L-3/T-2/CSE **Date : 02/10/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2021-2022

Sub : **CSE 313** (Operating System)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Consider the following workload: **(18)**

Process	Priority (Lowest Number has Highest Priority)	Duration (sec)	Arrival Time (sec)
P1	1	60	0
P2	1	25	30
P3	2	80	50
P4	3	20	70

Draw the Gantt chart and calculate the average turnaround time for each of the following scheduling algorithms:

- Shortest Remaining Time Next
- Priority Scheduling. Within the same priority class, schedule according to Round Robin with quantum 20 sec. Each priority class maintains separate FIFO queue.

(b) Four jobs have arrived at the same time in a batch system. Their expected run times are 9, 3, 5, and X. In what order should they be run to obtain optimal average turnaround time? (Hint: The jobs are non-preemptive) **(10)**

(c) Differentiate between an unsafe state and a deadlock state. **(7)**

2. (a) Peterson's solution for achieving mutual exclusion for using critical regions is presented in Figure for Question 2(a): **(12)**

(i) Discuss priority inversion problem with a high-priority process, H, and a low-priority process, L.

(ii) Does the same problem occur if round-robin scheduling is used instead of priority scheduling? Justify.

```
#define FALSE  0
#define TRUE   1
#define N      2                    /* number of processes */

int turn;                           /* whose turn is it? */
int interested[N];                  /* all values initially 0 (FALSE) */

void enter_region(int process);     /* process is 0 or 1 */
{
    int other;                      /* number of the other process */

    other = 1 - process;            /* the opposite of process */
    interested[process] = TRUE;     /* show that you are interested */
    turn = process;                 /* set flag */
    while (turn == process && interested[other] == TRUE) /* null statement */ ;
}

void leave_region(int process)      /* process: who is leaving */
{
    interested[process] = FALSE;    /* indicate departure from critical region */
}
```

Figure for Question 2(a): Peterson's solution for 2 processes

Contd P/2

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Contd. Q. No. 2(a)(ii)

(b) In the dining philosophers problem, let the following protocol be used: An even-numbered philosopher always picks up his left fork before picking up his right fork; an odd-numbered philosopher always picks up his right fork before picking up his left fork. Investigate whether this modified protocol prevents deadlock. **(10)**

(c) State the four requirements that must be present in a solution to support mutual exclusion among processes sharing resources. **(6)**

(d) Differentiate between microkernel and monolithic kernel architectures. **(7)**

3. (a) Consider a system with 4 processes: P1 through P4 and 3 resources types: A (9 units), B (3 units), C (6 Units). Current allocation of resources and maximum requirement of a process for each resource are given in Figure for Question 3(a). Determine whether the current state of this system is safe or not. **(15)**

	A	B	C
P1	1	0	0
P2	6	1	2
P3	2	1	1
P4	0	0	2

Current Allocation Matrix

	A	B	C
P1	3	2	2
P2	6	1	3
P3	3	1	4
P4	4	2	2

Maximum Requirement Matrix

Figure for Question 3(a)

(b) Suppose that there is a resource deadlock in a system. Give an example scenario to show that the set of processes deadlocked can include some processes that are not in the circular chain in the corresponding resource allocation graph. **(10)**

(c) Explain how to attack the following conditions to structurally prevent deadlock

(i) Hold and wait condition (ii) Circular wait condition. **(10)**

4. (a) Write down the steps in making a system call. **(7)**

(b) Differentiate between process context switching and thread context switching Identify which of the following are "per process item" and which are "per thread item"?

Program Counter, Stack, Address Space, Global Variables, Registers, Directories, Child Process, Local Variables **(13)**

Contd P/3

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Contd ... Q. No. 4

(c) Illustrate the position of scheduler, process table and thread table in user-level thread implementation and kernel-level thread implementation with diagrams. With the help of your diagrams, justify that kernel-level thread implementation is better than user-level thread implementation with respect to blocking. **(15)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) The following sequence of Virtual Page Numbers (VPN) has been referenced in your system. **(7+7+14=28)**

1, 2, 3, 4, 5, 2, 3, 1,2, 3, 4, 5, 1

Now, answer the following questions.

(i) Explain Belady's anomaly. Show that this anomaly occurs for cache size 3 and 4 in the above case.

(ii) Calculate hit and miss rate for the optimal page replacement algorithm.

(iii) If the TLB can keep at most 4 entries and employs LRU for TLB replacement and Page replacement uses CLOCK algorithm with cache size 4. Calculate the memory access time for the above memory access sequence. TLB access takes 5ns, memory access takes 60ns, and disk access takes 4ms.

