

## 436-354 Mechanics 3 (2009)

**Unit 1** Stress Analysis (SA)

18 lectures, 6 tutorials

**Unit 2** Dynamics of Mechanical Systems (DoMS)

15 lectures, 6 tutorials and 3 hours of laboratory work

**Credit points:** 12.5

**Coordinators:** Dr. P. Lee (unit 1)  
Dr. J. Krodkiewski (unit 2)

**Assessment:** Your total mark for this subject will be awarded on the following basis:

Assignment work in Stress Analysis:	10%
Assignment and laboratory work in Dynamics of Mechanical Systems	10%
Final examination	80%

The final examination will last for three hours. You will be asked to produce a paper consisting of two sections.

Section A will contain three questions on Stress Analysis.

Section B will contain three questions on Dynamics of Mechanical Systems.

You will be required to answer a total of four questions, two from each section.

### Timeframe:

Week	Date	DoMS Mon. 1:15 pm 200 Berkeley St- Physiotherapy Theatre	DoMS Mon. 2:15 pm 200 Berkeley St- Physiother apy Theatre.	Stress Analysis Wed. 2:15 pm Old Arts- Public Lecture Theatre [PLT]	Stress Analysis Fri. 2:10 pm Elisabeth Murdoch- Theatre A	Stress Analysis Tutes. Mon 3:15pm Ec & Comm-G13 [Theatrette 3]  Wed. 10:00am Architecture- Sisalkraft Theatre	DoMS Tutes. Mon 4:15pm Ec & Comm-G13 [Theatrette 3]  Mon 5:15pm Ec & Comm-115 [Prest Theatrette]
1	27-31	Lec. 1 (Introduction – 0.5hr)	No lecture	No lecture	No lecture	No tutorial	No tutorial
2	03-08	Lec. 2	Lec. 3	Lec 1	Lec. 2		Tut. 1
3	10-08	No lecture	No lecture	Lec. 3	Lec. 4	Tut.1	No tutorial
4	17-08	Lec.4	Lec. 5	Lec. 5	Lec. 6	Tut.1	Tut.1
5	24-08	Lec. 6	Lec. 7	Lec. 7	Lec. 8	Tut.2	Tut.2
6	31-08	Lec. 8	Lec. 9	Lec. 9	Lec. 10	Tut.2	Tut.2
7	07-09	Lec. 10	Lec. 11	Lec. 11	Lec 12	Tut.3	Tut.3
8	14-09	Lec. 12	Lec. 13	Lec. 13	Lec. 14	Tut.3	Tut.3
9	21-09	Non-Teaching Week					
10	28-09	Non-Teaching Week					
11	05-10	Tut.5	Tut.5	Lec. 15	Lec.16	Tut.4	Tut.4
12	12-10	Tut.5	Tut.5	Lect 17	Lec 18	Tut.4	Tut.4
13	19-10	Lec. 14 (repetition 0.5 hr)		Tut.5	Tut.5	Tut.6	Tut.6
14	26-10			Tut.5	Tut.5	Tut.6	Tut.6

UofM map: <http://www.pb.unimelb.edu.au/campusmaps/parkville.pdf>

UofM theatres: <http://www.studentadmin.unimelb.edu.au/leclist.html>

### Lecture Outline for Dynamics of Mechanical Systems.

**Lecturer:** Dr. Janusz Krodkiewski. (Dept of Mech. and Man. Eng., block D, third floor, room D301 tel. 8344-7242 e-mail januszmk@unimelb.edu.au)

**Objectives:** On completion of this subject students should:

- be able to formulate physical and mathematical models for three dimensional dynamic analysis of mechanical systems
- be able to solve the mathematical model by means of analytical and numerical methods and assess stability of those solutions

