7

G 6515

M.E. DEGREE EXAMINATION, MAY/JUNE 2007.

Elective

Structural Engineering

ST 1631 — OPTIMIZATION IN STRUCTURAL DESIGN

(Regulation 2005)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Differentiate feasible and optimum solution.

2. What is meant by 'bivariate' model?

3. Explain "monotonic objective functions".

4. What is meant by "Un constrained Model"?

5. Explain "Global Optima".

6. When do we use artificial variables?

7. Explain 'search methods'

8. When do we call the quadratic form as 'positive definite' or 'negative definite'?

9. Explain 'fully stressed design'

10. Under what circumstances deflection constraints are accounted?

PART B — ($5 \times 16 = 80$ marks)

11. (a) Solve the following by two-phase simplex method.

Minimize, $z = 4x_1 + 5x_2$

$$x_1 + x_2 \geq 1$$
$$2x_1 + 4x_2 \geq 3$$
$$3x_1 + 7x_2 \leq 6$$
$$x_1, > 0, x_2 > 0$$

Or

(b) Formulate the dual solution for the following and solve the dual by simplex method.

Minimize $z = 5x_1 - 10x_2 - 3x_3 + 2x_4$

$$2x_1 + x_2 + x_3 + x_4 \leq 20$$
$$x_1 + 3x_2 + 2x_3 \geq 30$$
$$x_4 \geq 5$$
$$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0, x_4 \geq 0$$

12. (a) Utilize the Lagrange multiplier method to find the global optimum.

Maximize $z = 3x_1 + 2x_2$

$$x_1^2 + 4x_2^2 \leq 6$$
$$x_1 \geq 0, x_2 \geq 0$$

Or

(b) Solve the following by method of substitution.

Minimize $z = x_1^2 + x_2^2 - 4x_1 - 2x_2 + 10$

$$x_1 + 2x_2 = 3$$
$$x_1 \geq 0, x_2 \geq 0$$

13. (a) Verify whether necessary Kuhn-Tucker conditions are sufficient for a global maximum for the following :

Maximize $z = (x_1 - 2)^2 + (x_2 - 1)^2 + 5$

$$x_1^2 + x_2^2 = 1$$
$$x_1 \geq 0, x_2 \geq 0$$

Or

(b) Minimize $z = (x_1 - 10)^2 + (x_2 - 5)^2$

$$x_1^2 + x_2^2 \leq 64$$
$$x_1 \geq 0, x_2 \geq 0$$

by graphical means or otherwise.

14. (a) The number of kilometers (M) that can be paved is a function of labour and machine hours.

M = 0.5 $L^{0.2}$ $K^{0.8}$ where L is the labour hour used in man hours and K is the machine hours. Determine the optimum combination of machine and labour to pave 30 km of highway. Labour is paid Rs. 200 per day in the machine operating cost is Rs. 1,500 per hour. Formulate a constrained model.

Or

lve the dual by

optimum.

sufficient for a

function of labour

ıan hours and K is
on of machine and
200 per day in the
late a constrained

(b) A laminated wooden beam of span 3 m is subjected to a central point load of 5 kN. The cross section of the beam is mode of four wooden rafters each of size (b × h/4) so as to have the beam size of b× h. bending stress is not to exceed 30 Mpa, shear stress cannot exceed 10 Mpa and shear stress for the glue is 7.5 Mpa. Formulate a mathematical model to meet the stated objective. Clearly define the control variables.

15. (a) A rectangular box is supported along all its edges by straight members. These members are cut from a single 12 m long rod. Determine the maximum volume of the box by formulating the required mathematical model.

Or

(b) Formulate the mathematical model to minimize the total weight of the truss shown in Fig. 1. Members in tension and compression are limited to a maximum stress of 150 Mpa and 90 Mpa respectively. Members 1 and 3 are assumed to have same cross-sectional area.

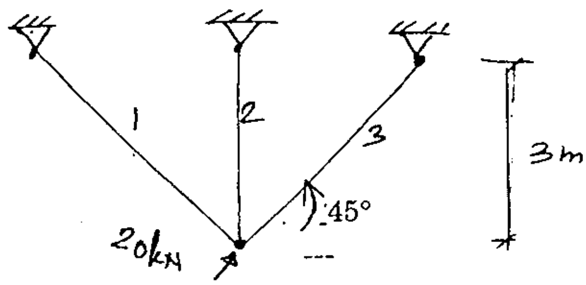

Fig.1