Hint: The first 5 memory references in CLOCK algorithm gives the following cache states:

Access	**Cache State (After)**			
1	1(1)*	?(0)	?(0)	?(0)
2	1(1)	2(1)*	?(0)	?(0)
3	1(1)	2(1)	3(1)*	?(0)
4	1(1)	2(1)	3(1)	4(1)*
5	5(1)*	2(0)	3(0)	4(0)

Here,

"?" refers to unused cache,

the number in bracket refers to *use bit* and

"*" is the location of the *clock hand.*

(b) Both **ffs** and **lfs** try to optimize on **vsfs** in some ways. State and elaborate the difference in their optimization criteria. **(7)**

6. (a) The following function writes a sequence of n numbers to a given file descriptor **fd**. **(5×3+13=28)**

```
void write_fd(int fd, int n){
    char buf[10];
    for (int i = 0; i < n; i++) {
        itoa(i, buf, 10);
        write(fd, buf, strlen(buf));
    }
}
```

Contd P/4

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Contd ... Q. No. 6(a)(i)

(i) For each of the following possible values of n, design a device driver where `write_fd` is called frequently with n. Explain your design decisions using illustrative pseudocodes.

(*a*) always 10

(*b*) always 1000000

(*c*) mixture of 10 and 1000000

(ii) What is the difference of output from the following two code blocks? Analyze with necessary figures and arguments showing what happens in the kernel.

Code block 1	**Code block 2**

`int fd1 = open("file.txt");`
`int fd2 = open("file.txt");`
`write_fd(fd1);`
`write_fd(fd2);`
	`int fd1 = open("file.txt");`
	`int fd2 = dup(fd1);`
	`write_fd(fd1);`
	`write_fd(fd2);`

(b) Memory allocation API consists mainly of the following two functions: **(7)**

```
void *malloc(size_t size);
void free(void *ptr);
```

With illustrative examples, show how the allocation API works. Mention the necessary bookkeeping structure(s) it requires.

7. (a) You have executed the following commands in the `root` of an **ffs** file system with 4 byte block number and 4 KB block size. The disk has an average disk-arm positioning time of 10 ms and max transfer rate of 100 MB/s. **(4×3+16=28)**

```
mkdir p
mv /q/foo.txt /p/bar.txt
```

Here, `foo.txt` is of size 1 GB.

Now answer the following questions.

(i) Given, bitmaps are in block 4, inodes are in block 5 and data for the root directory is in block 6. Also, the journal is kept in blocks 26 to 31. Determine the journaling timeline if the system uses:

(*a*) Data Journaling

(*b*) Metadata Journaling

(*c*) Metadata Journaling with Checksum Optimization

(ii) How will this file be laid out in **ffs**? How does **ffs** get the relevant information needed to decide that? Calculate how long it will take to sequentially read the whole file. *You can assume, there is enough space to save the file in ffs layout and only moving from one block group to another requires a disk-arm positioning.*

Contd P/5

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Contd ... Q. No. 7

(b) What is dynamic relocation and segmentation in the context of memory management? Why would you choose one over another? Using pseudocodes, elaborate the address translation process used by these two systems. **(7)**

8. (a) You have set up a RAID system with 10 disks and 4KB block size. You are using **lfs** as the default file system where segment size is 64 MB. The disk config is as follows:**(3+9+6+5×2=28)**

Capacity	1TB
Rotation speed	10,000 RPM
Max seek time	12 ms
Max transfer rate	100 MB/s
Platters	2
Sector size	1 KB
Cache	16 MB

The following command has been executed in your file system.

```
rm lfsfile.txt
```

Now, answer the following questions.

(i) How is the inode number problem solved in **lfs**?

(ii) Write down the steps that will be executed while running the command. How will **lfs** invalidate any subsequent access to `lfsfile.txt`?

(iii) Elaborate the recovery action that **lfs** will take, if a crash occurs during the operation.

(iv) Calculate the throughput for read and writes in your file system (lfs) for the following RAID setups.

(*a*) RAID-0

(*b*) RAID-1

Hint:

- lfs reads 1 block at a time and writes 1 segment at a time.
- You can read/write one sector at a time on a disk.

(b) What is *thrashing* in the context of memory management? Why is it a problem? List some solutions for it. **(7)**

L-3/T-2/CSE **Date : 18/10/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2021-2022

Sub : **CSE 317** (Artificial Intelligence)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) "Surely computers cannot be intelligent – they can do only what their programmers tell them." Is the latter statement true, and does it imply the former? Describe it in detail using the concepts of evolutionary algorithm. **(20)**

   (b) For each of the following activities, give a PEAS description of the task environment **(15)**

   (i) Bidding on an item at an auction

   (ii) Medical diagnosis system

   (iii) Interactive English tutor

2. (a) Explain why problem formulation must follow goal formulation. **(10)**

   (b) The traveling salesman problem (TSP) is described as follows: **(25)**

   "Given a list of cities and the distances between each pair of cities, what is the shortest possible route that visits each city exactly one time and returns to the origin city?" Describe in detail how we can solve TSP by applying genetic algorithm with appropriate representation scheme and operators.

