

UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER SCIENCE

SUPPLEMENTARY EXAMINATION, JULY 2009

Title of Paper : Databases and their Design I
Course Number : CS 345
Time Allowed : Three (3) Hours
Instruction : Answer ANY FIVE questions

This paper should not be opened until permission has been granted by the invigilator.

Question 1

- a) Why is it important that every relation has a primary key? [2]
- b) In a database system, how would you differentiate a relation from a relationship? [3]
- c) Draw an E-R diagram for a bookshop enterprise to show the relationship between books, publishers, authors and editors. [8]
- d) Using the database in some bookshop enterprise, describe existence dependence. [4]
- e) How does existence dependence assist in the design of a database? [3]

Question 2

- (a) Differentiate between a database management system and a database administrator. [4]
- (b) Briefly describe, with the aid of an example, redundancy and the problems associated with it. [4]
- (c) Why is it necessary to specify integrity constraints when designing a database. [4]
- (d) Describe four different end users (in databases) with their associated tasks. [8]

Question 3

- (a) The University of Learning admits either post-graduate students or undergraduate students. Every student: has a unique id number, a name (made up of first name, initial, and last name), an address, and date of birth; is enrolled in some department and has a guardian. Post-graduate students do research projects which must have a title, deadline for submission and the name of a supervisor. Undergraduates follow a given program in some academic year and do a number of courses.
 - (i) Draw an ER diagram that emphasizes the similarities between the postgraduate students and the undergraduates. Specify the guardian's attributes. [8]
 - (ii) Break down the ER diagram into tables. [8]
- (b) Describe how a database, that is not a tree, can be implemented by means of a hierarchical model scheme. [4]

Question 4

- (a) Why is an ER diagram desirable? [5]
- (b) Draw an ER schema diagram to represent some company's database. [15]
The company employees are associated with a department. Each employee identified by a pin number, name, date of birth, address, salary and gender. Every department in the company has a name, locations, and a number. The departments are assigned projects that they control. Each project has a location, name and number. Each department has a manager, from the pool of employees, the other employees service the department. Other than working for a department or managing it each employee is either a supervisor or is supervised.

Question 5

- a) At this University we have lecturers, courses, programmes, faculties, etc. Use your knowledge of this institution to draw an E-R diagram illustrating aggregation using a minimum of seven entities in the ER diagram. [10]
- b) Reduce the E-R diagram in a) into tables indicating all keys. [10]

Question 6

- a) Composite and multivalued attributes can be nested to any number of levels. Suppose we want to design an attribute for a STUDENT entity type to keep track of previous college education. Such an attribute will have one entry for each college previously attended, and each such entry will be composed of college name, start and end dates, degree entries (degrees awarded at that college, if any), and transcript entries (courses completed at that college, if any). Each degree entry contains the degree name, month and year the degree was awarded, and each transcript entry contains a name, semester, year and grade. Design an attribute to hold this information. (Either a table form or short notation). [10]
- b) Show an alternative design for a) that uses entity types (including weak entities) and relationship types. [10]

UNIVERSITY OF SWAZILAND

Faculty of Science

Department of Computer Science

SUPPLEMENTARY EXAMINATION 2009

Title of paper: NETWORKS AND CODING THEORY – I

Course number: CS437

Time allowed: 3 hours

Instructions to candidates:

This question paper consists of **SIX (6)** Questions. Answer any **FOUR (4)** questions. Marks are indicated in the square brackets.

All questions carry equal marks.

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QUESTION 1

- a) List three (3) data communications standards bodies. [3]
- b) Transmission media can be guided or unguided. What is the difference between the two? Given the following media, Twisted pair, Coaxial cable, Microwave, Satellite and Infrared, state which ones are guided and which ones are unguided. Hence compare their characteristics. [13]
- c) Distinguish between single and multimode fiber. State 2 advantages of using multimode fiber? [4]
- d) Why do communication protocols take a layered approach? Describe the responsibility of the Physical layer. [5]

QUESTION 2

- a) What are transmission impairments? State and briefly describe the different types of noise. [8]
- b) i) Define the Hamming Distance between two codewords. [2]
- ii) An 11-bit Hamming Code has 7 message bits and 4 check bits. The check bits are in the "power of two" positions and are calculated to give even parity. The codeword below, calculated according to the scheme above, has been subject to a 1-bit error. Which bit is in error (show your working)? [7]

| | | | | | | | | | | |
|----|----|---|---|---|---|---|---|---|---|---|
| 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |

- c) The Ethernet LAN uses Manchester Encoding. With the aid of an appropriate examples and or diagrams explain how Manchester encoding and NRZ-I work. Why is Manchester encoding well-suited to synchronous framing? [8]

QUESTION 3

- a) Two Ethernets can be interconnected using a bridge, which forwards packets between the networks at the OSI Datalink layer. Describe the operation of an Ethernet bridge. [7]
- b) Describe circuit switching. Describe the two "flavors" (or fundamental methods) of packet switching. Describe the overheads present in packet switching and in circuit switching. In the context of circuit switching, what is "blocking"? [12]
- c) Compute the CRC for a given message (M) and a generator polynomial (G).
Data ($M(x)$) = 101001101, $G(x)$ = 100111. Find $R(x)$ and hence find the transmitted message, $T(x)$. Why is Modulo 2 arithmetic used in calculating CRCs? [6]

QUESTION 4

- a) Automatic Repeat Request (ARQ) protocols aim to provide a Connection Oriented style service based on simple services providing only framing. "Go-back-N" and "Selective Retransmissions" are two such ARQ protocols.
 - i) Give illustrated examples of how Go-back-N and selective re-transmissions work. [6]
 - ii) Briefly discuss the relationship between sequence numbers and window sizes in ARQ protocols. [4]
 - iii) Briefly discuss the use of windows for flow control. [4]
- b) Explain the principle of operation of an ADSL modem. Include in your answer a discussion of the impact of ADSL modems on web access levels. [6]
- c) Briefly explain how CSMA/CD handles medium access on a multipoint link. [5]

QUESTION 5

- a) Give three (3) characteristics that differentiate between LANs and WANs. [3]
- b) Suppose a noisy channel has a signal-to-noise ratio of 30dB, and a bandwidth of 4 kHz. What is the maximum data rate possible for this channel? [4]
- c) Explain how synchronization is accomplished at the Data link layer. [6]
- d) The local loop is always a major consideration when designing new applications for the home market. A forward-looking telecommunications company wants to investigate the possibilities of transmitting high data rates over the local loop. You work for the SPTC, and have been asked to provide a survey of the different transmission impairments on the local loop, specifically noting the most significant impairments for digital transmission. Suggest how the major impairment is normally overcome. [8]

- e) Two antennas at a height 200m are supposed to communicate. Assuming that there are no intervening obstacles, what is the maximum distance that can be between the 2 antennas? [4]

QUESTION 6

- a) Explain, in terms of a network layered Model, the operation, performance and differences between a Hub and a Switch. [6]
- b) Briefly explain why in a 10Base Ethernet a station can be certain that a data frame is successfully transmitted without collision if no collision is detected during the transmission of the first 64 bytes of data. [6]
- c) i) Explain the operation of the Carrier-Sense, Multiple Access (CSMA) channel allocation algorithm. Distinguish between the persistent, non-persistent and p-persistent versions of the algorithm and indicate the effect each of these approaches has on performance as network load increases. [8]
- ii) Explain the operation of the Carrier-Sense, Multiple Access with Collision Detection (CSMA-CD) channel allocation algorithm and discuss how its performance compares with that of pure CSMA strategies. [5]