



Software Engineering  
4<sup>th</sup> Year

CS 4E1-CS434

Time allowed: 3 Hours

الدرجة من 75

هندسة البرمجيات  
السنة الدراسية الرابعة  
الزمن: 3 ساعات

يجب كتابة الإجابة في كراس الإجابة حسب ترتيب الأسئلة  
جاوب بإختصار شديد دون الإخلال بدقة و صحة الإجابة

**ANSWER ALL QUESTIONS**

**Group A : ( 12 Marks)**

1. What is Software Engineering?
2. What makes S/W difficult and different than other products?
3. Briefly discuss four major attributes of good software.
4. During the class, we discuss many software failure cases and in assignment#1 you were asked to search & report about one of the S/W problems.
  - a. Write down a paragraph (no more than 4 lines) summarizing the case.
  - b. Is the failure due to error in (requirement, design, code, environment, management, or ...)?
  - c. What are the implications/cost of the failure?
  - d. Could the error be discovered during testing?
  - e. How easy should the fault be fixed?

**Group B : ( 15 Marks)**

5. What we mean by software development process?
6. List the main activities of a software development process.
7. Why there is no ideal software development process?
8. Name 2 software development process models and draw diagrams that illustrate the flow of activities in each of the two process models.
9. If a software system is being developed for a new application where the customers are not sure of what they want, the requirements are poorly defined. The customer seems to be trying the concept (no attractive long term maintenance contract.) Which of the following would be an appropriate process model for this type of development? Why?
  - a- Fix-& Build Model
  - b- Waterfall Model
  - c- Risky Incremental Model
  - d- Evolutionary: Exploratory development
  - e- Evolutionary: Through-away prototyping
  - f- Rational Unified Process

**Group C : ( 12 Marks)**

10. Draw a diagram of a typical lifecycle for the Rational Unified Process development illustrating the relative resource use with time for each phase. Indicate the milestone and phase name on the diagram.
  11. UML use-cases are used extensively in the RUP. Give examples of their usage in the different activities of RUP.
  12. What is the goal of the requirement discipline in RUP? What kinds of requirements are needed?
  13. What is the goal of the analysis and design discipline RUP? What we mean by design model? What should it contain?
- 

**Group D : ( 9 Marks)**

14. What artifacts are resulted from the activities of requirement engineering?
  15. What are the activities conducted during requirement engineering?
  16. Briefly list the various techniques for requirement elicitation?
- 

**Group E : ( 12 Marks)**

17. What we mean by the principle of information hiding when design a software? Is this related to the cohesion and coupling? Why?
  18. Two designs of a software system are presented to you. The first is designed so that there is no obvious deficiency; the second is designed so that obviously there is no deficiency. For each of the following statements state True or False.
    - a. The 1<sup>st</sup> design is a good one and prove the designer ability of utilizing different choices.
    - b. The 2<sup>nd</sup> design is simple so the designer is not professional.
    - c. The 1<sup>st</sup> design may have clear bugs.
    - d. The 2<sup>nd</sup> design may have clear bugs.
    - e. I will choose 1<sup>st</sup> design.
    - f. I will choose 2<sup>nd</sup> design.
  19. In the lectures we discuss design tradeoff between efficiency and portability. Explain by giving an example.
-

**Group F ; ( 15 Marks)**

20.What is the difference between inspecting and testing a software piece?

21.Consider the program shown. Use McCabe's Basis Path testing method to generate test cases to exercise each path in the control flow graph of the given program. Show details of your answer.

```
do while records remain
    read record;
    if record.Field1 = 0 then {process (record); store (record); increment counter;}
    elseif record.Field2 = 0 then reset(record);
    else {process (record); store (record);}
    endif;
endif;
enddo
end
```

***GOOD LUCK***

***Prof. Dr. Hussien H. Aly***

**Course committee :**

**Prof. Dr. Hussien H. Aly**

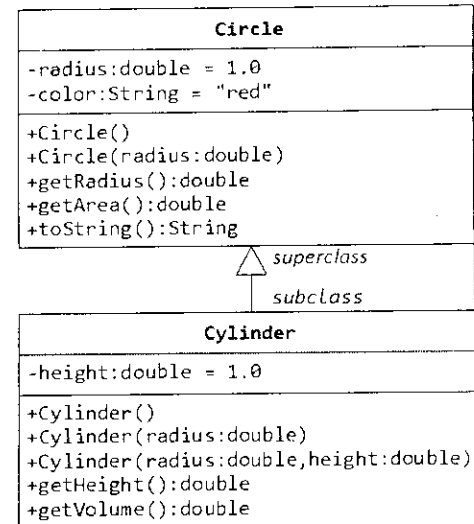
**Prof. Dr. Nagwa M. El-Mekkey**

**Dr. Mostafa Y. El-Naenaey**



**Q3)**

a) *Write C++ or Java Code for the Circle and Cylinder classes corresponding to the UML diagram (10 points)*



b) Imagine, you have to design a Tetris game. This game uses a 20x10 scoreboard, in upright form. From its ceiling, blocks fall down. The blocks have different forms (rectangular, square, Lshaped polygons). The player can rotate the blocks while they fall down. Once a block touches the ground, it is fixed where it landed. Only one block falls at any time. Once the current block has been fixed on the ground, a new block appears below the ceiling.

