CST 308	COMPREHENSIVE COURSE WORK	Category	L	T	P	Credit	Year of Introduction
		PCC	1	0	0	1	2019

Preamble:

The objective of this Course work is to ensure the comprehensive knowledge of each student in the most fundamental core courses in the curriculum. Six core courses credited from Semesters 3, 4 and 5 are chosen for the detailed study in this course work. This course helps the learner to become competent in cracking GATE, placement tests and other competitive examinations

Prerequisite:

1. **Discrete Mathematical Structures**
2. **Data Structures**
3. **Operating Systems**
4. **Computer Organization And Architecture**
5. **Database Management Systems**
6. **Formal Languages And Automata Theory**

Course Outcomes: After the completion of the course the student will be able to

CO1	Comprehend the concepts of discrete mathematical structures (Cognitive Knowledge Level: **Understand)**
CO2 :	Comprehend the concepts and applications of data structures (Cognitive Knowledge Level: **Understand)**
CO3 :	Comprehend the concepts, functions and algorithms in Operating System (Cognitive Knowledge Level: **Understand)**)
CO4 :	Comprehend the organization and architecture of computer systems (Cognitive Knowledge Level: **Understand)**
CO5 :	Comprehend the fundamental principles of database design and manipulation (Cognitive Knowledge Level: **Understand)**
CO6 :	Comprehend the concepts in formal languages and automata theory Cognitive Knowledge Level: **Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓										✓
CO3	✓	✓										✓
CO4	✓	✓										✓
CO5	✓	✓										✓

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	**10**
Understand	**20**
Apply	**20**
Analyse	
Evaluate	
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	**0**	**50**	**1 hour**

End Semester Examination Pattern: Objective Questions with multiple choice (Four). Question paper include fifty questions of one mark each covering the five identified courses.

Syllabus

Full Syllabus of all six selected Courses.

1. **Discrete Mathematical Structures**
2. **Data Structures**
3. **Operating Systems**
4. **Computer Organization And Architecture**
5. **Database Management Systems**
6. **Formal Languages And Automata Theory**

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**DISCRETE MATHEMATICAL STRUCTURES (14 hours)**	
1.1	Mock Test on Module 1 and Module 2	1 hour
1.2	Mock Test on Module 3, Module 4 and Module 5	1 hour
2	**DATA STRUCTURES**	
2.1	Mock Test on Module 1, Module 2 and Module 3	1 hour
2.2	Mock Test on Module 4 and Module 5	1 hour
3	**OPERATING SYSTEMS**	
3.1	Mock Test on Module 1 and Module 2	1 hour
3.2	Mock Test on Module 3, Module 4 and Module 5	1 hour
3.3	Feedback and Remedial	1 hour
4	**COMPUTER ORGANIZATION AND ARCHITECTURE**	
4.1	Mock Test on Module 1, Module 2 and Module 3	1 hour
4.2	Mock Test on Module 4 and Module 5	1 hour
5	**DATABASE MANAGEMENT SYSTEMS**	

5.1	Mock Test on Module 1, Module 2 and Module 3	1 hour
5.2	Mock Test on Module 4 and Module 5	1 hour
6	**FORMAL LANGUAGES AND AUTOMATA THEORY**	
6.1	Mock Test on Module 1, Module 2 and Module 3	1 hour
6.2	Mock Test on Module 4 and Module 5	1 hour
6.3	Feedback and Remedial	1 hour

Model Question Paper

QP CODE:

Reg No: _____

Name: _____ **PAGES : 10**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST 308

Course Name: Comprehensive Course Work

Max. Marks: 50 **Duration: 1 Hour**

Objective type questions with multiple choices. Mark one correct answer for each question. Each Question Carries 1 Mark

