Model Question Paper for the M.Tech. Admissions Test
INDUSTRIAL ENGINEERING & OPERATIONS RESEARCH, IIT BOMBAY

Disclaimer about this document: This question paper is a model for the admissions-test to IEOR department at IIT Bombay. Some of these questions may have appeared in the previous years' tests. The actual test may have a different number of questions and questions of different types. This paper is meant only to provide an idea of the kind of questions that may be asked in the test.

INDUSTRIAL ENGINEERING & OPERATIONS RESEARCH, IIT BOMBAY

2042 M.Tech. Admissions Test, 08.05.2042, hh:mm AM - hh:mm AM

NAME:_____ **GATE Reg. No.:** _____

GATE Score: _____/1000 **Qualifying (UG) Discipline:** _____

Called for (please circle): TA / RA / SW / IS / PS / IB **Category:** GN / OBC-NC

Date of Birth: _____ **Signature:** _____

Instructions

- No clarifications on questions should be sought during the examination.
- Answer as many questions as you can. There are a total of NN questions. Duration MM minutes.
- Write the answer in the space provided on the right side of the question. Answers written in the marked space only will be evaluated.
- Each correct answer will be awarded two marks.
- For multiple choice questions, you have to mention **all** the right choices for full marks; one mark will be **deducted** for wrong or incomplete solution.
- There is no negative marking for questions other than multiple-choice questions.
- Use of calculator is allowed. Mobile phones, tablets and other electronic items are not allowed.

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1. A manufacturing facility has four stages in series (i.e. every product has to go through each stage in sequence), A-B-C-D with processing rates of 4 units per hour, 5 units per hour, 4 units per hour and 6 units per hour respectively. The maximum achievable throughput is?

   1. _____

2. Consider the manufacturing facility given in the previous question. If you have to invest in any stage to improve the processing rate, so as to achieve higher throughput which stage(s) will you invest initially: stage A, B, C or D?

   2. _____

3. In designing a health facility (e.g. a diagnostic centre), there could be many objectives. One such objective is Maximize 'Utilization of the personnel in the facility'. Identify the objective(s) which are perhaps conflicting with the above objective.

   A. Minimizing the average waiting time of customers

   B. Minimizing the average number of customers waiting

   C. Minimizing the number of customers who wait beyond some time (e.g. two hours)

   D. Maximize the total revenue of the hospital

   3. _____

4. We flip a fair coin 10 times. What is the probability of getting exactly 5 heads?

   4. _____

5. Consider a group of children: 3 boys and x girls. We pick 2 children at random, and the probability that both are boys is $\frac{1}{2}$. How many girls are there in the group?

   A. 1

   B. 2

   C. 3

   D. 4

5. _____

6. Consider the algorithm given below. Let the inputs be A=4, 6, 8 and n=3. What is the final output of the algorithm?

```
PLAIN(A, n)
1.  Create array B of size n
2.  number:  s
4.  for i ← 1 to n
5.    s ← A[1]
6.    for j ← 2 to i
7.      s ← s + A[j]
8.    next j
9.    B[i] ← s / i
10.  next i
11.  output:  array B
```

   A. $\{4, 6, 8\}$

   B. $\{4, 6, 7\}$

   C. $\{4, 5, 7\}$

   D. $\{4, 5, 6\}$

6. _____

7. The condition "U is true if V is true" is captured in which of the following constraints (if we follow the convention that 0=false and 1=true)?

   A. $V \leq U$

   B. $U \leq V$

   C. $U = V$

   D. $U + V = 1$

7. _____

8. The function $f(x) = x^4$ over the real numbers always satisfies $f(x) \geq 0$. At point x = 0, we have $f(x) = 0, f'(x) = 0$ and $f''(x) = 0$. This illustrates the fact that

   A. $f'(x^*) = 0$ and $f''(x^*) \geq 0$ are necessary conditions for x^* to be a minimum point of f.

   B. $f'(x^*) = 0$ and $f''(x^*) = 0$ are necessary conditions for x^* to be a minimum point of f.

   C. $f'(x^*) = 0$ and $f''(x^*) \geq 0$ are sufficient conditions for x^* to be a minimum point of f.

   D. $f'(x^*) = 0$ and $f''(x^*) = 0$ are sufficient conditions for x^* to be a minimum point of f.

8. _____

9. Consider the LP: maximize $3x_1 - x_2$, subject to $x_1 - 2x_2 \leq 0, x_1 \leq 2; x_2 \leq 0$. The LP has

   A. bounded feasible region

   B. unbounded feasible region

C. unique optimum solution

D. unbounded objective value

9. _____

10. The price of an item is marked up by $u\%$. If the new price is then marked down by $d\%$ to return the price of the item to the original price, then

A. $\frac{1}{u} + \frac{1}{100} = \frac{1}{d}$

B. $\frac{1}{d} + \frac{1}{100} = \frac{1}{du}$

C. $\frac{1}{u} + \frac{1}{d} = \frac{1}{100}$

D. $\frac{1}{d} + \frac{1}{100} = \frac{1}{u}$

10. _____

11. Consider the system of equations: $\pi_1 = \frac{\pi_1}{2} + \frac{\pi_2}{3}; \pi_2 = \frac{\pi_1}{2} + \frac{\pi_2}{3} + \frac{\pi_3}{2}; \pi_3 = \frac{\pi_2}{3} + \frac{\pi_3}{2}; \pi_1 + \pi_2 + \pi_3 = 1$. The value of π_3 that satisfies the above equations is?

11. _____

12. Let $A = \begin{pmatrix} 2 & -1 \\ -1 & 2 \end{pmatrix}$. The eigenvalues of A^{-1} are?

12. _____

13. The following frequency table gives the values obtained in 40 rolls of a die.

Value	1	2	3	4	5	6
Frequency	9	8	5	5	6	7

The sample median of the above data is?

13. _____

14. Consider the data given in the previous question. The sample mode of the data is?

14. _____

15. A 'basic feasible solution' in the context of linear programming is:

A. An optimal solution.

B. An optimal solution that is a candidate for being a feasible solution.

C. A feasible solution that is a candidate for being an optimal solution.

D. A solution that satisfies all the constraints.

15. _____

16. A country has n cities, each of which is connected by road to every other city. A tourist wants to tour the country in such a way that starting from city 1, she visits each city exactly once, and returns to city 1. In how many ways can she do this?

16. _____

17. A cook-book gives a recipe (instructions) to bake a cake of 8 inches diameter and of a certain height. If you want to use the recipe to bake a cake of the same height but of 12 inches diameter, by what factor should you multiply the recipe ingredients?

17. _____

18. If $z = \max\{3x + 4y : x^2 + y^2 \leq 1\}$, then $z =$?

18. _____

19. There are n jobs that have to be scheduled. Each job required operations on two machines. For reasons of control, the order in which the jobs are processed on the two machines is the same. The number of ways in which the jobs can now be scheduled is:

A. $n!$ B. $\frac{n(n-1)}{2}$ C. $(n-1)!$ D. n^2

19. _____

20. Most of the fast growing jobs in today's economy need a college degree but require knowledge other than that gained from earning the degree. Good basic skills in reading, communication and mathematics play an important role in getting a job and developing one's career. From the above paragraph it can be validly concluded that:

A. New jobs being created do not require knowledge gained from earning a degree

B. If a job is a fast growing job then it would need a college degree

C. Communication skills play a valuable role in getting a job

D. Getting a job and earning a degree are two different things

20. _____

21. Acceptance sampling of incoming lots is an example of

A. end of line quality control or quality assurance

B. quality at source

C. quality function deployment

D. statistical process control

21. _____