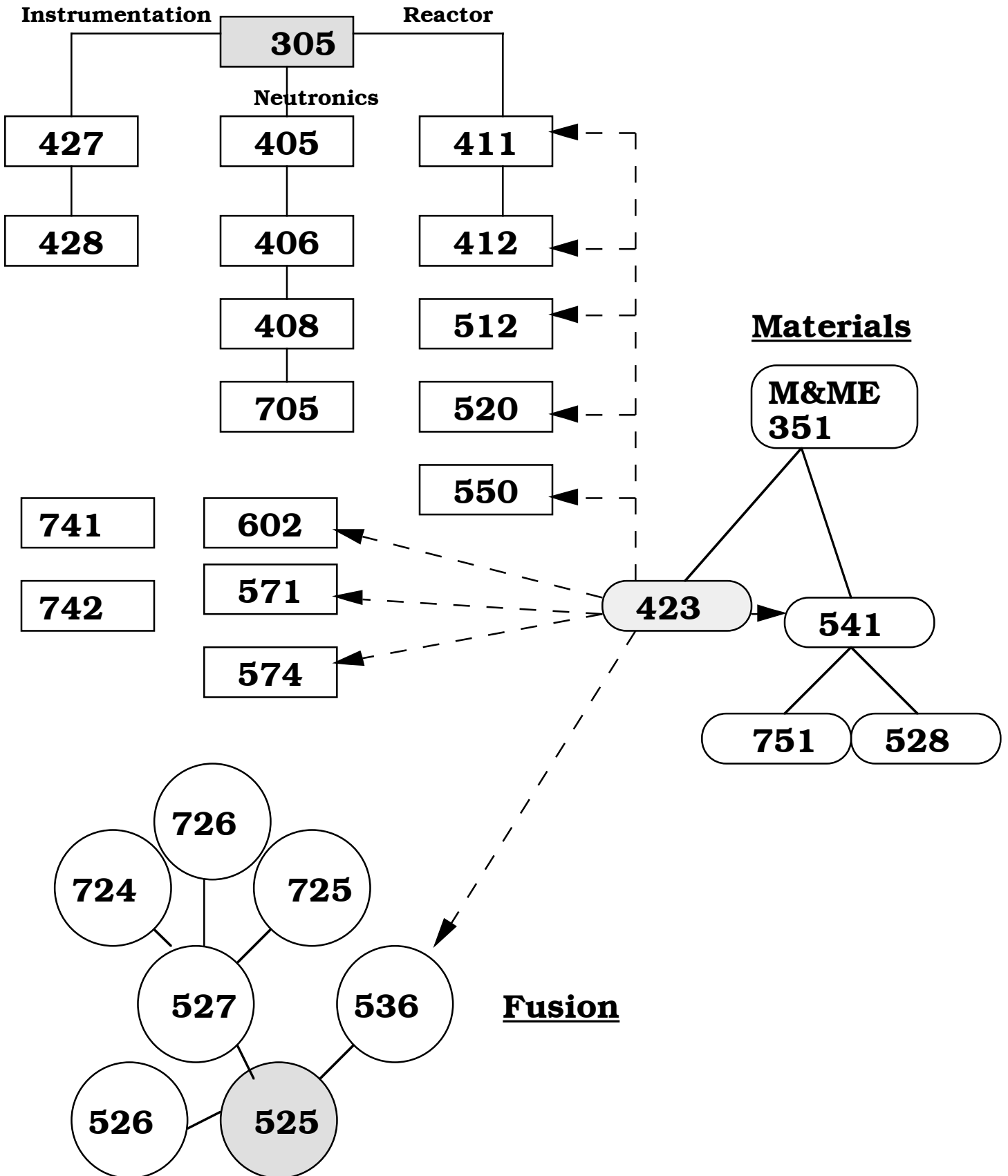
3-Sep-97				
Tentative Syllabus For NEEP 423-Fall 1997				
Nuclear Engineering Materials*				
314 Mechanical Engineering, 11:00-11:50 AM, MWF				
Date	#	Day	Topic	Reference
3-Sep	1	W	Introduction	notes
5-Sep	2	F	Materials for Fission Reactors	notes
8-Sep	3	M	Metallic Fuels	notes/Ref Book
10-Sep	4	W	Metallic Fuels	notes/Ref Book
12-Sep	5	F	LMR Fuels	notes/Ref Book
15-Sep	6	M	LMR Fuels	notes/Ref Book
17-Sep	7	W	Enrichment of Nuclear Fuels	Notes
19-Sep	8	F	Enrichment of Nuclear Fuels	Notes
22-Sep	9	M	Zircalloy	notes/Ref Book
24-Sep	10	W	Zircalloy	notes/Ref Book
26-Sep	11	F	Failure of Fuel Elements	Garzarolli Article
29-Sep	12	M	Failure of Fuel Elements	Garzarolli Article
1-Oct	13	W	Failure of Fuel Elements	Garzarolli Article
3-Oct	14	F	Chapter 10 Fuel Element Performance	Olander
6-Oct	15	M	Exam	
8-Oct	16	W	Review Exam	
10-Oct	17	F	Chapter 10 Fuel Element Performance	Olander
13-Oct	18	M	Chapter 10 Fuel Element Performance	Olander
15-Oct	19	W	Chapter 10 Fuel Element Performance	Olander
17-Oct	20	F	Chapter 11 Fuel Element Chemistry	Olander
20-Oct	21	M	Chapter 11 Fuel Element Chemistry	Olander
22-Oct	22	W	Chapter 11 Fuel Element Chemistry	Olander
24-Oct	23	F	Chapter 11 Fuel Element Chemistry	Olander
27-Oct	24	M	Chapter 12 Behaviour of Fission Products	Olander
29-Oct	25	W	Chapter 12 Behaviour of Fission Products	Olander
31-Oct	26	F	Chapter 13 Swelling Due to Fission Products	Olander
3-Nov	27	M	Chapter 13 Swelling Due to Fission Products	Olander
5-Nov	28	W	Chapter 13 Swelling Due to Fission Products	Olander
7-Nov	29	F	Chapter 13 Swelling Due to Fission Products	Olander
10-Nov	30	M	Exam	