1. What is the maximum possible number of relations from a set with 5 elements to another set with 4 elements?

   (A) 2^10 (B)2^16 (C)2^20 (D)2^25

2. The set {1,2,4,7,8,11,13,14} is a group under multiplication modulo 15. Find the inverse of element 13

   (A) 7 (B) 13 (C) 1 (D) 8

3. Consider the recurrence relation $a_1 = 2$, $a_n = 3n+a_{n-1}$ Then a_{72} is

(A) 7882 (B) 7883 (C) 7884 (D) 7885

4. Which among the following is a contradiction?
   (A) $(p \wedge q) \vee \neg(p \vee q)$ (B) $(p \vee q) \wedge \neg(p \wedge q)$
   (C) $(p \wedge q) \wedge \neg(p \vee q)$ (D) $(p \wedge q) \vee (p \wedge \neg q)$

5. The number of non-negative solutions to $x + y + z = 18$, with conditions $x \geq 3, y \geq 2, z \geq 1 is$
   (A) 84 (B) 91 (C) 105 (D) 121

6. The solution of the recurrence relation $a_n = a_{n-1} + 2a_{n-2}$ with initial conditions $a_0 = 2, a_1 = 7$, is
   (A) $3(2)^n - (-1)^n$ (B) $3(2)^n + (-1)^n$
   (C) $-3(2)^n - (-1)^n$ (D) $-3(2)^n + (-1)^n$

7. Which among the following is not a subgroup of the set of Complex numbers under addition?
   (A) R, the set of all Real numbers.
   (B) Q^+, the set of positive rational numbers.
   (C) Z, the set of all integers.
   (D) The set iR of purely imaginary numbers including 0

8. Minimum number n of integers to be selected from $S = \{1,2,\ldots,9\}$ to guarantee that the difference of two of the n integers is 5 is
   (A) 3 (B) 4 (C) 6 (D) 9

9. Find the contrapositive the of statement "If it is a sunday, then I will wake up late"
   (A) If I am not waking up late, then it is a suniday
   (B) If I am not waking up late, then it is not a suniday
   (C) If it is not a sunday, then I will not wake up late.
   (D) It is not a sunday or I will wake up late

10. In the poset (Z^+, |) (where Z^+ is the set of all positive integers and | is the divides relation), which of the following are false?
   I. 3 and 9 is comparable
   II. 7 and 10 is comparable
   III. The poset (Z+, |) is a total order
   (A) I and III (B) II only (C) II and III (D) III only

11. Consider the following sequence of operations on an empty stack.
   push(22); push(43); pop(); push(55); push(12); s=pop();

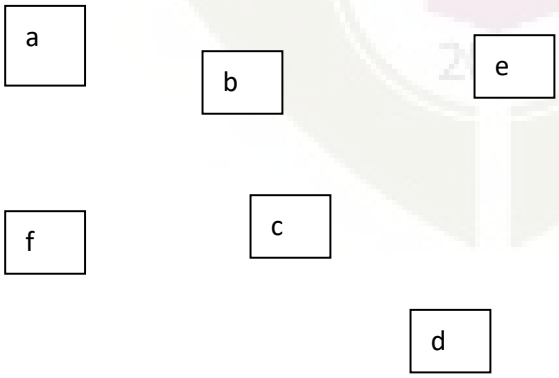
Consider the following sequence of operations on an empty queue.
enqueue(32);enqueue(27); dequeue(); enqueue(38); enqueue(12); q=dequeue();
The value of s+q is _____
(A) 44 (B) 54 (C) 39 (D) 70

12. The following postfix expression with single digit operands is evaluated using a stack:
8 2 2 ^ / 4 3 * + 5 1 * -
Note that ^ is the exponentiation operator. The top two elements of the stack after the first * is evaluated are:
(A) 12,2 (B) 12,5 (C) 2,12 (D) 2,5

13. Construct a binary search tree by inserting 8, 6, 12, 3, 10, 9 one after another. To make the resulting tree as AVL tree which of the following is required?
(A) One right rotation only
(B) One left rotation followed by two right rotations
(C) One left rotation and one right rotation
(D) The resulting tree itself is AVL

14. In a complete 4-ary tree, every internal node has exactly 4 children or no child. The number of leaves in such a tree with 6 internal nodes is:
(A) 20 (B) 18 (C) 19 (D) 17

15. Consider the following graph with the following sequences
I. a b c f d e
II. a b e d f c
III. a b f c d e
IV. a f c b e d



Which are Depth First Traversals of the above graph?