3. (a) Describe simulated annealing algorithm with the help of its pseudo code. Explain how this algorithm can avoid local optima problem of a greedy search algorithm. **(20)**

   (b) Show that A* search algorithm is optimal if the heuristic used in it is admissible and/or consistent. **(15)**

4. (a) Describe the main challenges of adversarial search as contrasted with single-agent search. Explain why it is a good heuristic to choose the variable that is the most constrained but the value that is the least constraining in a CSP search. **(15)**

   (b) Show that the worst case time complexity the arc-consistency algorithm AC-3 is in cubic order. **(20)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) We have a bag of three biased coins *a, b,* and *c* with probabilities of coming up heads of 20%, 60%, and 80%, respectively. One coin is drawn randomly from the bag (with equal chance of drawing each of the three coins), and then the coin is flipped three times to generate the outcomes X_1, X_2, and X_3. **(6+12=18)**

Contd P/2

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Contd ... Q. No. 5(a)

(i) Construct a Bayesian network corresponding to this setup and state the necessary conditional probability tables (CPTs).

(ii) Compute which coin was most likely to have been drawn from the bag if the observed flips come out as X_1 = head, X_2 = head, and X_3 = tail.

(b) Let H_x be a random variable denoting the handedness of an individual x, with possible values l or r. A common hypothesis is that left- or right-handedness is inherited by a simple mechanism; that is, perhaps there is a gene G_x, also with values l or r, and perhaps actual handedness turns out mostly the same (with some probability s) as the gene an individual possesses. Furthermore, perhaps the gene itself is equally likely to be inherited from either of an individual's parents, with a small nonzero probability m of a random mutation flipping the handedness. **(5+6+6=17)**

(i) Show which of the three networks shown in Figure 5 satisfy the following equation:

$$\boldsymbol{P}(G_{father}, G_{mother}, G_{child}) = \boldsymbol{P}(G_{father})\boldsymbol{P}(G_{mother})\boldsymbol{P}(G_{child})$$

(ii) Compute the conditional probability table (CPT) for the G_{child} node in network (a) (of Figure 5), in terms of s and m.

(iii) Suppose the $P(G_{father} = l) = P(G_{mother} = l) = q$. in the given network (a) (of Figure 5), compute an expression for $P(G_{child} = l)$ in terms of m and q only, by conditioning on its parent nodes.

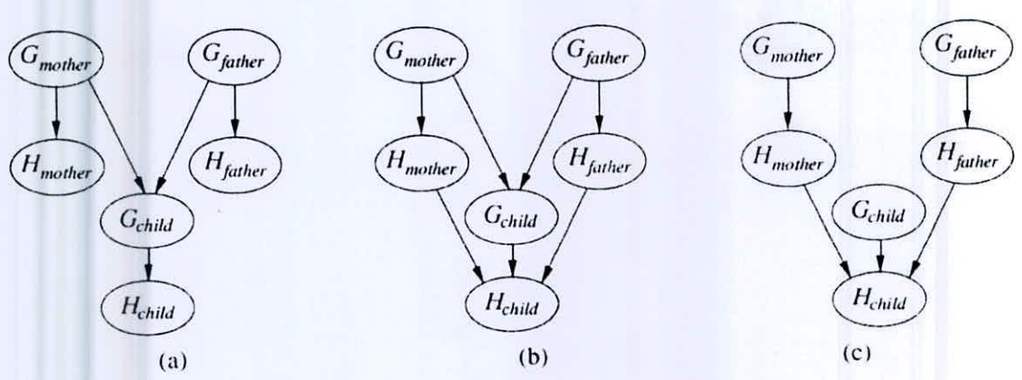

Figure 5

6. (a) Discuss why overfitting is bad in machine learning. Briefly explain How you would prevent overfitting in decision tree learning. **(7)**

(b) Why is a complex hypotheses space not always preferred in machine learning? Justify with respect to Occam's razor principle. **(5)**

Contd P/3

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Contd ... Q. No. 6

(c) A professor wants to know if students are getting enough sleep. Each day, the professor observes whether the students in the class have red eyes. The professor has the following domain theory: The prior probability of getting enough sleep, with no observations, is 0.7. The probability of getting enough sleep on night t is 0.8 given that the student got enough sleep the previous night, and 0.3 if not. The probability of having red eyes is 0.2 if the student got enough sleep, and 0.7 if not. Answer the following questions. **(8+15=23)**

(i) Build a hidden Markov model (HMM) to formulate the above problem that the professor could use to filter or predict from a sequence of observations. Show the state transition probabilities (transition model) and observation probabilities (sensor model).

