MEEM 3501
Product Realization I
Course Schedule
Summer 2006

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

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

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	(28)	Numerical Methods, cont'd	Newton's method – multiple variables Numerical integration Time stepping – simulation	1/3 1/3 1/3	Read WK3.1–3.2
Th 06/08	(29)	Analytic Linkage Analysis	Vector loops – Introduction, 1-loop and 2-loop Vector loops – choice of vectors and coordinate systems Position solution – vector component equations	2/3 1/3 1/3	*HW3 Due* Read WK3.3
M 06/12	(30)	Analytic Linkage Analysis, cont'd	Position solution – iterative via Newton's method Example – position analysis	1/3 1/3	Read WK3.5, 3.11 Assign HW4
	(31)	Project 4 Discussion Analytic Linkage Analysis, cont'd	Q&A and HW4 Matlab solution Example, cont'd – link-force analysis	2/3 1/3	*HW4 Due* Read WK1.18, 4.4
Tu 06/13	(32)	Analytic Linkage Analysis, cont'd	Example, cont'd – link/joint-force analysis Velocity and acceleration	2/3 1/3	
	(33)	Quiz 4 Prescribed Timing	Extreme positions Synthesis (design)	1/3 1/3 1/3	Read HO6 Do HO6 Exercises
W 06/14	(34)	Power Trans. Components (6)	Overview Levers – force magnification and speed reduction	2/3 1/3	*HO6 Exercises Due in Lect.*
Th 06/15	(35)	Power Trans. Components (6), cont'd	Reinventing the gear with levers, belts Wedges and screws Review HO6 Exercises	1/3 1/3 1/3	Read JM19.5, SDP pp. 478–484 (chains)
	(36)	Chain Drives	Geometry Transmission/train ratio Catalogs	1/3 1/3 1/3	Assign HW5
M 06/19	(37)	Project 4 Testing		3/3	*Proj. 4 Product & Report Due* Read HO7 Do HO7 Exercises Assign Proj. 5 – Part 1
	(38)	Torque-Speed Matching (7)	Torque-speed curves Maximum power and torque scenarios Review HO7 Exercises	1/3 1/3 1/3	*HO7 Exercises Due in Lect.* Read JM5.8–5.9
Tu 06/20	(39)	Static Failure	Static failure – Stiffness vs. strength Castigliano's method — complex beam-like structures	1/3 2/3	*HW5 Due* *Proj. 5 – Part 1 Due* Read JM6.1–6.1, 6.5, 6.7–6.8 Assign HW6

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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	*Proj. 5 Product & Part 2 Report Due*
	(44)	Quiz 5		1/3	*HW6 Due*
F 06/23		Take-home Final Exam	Due 10:00 am		