(A) I, II and IV only (B) I and IV only
(C) II, III and IV only (D) I, III and IV only

16. Consider a hash table of size seven, with starting index zero, and a hash function (2x + 5) mod7. Assuming the hash table is initially empty, which of the following is the contents of the table when the sequence 1, 4, 9, 6 is inserted into the table using closed hashing? Note that '_' denotes an empty location in the table.
(A) 9, _, 1, 6, _, _, 4 (B) 1, _, 6, 9, _, _, 4
(C) 4, _, 9, 6, _, _, 1 (D) 1, _, 9, 6, _, _, 4

17. Consider the following C program where TreeNode represents a node in a binary tree

```
struct TreeNode{
struct TreeNode *leftChild;
struct TreeNode *rightChild;
int element;
};
int CountNodes(struct TreeNode *t)
{
if((t==NULL)||((t->leftChild==NULL) && (t->rightChild==NULL)))
        return 0;
else
{
        return 1+CountNodes(t->leftChild)+CountNodes(t->rightChild)
}
}
```

The value returned by CountNodes when a pointer to the root of a binary tree is passed as its argument is
(A) number of nodes
(B) number of leaf nodes
(C) number of non leaf nodes
(D) number of leaf nodes-number of non leaf nodes

18. How many distinct binary search trees can be created out of 6 distinct keys?
(A) 7 (B) 36 (C) 140 (D) 132

19. Suppose a disk has 400 cylinders, numbered from 0 to 399. At some time the disk arm is at cylinder 58, and there is a queue of disk access requests for cylinder 66, 349, 201, 110, 38, 84, 226, 70, 86. If Shortest-Seek Time First (SSTF) is being used for scheduling the disk access, the request for cylinder 86 is serviced after servicing _____ number of

requests.
(A) 1 (B) 2 (C)3 (D)4

20. If frame size is 4KB then a paging system with page table entry of 2 bytes can address _____ bytes of physical memory.
(A) 2^12 (B) 2^16 (C) 2^18 (D) 2^28

21. Calculate the internal fragmentation if page size is 4KB and process size is 103KB.
(A) 3KB (B) 4KB (C) 1KB (D) 2KB

22. Which of the following scheduling policy is likely to improve interactiveness?
(A) FCFS (B) Round Robin
(C) Shortest Process Next (D) Priority Based Scgeduling

23. Consider the following program

Semaphore X=1, Y=0

```
Void A ( )
{
    While (1)
    {
    P(X);
    Print'1';
    V(Y);
    }
}
```

```
Void B ( )
{
    While (1)
    {
    P(Y);
    P(X);
    Print'0';
    V(X);
    }
}
```

The possible output of the program:
(A) Any number of 0's followed by any number of 1's.
(B) Any number of 1's followed by any number of 0's.
(C) 0 followed by deadlock
(D) 1 followed by deadlock

24. In a system using single processor, a new process arrives at the rate of 12 processes per minute and each such process requires 5 seconds of service time. What is the percentage of CPU utilization?
(A) 41.66 (B) 100.00 (C) 240.00 (D) 60.00

25. A system has two processes and three identical resources. Each process needs a maximum of two resources. This could cause
(A) Deadlock is possible (B) Deadlock is not possible

(C) Starvation may be present (D) Thrashing

26. Which of the following is true with regard to Round Robin scheduling technique?
    (A) Responds poorly to short process with small time quantum.
    (B) Works like SJF for larger time quantum
    (C) Does not use a prior knowledge of burst times of processes.
    (D) Ensure that the ready queue is always of the same size.