(i) Design the class model of the game. Consider a main class for the game, a game scoreboard, and a class hierarchy for blocks. (5 points)

(ii) Design an AbstractFactory with some concrete factories for the block hierarchy. Convert your design in (i) and (ii) into code fragments and determine which concrete block type is created by using a random generator. (15 points)

**Q4)**

Suppose you should design an application, which enables clients to book the cheapest flight to a destination of their choice from a number of providers.

- a) Assume, every provider is known in advance, and implements an interface IFlightProvider, which provides operations for querying for a flight/connection to a destination city, and for booking a flight. In this application you will need a way to enable clients to interface to these providers and book the cheapest flight on offer for the destination and date they are interested in. Flight providers should require (and receive) no knowledge on other flight providers known to the system. Which design pattern could you use? Draw the pattern for your solution (Hint: you may use the Mediator pattern). (10 points)
- b) Many airlines offer on-line booking services as web services but may not have the same interface (IFlightProvider) implemented. However, they will have compatible interfaces to call similar to querying and booking interfaces. How can you incorporate such an airline as a flight provider in the system above?

Select the most appropriate design pattern to use to address the problem and show how it is applied. In particular, show an appropriate class diagram(s) and enough code fragments to illustrate your use of the pattern to solve the problem. (10 points)



**Answer All Questions IN ORDER (Total 90 points):**

**Q1)**

- a) "Favor Composition over Inheritance" is one of the design principles, explain why and give an example. (5 points)
- b) There are two principal implementation approaches for the Filter pattern; pull and push filters. Provide UML class diagrams for the design structure for each, explain the difference between the two models, and provide an example application in which each model would be advantageous. (10 points)
- c) Opening a new connection to a Database Management system is usually an expensive operation. Most of the systems keep of a pool of available connections. Draw the Object Pool design pattern structure and explain its participants. (5 points)

**Q2)**

- a) In the approach to "analysis" and "design" that has been studied in this course, briefly compare and contrast these two terms. What is "analysis" about? What is "design" about? (5 points)
- b) Consider the following problem domain and assumptions. There is an information system for a video rental store. Simplifying assumptions and details for the system are as follows:
- It is a stand-alone store, not part of a larger organization.
  - Rents only videos, not computer games or other items.
  - A "video" can be in any medium: tape, DVD, Blu-ray, and so on.
  - The rental charge may vary by medium. For example, DVD rentals are more expensive than tapes.
  - The store does not sell anything. For example, there are no sales of videos or food.
  - All transactions are rentals.
  - Cash-only payments.
  - On completion of a rental, the customer receives a transaction report.
  - Each renter has a separate membership.
- (i) Identify at least 4 primary use cases and related actors. Draw the results in a UML use case diagram. (5 points)
- (ii) Write the Rent Videos use case primary and secondary scenarios. (10 points)

A handwritten signature in black ink, appearing to be "Z. J. ...".

يناير ٢٠١٣

الزمن: ساعتان

المادة: اقتصاد هادسي

الفرقة الرابعة حاسب آلي

جامعة الإسكندرية

كلية الهندسة

ملاحظة هامة: يجب الالتزام بالإجابة وفقاً للترتيب الموجود في ورقة الأسئلة. ويمكن الاستعانة بالكتاب.

### السؤال الأول

وضح مدى صحة أو خطأ العبارات التالية مع التبرير مستخدماً الرسم البياني كلما أمكن ذلك:

- ١- يكون ثمن السوق السوداء أكبر من الثمن التوازني.
- ٢- يختلف العمر الاقتصادي للمشروع عن العمر الإنتاجي له.
- ٣- قد تكون مرونة الطلب السعرية ثابتة على كافة نقاط منحنى الطلب.
- ٤- من الممكن أن تكون التكلفة الحدية في بعض الحالات سالبة مثل الناتج الحدي.
- ٥- يتناقص نصيب الوحدة المنتجة من التكلفة الثابتة باستمرار مع زيادة حجم الناتج.
- ٦- تخرج التكاليف المتغيرة عن المدفوعات لعناصر الإنتاج التي تتغير أثمانها بصفة دائمة.
- ٧- يكون توازن السوق غير مستقر إذا كان ميل منحنى الطلب أكبر من ميل منحنى العرض.
- ٨- لا بد أن يكون منحنى العرض متكافئ المرونة خطاً مستقيماً نابعاً من نقطة الأصل بزاوية ٤٥.
- ٩- يتوزع عبء الضريبة بالتساوي بين المنتج والمستهلك إذا تساوت مرونة الطلب السعرية مع مرونة العرض السعرية.
- ١٠- إذا أدى ارتفاع ثمن سلعة ما بوحدة نقدية واحدة إلى انخفاض الكمية المطلوبة منها بوحدة واحدة وكان الطلب على هذه السلعة متكافئ المرونة.

