2022

COMPUTER SCIENCE

PAPER-II

Time Allowed — 3 Hours   *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and the same language.*

Question No.-8 *is compulsory and answer* any 6 *questions from the rest.*

1. (a) What is a compiler? Explain the different phases of a compiler in detail. Differentiate token, pattern and lexeme. Define operator precedence grammar. Define triples, indirect triples and quadruples. Define loop unrolling with an example.

   (b) Construct SLR(1) for the following grammar:

   E-->E+T/T

   T-->TF/F

   F-->F*/a/b

   (c) Check whether the grammar is LALR(1) but not SLR(1).

   S-->Aa/bAc/dc/bda

   A-->d   (10+10+10)=30

2. (a) What do you mean by a process? Draw a process state transition diagram and define its states in brief. What is a Deadlock? What are the necessary conditions for a deadlock to occur? How is it detected? What is the critical section problem? What are its various solutions?

   (b) Consider a machine with 64 MB of physical memory and a 32-bit virtual address space. If the page size is 4 KB, what is the approximate size of the page table?

   (c) Suppose the time to service a page fault is on average 10 milliseconds, while a memory access takes 1 microsecond. Then a 99·99% hit ratio results is an average memory access time of 'x' micro sec. Find x.

   (d) Consider a disk system with 100 cylinders. The requests to access the cylinders occur in the following sequence:

   4,   34,   10,   7,   19,   73,   2,   15,   6,   20

   Assuming that the head is currently at cylinder 50, what is the time taken to satisfy all requests if it takes 1 ms to move from one cylinder to the adjacent one and the shortest seek time first policy is used?   (15+5+5+5)=30

3. (a) Define primary key, foreign key, candidate key and super key. What is normalization? And what explains different normalization forms? What are the advantages of RDBMS? What is a different type of index? Explain three levels of data abstraction.

    (b) What is a relationship and what are their types? What is the difference between DELETE, TRUNCATE and DROP commands? What is Self-Join and Cross-Join? What is a View? What is a Cursor? What is a Stored Procedure? What are the advantages and disadvantages of the Stored Procedure?

    (c) What is a Transaction? What are ACID properties? Explain the following:

    (i) Unrepeatable read problem, (ii) Lost update problem. (10+15+5)=30

4. (a) What is meant by Structured Programming? Briefly describe the main features of OOPs. What is Compile time Polymorphism and how is it different from Runtime Polymorphism?

    (b) How much memory does a class occupy? Is it always necessary to create objects from class? What is a constructor? How is an abstract class different from an interface? What is meant by Garbage Collection in the OOPs world?

    (c) What is Coupling in OOP and why is it important? What is a *finally* block? What is the use of 'finalize'? What is Diamond problem in Inheritance? What is the significance of a virtual destructor? (10+10+10)=30

5. (a) What are the different addressing modes typically supported by microprocessors and how do they affect the programming process?

    (b) What are the various interrupts in 8086? Explain each type with a suitable example. What is the significance of RISC and CIS architectures in microprocessors?

    (c) What is stack pointer in a microprocessor? What is the position of the Stack Pointer after the PUSH and POP instruction? A microprocessor has a clock speed of 2·5 GHz. Calculate the time taken by the microprocessor to execute a program consisting of 5,00,000 instructions. Assume each instruction takes one clock cycle to execute. (8+10+12)=30

6. (a) Explain the purpose of DNS and how it resolves domain names to IP addresses. In a block of addresses, the IP address of one host is 182.44.82.16/26. What is the first address (network address) and the last address (limited broadcast address) in this block?

    (b) Describe Distance Vector Routing Protocol briefly. Use Dijkstra's algorithm to find the shortest path tree and the forwarding table for node A in the Figure.
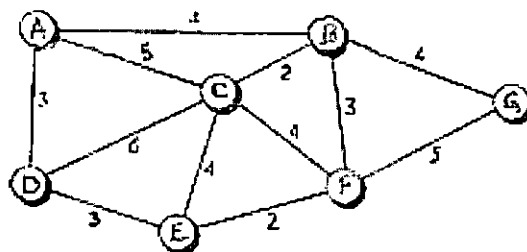
    (c) What is CSMA/CD and how does it work to avoid collisions in an Ethernet network? (10+14+6)=30

7. (a) Explain the role of caches in a computer system and how they improve memory access efficiency. Compare the different cache mapping techniques. A computer has a 256 KByte, 4-way set associative, write-back data cache with a block size of 32 Bytes. The processor sends 32-bit addresses to the cache controller. Each cache tag directory entry contains, in addition to the address tag, 2 valid bits, 1 modified bit and 1 replacement bit. What is the number of bits in the tag field of an address?

   (b) Explain RAM, ROM, EPROM and EEPROM.

   (c) Write a short note on USB. A RAM chip has a capacity of 1024 words of 8 bits each ($1K \times 8$). What is the number of 2×4 decoders needed with enable line needed to construct a $16K \times 16$ RAM from $1K \times 8$ RAM?   (14+8+8)=30

8. Write short notes on (*any two*):   10×2=20

   (a) Operator overloading and overriding

   (b) TCP vs. UDP

   (c) Instruction Set Architecture in Microprocessors

   (d) Process Control Block in OS

   (e) Assembler, Loader, Linker

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