27. The size of the physical address space of a 32-bit processor is 2^W words. The capacity of cache memory is 2^N words. The size of each cache block is 2^K words. For a M-way set-associative cache memory, the length (in number of bits) of the tag field is
    (A) $W - N + \log_2 M$ (B) $W - N - \log_2 M$
    (C) $W - N - K - \log_2 M$ (D) $W - N - K + \log_2 M$

28. A 64-bit processor can support a maximum memory of 8 GB, where the memory is word-addressable (one word is of 64 bits). The size of the address bus of the processor is atleast ____ bits.
    (A) 30 (B) 31 (C) 32 (D) None

29. The stage delays in a 4-stage pipeline are 900, 450, 400 and 350 picoseconds. The first stage (with delay 900 picoseconds) is replaced with a functionally equivalent design involving two stages with respective delays 600 and 550 picoseconds. The throughput increase of the pipeline is _____ percent.
    (A) 38 (B) 30 (C) 58 (D) 50

30. Consider a direct mapped cache of size 256 Kilo words with block size 512 words. There are 6 bits in the tag. The number of bits in block (index) and word (offset) fields of physical address are is:
    (A) block (index) field = 6 bits, word (offset) field = 9 bits
    (B) block (index) field = 7 bits, word (offset) field = 8 bits
    (C) block (index) field = 9 bits, word (offset) field = 9 bits
    (D) block (index) field = 8 bits, word (offset) field = 8 bits

31. The memory unit of a computer has 1 Giga words of 64 bits each. The computer has instruction format, with 4 fields: an opcode field; a mode field to specify one of 12 addressing modes; a register address field to specify one of 48 registers; and a memory address field. If an instruction is 64 bits long, how large is the opcode field?
    (A) 34 bits (B) 24 bits (C) 20 bits (D) 14 bits

32. A computer has 64-bit instructions and 28-bit address. Suppose there are 252 two-address instructions. How many 1-address instructions can be formulated?

(A) 2^24 (B) 2^26 (C) 2^28 (D) 2^30

33. Determine the number of clock cycles required to process 200 tasks in a six-segment pipeline.(Assume there were no stalls),each segment takes 1 cycle.
(A) 1200 cycles (B) 206 cycles (C) 207 cycles (D) 205 cycles

34. Match the following Lists:

P.DMA	1.Priority Interrupt
Q. Processor status Word	2.I/O Transfer
R. Daisy chaining	3.CPU
S. Handshaking	4.Asynchronous Data Transfer

(A) P-1, Q-3, R-4, S-2 (B) P-2, Q-3, R-1, S-4
(C) P-2, Q-1, R-3, S-4 (D) P-4, Q-3, R-1, S-2

35. Let E1, E2 and E3 be three entities in an E/R diagram with simple single-valued attributes. R1 and R2 are two relationships between E1 and E2, where R1 is one-to-many, R2 is many-to-many. R3 is another relationship between E2 and E3 which is many-to-many. R1, R2 and R3 do not have any attributes of their own. What is the minimum number of tables required to represent this situation in the relational model?
(A) 3 (B) 4 (C) 5 (D) 6

36. Identify the minimal key for relational scheme R(U, V, W, X, Y, Z) with functional dependencies F = {U → V, V → W, W → X, VX → Z}
(A) UV (B) UW (C) UX (D) UY

37. It is given that: "Every student need to register one course and each course registered by many students", what is the cardinality of the relation say "Register" from the "Student" entity to the "Course" entity in the ER diagram to implement the given requirement.
(A) M:1 relationship (B) M:N relationship
(C) 1:1 relationship (D) option (B) or(C)

38. Consider the relation branch(branch_name, assets, branch_city)
SELECT DISTINCT T.branch_name FROM branch T, branch S WHERE T.assets > L.assets AND S.branch_city = "TVM" .
Finds the names of
(A) All branches that have greater assets than all branches located in TVM.
(B) All branches that have greater assets than some branch located in TVM.
(C) The branch that has the greatest asset in TVM.
(D) Any branch that has greater asset than any branch located in TVM.

