Revision plan for MM III

1. vector and tensor calculus in cylindrical and spherical polar coordinates; expressions for the del operator and its various combinations (del-dot, del-cross, etc);
2. the transformation of the components of a vector or a tensor when the basis is changed;
3. derivation of basic identities involving the del operator and its various combinations;
4. the model of a linearly elastic solid (the isotropic case) – this involves the equation of motion/equilibrium, geometrical equations, constitutive equation, compatibility;
5. derivation of the Navier-Láme system and the expression of the BC's in terms of displacement in a traction boundary-value problem;
6. the statement of the Beltrami-Michell equations (which represent the compatibility equations expressed in terms of stresses);
7. basic principles for solving BVP's (semi-inverse method, types of BC's, etc);
8. the problem of a pressurised spherical cavity in an infinite elastic medium;
9. plane-stress & plane strain approximations: kinematic assumptions and the expression of the constitutive laws; the reduced compatibility equation;
10. the Airy stress potential;
11. the Kirsch problem (plates with holes, etc): (i) shear; (ii) tension;
12. pressurised cylinder;
13. mathematical models for fluids;
14. streamlines/pathlines/streaklines and how to find them (remember that in steady flow all three concepts coincide);
15. Euler's equation for inviscid fluids (statement + interpretation of various terms that enter in it);
16. Navier-Stokes equation for viscous fluids (statement + interpretation ....);
17. Reynolds number;

18. types of boundary conditions used in fluid mechanics;
19. definitions for: (i) incompressible; and (ii) irrotational flow;
20. derivation of the Bernoulli's Streamline Theorem; the assumption of irrotational flow;
21. complex potential; streamfunction; velocity potential (definitions + basic properties);
22. source/sink, vortex, doublet;
23. definitions for vortex line and vortex tube;
24. statement of the equation of vorticity;
25. definition of plane flow; interpretation;
26. Kelvin's Circulation Theorem (without proof) – interpretation;
27. flow due to a source, vortex, etc in an infinite plane;
28. flows in the presence of a straight boundary; the method of images (only half-plane problems);
29. rectilinear flow in the presence of a circular cylinder; Milne-Thompson's Circle Theorem (without proof); flow with circulation and interpretation in terms of the streamline pattern;
30. Blasius' Theorem – statement and how is applied to concrete situations;

Questions from the Problem Sheets:

- `PS#1:` 3, 5, 7, 9, 13, 15, 18;
- `PS#2:` 2, 3, 4, 6, 7, 8, 10,11;
- `PS#3:` 2, 3, 4, 5, 6;
- `PS#4:` inviscid: 3, 5, 6, 7, 8, 9, 11, 12, 14; viscous: 1, 3, 4;
- `PS#5:` 1, 2, 3, 4, 6, 7;