Menoufia University Faculty of Engineering, Shebin El-Kom, Basic Engineering science Department First Semester Examination, 2016-2017 Date of Exam: 12/1/2017	Subject: Operations research Code : BES 603 Year : postgraduate students Time Allowed : 3 hours Total Marks: 100 marks

Answer the following questions

(Question 1)

a) Define each of the following expressions:

Algorithm- Method- Technique- Heuristic- Metaheuristic.

b) State the differences between the traditional algorithms and metaheuristic algorithms.

c) Explain the Basics of Game theory.

d) What are the necessary and sufficient conditions for the multi-variable optimization problem without constraints?

e) Determine the minimum value of the function

$$f(x) = x_1^2 + x_2^2 - 2x_1 - 4x_2$$

Subject to:

$$g_1(x) = x_1 + 4x_2 \le 5$$
$$g_2(x) = 2x_1 + 3x_2 \le 6$$
$$x_1, x_1 \ge 0$$

Start from the point $\mathbf{x} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$

f) Find the minimum value for the function $f(x) = 2x_1^2 + 2x_1x_2 + x_2^2 + x_1 - x_2$ using the Steepest Descent (Cauchy) Method, start from the point (0, 0).

g) Find the dimensions of a box of largest volume that can be inscribed in a sphere of unit radius.

h) Determine the maximum and minimum values of the function

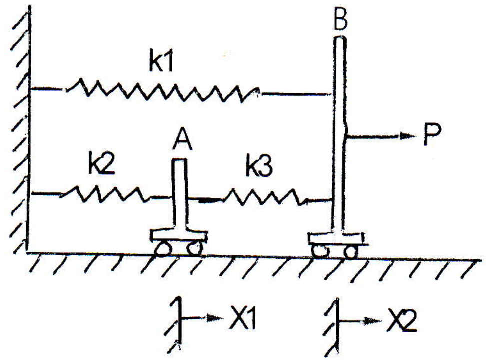
$$f(x) = 12x^5 - 45x^4 + 40x^3 + 5$$

i) How do you test the positive, negative, or indefiniteness of a square matrix [A]? Then what is the type of the following matrix?

$$A = \begin{bmatrix} 4 & -3 & 0 \\ -3 & 0 & 4 \\ 0 & 4 & 2 \end{bmatrix}$$

(Question 2)

a) The following Figure shows two frictionless rigid bodies (carts) A and B connected by three linear elastic springs having spring constants k_1, k_2, and k_3. The springs are at their natural positions when the applied force P is zero. Find the displacements x_1 and x_2 under the force P by using the principle of minimum potential energy.



b) Find the function x(t) that minimizes the following cost functional $J = \int_{-1}^{1} x(t)\,dt$ Subject to:

$$\int_{-1}^{1} [1 + \dot{x}^2(t)]^{\frac{1}{2}}\, dt = 1$$

c) Solve the following multiple criteria decision problem by the weighted method, assume that the decision maker gives the weights, $w_1 = 0.6$ and $w_2 = 0.4$ to indicate the importance of each objective

$$Max\ f_1 = 0.4x_1 + 0.3x_2$$
$$Max\ f_2 = x_1$$
$$subject\ to:$$
$$x_1 + x_2 \le 400,$$
$$2x_1 + x_2 \le 500,$$
$$x_1 \ge 0,\ x_2 \ge 0.$$

d) Solve the following problem by using ϵ-constraint method

$$Min\ f_1 = x^4$$
$$Min\ f_2 = (x-2)^4$$
$$subject\ to:$$
$$-4 \le x \le 4$$

With my best wishes *Dr. Rizk Masoud*