Date: 03/08/2015

In addition to part -I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

*Course No.*             : ME F312
*Course Title*           : Advanced Mechanics of Solids
*Instructor-in-charge* : **Prof. M. S. DASGUPTA**
*Tutorial Instructors*   : Dr. Arun Jalan

**1. Course Description:** The course starts with generalized Hooke's law and three dimensional stress strain relations putting emphasis on Materials-Mechanics linkage to elucidate mechanical properties of materials. It also includes Energy methods; Torsion of non-circular members; Shear center and Asymmetrical bending of beams; Curved beams; Thick cylinders; Plates and shells; Contact stress.

**2. Scope and Objective of the Course:** The course deals with in-depth analysis of some advanced topics in Mechanics of Solids, necessary for Mechanical Engineering students, beyond what is covered in the common course Mechanics of Solids.

**3. Text books:**
T1:     "Advanced Mechanics of Materials" - Arthur P., Boresi and R.J. Schinid, John Wiley, $6^{th}$ Edition.

**Reference books:**
R1:     "Advanced Mechanics & Solids" - L.S. Srinath, Tata Mc.Graw-Hill Publishing Co. $2^{nd}$ Edition, 2003
R2:     "Advanced Mechanics of Solids" – Otto T. Bruhns, Springer Verlag, 2003
R3:     "Advanced Mechanics of Materials" – R. Davis Cook and Warren C. Young, Prentice Hall $2^{nd}$ Edition, 1998.

**4. Lecture Plan:**

| Lect. No. | Learning Objectives | Topics to be Coursed | Chap/Sec. (Book) |
|---|---|---|---|
| 1 | Review of elementary Mechanics of Materials and methods of analysis, failure analysis & properties of material | Introduction & review of elementary mechanics of solids, methods of analysis, failures in design | CH1 (TB1) |
| 2-6 | Energy methods and applications | Principle of stationary potential energy, Castigliano's theorem, Deflections in statically determinate structures and statically indeterminate | CH5 (TB1) |

| | | structures, applications to curved beam treated as straight beams. | |
|---|---|---|---|
| 7-12 | Theories of stress and strain | Stress at a point, stress on an arbitrarily oriented plane, transformation of stress, principal stresses, differential equations of motion of a deformable body, deformation, strain theory, small displacement theory | CH2 (TB1) |
| 12-16 | Linear stress strain temperature relations. | Generalized Hooke's Law, anisotropic and isotropic elasticity, thermoelasticity for isotropic materials, Hook's law for orthotropic material | CH3 (TB1) |
| 17-22 | Torsion of non-circular member | Torsion of prismatic bar, Saint Venant's Semi-inverse method, linear elastic solutions, Prandtle elastic membrane analogy torsion of rectangular cross section | CH 6.1-6.6 (TB1) |
| 23-25 | Asymmetrical bending | Non-symmetrical loading bending and deflection of straight beams. | CH7.1-7.3(TB1) |
| 26-28 | Shear Center for thin walled beam cross sections | Shear flow in thin-walled beam cross sections , Shear Center for channel section | CH 8.1-8.3 (TB1) |
| 29-31 | Curved beams | Location of neutral axis, radial stress, correction of circumferential stress and deflections of curved beams. Curved beams of standard sections: I & T. Analysis of statically indeterminate curved beams (closed ring). | CH9.1-9.6 (TB1) |
| 32-33 | Thick walled cylinders | Stress – Stain – Temperature relation for thick walled cylinders and composite cylinders. Analysis of open and closed cylinders | CH11 (TB1) |
| 34-37 | Flat Plates | Stress resultants in a flat plate, kinematics, equilibrium equations, stress strain temperature relations, strain energy of a plate, boundary | CH 13 (TB1) |

| 38-40 | Contact stress | Geometry of contact surface, methods of computing contact stress, deflection of bodies in point contact and line contact with normal load. | CH17 (TB1) |
|---|---|---|---|
| | | conditions, solution of rectangular and circular plate problems | |

**Evaluation Scheme :**

| EC No | Evaluation Component | Duration (min.) | Weightage | Date, time & Venue | Nature of component |
|---|---|---|---|---|---|
| 1 | Surprise tests | - | 10 | | CB |
| 2 | Mid-semester Test | 90 | 25 | *5/10  8:00 - 9:30 AM* | OB |
| 3 | *Tutorials | 50 | 15 | Tutorial hour as announced in Timetable, OB | |
| 4 | Comprehensive Exam | 180 | 50 | 1/12  FN | CB & OB |

**\*** Tutorials will be utilized for numerical problem solving and computer assisted problem solving under guidance of tutorial instructor and the same will be evaluated. Best **four** performances out of evaluated ones for each student will be counted for aggregate marks.

**Chamber Consultation Hour:** To be announced in the class.

**Notices:** If any, will be displayed in Mechanical Engineering notice board only.

**Make-up policy:** No makeup is allowed for Tutorials / Surprise test.

Instructor-in-charge
ME 392