

20/6.

2021-51-2200

$\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{x}} \right) = \frac{\partial L}{\partial x}$

$$\frac{d}{dt} \left(\int_{\Omega} u^2 dx + \int_{\Gamma} u^2 d\sigma \right) = -2 \int_{\Omega} u \Delta u dx - 2 \int_{\Gamma} u \nabla_n u d\sigma,$$
$$\begin{pmatrix} \vdots & \vdots \\ \vdots & \vdots \end{pmatrix} = \begin{pmatrix} \vdots & \vdots \\ \vdots & \vdots \end{pmatrix}$$

Roll No. (Write the digits in words)

Serial No. of OMR Answer Sheet ..

Day and Date

(Signature of Invigilator)

SEAL

1. Within 30 minutes of the issue of the Question Booklet, Please ensure that you have got the correct booklet and it contains all the pages in correct sequence and no page/question is missing. In case of faulty Question Booklet, Bring it to the notice of the Superintendent/Invigilators immediately to obtain a fresh Question Booklet.
2. Do not bring any loose paper, written or blank, inside the Examination Hall *except the Admit Card without its envelope*.
3. *A separate Answer Sheet is given. It should not be folded or mutilated. A second Answer Sheet shall not be provided.*
4. Write your Roll Number and Serial Number of the Answer Sheet by pen in the space provided above.
5. *On the front page of the Answer Sheet, write by pen your Roll Number in the space provided at the top, and by darkening the circles at the bottom. Also, wherever applicable, write the Question Booklet Number and the Set Number in appropriate places.*
6. *No overwriting is allowed in the entries of Roll No., Question Booklet No. and Set No. (if any) on OMR sheet and Roll No. and OMR sheet no. on the Question Booklet.*
7. *Any change in the aforesaid entries is to be verified by the invigilator, otherwise it will be taken as unfair means.*
8. *This Booklet contains 40 multiple choice questions followed by 10 short answer questions. For each MCQ, you are to record the correct option on the Answer Sheet by darkening the appropriate circle in the corresponding row of the Answer Sheet, by pen as mentioned in the guidelines given on the first page of the Answer Sheet. For answering any five short Answer Questions use five Blank pages attached at the end of this Question Booklet.*
9. For each question, darken only **one** circle on the Answer Sheet. If you darken more than one circle or darken a circle partially, the answer will be treated as incorrect.
10. *Note that the answer once filled in ink cannot be changed. If you do not wish to attempt a question, leave all the circles in the corresponding row blank (such question will be awarded zero marks).*
11. For rough work, use the inner back pages of the title cover and the blank page at the end of this Booklet.
12. *Deposit both OMR Answer Sheet and Question Booklet at the end of the Test.*
13. You are not permitted to leave the Examination Hall until the end of the Test.
14. If a candidate attempts to use any form of unfair means, he/she shall be liable to such punishment as the University may determine and impose on him/her.

Total No. of Printed Pages : 24

79.

Research Entrance Test-2016

No. of Questions : 50

प्रश्नों की संख्या : 50

Time : 2 Hours

Full Marks : 200

समय : 2 घण्टे

पूर्णाङ्क : 200

Note: (1) This Question Booklet contains **40** Multiple Choice Questions followed by **10** Short Answer Questions.

इस प्रश्न पुस्तिका में **40** वस्तुनिष्ठ व **10** लघु उत्तरीय प्रश्न हैं।

(2) Attempt as many MCQs as you can. Each MCQ carries **3 (Three)** marks. **1 (One)** mark will be deducted for each incorrect answer. **Zero** mark will be awarded for each unattempted question. If more than one alternative answers of MCQs seem to be approximate to the correct answer, choose the closest one.

अधिकाधिक वस्तुनिष्ठ प्रश्नों को हल करने का प्रयत्न करें। प्रत्येक वस्तुनिष्ठ प्रश्न **3 (तीन)** अंकों का है। प्रत्येक गलत उत्तर के लिए **1 (एक)** अंक काटा जायेगा। प्रत्येक अनुत्तरित प्रश्न का प्राप्तांक शून्य होगा। यदि वस्तुनिष्ठ प्रश्नों के एकाधिक वैकल्पिक उत्तर सही उत्तर के निकट प्रतीत हों, तो निकटतम सही उत्तर दें।

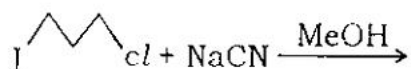
(3) Answer only **5** Short Answer Questions. Each question carries **16 (Sixteen)** marks and should be answered in **150-200** words. Blank **5 (Five)** pages attached with this booklet shall only be used for the purpose. Answer each question on separate page, after writing Question No.