### السؤال الثاني

وضح بيانياً مع الشرح المستعمل على الرسم نفسه (دون شرح إضافي) كل ما يلي:

- ١- منحنى طلب غطي يجمع كل درجات المرونة.
- ٢- عندما يتحمل المستهلك عبء ضريبة المبيعات بالكامل.
- ٣- أثر تدخل الحكومة بفرض حد أدنى للأجور في سوق العمل.
- ٤- العلاقة بين الطلب على السلعة والدخل في حالة السلع الدنيا.
- ٥- العلاقة بين منحنيات التكلفة المتوسطة (الكلية والمتغيرة والثابتة) والحدية في الأجل القصير.
- ٦- أثر ارتفاع أثمان اللحوم المصاحب بزيادة أجور السيادين بمقدار أكبر على ثمن وكمية التوازن لنوع معين من الأسماك في مصر عام ٢٠١٣.

### السؤال الثالث

(١) إذا كان الناتج الكلي وعدد العمال كما يلي:

عدد العمال	١	٢	٣	٤	٥	٦	٧	٨
الناتج الكلي	٨	٢٠	٢٨	٤٨	٥٧	٦٠	٦٠	٥٦

المطلوب :

$$\frac{1}{18} \times \frac{1}{75} = \frac{1}{1350}$$

(أ) وضح رقمياً وبيانياً مراحل دالة الإنتاج في الأجل القصير (متضمناً كل من الناتج الحدى والمتوسط لعنصر العمل) ولماذا تأخذ الدالة بهذا الشكل ؟

(ب) إذا كان أجر العامل ٦٠ وحدة نقدية أحسب كل من التكلفة الحدية ومتوسط التكلفة المتغيرة عند مستويات الناتج المختلفة .

(ج) إذا كان كل من ثمن البيع والتكلفة الثابتة ١٥ و ٥٠٠ وحدة نقدية على الترتيب أحسب حجم الأرباح عند مستويات الناتج المختلفة . وهل يستمر المشروع في الإنتاج رغم تحقيقه بعض الخسائر؟ ولماذا؟

(٢) افترض أن الكمية المطلوبة والمعروضة من أحد أنواع اللحوم في السوق المصري عام ٢٠١٢ عند مستويات سعرية مختلفة كانت على النحو التالي:

الكمية المطلوبة (بالآلاف كيلوجرام)	٢٦٠	٢٤٠	٢٢٠	٢٠٠	١٨٠	١٦٠	١٤٠	١٢٠	١٠٠
الكمية المعروضة (بالآلاف كيلوجرام)	١٠٠	١٢٠	١٤٠	١٦٠	١٨٠	٢٠٠	٢٢٠	٢٤٠	٢٦٠

المطلوب :

(أ) تحديد ثمن التوازن وكمية التوازن في سوق هذه المشعة. وما الإيراد الكلي الذي يحصل عليه البائع عند وضع التوازن؟

(ب) إذا تدخلت الحكومة بفرض ثمن قدره ١٢ جنيه الكيلو، فهل تعتقد أنه يمثل حداً أقصى أم أدنى الثمن، وما مقدار فائض الطلب أو فائض العرض إن وجد؟

(ج) وضح أثر زيادة العرض بمقدار ٤٠ (ألف) كيلوجرام عند كافة الأثمان على كل من ثمن التوازن وكمية التوازن، مع التوضيح البياني لذلك.

انتهى الامتحان مع أطيب التمنيات بالتوفيق والتفاني.

3/10/2012

Alexandria University  
Faculty of Engineering  
Dept. of Comp. & system  
Engineering



جامعة الإسكندرية  
كلية الهندسة  
قسم هندسة الحاسب والنظم

Wednesday Jan, 16, 2013

الأربعاء 16 يناير 2013

Modern Control Engineering

نظم التحكم الحديثة

4<sup>th</sup> Year, Computer Dept.

أ.د. بدر أبو النمر

Time allowed: Three Hrs.

الفرقة الرابعة - حاسبات  
الزمن : ثلاث ساعات

Answer ALL Questions

Q-1

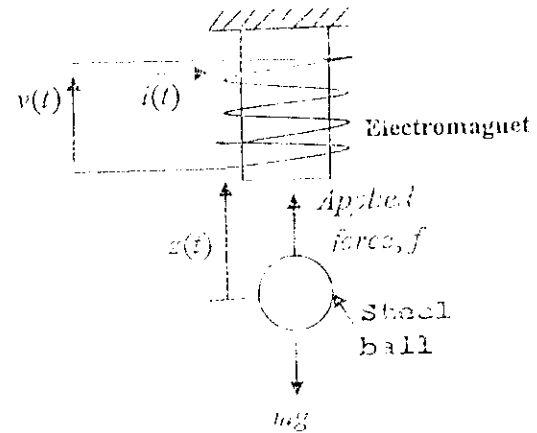


Fig1 Ball suspension system

A steel ball of mass  $m=8.4 \times 10^{-3} \text{ Kg}$ , is attracted by the magnetic force of an electromagnet at a distance  $z$  from the magnet. The objective is to keep the ball suspended at a fixed distance from the magnet. Using Newton's law:

$$m \frac{d^2 z}{dt^2} = \text{applied force},$$

(1) Derive the state equations of the ball system in the form:

$$\frac{dx}{dt} = Ax + Bu,$$

$$y = Cx$$

Where :

$$x = [x_1 \ x_2]^T, u = i, x_1 = z, x_2 = \frac{dz}{dt}, y = z.$$

It is noted that  $x_1$  and  $x_2$  are the incremental variables from the equilibrium position of the ball (neglect the effect of  $mg$ ). The electromagnetic force applied to the ball is given by:

$$f = 14z + 0.4i,$$



- (ii) Find the transfer function  $G = \frac{Z(s)}{I(s)}$ , where:  $Z(s) = L(z(t))$ ,  $I(s) = L(i(t))$
- (iii) Test for the Controllability and Observability of the system.
- (iv) Is the system Stable? Prove your answer.
- 