(ii) Let the state variable be X_t = $EnoughSleep_t$. Given the evidence values $\boldsymbol{e}_1$ = not red eyes, $\boldsymbol{e}_2$ = red eyes, and $\boldsymbol{e}_3$ = red eyes for the first three days, compute the filtered estimates $P(X_t|\boldsymbol{e}_{1:t})$ for each of t = 1,2,3 using filtering algorithm. Using the filtered estimate, compute smoothed probability estimates $P(X_t|\boldsymbol{e}_{1:3})$ for each of t = 1,2,3 using forward-backward algorithm.

7. (a) Sometimes Markov decision processes (MDPs) are formulated with a reward function $R(s, a)$ that depends on the action a taken on state s or with a reward function $R(s, a, s')$ that also depends on the outcome state s'. Express the Bellman equations for these formulations. **(7)**

(b) Figure 7 shows an instance of a grid world Markov decision process (MDP). Shaded cells represent walls. In all states, the agent has available actions UP (↑), Down (↓), Left (←), and Right (→). Performing an action that would transition to an invalid state (outside the grid or into a wall) results in the agent remaining in its original state. In states with an arrow coming out, the agent has an additional action *EXIT*. In the event that the *EXIT* action is taken, the agent receives the labeled reward and ends the game in the terminal state *T*. Unless otherwise stated, all other states generate no reward, and all transitions are deterministic (not stochastic). Let the discount factor be $\gamma = ½$. **(16)**

Suppose that we are performing value iteration algorithm on the given grid world MDP. Assume that value iteration begins with all states initialized to zero, i. e., $U(s) = 0 \forall s$. Compute the optimal utility values $U(s)$ for states (i.e., cells in the grid) A and B. Show the utility values $U(s)$ for all states after every iteration of the value iteration algorithm. Show the optimal policy.

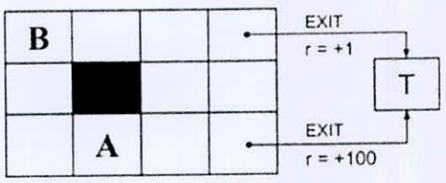

Figure 7

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Contd ... Q. No. 7

(c) Consider the following random process. A magician has three coins, each of which has a distinct type. One is a fair coin (50/50 odds of heads vs tails). The other two are tricky coins: one has heads on both sides and the other has tails on both sides. At every time step, the magician picks a coin randomly with the exception that a fair coin is not picked at two successive time steps (in which case remaining coins are equally likely to be chosen). After picking a coin (without actually showing you which coin was picked), the magician flips (toss) it, and shows you the result, However, unfortunately, the magician only shows you the coin very briefly, and 10% of the time you make a mistake when you observe the true side of the coin (e.g., you see heads when it was actually tails). Construct a hidden Markov model (HMM) to formulate the problem. Show the state transition probabilities (transition model) and observation probabilities (sensor model). **(12)**

8. (a) Consider the following data set comprised of three binary input attributes (A_1,A_2, and A_3) and one binary output y: **(16)**

Example	A_1	A_2	A_3	Output y
x_1	1	0	0	0
x_2	1	0	1	0
x_3	0	1	0	0
x_4	1	1	1	1
x_5	1	1	0	1

Construct a decision tree for these data. Show the entropy and information-gain computations made to determine the attribute to split at each node.

(b) Discuss how would you handle the following cases in decision tree learning? (i) No examples left at a child node, (ii) No attributes are left, but both positive and negative examples remain at a child node, and (iii) Missing values in an attribute. **(6)**

(c) Consider the Bayes net shown in Figure 8 with Boolean variables B = *BrokeElectionLaw*, I = *Indicted*, M = *PoliticallyMotivatedProsecutor*, G = *FoundGuilty*, J = *Jailed*. Using variable elimination algorithm, compute the probability that someone goes to jail given that they broke the law, have been indicted, and face a politically motivated prosecutor. **(13)**

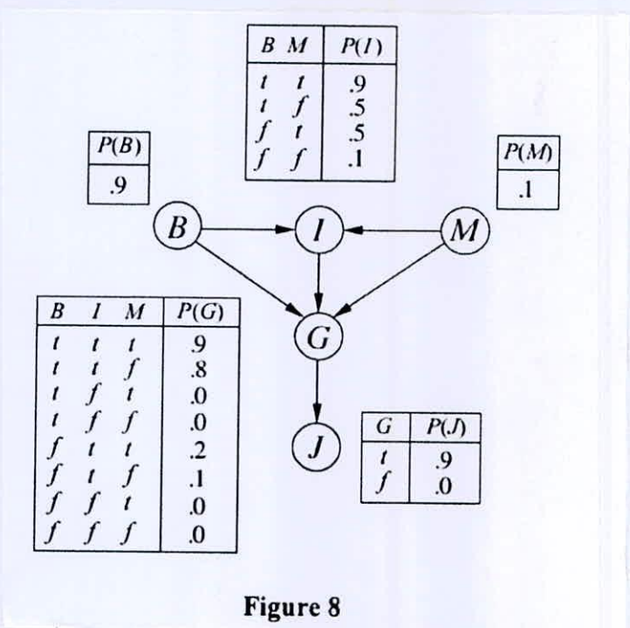

Figure 8

L-3/T-2/CSE **Date : 12/10/2023**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2021-2022