39. Consider the following relation instance, where "A" is primary Key.

A1	A2	A3	A4
1	1	1	Null
5	2	5	1
9	5	13	5
13	13	9	15

Which one of the following can be a foreign key that refers to the same relation?
(A) A2 (B) A3 (C) A4 (D) ALL

40. A relation R(ABC) is having the tuples(1,2,1),(1,2,2),(1,3,1) and (2,3,2). Which of the following functional dependencies holds well?
(A) A → BC (B) AC → B (C) AB → C (D) BC → A

41. Consider a relation R with attributes A, B, C, D and E and functional dependencies A → BC, BC → E, E →DA. What is the highest normal form that the relation satisfies?
(A) BCNF (B) 3 NF (C) 2 NF (D) 1 NF

42. For the given schedule S, find out the conflict equivalent schedule.
S : r1(x); r2(Z) ; r3(X); r1(Z); r2(Y); r3(Y);W1(X); W2(Z); W3(Y); W2(Y)
(A) T1→T2→T3 (B) T2->T1->T3
(C) T3→T1→T2 (D) Not conflict serializable

43. Which of the following strings is in the language defined by the grammar:
S → aX
X → aX | bX | b
(A) aaaba (B) babab (C) aaaaa (D) ababb

44. Consider the regular expression (x+y)*xyx(x+y)* where Σ = (x,y). If L is the language represented by this regular expression, then what will be the minimum number of states in a DFA recognizing L ?
(A) 2 (B) 3 (C) 4 (D) 5

45. Which of the following cannot handle the same set of languages?
(A) Deterministic Finite Automata and Non-Deterministic Finite Automata
(B) Deterministic Push Down Automata and Non-Deterministic Push Down Automata
(C) All of these
(D) None of these

46. Consider L be a context-free language and M be a non-context-free language. Which among the following is TRUE?

(I) L will definitely pass the pumping lemma test for CFLs.
(II) M will definitely pass the pumping lemma test for CFLs.
(III) L will not definitely pass the pumping lemma test for CFLs.
(IV) M will not definitely pass the pumping lemma test for CFLs.
(V) L may or maynot pass the pumping lemma test for CFLs.
(VI) M may or maynot pass the pumping lemma test for CFLs.
(A) I, II (B) II, V (C) I, VI (D) IV, V

47. Which of the following problem(s) is/are decidable?
(I) Whether a CFG is empty or not.
(II) Whether a CFG generates all possible strings.
(III) Whether the language generated by a Turing Machine is regular.
(IV) Whether the language generated by DFA and NFA are same.
(A) I and II (B) II and III (C) II and IV (D) I and IV

48. Which of the following is/are TRUE?
(I) Regular languages are closed under complementation.
(II) Recursive languages are closed under complementation.
(III) Context free languages are closed under complementation.
(IV) Context free languages are not closed under complementation.
(A) I, II and III (B) I, II and IV (C) II and III (D) III only

49. Which of the following regular expressions defined over the alphabet $\Sigma = \{0,1\}$ defines the language of all strings of length l where l is a multiple of 3?
(A) (0 + 1 + 00 + 11 + 000 +111)* (B) (000 + 111)*
(C) ((0 + 1)(0 + 1)(0 + 1))* (D) ((000 + 01 + 1)(111 + 10 + 0))*

50. Determine the minimum number of states of a DFA that recognizes the language over the alphabet {a,b} consisting of all the strings that contain at least three a's and at least four b's.
(A) 6 (B) 12 (C) 15 (D) 20

ANSWER KEY:-

QNo	Ans. Key	QNo	Ans. Key	QNo	Ans. Key	QNo	Ans. Key	QNo	Ans. Key
1	(C)	11	(C)	21	(C)	31	(B)	41	(A)

2	(A)	12	(A)	22	(B)	32	(D)	42	(D)
3	(B)	13	(A)	23	(D)	33	(D)	43	(D)
4	(C)	14	(C)	24	(B)	34	(B)	44	(C)
5	(B)	15	(A)	25	(B)	35	(C)	45	(B)
6	(A)	16	(D)	26	(C)	36	(D)	46	(C)
7	(B)	17	(C)	27	(A)	37	(A)	47	(D)
8	(C)	18	(D)	28	(A)	38	(B)	48	(B)
9	(B)	19	(C)	29	(D)	39	(B)	49	(C)
10	(C)	20	(D)	30	(C)	40	(D)	50	(D)