Q-2

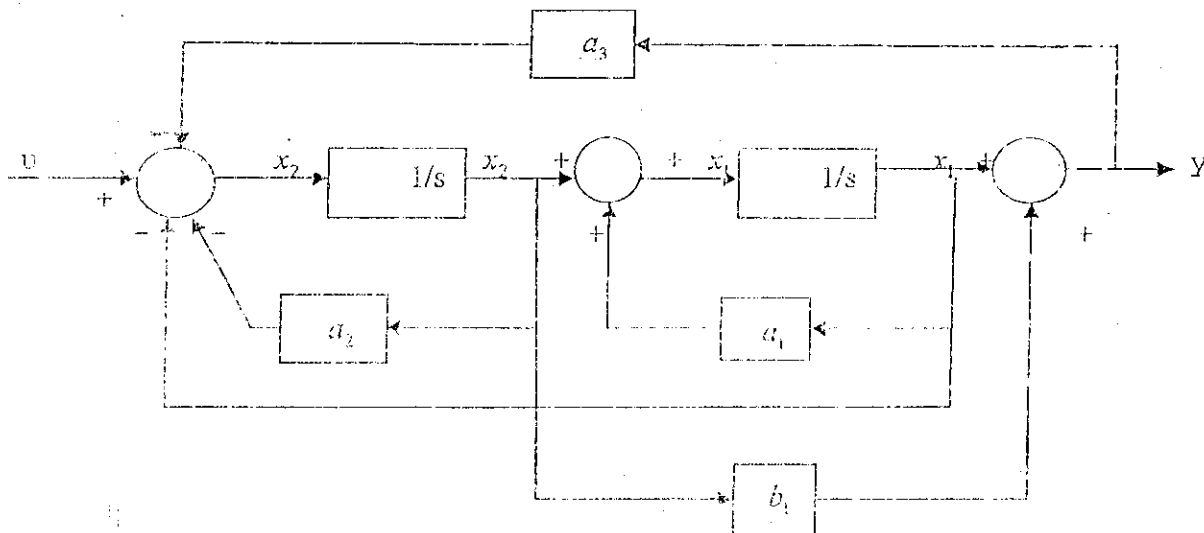


Fig. 2

a-(i) Explain, mathematically, what is meant by Similarity Transformation to the state equations:

$$\dot{x} = Ax + Bu,$$

$$y = Cx$$

a-(ii) Show, mathematically, that Controllability and Observability of the system in (i) is Invariant under similarity transformation.

(b) Using the indicated state variables, as in Fig. 2, obtain the  $A$ ,  $B$ ,  $C$ , and  $D$  matrices in terms of  $a_1, a_2, a_3$ , and  $b_1$ .

(c) Let  $a_1 = 0, a_2 = 2, a_3 = 1; b_1 = 1$ ,

test for the controllability and observability of the system.

(d) Test for the stability of system using Lyapunov stability test.

(e) Compute the state transition matrix, and hence the response  $y(t)$ , when  $u(t)$  is a unit delta function. Assume

zero initial conditions.

---

Q-3

Given a linear system, described by:

$$\dot{x} = Ax + Bu, \text{ and } y = Cx$$

Where  $x$  is the system state, and  $y$  its output,

$$A = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, C = \begin{bmatrix} 1 & 0 \end{bmatrix}$$

- (i) Test the controllability and Observability of the system.  
(ii) Design a state-variable feedback controller, which satisfies the following closed-loop specifications:

- (1) %age overshoot = 16.3%  
(2) Settling time equals 1 sec.

- (iii) Design a full state-observer, with desired eigen-values of -10 and -10.  
(iv) Find the closed-loop transfer function of the system, after combining the controller and observer.  
(v) Find the steady-error of the closed-loop system, if the reference input  $r(t)$  is a unit step function.  
Do (ii) and (iii), in a direct way, and then check using Ackermann's formulas.

---

Hints:

$$\% \text{age overshoot} = e^{-\pi\zeta/\sqrt{1-\zeta^2}},$$

Ackermann's formulas

For the design of a state feedback controller:

$$K = [0 \ 0 \ \dots \ 0 \ 1] C^{-1}(A, B) \alpha_c(A)$$

Where:

$C$  is the system controllability matrix,

$\alpha_c(s)$  is the characteristic polynomial of the closed loop system.