Sub : **CSE 321** (Computer Networks)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Design a network with necessary agents to support mobile hosts. Describe how we can apply the network over different types of networks covering LANs, WANs, etc. **(23)**

   (b) Classful IP addressing needs to be done for a company with different distant brances each having a number of computers. Analyze whether the notion of subnetting will be required here. Explain with necessary example(s) **(12)**

2. (a) In datagram subnets, DVR is applied with the notions of Forced Update and Split Horizon Rule. You need to design an example network, where such applications cannot remove the inefficiency of count-to-infinity problem. Analyze your example with necessary diagram(s). **(23)**

   (b) Describe the types of networks where we need BGP to operate. Discuss peering options over such networks with necessary diagram(s). **(12)**

3. (a) Construct a network where we can experience congestion collapse. Analyze how AIMD can lessen the extent of such congestion, with necessary figure(s). **(23)**

   (b) Explain how a remote application can be called from a networked machine at distance. Discuss the process with necessary figure(s). **(12)**

4. (a) In the networking word, there exist different types of computing machines. Some of the machines are fast, whereas some other machines are slow. Thus, in the case of networked data transmission, we can have slow receivers as well as slow senders.

   Now, from the perspective of the Transport layer, you need to distinguish between solutions for the slow receivers as well as slow senders. Explain your answer with necessary figure(s). **(23)**

   (b) Develop a methodology for RTO estimation in a network, where packet drops are common. Explain your methodology with necessary figure(s). **(12)**

Contd P/2

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SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Suppose four active nodes -- nodes A, B, C, and D-- are competing for access to a channel using slotted ALOHA. Assume each node has an infinite number of packets to send. Each node attempts to transmit in each slot with probability p. The first slot is numbered slot 1, the second slot is numbered slot 2, and so on. **(8+7=15)**

(i) Find the probability that the first success occurs in slot 4.

(ii) Calculate the efficiency of this four-node system.

(b) Draw the Ethernet frame format. You need to write the lengths of each field. (*Hint 1: There are seven fields. Hint 2: The payload field is of variable length ranging from 46-1500 bytes*). Illustrate the reason(s) behind keeping the last two bits of Preamble field different than the rest. **(10)**

(c) Suppose, you (Hostname: *ckruet.edu*) are querying the IP-address for *cse.buet.edu.* However, BUET maintains an authoritative DNS server *dns.buet.edu* for the hostnames ending with *buet.edu.* List all the DNS record(s) stored in 1).edu TLD DNS server and 2) *dns.buet.edu* DNS server that facilitate(s) your query. You need to mention the record(s) in this format (Name, Value, Type). Feel free to use any IP address(es) of your choice, if need arises. **(10)**

6. (a) Consider three LANs interconnected by two routers, as shown in Figure below. Answer the following questions. **(5+5+5+5=20)**

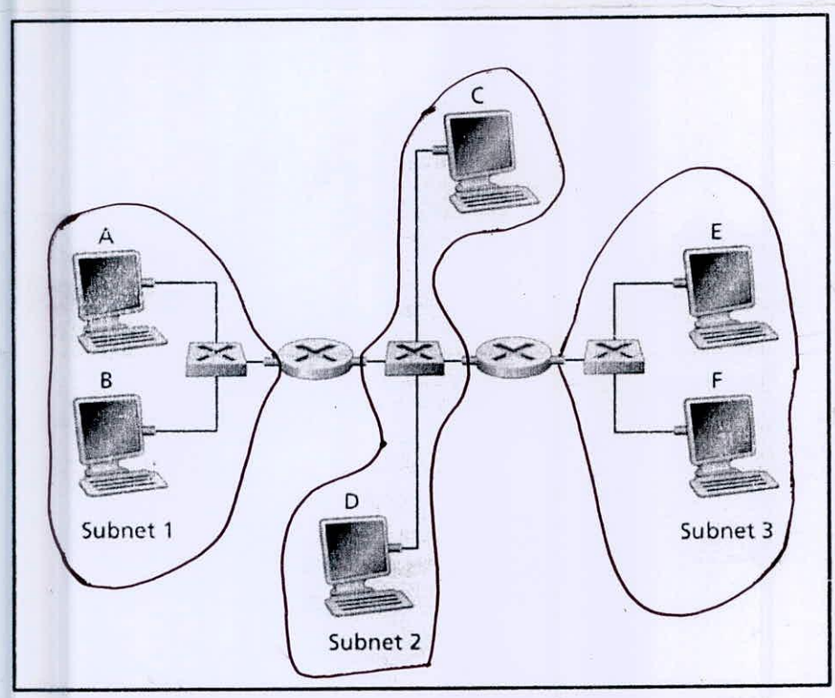

Figure for Question 6(a)