12-Nov	31	W	Review Exam	
14-Nov	32	F	Chapter 14 Pore Migration and Restructuring	Olander
17-Nov	33	M	Corrosion Effects in Fuel Elements	Notes
19-Nov	34	W	Chapter 15-Fission Gas Release	Olander
21-Nov	35	F	Chapter 15-Fission Gas Release	Olander
24-Nov	36	M	Corrosion Effects in Fuel Elements	Notes
26-Nov	37	W	Nuclear Plant Life Extension	Shaw Article
28-Nov			Thanksgiving Break	
1-Dec	38	M	Embrittlement of Pressure Vessels	Shaw Article
3-Dec	39	W	Embrittlement of Pressure Vessels	Shaw Article
5-Dec	40	F	Fusion Materials-Tritium	notes
8-Dec	41	M	Fusion Materials-Structural	notes
10-Dec	42	W	Fusion Materials-Radioactive Waste	notes
12-Dec	43	F	Review for Exam-GLK	notes
16-Dec		Tu	Final Exam- 12:25-2:25	
* Web Site http://elvis.neep.wisc.edu/~neep423/FALL97/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. Wymer, Raymond G. and Vondra, Benedict L., "Light Water Reactor Nuclear Fuel Cycle," CRC Press, Inc., Boca Raton, FL, 1981.
3. Roberts, J.T. Adrian, "Structural Materials in Nuclear Power Systems," Plenum Press, New York, NY, 1981.
4. Frost, Brian R.T., "Nuclear Fuel Elements," Pergamon Press, Elmsford, NY, 1982.
5. Ma, Benjamin M., "Nuclear Reactor Materials and Applications," Van Nostrand Reinhold Company, New York, NY, 1983.
6. Olander, Donald R., "Fundamental Aspects of Nuclear Reactor Fuel Elements," TID-26711-P1, Technical Information Center, Springfield, Virginia, March 1985.
7. "Materials Science and Technology", Edited by R. W. Cahn, P. Haasen, E. J. Kramer, Volume 10A & 10B, VCH Publishers, New York, 1994

Relationship of NEEP to Other NEEP Courses

Fission



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