For the design of the full state observer:

$$k_o = \alpha_o(A) O^{-1}(c, A) \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \end{bmatrix},$$

where

$O$  is the observability matrix ,

$\alpha_o(s)$  is the characteristic polynomial of the observer.

---

Good Luck

Dr. Badr Abuelnasr

# Laplace - Transform Table

1	$\frac{1}{s}$
$\delta$	1
$\delta^{(k)}$	$s^k$
$t$	$\frac{1}{s^2}$
$\frac{t^k}{k!}, k \geq 0$	$\frac{1}{s^{k+1}}$
$e^{at}$	$\frac{1}{s-a}$
$\cos \omega t$	$\frac{s}{s^2 + \omega^2} = \frac{1/2}{s-j\omega} + \frac{1/2}{s+j\omega}$
$\sin \omega t$	$\frac{\omega}{s^2 + \omega^2} = \frac{1/2j}{s-j\omega} - \frac{1/2j}{s+j\omega}$
$\cos(\omega t + \phi)$	$\frac{s \cos \phi - \omega \sin \phi}{s^2 + \omega^2}$
$e^{-at} \cos \omega t$	$\frac{s+a}{(s+a)^2 + \omega^2}$
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كلية الهندسة  
قسم هندسة الحاسب والنظم

الأربعاء 16 يناير 2013

نظم التحكم الحديثة  
أ.د. ممد أبو النصر

الفرقة الرابعة - حاسبات  
الزمن : ثلاث ساعات

Answer ALL Questions

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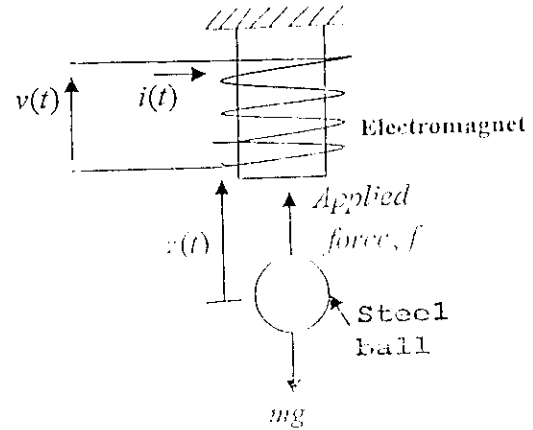


Fig.1 Ball suspension system

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Q-2

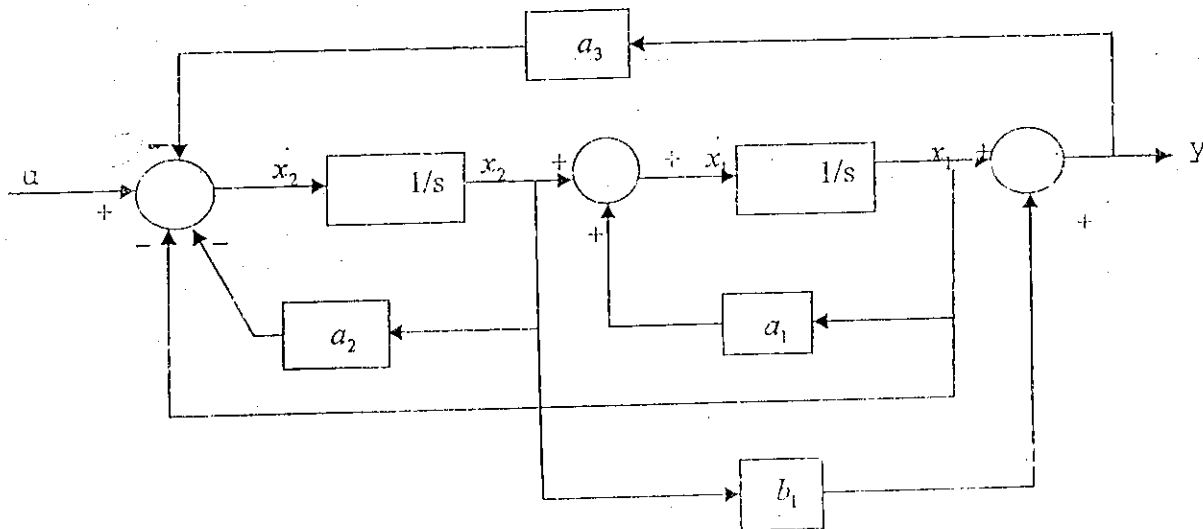


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$e^{-at} \cos \omega t$	$\frac{s+a}{(s+a)^2 + \omega^2}$
$e^{-at} \sin \omega t$	$\frac{\omega}{(s+a)^2 + \omega^2}$