केवल **5 (पाँच)** लघुउत्तरीय प्रश्नों के उत्तर दें। प्रत्येक प्रश्न **16 (सोलह)** अंकों का है तथा उनका उत्तर **150-200** शब्दों के बीच होना चाहिए। इसके लिए इस पुस्तिका में लगे हुए सादे **5 (पाँच)** पृष्ठों का ही उपयोग आवश्यक है। प्रत्येक प्रश्न का उत्तर एक नए पृष्ठ से, प्रश्न संख्या लिखकर शुरू करें।

01. Which of the following is not a characteristic of S_N2 reaction?

- (1) rate of reaction is highly dependent on the strength of nucleophile
- (2) tends to proceed with weak nucleophiles solvents like CH_3OH , H_2O , $\text{CH}_3\text{CH}_2\text{OH}$.
- (3) rate of reaction proceeds from primary (fastest) > secondary > tertiary (slowest)
- (4) occurs in one step

02. Which is the main product of the following reaction ?



- | | |
|---|--|
| (1) $\text{NC}-\text{CH}_2\text{CH}_2\text{CH}_2\text{I}$ | (2) $\text{NC}-\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$ |
| (3) $\text{MeO}-\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$ | (4) $\text{CH}_2=\text{CHCH}_2\text{Cl}$ |

03. Which of the following conditions is necessary for a reaction to be spontaneous ?

- | | |
|---|---|
| (1) $\Delta S_{\text{sur}} > 0$ | (2) $\Delta S_{\text{sys}} > 0$ |
| (3) $\Delta S_{\text{sur}} + \Delta S_{\text{sys}} > 0$ | (4) $\Delta S_{\text{sur}} + \Delta S_{\text{sys}} < 0$ |

04. Dead organs are generally stored in formalin. Formalin is :

- | | |
|--------------------------|------------------------------|
| (1) aqueous formaldehyde | (2) aqueous ferrous sulphate |
| (3) aqueous formic acid | (4) aqueous ferric alum |

05. The phrase "carbon credits" which one of the following statements is not correct :

- (1) The carbon credit system was notified in conjunction with the Kyoto Protocol.
- (2) Carbon credits are awarded to countries or groups that have reduced greenhouse gases below their emission quota.
- (3) The goal of the carbon credit system is to limit the increase of carbon dioxide emission.
- (4) Carbon credits are traded at a price fixed from time to time by the United Nations Environment Programme.

06. Ball bearings are used in bicycles, cars, etc., because :

- (1) the actual area of contact between the wheel and axle is increased.
- (2) the effective area of contact between the wheel and axle is increased
- (3) the effective area of contact between the wheel and axle is reduced
- (4) the actual area of contact between the wheel and axle is reduced.

07. During respiration, energy is released. It is stored in the form of :

- (1) ADP (2) ATP (3) NADP (4) APP

08. Which of the following is known as Royal disease :

- (1) Sickle cell anemia (2) Haemophilia
- (3) Alzheimers disease (4) Colour blindness

09. The xylem in plants is responsible for :

- (1) transport of water (2) transport of food
- (3) transport of oxygen (4) transport of amino acids

10. Two wires, of the same material, have their lengths in the ratio 7:22 and their diameters in the ratio 2:1. If both are stretched separately by equal weights, the ratio of increase in their lengths, $L_1 : L_2$ would be :
- (1) 1:2 (2) 2:1 (3) 1:8 (4) 8:1
11. The median of five distinct values can be found with no more than n comparisons. What is the value of n ?
- (1) 4 (2) 5 (3) 6 (4) 7
12. Which of the following is lexicographically sorted ?
- (1) abc, acb, abca, bbca, aac, baa, cab, bb
 (2) abc, bbca, bb,aac, baa, abca, cab, acb
 (3) aac, abc, abca, acb, baa, bb, bbca, cab
 (4) abc, acb, bbca, baa, abca, cab, bb, aac
- (1) 1 (2) 3 (3) 4 (4) 2
13. How many integer solutions are there to the equation ?
- $x_1 + x_2 + x_3 + x_4 = 10$, with $x_i \geq 0$?
- (1) 286 (2) 165
 (3) 455 (4) 36

14. An OS uses Shortest – Remaining Time first (SRT) process scheduling algorithm :

Process	Execution Time	Arrival Time
P1	30	0
P2	25	10
P3	15	20
P4	05	30

What is the completion time of P3 ?