**Content:**

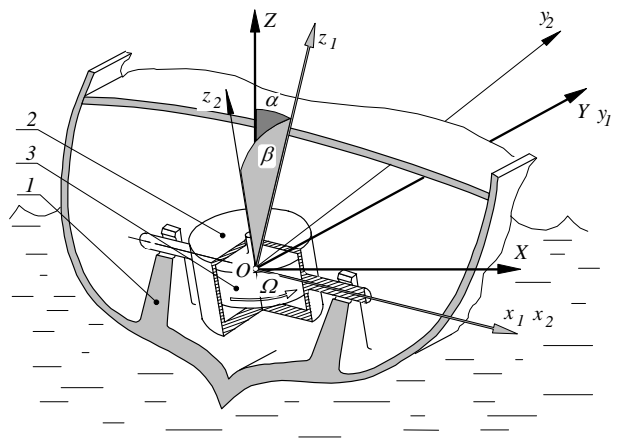
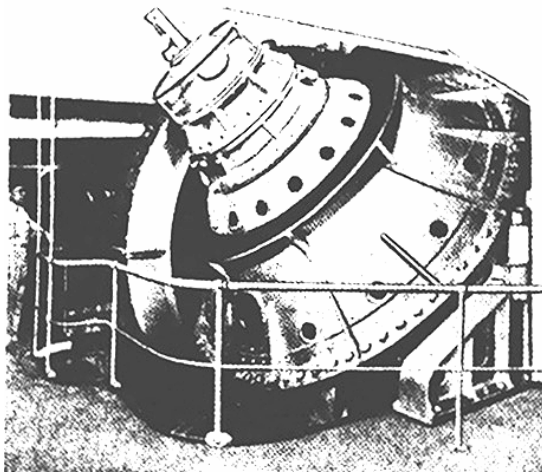
Lecture	Topic(s) intended to be covered
Lec 1	Introduction (half an hour)
Lec 2	Modelling of mechanical systems by means of Euler's equations: mobility, generalized coordinates
Lec 3	Modelling of mechanical systems by means of Euler's equations number of degree of freedom, driving forces, equations of motion
Lec 4	Modelling of mechanical systems by means of Euler's equations: problems
Lec 5	Modelling of mechanical systems by means of Lagrange's equations: virtual displacement, generalized force
Lec 6	Modelling of mechanical systems by means of Lagrange's equations: impressed forces and constraint forces, principle of virtual work
Lec 7	Modelling of mechanical systems by means of Lagrange's equations: equations of motion, kinetic energy function, potential energy function
Lec 8	Modelling of mechanical systems by means of Lagrange's equations: problems
Lec 9	Modelling of mechanical systems by means of Lagrange's equations: problems
Lec 10	Modelling of collisions: collisions of unconstrained and constrained bodies
Lec 11	Modelling of collisions: centre of percussion
Lec 12	Modelling of collisions: problems
Lec 13	Analysis of mathematical models: analytical solution of equations of motion, state space formulation of equations of motion
Lec 14	Analysis of mathematical models: equation of perturbations, stability in Lapunov's sense, criteria of stability

**Recommended Text:**

436-354 MECHANICS 3 UNIT 2 Dynamics of Mechanical Systems, J. M. Krodkiewski © 2009. Can be printed out from the subject 'home page' or can be ordered from The University Bookshop.

**Recommended Reading:**

Advanced Dynamics - Modelling and Analysis, Frank A., D'Souza V.K.G., ed. Prentice Hall, Englewood Cliffs, 1984.  
Methods of Analytical Dynamics, Meirovitch L., ed. McGraw-Hill Book Co., New York, 1970.  
Analytical Dynamics, Haim Baruh, ed. McGRAW-HILL International Editions, 1999  
Dynamics, Meriam J.L., Kraige L.G., ed. John Wiley & Sons, Inc. 1992.  
Multi-Body Dynamics, H. Rahnejat, Professional Engineering Publishing, 1998



## Lecture Outline for Mechanics of Solids

**Lecturer:** Dr Peter Lee

Department of Mechanical and Manufacturing Engineering, block E room, third floor, E307

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### **Objectives:**

On completion of this unit students should be familiar with the elastic stress analysis of a number of components commonly found in mechanical engineering. Students should also be familiar with plastic analysis of simple structures, the fundamentals of fracture mechanics. Students will have had an introduction to a *Finite Element* stress analysis computer package.

### **Content:**

1. Axisymmetric thin shells (pressure vessels).
2. Bending of flat circular plates
3. Thick walled cylinders as pressure vessels
  - a. Duplex pressure vessels
  - b. Autofrettage
  - c. Stresses due to shrink fits.
4. Stresses in rotating discs
5. Plastic analysis of structures
6. Fracture mechanics

### **Recommended Text:**

436-354 lecture notes, tutorial questions, assignment sheet will be made available in the LMS throughout the semester. Solutions to some of the tutorial problems will also be made available, following the associated tutorial sessions. It is hoped that students will prepare for tutorial sessions by attempting to solve some of the problems.

### **Recommended Reading:**

Richard Budynas, "Advanced Strength and Applied Stress Analysis", McGraw Hill, 1999, 2nd Edition (*not a mandatory reference but copies should be available in the UofM bookshop*)

P.P. Benham, R.J. Crawford, and C.G. Armstrong, "Mechanics of Engineering Materials", Harlow - Longman, 1996, ISBN 0582251648 (UniM 620.11 BENH)

E.P. Popov, "Mechanics of Materials, 2e", Pearson, ISBN 0135713560

Robert Cook and Warren Young, "Advanced Mechanics of Materials", Prentice Hall, 1999

H.L. Langhaar, "Energy methods in applied mechanics", Wiley, New York, 1962 (UniM 620.1 LA)

O. C. Zienkiewicz, "The finite element method in engineering science", London, New York, McGraw-Hill, 1971 ISBN 0070941386 (UniM 620.1 ZIEN)

S Timoshenko and S. Woinowsky-Krieger, "Theory of Plates and Shells", McGraw-Hill, 1959 (UniM 620.11282 TI)