(i) Assign IP addresses to all of the interfaces. For Subnet 1 use addresses of the form ***172.16.1.XXX***; for Subnet 2 use addresses of the form ***172.16.2.XXX***; and for Subnet 3 use addresses of the form ***172.16.3.XXX***

Contd P/3

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Contd...Q.No. 6(a)

(ii) Assign MAC addresses to all of the adapters.

(iii) Consider sending an IP datagram from Host E to Host B. Suppose all of the ARP tables are up to date. Enumerate all the steps.

(iv) Repeat (iii), now assuming that the ARP table in the sending host is empty (and the other tables are up to date)

(b) We need to send data at a 5-Mbps rate. There are two encoding options: **(8)**

(*i*) *A combination of 4B/5B and NRZ-I, or*

(*ii*) *Manchester coding*

Argue which option should be followed to minimize the required bandwidth.

(c) Why switches are considered **self-learning**? Briefly explain. **(7)**

7. (a) Very briefly answer the following questions: **(10)**

What is the main improvement CSMA brought over ALOHA variants (Plain ALOHA, Slotted ALOHA)? Could CSMA solve the problem entirely? What is the need for CSMA/CD?

(b) Assume the generator G (= 1001) is used in CRC. Now, answer the following questions. **(5+5=10)**

(i) Illustrate how this generator can detect any single bit error in data D.

(ii) Determine whether the above G detects any odd number of bit errors. State the reason(s) clearly.

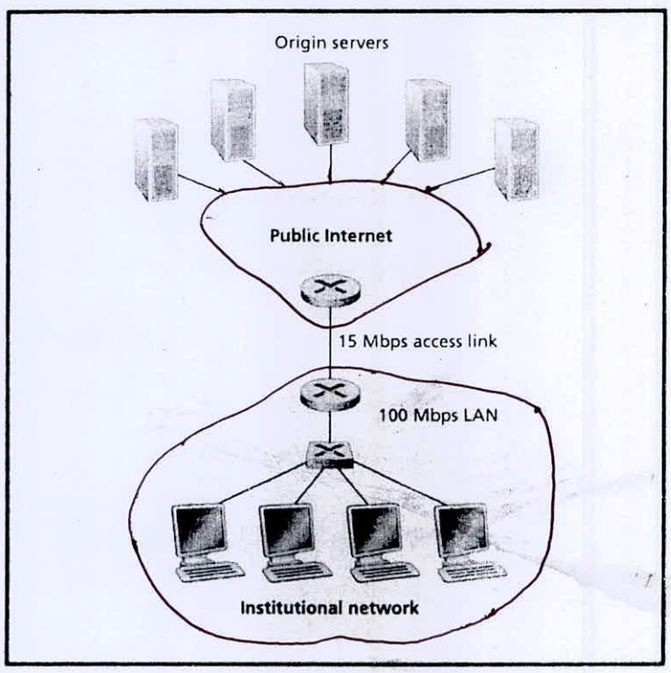

Figure for Question 7(c)

(c) Consider the figure above, for which there is an institutional network connected to the Internet. Suppose that the average object size is 850,000 bits and that the average request rate from the institution's browsers to the origin servers is 20 requests per second. Also suppose that the amount of time it takes from when the router on the Internet side of the access link forwards an HTTP request until it receives the response is three seconds on average.

Contd P/4

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Contd...Q.No. 7(c)

Model the total average response time as the sum of the average access delay (that is, the delay from Internet router to institution router) and the average Internet delay. For the average access delay, use $\frac{x}{1-xy}$ where x is the average time required to send an object over the access link and y is the arrival rate of objects to the access link. **(8+7=15)**

(i) Determine the total average response time.

(ii) Now suppose a cache is installed in the institutional LAN. Suppose the miss rate is 0.4. Find the total average response time in this case.

8. (a) Suppose you walk into a room, connect to Ethernet, and want to download a Web page. Identify all the protocol steps that take place, starting from powering on your PC to getting the Web page. Assume there is nothing in our DNS or browser caches when you power on your PC. Explicitly indicate in your steps how you obtain the IP and MAC addresses of a gateway router. **(20)**

(b) Consider sending over HTTP/2 a Web page that consists of one video clip, and five images. Suppose that the video clip is transported as 2000 frames, and each image has three frames. **(5+5=10)**

(i) If all the video frames are sent first ***without interleaving***, calculate the number of frames to be transported until all five images are sent.

