

M.Tech. (CrS) — 1st Semester

Indian Statistical Institute

Academic Year (2025-26)

Computing Systems – I (Supplementary Paper)

Full Marks: 100 | No. of Students: 01 | Time: 3 Hrs

Answer Any Five Questions

1. a) Simplify by using K-map— $F(A,B, C,D) = \sum(1,3,7,11,15)$ **7 [20]**
 $d(A,B, C,D) = \sum(0, 2, 5)$
- b) Express the Boolean function $F(a, b, c) = A + B'C$ in product of maxterm form. **3**
- c) Define *Speed-up ratio* of a pipelined system over a non-pipelined system. **3**
- d) Implement a full adder with two 4 X 1 multiplexers. **7**
2. a) Design a 4 x 1 line multiplexer by using a 2 x 4 line decoder. **6 [20]**
- b) Design a four-bit binary ripple up counter with D flip-flops. **7**
- c) Explain 4-segment instruction pipeline with appropriate flow chart considering the segments as follows—
FI (Fetch Instruction) DA (Decode Address)
FO (Fetch Operand) EX (Execute) **7**
3. a) Design a general register organization with 4 registers (R1, R2, R3, R4) and write down the control word (14-bit) for the operation: $R4 \leftarrow R1 + R3$ **7 [20]**
- b) Convert the following infix expression to reverse polish notation: **3**
 $A * B + C * (D * E) + F$
- c) Execute Multiplication Algorithm stepwise for: $(13) X (19)$ **10**
4. a) Write down the difference between programmed I/O and direct memory access. **5 [20]**
- b) What is *Handshaking* in asynchronous data transfer **2**
- c) Write down the microinstructions for a computer having stack organization for the operation: $T = A * B + C * D.$ **6**
- d) Draw the flowchart and explain the execution of instruction cycle for a system having 16-bit instruction register and 12-bit address register. **7**
5. a) With a proper block diagram explain segmentation mechanism, where the size of physical memory is 5200K. **7 [20]**
page fault.
- b) Considering the following reference string calculate the hit ratio for FIFO and Optimal algorithms for a process that is allocated 4 frames of physical memory — **8**

c) How Strict Alteration method for handling critical section problem restricts the *Progress*? Explain with necessary program code **5**

6. a) Calculate the average waiting time of all the processes according to Round Robin and Shortest Remaining Time First scheduling algorithm. For Round Robin scheduling; assume the time slice is 3 ms. **5+5 [20]**

PROCESS	BURST TIME (ms)	ARRIVAL TIME (ms)
P1	12	0
P2	4	2
P3	6	3
P4	5	8

b) Currently the RD/WR head of the disk is at sector 53. A request string is received from the user as 98 183 37 122 14 124 65 67. Compute the total head movement count according to C-SCAN and SSTF. **5+5**

7. a) What is *Thrashing*? **2 [20]**

b) Explain the Dining Philosopher Problem having 3 nos. of Philosophers. Provide necessary program codes. **8**

c) Execute Banker's Algorithm step-wise considering the following snapshot of a system and identify the safe sequence: **10**

PROCESS	Allocation			Max			Currently Available		
	A	B	C	A	B	C	A	B	C
P0	0	1	0	7	5	3	3	3	2
P1	2	0	0	3	2	2			
P2	3	0	2	9	0	2			
P3	2	1	1	2	2	2			
P4	0	0	2	4	3	3			