- (1) 10 (2) 50 (3) 50 (4) 45
 (1) 4 (2) 2
 (3) 1 (4) 3

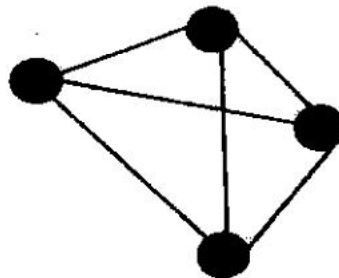
15. A process refers to 5 pages A,B,C,D and E in the order B,A,D,C,B,E,C,D,E,A. If the page replacement algorithm is FIFO, the number of page transfers from the disk to an initially empty internal store of 3 frames is :

(1) 10 (2) 11 (3) 12 (4) 9
 (1) 1 (2) 4
 (3) 3 (4) 2

16. *ud*-chaining is useful for :

(1) Determining whether a particular definition is used anywhere or not
 (2) Folding constant
 (3) Checking whether a variable is used, without prior assignment
 (4) Not useful
 (1) 1 (2) 3 (3) 2 (4) 3
 (1) 1 (2) 3
 (3) 2 (4) 4

17. How many ways the following graph may be coloured using red, blue, green and violet colours ?



(1) 4 (2) 12 (3) 36 (4) 24
 (1) 1 (2) 2
 (3) 3 (4) 4

18. Banker's algorithm for resource allocation deals with

- (1) deadlock avoidance
- (2) deadlock prevention
- (3) deadlock recovery
- (4) mutual exclusion

(1) 1 (2) 3 (3) 4 (4) 2

19. Which one of the following algorithm is not used in asymmetric-key cryptography ?

- (1) RSA algorithm
- (2) Diffie-Hellman algorithm
- (3) Electronic code book algorithm
- (4) Cipher block Chaining mode

(1) 2 (2) 3 (3) 4 (4) 1

20. Which is not a black-box testing technique ?

- (1) Cause-effect graphing
- (2) Equivalence partitioning
- (3) Pair-wise testing
- (4) Data-flow testing

(1) 4 (2) 3 (3) 2 (4) 1

21. Distributed system should aim :

- (1) Hard time constraints
- (2) Better resource sharing
- (3) Better system utilization
- (4) Low system overhead

(1) 2 (2) 1 (3) 3 (4) 4

22. A binary max-heap is represented through an array. Which one is correct ?

- (1) [24, 11, 15, 12, 9, 7, 14]
- (2) [24, 13, 12, 15, 9, 7, 11]
- (3) [24, 13, 15, 12, 9, 7, 11]
- (4) [24, 13, 11, 12, 9, 7, 15]

(1) 1 (2) 2 (3) 3 (4) 4

23. Consider the following truth table :

x	y	z	F(x,y,z)
1	1	1	1
1	1	0	1
1	0	1	0
1	0	0	1
0	1	1	0
0	1	0	0
0	0	1	0
0	0	0	1

(1) $F = xy + y'z' + xyz$

(2) $F = xy + y'z'$

(3) $F = x'y + y'z'$

(4) $F = xyz + y'z' + xy'$

(1) 4

(2) 2

(3) 1

(4) 3

24. What is the value of nC_0 ?

- (1) 0 (2) ∞ (3) 1 (4) 0^0
 (1) 4 (2) 2
 (3) 1 (4) 3

25. What is the maximum value of f ?

$$f = x_1 + 6x_2, \text{ where } x_1 \leq 200, x_2 \leq 300, x_1 + x_2 \leq 400, x_1 \geq 0, x_2 \geq 0$$