(ii) If frames are ***interleaved***, calculate the number of frame(s) needed until all five images are sent.

(c) How self-synchronization property helps the data transmission? Explain briefly. **(5)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2021-2022

Sub : **CSE 325** (Information System Design)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) A company is very much reputed in completing their IT projects in time with desired quality which meets functional and non-functional requirements correctly. The have pool of experienced and qualified programmers who are key to this success. If a project does not get that much progress then those qualified programmers are assigned to solve the problem. The programmers are low paid and generally without experience. The software development company were awarded so many S/W development projects in the past. Recently the company did not win a bid where there was a requirement to have a process to deliver quality software. Assess the company in terms of CMMI level. What are the necessary steps to be done to upgrade the company in the next CMMI level? **(10)**

   (b) Compare different versioning models with examples focusing the following: **(10)**

   (i) Locking
   (ii) Conflict resolution
   (iii) Practical use
   (iv) Merging

   (c) How are Push and Pull operations performed in Distributed Version Control? Consider a scenario in a Distributed Version Control system when three users work locally on a file A at the same time. Show the steps of committing their changes. **(15)**

2. (a) Explain the following rules with suitable examples in designing user interfaces. **(12)**

   (i) Offer informative feedback
   (ii) Design dialogue to yield closure
   (iii) Permit easy reversal of action
   (iv) Reduce short term memory load to the user

   (b) What are the basic principles to make the effort estimation of software projects accurate? **(5)**

   (c) If is difficult to estimate the effort when you start a project. In the subsequent steps of S/W development, the scope and complexity of the project becomes clear and we get chance to do better estimation. Explain how COCOMO II model addresses this during estimation. **(6)**

   (d) Titas Gas Transmission and Distribution Company is trying to have a new billing software. There are several alternatives to implement that. The first one is to acquire a ready made billing software from a software development company with the cost of Tk 1 crore.

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Contd ... Q. No. 2(d)

It might require 20 additional changes/reports to customize the software for the use of the company. The cost of each easy, moderately difficult or extremely difficult change/report is Tk 50K, Tk 75K or Tk 100K, respectively. The probability of the changes/reports are easy and moderately difficult are 0.30 or 0.25, respectively. The second option is to reuse an open source billing software by an in-house team of 10 members. There are actually two steps in using such a software. In the first step, the in-house team must understand the open source code and install it for proper understanding. The average salary of the in-house team members is Tk 75K. It will take 6 months to understand the open source system if it is straight forward with the probability of 0.60. Otherwise it will take 9 months if the open source system is complex. In the next step it may require another 10, 20 or 40 additional screens or reports with the probability of 0.25, 0.50 and 0.25, respectively to fulfill the need of the client. The cost of developing one screen/report is 1 man-month by the recruited employees. The third option is to purchase a generalized billing software and customize it for the use of the client. The cost of the generalized billing software is Tk 50 lacs. But the cost of consultants for necessary configuration is Tk 20 lacs. It might require 30 additional changes/reports to customize the software for the use of the company. The cost of each easy or extremely difficult change/report is Tk 100K or Tk 150K. The probability of the changes/reports are easy is 0.30. Which one would be best strategy for developing the billing software? **(12)**

3. (a) Consider an Automated Teller Machine (ATM) of a Bank. You can have the following banking operations using the ATM card: **(8)**

   (i) Withdrawing money
   (ii) Checking Balance from Core Banking System
   (iii) Changing PIN (Personal Identification Number)
   (iv) Depositing money
   (v) Transferring money to another account
   (vi) Recharging your mobile phone

   Draw a use case diagram showing the actors and use cases.

   (b) Write down the use case for withdrawing money and changing PIN. **(8)**

   (c) Draw collaboration diagram for the use case for withdrawing money using ATM Card. Show the steps of deriving class diagram from the collaboration diagram. **(19)**

4. (a) As project manager how do you form your team for the following software projects: **(9)**

   (i) A project for solving complex scientific problem
   (ii) Development of ERP with many modules
   (iii) A software which must be ready at the beginning of the next year.

   (b) What is Software Failure? What are the components failure cost? How can you prevent the failure in software development? **(8)**

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Contd ... Q. No. 4

(c) Explain the term measure and metric with examples in the discipline of software measurement. Explain two measurement principles with necessary examples. **(7)**

(d) Your goal is to evaluate the performance of the programmers. Define the metrics to achieve this goal using goal oriented software measurement. **(11)**

SECTION – B

There are **FOUR** questions in this section. **Answer Question 5 (compulsory) and any other two (2) questions.**

5. (a) In Bangladesh, every school teacher is appointed based on MPO regulation. According to this regulation, each candidate has to meet certain qualification criteria defined for each post (of a particular subject) of a certain salary grade. The qualifications are stated in terms of age, subject of graduation, and result at different levels. Example of such requirement is shown below. This is for a particular type of institution, e.g., school, college, etc. **(13)**