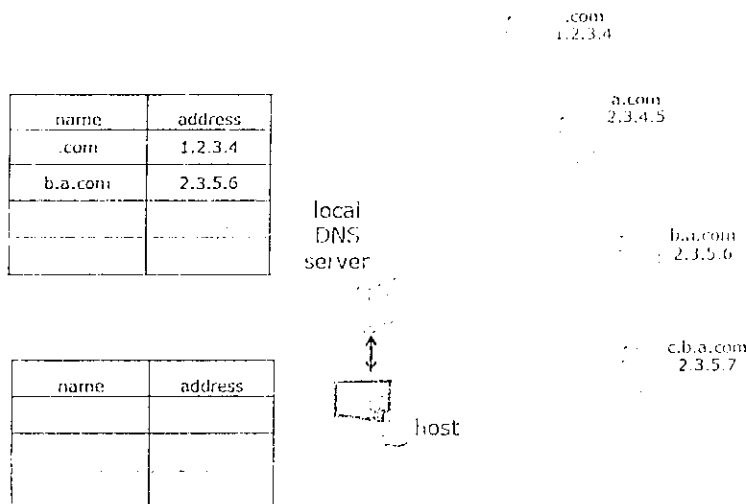


**Please answer all questions:**

**Question 1:**

[10 marks]

The figure below shows a host, its local DNS server, three additional DNS servers and a web server (c.b.a.com). The tables at left represent the DNS caches for the local server and the host. Suppose the user at the host enters c.b.a.com/foo.html into a web browser.



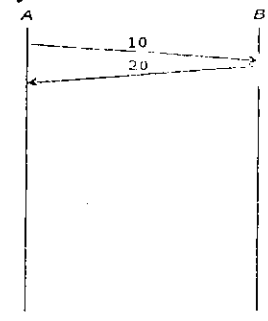
List all packets sent, leading up to the first packet sent from the host to the web server. For each packet, identify the sender, the receiver and give a brief description of the packet (for example, "query on name x.y.z" or "response IP=9.8.7.6"). Assume that the local server uses recursive query processing, but all others use iterative query processing. Show all changes to the contents of the DNS caches at the end of the sequence.

**Question 2:**

[10 marks]

The diagram below shows a TCP segment being sent from host A to host B and an ACK being returned. The numbers on the arrows are the sequence numbers of the data segments and the ACK numbers. Suppose that after receiving the ACK with ack number 20, A sends packets with sequence numbers 20, 30, 40, 50, 60, 70, 80, 90 and 100. Some time later, it receives ACKs with sequence numbers 40, 40, 60, 60, 60, 60, 60. (Assume that A sends no additional data segments in the meantime)

- Complete the diagram in a way that is consistent with the given information and what you know about the way TCP behaves. What sequence number would you expect to see in the next packet sent by A?
- What ACK number would you expect in the next ACK? You may assume that all packets sent by A carry 10 bytes of data.



**Question 3:**

[9 marks]

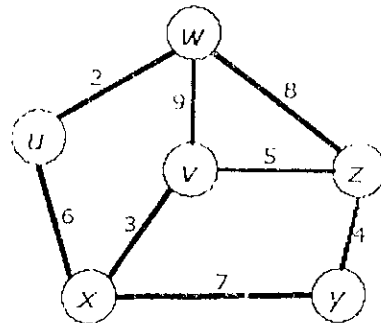
Consider a packet with a total length of 250 bytes (including IPv4 header) and an id field equal to 17, sent from a host *A* to a host *B*, passing through routers *X* and *Y*. Assume that the subnet where host *A* is connected has an MTU of 500 bytes, the subnet where host *B* is connected has an MTU of 80 bytes and the subnet between *X* and *Y* has an MTU of 120 bytes.

- Assuming that the "don't fragment" flag is not set, how many fragments does router *X* divide the packet into? What is the length of each fragment?
- For the first two fragments forwarded by router *Y*, what will be the values of offset, total length, DF and MF flags?. Fill in all the blanks.

**Question 4:**

[6 marks]

Consider the topology graph shown below. Construct the routing table at node *X* by applying Dijkstra algorithm. Show your workout.



**Question 5:**

[10 marks]

An organization has a class C network of address 200.1.1.0 and it wants to form subnets for 4 departments with the number of hosts as follows:

- Subnet A: 72 hosts
- Subnet B: 25 hosts
- Subnet C: 20 hosts
- Subnet D: 18 hosts

- Provide a possible arrangement of the network address space, together with the respective range of IP addresses for each subnet and the subnet mask. Explain your work
- Suggest what the organization might do if it needs to create the 5<sup>th</sup> subnet (subnet E) with 20 new hosts