- (1) 1400 (2) 1300 (3) 2000 (4) 1900
 (1) 4 (2) 2
 (3) 1 (4) 3

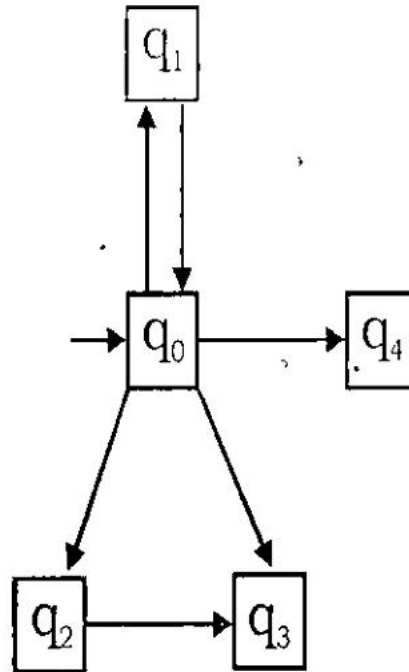
26. C is a positive real number and $f(n) = 1 + c + c^2 + \dots = c^n$:

- (1) $\Theta(1)$, if $c > 1$, $\Theta(n)$, if $c = 1$, $\Theta(c^n)$, if $c < 1$
 (2) $\Theta(1)$, if $c < 1$, $\Theta(n)$, if $c \neq 1$, $\Theta(1)$, if $c < 1$
 (3) $\Theta(1)$, if $c > 1$, $\Theta(n)$, if $c = 1$, $\Theta(c^n)$, if $c < 1$
 (4) $\Theta(1)$, if $c < 1$, $\Theta(n)$, if $c = 1$, $\Theta(c^n)$, if $c > 1$
 (1) 3 (2) 2 (3) 1 (4) 4

27. A programme contains 10% serial code. How do the speedup and efficiency change of the number of processors is increased from 4 to 8?

- (1) Speedup increases but efficiency decreases
 (2) Speedup decreases but efficiency increases
 (3) Speedup decreases and efficiency decreases
 (4) Speedup increases and efficiency increases
 (1) 1 (2) 2 (3) 4 (4) 3

33. What are the strings accepted by following automata?



Assume q_0 is the start state, q_3 and q_1 are the final states. Edge labels are as follows :

(q_0, q_1) is 1, (q_1, q_0) is 0, (q_0, q_2) is 1, (q_2, q_3) is 1, (q_0, q_3) is 0, (q_0, q_4) is 0,

(1) $L = \{1^*0^*0\}$

(2) $L = \{(10)^*0, 11\}$

(3) $L = \{1^*011\}$

(4) $L = \{1^*0^*11, 11\}$

(1) 1

(2) 2

(3) 4

(4) 3

29. The reliability of program A is 0.8 and that of B is 0.65. A and B solve the same problem. What is the probability that both A and B do not give wrong results for the same input problem.

(1) 0.03 (2) 0.2 (3) 0.35 (4) 0.55

(1) 1 (2) 2

(3) 4 (4) 3

30. How many characters (7 bits with 1 parity bit) per second can be transmitted over a 1200 bps line if the transfer is asynchronous (1 start and 1 stop bit) ?

(1) 220 (2) 1200 (3) 240 (4) 120

(1) 1 (2) 4

(3) 2 (4) 3

31. The following functional dependencies hold for relations R(A, B,C) and S(B,D,E) :

$$B \rightarrow A, A \rightarrow C$$

R contains 200 tuples and S contains 100 tuples. What is the maximum number of tuples possible in the natural join $R \bowtie S$?

(1) 200 (2) 300 (3) 100 (4) 20000

(1) 1 (2) 4

(3) 2 (4) 3

32. Let $f: R^1$ to R^1 be the mapping defined by $f(x, y) = \left(\frac{x}{3}, \frac{y}{4}\right)$. The image

under f of the ellipse $\frac{x^2}{9} + \frac{y^2}{16} = 1$, is

- | | |
|----------------|---------------------|
| (1) A circle | (2) A straight line |
| (3) An ellipse | (4) Hyperbola |
| (1) 1 | (2) 4 |
| (3) 2 | (4) 3 |

33. A process executes the following code. What is the total number of child processes created ?

For ($i = 2; i < k + 1; i++$) fork ();

