

MEEM 3501

Product Realization I

Course Schedule Summer 2006

Day	(#)	Topic (HO#)	Description	# Lec.	Assignments
M 05/08	(1)	Course Information Prod. Devl. Ex. Part 1 (1)	Format, Grading, Policies, Goals Key points of course	1/3 1/3	Assign Proj. 1 Read HO1 and HO2
Tu 05/09	(2)	Prod. Devl. Ex. Part 1 (1), cont'd	Thought process – “motor” sizing analysis Thought process – manufacturing Mistakes made	1/3 2/3 1/3	Read HO3 Do HO3 Exercises
W 05/10	(3)	D&M Overview (2)	Design and manufacturing scenarios Tradition, the ideal and the practical	1/3 2/3	<i>HO3 Exercises Due in Lect.</i> Read HO4
	(4)	D&M Overview (2), cont'd Fundamentals of Modeling and Analysis (3)	D&M resources Systems and boundaries overview Conservation and constitutive relations	1/3 1/3	
Th 05/11	(5)	Fundamentals of Modeling and Analysis (3), cont'd	Subsystems, connections and boundaries Review HO3 Exercises	2/3 1/3	Do HO4 Exercises
	(6)	Springs and Dampers (4)	Everything is a spring Where do the equations come from? Energy storage (the catapult example)	1/3 1/3	
M 05/15	(7)	Project 1 Testing			<i>Proj. 1 Product & Report Due</i> Assign Proj. 2 – Part 1
	(8)	Springs and Dampers (4), cont'd	Review HO4 Exercises Dampers	1/3 2/3	<i>HO4 Exercises Due in Lect.</i> Read HO5 Do HO5 Exercises
Tu 05/16	(9)	Quiz 1 Springs and Dampers (4), cont'd Symmetry (5)	Review HO4 Exercises Symmetry in analysis	1/3 1/3	<i>HO5 Exercises Due in Lect.</i> Read JM5.1–5.2, 5.5–5.7
W 05/17	(10)	Symmetry (5), cont'd	Review HO5 Exercises Symmetry in design and manufacturing	2/3 1/3	
	(11)	Loading Modes	“Static loads” – time-invariant loads “Dynamic loads” – time-varying loads	1/3 2/3	<i>Proj. 2 – Part 1 Report Due</i> Assign Proj. 2 – Part 2 Read JM7.1–7.4
Th 05/18	(12)	Loading Modes, cont'd	Impact – overview Impact – energy solution	2/3 1/3	Read JM6.13–6.15 Assign HW1
	(13)	Design for Reliability — Stochastic Analysis	Where it is used — uncertainty in prop's, BCs & dim's Mathematical representation of probability Normal distribution	1/3 1/3 1/3	Read JM6.11–6.12

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M 05/22	(14)	Safety Factor	Safety factor – the idea Safety factor – values Uncertainty vs. reliability	1/3 1/3 1/3	Read JM4.1–4.6
Tu 05/23	(15)	Quiz 2	State of stress – biaxial vs. triaxial	1/3	<i>HW1 Due</i>
	(16)	Rev. of Stress & Strain Rev. of Stress & Strain, cont'd	Mohr's circle Principal stresses, maximum shear and octahedral stress	2/3 1/3 2/3	
W 05/24	(17)	Project 2 Testing		3/3	
	(18)	Rev. of Stress & Strain, cont'd	Beam bending – transverse shear and moments Stresses in beams – normal bending, transverse shear and torsional shear Stress concentration	1/3 1/3 1/3	<i>Proj. 2 Product & Report Due</i> Assign Proj. 3 Read JM12.1–12.4 Assign HW2
Th 05/25	(19)	Helical (Coil) Springs	Why analyze springs? Stresses	1/3 2/3	Read JM12.5–12.7, 12.9
M 05/29	(20)	Memorial Day	Relax and Enjoy!		Read JM12.10–12.12
Tu 05/30		Helical (Coil) Springs, cont'd	Curvature effect – a stress concentration Deflection	2/3 1/3	
W 05/31	(21)	Helical (Coil) Springs, cont'd	Other considerations (e.g., stability, preset/pre-tension) Leaf springs	2/3 1/3	Read WK1.1–1.2, 1.4
	(22)	Mechanisms & Kinematics	Overview Mechanisms defined	1/3 2/3	
Th 06/01	(23)	Mechanisms & Kinematics, cont'd	Planar linkages Degrees of freedom of linkages	1/3 2/3	Read WK1.5–1.7 Assign Proj. 4
	(24)	Mechanisms & Kinematics, cont'd	Motion limits and actuation – RRRR Motion limits and actuation – RRRP	2/3 1/3	<i>HW2 Due</i> Read WK1.11–1.17
M 06/05	(25)	Quiz 3 Project 3 Testing		1/3 2/3	<i>Proj. 3 Product & Report Due</i> Assign Proj. 4 Read www.engin.umich.edu/group/ctm/basic/basic.html Assign HW3
	(26)	Matlab Overview	Syntax overview, matrices and vectors	2/3	
Tu 06/06			Solving linear systems of equations	1/3	
W 06/07	(27)	Numerical Methods	Iteration Newton's method – single variable	1/3 2/3	