**Question # 6: [20 points] Select the correct answer**

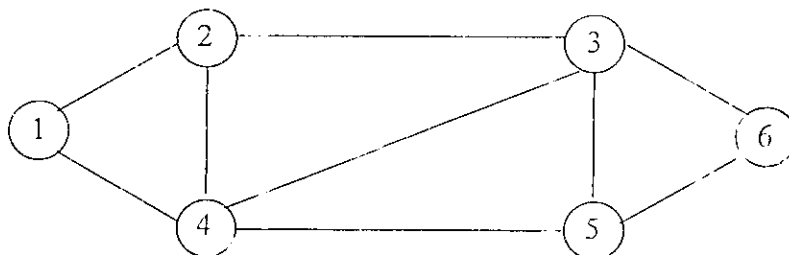
- 1) If the baud rate for a QAM signal is 1800 and the bit rate is 9000, how many bits are there per signal element?  
(a) 3  
(b) 4  
(c) 5  
(d) 6
- 2) In ..... propagation, the core of the fiber is of varying densities  
(a) multimode step-index  
(b) multimode graded-index  
(c) multimode single-index  
(d) single mode
- 3) The performance of a data communications network depends on .....  
(a) The number of users  
(b) The transmission media  
(c) The hardware and software  
(d) all of the above
- 4) In CRC, there is no error if the remainder at The receiver is  
(a) equal to the remainder at sender  
(b) nonzero  
(c) zero  
(d) the quotient at the sender
- 5) If the data unit is 111111 and the divisor 1010, then the CRC is  
(a) 100  
(b) 101  
(c) 110  
(d) 111
- 6) Which of the following is necessary for multiplexing?  
(a) Modem  
(b) Parallel transmission  
(c) High-capacity links  
(d) Network card
- 7) In asynchronous transmission, the gap time between bytes is ..... transmission does not have  
(a) fixed  
(b) variable  
(c) a function of the data rate  
(d) zero
- 7) In sliding window flow control, the frames to the left of the receiver window are..... frames  
(a) received but not acknowledged  
(b) received and acknowledged  
(c) not received  
(d) not sent
- 8) Where is the token in token ring, when a data frame is in circulation  
(a) at the receiving station  
(b) at the sending station  
(c) circulating in the ring  
(d) damaged
- 9) Which project 802 standard provides for collision free protocol  
(a) 802.2  
(b) 802.3  
(c) 802.5  
(d) 802.6
- 10) IEEE802.2 and IEEE802.3 have different  
(a) Topology  
(b) maximum data rate  
(c) maximum segment length  
(d) UTP number
- 11) In the ..... layer, translation from one character code to another code occur  
(a) transport  
(b) session  
(c) presentation  
(d) application
- 12) Which of the following encoding does not provide for synchronization  
(a) NRZ-L  
(b) RZ  
(c) CTS  
(d) HDB3
- 13) Which of the following modulation techniques are used by modems  
(a) 16-QAM  
(b) PSK  
(c) 8-PSK  
(d) all of the above
- 14) In ..... propagation, low-frequency radio waves hug the earth  
(a) space  
(b) ionospheric  
(c) tropospheric  
(d) surface
- 15) Which of the following is necessary for multiplexing  
(a) Parallel transmission  
(b) QAM  
(c) High-capacity links  
(d) modems
- 16) Packet sequencing is guaranteed in .....  
(a) circuit switching  
(b) datagram  
(c) message switching  
(d) virtual circuit
- 17) Flooding is a technique used for  
(a) Flow control  
(b) Routing  
(c) Error control  
(d) all of the above
- 18) In a ..... packet switching all packets must contain full destination address  
(a) Virtual circuit  
(b) Datagram  
(c) a & b  
(d) none of the above
- 19) Bridges will logically interface at ..... Layer  
(a) application  
(b) transport  
(c) network  
(d) none of the above
- 20) In distance vector routing, from where does each router receive vectors?  
(a) all routers  
(b) adjacent routers  
(c) locally  
(d) none of the above

**Question # 7 : [10 points] Give ONLY ONE reason for each of the following statements**

- (a) Manchester encoding is a self-clocking code.
- (b) Optical fiber, unlike wire media, is highly resistant to electromagnetic interference.
- (c) Go-back-n ARQ is more popular than Selective-reject ARQ
- (d) In a datagram packet switching all packets must contain full destination address.
- (e) Stop-and-wait is not efficient for satellite links
- (f) Unlike ring LANs, in a bus connected LAN we do not worry about packets staying indefinitely on the medium.
- (g) In-time-division circuit switching, the delivery of data is delayed.
- (h) Flooding is a preferred routing technique for sending emergency message.
- (i) By using virtual circuit switching network, packet sequencing is guaranteed.

**Question # 8 : [15 points]**

- (a) [3 points] Twenty-four voice signals (each requiring 4000 Hz and 200 Hz guard band) are to be multiplexed and transmitted over twisted pair. What is the bandwidth required for FDM ?
- (b) [4 points] Calculate the total time required to transfer a 5000 KB file in the following case, assuming an RTT of 100 msec, a packet size of 1 KB, and an initial RTT for "handshaking" between sender and receiver before data is sent. The bit rate is 1 Mbps, but after we finish sending each packet we must wait one RTT before sending the next.
- (c) [4 points]  $N$  routers  $R_1, R_2, \dots, R_N$  are to be connected using  $M$  bi-directional links such that each router is reachable from every other router. If no more than one link is to be used between any two routers, what are the maximum and minimum values for  $M$ ?
- (d) [4 points] In the following network, node 1 sends packet to node 6 using flooding routing. Counting the transmission of one packet across one link as a load of one, what is the total load generated if each node discards duplicate incoming packet.



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**GOOD LUCK**

**Professors: Dr. Amal ElNahas, Dr. Magdy A.Azim**

*3/26/21*



Topics in Information Systems

Fourth Year

January 2013

Time: 3 hours

Answer the following questions: Full Mark = 75 Points

Question One (19 Marks)

Consider the following transactional database D. Assume that the min. support = 40%.