- | | | | |
|---------|---------------|-------------------|--------------|
| (1) k | (2) $2^k - 1$ | (3) $2^{k-1} - 1$ | (4) $2k - 1$ |
| (1) 1 | (2) 4 | | |
| (3) 2 | (4) 3 | | |

34. A CPU has five - stage pipeline and runs at 1 GHz frequency. Instruction fetch happens in the first stage of the pipeline. A conditional branch instruction computes the target address and evaluates the condition in the third stage of the pipeline. The processor stops fetching new instructions following a conditional branch until the branch outcome is known. a programme executes 10^9 instructions out of which 20% are conditional branches. If each instruction takes one cycle to complete on average, then total execution time of the programme is :

- | | | | |
|-------------|-------------|-------------|-------------|
| (1) 1.0 sec | (2) 1.4 sec | (3) 1.2 sec | (4) 1.5 sec |
| (1) 1 | (2) 4 | | |
| (3) 2 | (4) 3 | | |

35. A binary tree contains the numbers $\{i\}$, where $1 \leq i \leq 8$. When the tree is traversed in pre-Order and the values in each node printed out, the sequence of values obtained is 5, 3, 1, 2, 4, 6, 8, 7. If the tree is traversed in post-order, the sequence obtained would be :

- | | |
|----------------------------|----------------------------|
| (1) 5, 1, 4, 3, 7, 8, 6, 5 | (2) 1, 2, 4, 3, 7, 8, 6, 5 |
| (3) 2, 1, 4, 3, 7, 8, 6, 5 | (4) 2, 1, 4, 3, 7, 8, 6, 5 |
| (1) 1 | (2) 3 |
| (3) 4 | (4) 2 |

36. What is the availability of a piece of software with the following reliability figures ? MTBF = 25 days, MTTR = 6 hours :

- | | | | |
|---------|---------|------------|-------------|
| (1) 10% | (2) 24% | (3) 99.55% | (4) 99.009% |
| (1) 1 | (2) 3 | | |
| (3) 4 | (4) 2 | | |

37. How many Boolean functions of n variables may be defined ?

- | | | | |
|----------|-----------|---------------|-----------|
| (1) $2n$ | (2) 2^n | (3) 2^{n^2} | (4) 2^n |
| (1) 1 | (2) 3 | | |
| (3) 4 | (4) 2 | | |

38. What is the minimum number of multiplications required to evaluate the following polynomial :

$$a_0 + a_1x + a_2x^2 + a_3x^3 + a_4x^4$$

- | | | | |
|-------|-------|-------|--------|
| (1) 9 | (2) 4 | (3) 7 | (4) 12 |
| (1) 1 | (2) 4 | | |
| (3) 2 | (4) 3 | | |

39. Consider three parsing techniques SLR, Canonical LR, and LALR. Suppose the corresponding parsers have k , l and m states respectively.

Which statement is true ?

(1) $k = l - m$ (2) $l = k + m$ (3) $k = m \neq l$ (4) $k \neq m \neq l$

(1) 1 (2) 4

(3) 2 (4) 3

40. $(34.4)_8 \times (23.4)_8$ evaluates to :

(1) $(1053.6)_8$ (2) $(1053.2)_8$ (3) $(1024.2)_8$ (4) $(1023.2)_8$

(1) 1 (2) 4 (3) 2 (4) 3

(1) 1 (2) 3

(3) 2 (4) 4

Short Answer Questions

Note: Attempt any **five** questions. Write answer in **150-200** words. Each question carries **16** marks. Answer each question on separate page, after writing Question Number.

- 01.** What is the best way to multiply the following chain of matrices ? Explain.

$$A_{10 \times 15} \times B_{15 \times 5} \times C_{5 \times 5} \times D_{5 \times 2}$$

Dimensions of these matrices appear as suffix, for example A has 10^7 rows and 15 columns.

- 02.** What are B- Trees ? Explain with an example.
- 03.** An Algorithm A requires n^2 days, algorithm B requires n^3 seconds to solve a problem. Which algorithm would you prefer for a problem instance with $n = 10^7$ and why ?
- 04.** How many key comparisons are made in the quick-sort if the input data of n integers is already sorted ?
- 05.** Make a breadth – first search of (i) $K_{3,3}$ and (ii) depth – first search of K_5 .

