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|     | Reg. No. :  |
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|     | Question Paper Code: 10877  |
|     | M.E./M.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.   |
|     | Second Semester   |
|     | Manufacturing Engineering   |
|     | MF 4201 – OPTIMIZATION TECHNIQUES IN MANUFACTURING  |
|     | (Regulations 2021)  |
| Tim | ne: Three hours Maximum: 100 mark   |
|     | Answer ALL questions.   |
|     | PART A — $(10 \times 2 = 20 \text{ marks})$   |
| 1.  | Suppose the monthly profit a manufacturer realizes from selling q" units given by $P(q) = -5q^2 + 1300q - 15000$ dollars. What is the maximum monthly profit? |
| 2.  | Classify the optimization problems according to their complexity.   |
| 3.  | Mention the general rules for formulating a dual linear programming proble from its primal.   |
| 4.  | In the context of network simplex method, define basic and non basic arcs.  |
| 5.  | What do you mean by separable and/or non-linear convex programming?   |
| 6.  | Write the Kuhn-Tucker necessary and sufficient conditions in non-line programming.  |
| 7.  | Define the following dynamic programming terms: (a) Stage (b) State variable (c) Decision variable (d) Immediate return                                       |
| 8.  | What is the effect of the integer' restriction of all the variables on the feasib space of integer programming problem?                                       |

What are neural networks? How they are used in optimization?

10. What is meant by Meta-heuristic?

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PART B —  $(5 \times 13 = 65 \text{ marks})$ 

- 11. (a) State the optimization problem and explain its elements
  - (b) What is meant by a mathematical model of a real situation? Discuss the importance of models in the solution of operations research problems.
- 12. (a) Use the revised simplex method to solve the following linear programming problem:

Maximize  $Z = 3x_1 + 5x_2$ 

Subject to the constraints

- (i)  $x_1 \le 4$
- (ii)  $x_2 \le 6$



(b) Solve the following goal programming problem

Minimize  $Z = P_1 d_1^- + P_2 d_4^+ + 5P_3 d_2^- + 3P_3 d_3^- + P_4 d_1^+$ 

Subject to the constraints

- (i)  $x_1 + x_2 + d_1^- d_1^+ = 80$
- (ii)  $x_1 + d_2 = 70$
- (iii)  $x_2 + d_3^- = 45$
- (iv)  $x_1 + x_2 + d_4^- d_4^+ = 90$

and  $x_j$ ,  $d_i^-$ ,  $d_i^+ \ge 0$ ; i = 1, 2, 3, 4; j = 1, 2

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13. (a) Use Wolfe's method to solve the quadratic programming problem:

Maximize  $Z = 4x_1 + 6x_2 - 2x_1^2 - 2x_1x_2 - 2x_2^2$ 

Subject to the constraint

 $x_1 + 2x_2 \le 2$  and  $x_1, x_2 \ge 0$ 

Or

- (b) When n > m + 1 solve the following non linear programming problem: Minimize  $f(x) = 5x_1 x_2^{-1} + 2x_1^{-1} x_2 + 5x_1 + x_2^{-1}$  using the geometric programming method.
- (a) Solve the following all-integer programming problem using the branch and bound method.

Maximize  $Z = 3x_1 + 5x_2$ 

Subject to the constraints



and  $x_1, x_2 \ge 0$  and integers.

Or

(b) Solve the following Integer linear programming problem using Gomory's cutting plane method.

Maximize  $Z = x_1 + x_2$ 

Subject to the constraints

- (i)  $3x_1 + 2x_2 \le 5$
- (ii) x<sub>2</sub> ≤2

and  $x_1, x_2 \ge 0$  and are integers.

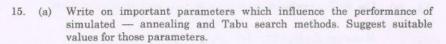
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(b) Write short notes on: (i) Genetic algorithm (ii) Fuzzy system

PART C — 
$$(1 \times 15 = 15 \text{ marks})$$

16. (a) Four types of machine tools are to be installed (purchased) in a production shop. The costs of the various machine tools and the number of jobs that can be performed on each are given below.

|               | Machine<br>tool<br>type | Cost of<br>machine<br>tool (Rs) | Number<br>of jobs<br>that can<br>be<br>performed |  |
|---------------|-------------------------|---------------------------------|--|--|
|               | 1                       | 35000                           | 9  |  |
|               | 2                       | 25000                           | 4  |  |
|               | 3                       | 20000                           | 3  |  |
| machine tools | of various              | types to b                      | e purchased                                      | etermine the number of<br>to maximize the number<br>as integer programming |

Or

(b) Choose an engineering field of your choice and identify the product/system/process that may require optimal design. Clearly indicate the objective, decision/design variables and constraints. Formulate the mathematical model and categorize the type of problem. Also suggest suitable solution technique and demonstrate the same with at least one iteration.

problem as dynamic programming problem. Solve the same by any one

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