TID	Items bought
T1	{I6, I1, I3}
T2	{I1, I2, I4, I5, I3}
T3	{I3, I2, I5}
T4	{I6, I7}
T5	{I1, I3, I2, I4, I5}
T6	{I1, I3, I6}
T7	{I1, I2, I5, I7}
T8	{I2, I8, I5, I1}
T9	{I4, I6}
T10	{I1, I2, I5}

- Apply the FP-growth algorithm to generate all the frequent item sets of D. Show the FP-tree and the header table. For each frequent item, show how to generate the conditional pattern bases and conditional FP-trees, and the frequent item sets generated by them.
- What is the set of closed (but not maximal) frequent item sets?
- Using the frequent item sets obtained in (a), generate **two** association rules of confidence 100%.

Question Two (11 Marks)

Consider the training data set given below. Let "Lenses" be the class label.

Age	Prescription	Astigmatism	Tear Rate	Lenses
pre-presbyopic	myope	no	normal	soft
young	myope	no	normal	soft
presbyopic	hypermetrope	no	normal	soft
presbyopic	myope	yes	normal	hard
pre-presbyopic	myope	yes	normal	hard
young	myope	yes	normal	hard
pre-presbyopic	hypermetrope	yes	normal	none
presbyopic	hypermetrope	yes	reduced	none
pre-presbyopic	myope	yes	reduced	none
young	hypermetrope	no	reduced	none

It is required to construct a decision tree for predicting the class label using the **information gain** as the attribute selection measure. Assume that "Tear Rate" is the root of the tree (you do not need to verify that). Complete the decision tree starting from the root node. Show all your work neatly.

### Question Three (15 Marks)

a- Consider the training data set given below. Assume that “Loan Worthy” is the class label. Use the Naïve Bayes approach to predict the class label for the sample (Married = no, Salary: 20K...50K, Acct balance < 5K, Age >= 25).

Married	Salary	Acct Balance	Age	Loan Worthy
no	>=50 K	<5K	>=25	yes
yes	>=50 K	>=5K	>=25	yes
yes	20K...50K	<5k	<25	no
no	<20K	>=5K	<25	no
no	<20K	<5K	>=25	no
yes	20K...50K	>=5k	>=25	yes

b- Knowing that “Electricity use” is the class to be predicted, would the Naïve Bayes approach be effective for developing a classifier for the following data set? Why or why not?

Temperature	Season	Electricity use
Below Average	Winter	High
Above Average	Winter	Low
Below Average	Summer	Low
Above Average	Summer	High

c- After an undergraduate course, the results of the exam were recorded along with some data about the students. The results can be found in in the table below.

ID	Language	Passed all assignments	GPA	Passed exam
1	Java	No	3.1	Yes
2	Java	No	2.0	No
3	C++	Yes	3.5	Yes
4	Python	Yes	2.5	Yes
5	Java	Yes	3.9	No
6	C++	No	2.9	No
7	Java	No	1.9	No
8	Python	Yes	3.2	Yes

Knowing that “Passed exam” is the class label, predict the class of the following student using K-Nearest Neighbor (with majority voting) for K =3.

ID	Language	Passed all assignments	GPA	Passed Exam
9	C++	Yes	3.0	?

#### Question Four (15 Marks)

Consider the set of 2-dimensional records given below.

RID	X	Y
1	8	4
2	5	4
3	2	4
4	2	6
5	2	8
6	8	6

a- Use the K-means algorithm to cluster the given set of records. Use a value of 3 for K and assume that the records with RIDs 1, 3 and 5 are used for the initial cluster centroids (means). Use the Euclidean distance as a distance function.

b- Measure the Sum of Squared Error (SSE) for the clustering obtained in (a).

c- If the data records were clustered into 2 clusters: {1,6} and {2,3,4,5}, would this clustering have a better cohesion than the clustering obtained in (a)? Justify your answer.

#### Question Five (15 Marks)

a- Consider the **distance** matrix given below.

	P1	P2	P3	P4	P5	P6
P1	0	0.8	0.85	1	2	0.85
P2	0.8	0	1	0.5	1	0.8
P3	0.85	1	0	2	1	2
P4	1	0.5	2	0	1	0.3
P5	2	1	1	1	0	1
P6	0.85	0.8	2	0.3	1	0

Use the above matrix to perform complete link hierarchical clustering. Show your result by drawing a dendrogram. The dendrogram should clearly show the order in which the points are merged.

b- Given the distance matrix in part (a), perform the DBScan algorithm for Eps (radius) = 0.9 and MinPts (minimum number of points) = 3. How many clusters are generated? Indicate clearly the core, border and outlier points.

c- Consider a dataset that contains a target (class label) attribute. In this problem, you will be asked to evaluate a clustering of this dataset with respect to the target attribute (using external measures). Assume that the dataset contains 5 data points: p1, p2, p3, p4, and p5. Assume that these points have been clustered into 2 clusters, without using the target attribute, such that p1, p2, and p3 belong to one cluster, and p4 and p5 belong to the other cluster. Assume that p1 and p2 share the same target (class) value; and that p3, p4, and p5 share the same target (class) value, different from that of p1 and p2. Compute the overall purity and the overall F-measure for the given clustering.