06. Distinguish between PDA and CDA and their uses.

07. What is locality of reference? Where in the design of computer systems this principle is used?

08. Solve the following recurrence relation :

$$T(N) = 2T(N - 1) + 1, \text{ with } T(1) = 1 \text{ and } T(2) = 3.$$

09. Distinguish between Streams and Block ciphers.

10. Discuss halting problem of Turing machine.

1. (10 points)

Write a function that takes a list of integers and returns the sum of the squares of the even numbers.

Question No. _____ Page for Short Answer _____

Question No.

Space for Short Answer

Question No.

Page for Short Answer

1. The first part of the test is a multiple choice section.

2. The second part of the test is a short answer section.

ROUGH WORK

१६ अंक

अभ्यर्थियों के लिए निर्देश

1. प्रश्न-पुस्तिका में लिखित प्रश्नों-उत्तर के अनिवार्य, प्रश्न का भाग कोई भी अनुमति प्राप्त करने में न लीजिए।
2. उत्तर-पत्र अलग से दिया गया है। इसे न तो मोड़ें और न ही विकृत करें। दूसरा उत्तर-पत्र नहीं दिया जायेगा। केवल उत्तर-पत्र का ही मूल्यांकन किया जायेगा।
3. अपना अनुक्रमांक तथा उत्तर-पत्र का क्रमांक प्रथम आवरण-पृष्ठ पर देने से निर्धारित स्थान पर लिखें।
4. उत्तर-पत्र के प्रथम पृष्ठ पर देने से अपना अनुक्रमांक निर्धारित स्थान पर लिखें तथा नीचे दिये वृत्तों को गाढ़ा कर दें। जहाँ-जहाँ आवश्यक हो वहाँ प्रश्न-पुस्तिका का क्रमांक तथा सेट का नम्बर उचित स्थानों पर लिखें।
5. ओ० एम० आर० पत्र पर अनुक्रमांक संख्या, प्रश्नपुस्तिका संख्या व सेट संख्या (यदि कोई हो) तथा प्रश्नपुस्तिका पर अनुक्रमांक और ओ० एम० आर० पत्र संख्या की प्रविष्टियों में उपरिलेखन की अनुमति नहीं है।
6. उपर्युक्त प्रविष्टियों में कोई भी परिवर्तन कक्ष निरीक्षक द्वारा प्रमाणित होना चाहिये अन्यथा यह एक अनुचित साधन का प्रयोग माना जायेगा।
7. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार वैकल्पिक उत्तर दिये गये हैं। प्रत्येक प्रश्न के वैकल्पिक उत्तर के लिए आपको उत्तर-पत्र की सम्बन्धित पंक्ति के सामने दिये गये वृत्त को उत्तर-पत्र के प्रथम पृष्ठ पर दिये गये निर्देशों के अनुसार देने से गाढ़ा करना है।
8. प्रत्येक प्रश्न के उत्तर के लिए केवल एक ही वृत्त को गाढ़ा करें। एक से अधिक वृत्तों को गाढ़ा करने पर अथवा एक वृत्त को अपूर्ण भरने पर वह उत्तर गलत माना जायेगा।
9. ध्यान दें कि एक बार स्याही द्वारा अंकित उत्तर बदला नहीं जा सकता है। यदि आप किसी प्रश्न का उत्तर नहीं देना चाहते हैं, तो संबंधित पंक्ति के सामने दिये गये सभी वृत्तों को खाली छोड़ दें। ऐसे प्रश्नों पर शून्य अंक दिये जायेंगे।
10. रफ कार्य के लिए प्रश्न-पुस्तिका के मुखपृष्ठ के अंदर वाला पृष्ठ तथा उत्तर-पुस्तिका के अंतिम पृष्ठ का प्रयोग करें।
11. परीक्षा के उपरान्त केवल ओ एम आर उत्तर-पत्र परीक्षा भवन में जमा कर दें।
12. परीक्षा समाप्त होने से पहले परीक्षा भवन से बाहर जाने की अनुमति नहीं होगी।
13. यदि कोई अभ्यर्थी परीक्षा में अनुचित साधनों का प्रयोग करता है, तो वह विश्वविद्यालय द्वारा निर्धारित दंड का/की, भागी होगा/होगी।