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Th 06/08	(28)	Numerical Methods, cont'd	Newton's method – multiple variables	1/3	Read WK3.1–3.2
			Numerical integration	1/3	
			Time stepping – simulation	1/3	
M 06/12	(29)	Analytic Linkage Analysis	Vector loops – Introduction, 1-loop and 2-loop	2/3	<i>HW3 Due</i> Read WK3.3
			Vector loops – choice of vectors and coordinate systems	1/3	
			Position solution – vector component equations	1/3	
Tu 06/13	(30)	Analytic Linkage Analysis, cont'd	Position solution – iterative via Newton's method	1/3	Read WK3.5, 3.11 Assign HW4
			Example – position analysis	1/3	
			Project 4 Discussion	2/3	
W 06/14	(31)	Analytic Linkage Analysis, cont'd	Q&A and HW4 Matlab solution	1/3	<i>HW4 Due</i> Read WK1.18, 4.4
			Example, cont'd – link-force analysis	1/3	
			Example, cont'd – link/joint-force analysis	2/3	
Th 06/15	(32)	Analytic Linkage Analysis, cont'd	Velocity and acceleration	1/3	Read HO6 Do HO6 Exercises
			Quiz 4	1/3	
			Prescribed Timing	1/3	
M 06/19	(33)	Power Trans. Components (6)	Extreme positions	1/3	<i>HO6 Exercises Due in Lect.</i>
			Synthesis (design)	1/3	
			Overview	2/3	
Th 06/20	(34)	Power Trans. Components (6), cont'd	Levers – force magnification and speed reduction	1/3	Read JM19.5, SDP pp. 478–484 (chains)
			Reinventing the gear with levers, belts	1/3	
			Wedges and screws	1/3	
M 06/19	(35)	Chain Drives	Review HO6 Exercises	1/3	Assign HW5
			Geometry	1/3	
			Transmission/train ratio	1/3	
M 06/19	(36)	Chain Drives	Catalogs	1/3	Proj. 4 Product & Report Due Read HO7 Do HO7 Exercises Assign Proj. 5 – Part 1 <i>HO7 Exercises Due in Lect.</i> Read JM5.8–5.9
			Project 4 Testing	3/3	
			Torque-Speed Matching (7)	1/3	
Tu 06/20	(37)	Static Failure	Torque-speed curves	1/3	<i>HW5 Due</i> <i>Proj. 5 – Part 1 Due</i> Read JM6.1–6.1, 6.5, 6.7–6.8 Assign HW6
			Maximum power and torque scenarios	1/3	
			Review HO7 Exercises	1/3	
Tu 06/20	(38)	Static Failure	Static failure – Stiffness vs. strength	1/3	<i>HW5 Due</i> <i>Proj. 5 – Part 1 Due</i> Read JM6.1–6.1, 6.5, 6.7–6.8 Assign HW6
			Castigliano's method — complex beam-like structures	2/3	

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	(40)	Static Failure, cont'd	Yield criteria concept Max shear stress Max distortion energy	1/3 1/3 1/3	Read JM8.1–8.6 Assign Proj. 5 – Part 2
W 06/21	(41)	Dynamic Failure — Fatigue	Fully reversed Fatigue strength modifiers	2/3 1/3	Read JM8.7–8.9
	(42)	Dynamic Failure — Fatigue, cont'd Project 5 Q&A	Fluctuating — mean stress effects As needed	2/3 1/3	
Th 06/22	(43)	Project 5 Testing		3/3	<i>Proj. 5 Product & Part 2 Report Due</i>
	(44)	Quiz 5		1/3	<i>HW6 Due</i>
F 06/23		Take-home Final Exam	Due 10:00 am		