Bengal Engineering and Science University, Shibpur
B.E. 4th Semester (Aerospace Engineering) Final Examinations, 2012
Aerospace Structure – I (AE 402)

Full Marks: 70 *Time: 3 hrs*

Answer any five(5) questions
All questions carry equal marks

1. The state of strain at a point is given by $\varepsilon_x = 0.001, \varepsilon_y = -0.003, \varepsilon_z = 0 = \gamma_{xy}, \gamma_{yz} = 0.001, \gamma_{zx} = -0.04$. Determine the stress tensor at the point. Also compute Lamé constants. Take E = 2.1 x 10^5 MPa, ν = 0.28.

2. What is the plane strain condition? Starting from the fundamentals derive the expression of Beltrami–Michell equation for plane strain.

3. (a) Prove the identity: $\varepsilon_{ijk} e_{imn} = \delta_{jm}\delta_{kn} - \delta_{jn}\delta_{km}$.
   (b) If J and J' are the Jacobians for forward transformation and inverse transformation respectively, prove that $JJ' = 1$
   (c) Define covariant and contravariant tensors.

4. Starting from the fundamentals, derive the yield criterion in plane stress condition, based on maximum shearing distortion energy theory. In this connection, draw the yield surfaces for three-dimensional state of stress.

5. (a) Explain complete and incomplete tension field beam
   (b) The beam shown in Fig. Q5 is assumed to have a complete tension field web. If the c/s area of each stiffener and flange are 275 mm^2 and 325 mm^2 respectively and the elastic section modulus of each flange is 750 mm^3, determine the maximum stress in a flange and also whether or not the stiffener will buckle. Assume web thickness 1.5 mm, second moment of area of a stiffener about an axis in the plane of the web 1875 mm^4, and E = 7 x 10^4 MPa.

6. Starting from fundamentals, derive the equation of Southwell Plot for the experimental determination of the elastic buckling load of an imperfect column.

7. Using the Principle of Stationary Value of TPE, derive the expression for the critical load for a long column, hinged at both ends.

8. Using the Principle of Stationary Value of TCE, calculate the vertical deflection at points C and D of the beam ACDB with flexural rigidity EI as shown in Fig. Q8.

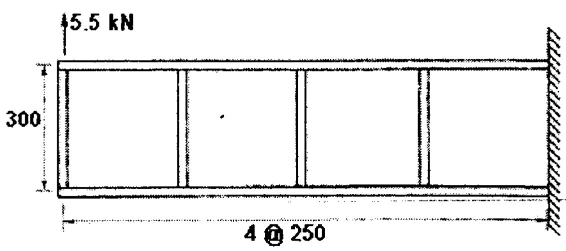

Fig. Q5

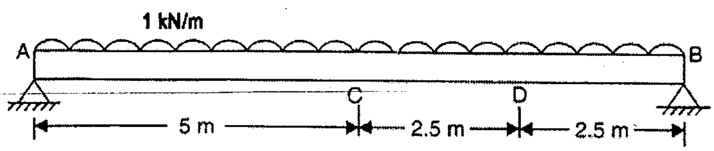

Fig. Q8