Table for Q 5(a)

১৩	সহকারী শিক্ষক (সামাজিক বিজ্ঞান)	১)স্বীকৃত বিশ্ববিদ্যালয় হতে সংশ্লিষ্ট বিষয়সহ স্নাতক ডিগ্রি /সমমান ও বিএড ডিগ্রি / সমমান। অথবা ২) স্বীকৃত বিশ্ববিদ্যালয় হতে সংশ্লিষ্ট বিষয়সহ স্নাতক ডিগ্রি /সমমান। সমগ্র শিক্ষাজীবনে ০১ (এক) টির বেশি ৩য় বিভাগ/শ্রেণি/সমমান গ্রহণযোগ্য হবে না।	অনূর্ধ্ব ৩৫ বছর (সমপদের ইনডেক্সধারীদের জন্য বয়সসীমা শিথিলযোগ্য)	(১) গ্রেড-১০ (১৬০০০-৩৮৬৪০/-) (২) গ্রেড-১১ (১২৫০০-৩০২৩০/-)
১৪	সহকারী শিক্ষক (পণিত)	১) স্বীকৃত বিশ্ববিদ্যালয় হতে পণিতসহ বিজ্ঞান বিভাগে স্নাতক ডিগ্রি / সমমান ও বিএড ডিগ্রি / সমমান। অথবা ২) স্বীকৃত বিশ্ববিদ্যালয় হতে পণিতসহ বিজ্ঞান বিভাগে স্নাতক ডিগ্রি /সমমান। সমগ্র শিক্ষাজীবনে ০১ (এক) টির বেশি ৩য় বিভাগ/শ্রেণি/সমমান গ্রহণযোগ্য হবে না।	অনূর্ধ্ব ৩৫ বছর (সমপদের ইনডেক্সধারীদের জন্য বয়সসীমা শিথিলযোগ্য)	(১) গ্রেড-১০ ১৬০০০-৩৮৬৪০/- (২) গ্রেড-১১ ১২৫০০-৩০২৩০/-

When a candidate applies for a post, his/her qualifications are matched against such requirements, If the qualification criteria satisfy, he/she is eligible to sit for a recruitment test. Design a BPMN diagram to design the scenario discussed above.

(b) Draw an ERD to design database for storing the qualification criteria depicted in Q 5(a) for each type of institution. **(12)**

(c) Draw a Mock dashboard (considering scenario of Q 5(a)) to show the list of candidates who are found not eligible to appear at the recruitment test for not satisfying one or more criteria. You have to clearly demonstrate the criteria not matched so that the viewer can easily understand the reason for disqualify. **(10)**

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6. (a) To purchase books, the sites like Amazon.com or Rokomari.com are widely used. Draw a software architecture to implement such a system following Microservice architecture. **(15)**

(b) The web portal of stock market experiences frequent write operation and also updated data is expected by viewers. Which cache write strategy is most appropriate for such application and why? **(11)**

(c) Give three example scenarios where Data-Centered software architecture is appropriate. **(9)**

7. (a) There is a common printing service for printing secured official documents in an office which is used by different departments. Sometimes, multiple departments send lots of printing request simultaneously and want to get assured of their request is being addressed. What technology should be recommended by the designer of such a system? Draw a block diagram for the required design. **(9)**

(b) What do you understand by Second Order SQLinjection? Give an example. What is the primary (most recommended) way of preventing SQLinjection? **(12)**

(c) You have developed an application for different clients. You need to deploy that quickly in different types of servers of the clients. What DevOps technology will serve your purpose? **(8)**

(d) In your hardware infrastructure, servers of different capacity are being used. Which load balancing algorithm is best suited for your case? **(6)**

8. (a) A university department organizes seminars on a number of research topics. These seminars take place in September each year. There is a computer program to help with the administration of these seminars. In the program there is an object representing a seminar, and this Seminar Class has a number of possible states. **(13)**

A seminar is first proposed by a professor. Once dates, times and rooms for the seminar have been arranged, it is considered as scheduled. On the second Monday in August the seminar is advertised and it becomes open for enrolment to the students. When all places are taken, the seminar is full and cannot allow any more enrolment. If a student drops out (cancels his/her application) the seminar reverts to the Open For Enrolment position. Two days before the start of the seminar, enrolment will be closed (no more applicants will be considered).

Design a State diagram to show different states of a Seminar in the context discussed above.

(b) What is the difference between Reflected and DOM-based XSS attack? Draw the flow of a Reflected XSS attack? **(12)**

(c) Discuss Interactor, Indirect and Domain viewpoints for the requirement analysis of a Stock Price Prediction system. Mention three non-functional requirements for such a system. **(10)**
