PERSONAL PREPARATION ASSESSMENT TEST FOR THE ADMISSION TO THE LAUREA MAGISTRALE IN **COMPUTER ENGINEERING**

CANDIDATE (please write in block capitals)

FAMILY NAME : _____

GIVEN NAME : _____

INSTRUCTIONS

TEST DURATION: 2.30 h

DO NOT OPEN THE BOOKLET BEFORE THE START OF THE TEST

THE ADMISSION TEST CONSISTS OF A MULTIPLE CHOICE TEST COMPRISING **36 QUESTIONS**; FOR EACH QUESTION THE CANDIDATE MUST INDICATE ONLY ONE SOLUTION AMONG 3 POSSIBILITIES. ONE AND ONLY ONE OF THE SUGGESTED ANSWERS IS CORRECT. THE TEST IS PASSED IF **AT LEAST 24 CORRECT ANSWERS** ARE GIVEN.

PLEASE CROSS THE PREFERRED ANSWER.
USE A PEN, NOT A PENCIL.

IF NECESSARY FOR CALCULATIONS AND DRAWINGS, USE THE BLANK SHEETS OF PAPER THAT WILL BE PROVIDED.

FILL THIS SHEET WITH THE NAME. DO NOT SEPARATE THIS SHEET FROM THE OTHER ONES.

RETURN ALL THESE SHEETS.

THE USE OF MOBILE PHONES, LAPTOPS PC, IPAD AND OTHER DEVICES, TEXT AND NOTES OF ANY KIND, IS FORBIDDEN, <u>STUDENTS CAUGHT BREAKING ANY OF THESE RULES WILL BE EXPELLED.</u>

TURN OFF ALL MOBILE DEVICES

THE USE OF DIGITAL CALCULATORS AND DICTIONARIES IS ALLOWED.

Automatica

1. The following linear time-invariant systems

$$\Sigma_1 : \begin{cases} \dot{x}_1 = -x_1 \\ \dot{x}_2 = -x_1 - 2x_2 \end{cases}, \qquad \Sigma_2 : \begin{cases} \dot{x}_1 = 3x_2 \\ \dot{x}_2 = -2x_2 \end{cases}$$

□ are both asymptotically stable

□ are both unstable

□ Σ_1 is asymptotically stable and Σ_2 is stable

2. The nonlinear system

$$\dot{x}_1 = x_2 - u$$
$$\dot{x}_2 = x_1^3 x_2^3 + x_1 u$$

for $u(t) = 2, \ \forall t \geq 0$ has

□ one equilibrium state

□ two equilibrium states

□ three equilibrium states

3. For the nonlinear system at the previous point, let $\dot{\delta x} = A\delta x + B\delta u$ be the linearization about the equilibrium state $\bar{x}^T = \begin{bmatrix} \bar{x}_1 & \bar{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 2 \end{bmatrix}$ and the equilibrium input $u(t) = 2, \ \forall t \geq 0$. One has

□ $A = \begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix}$

□ $A = \begin{bmatrix} 0 & 1 \\ 2 & 0 \end{bmatrix}$

□ $A = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$

4. The transfer function $G(s)$ of the linear system

$$\dot{x} = 2x + 3u$$
$$y = 4x$$

is

□ $G(s) = \dfrac{12}{s+2}$
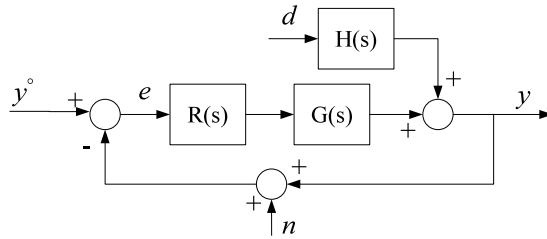
□ $G(s) = \dfrac{3}{s-2}$

□ $G(s) = \dfrac{12}{s-2}$

5. The step response of $G(s) = \dfrac{5}{(s^2 + 0.1s + 1)}$

□ has an overshoot

□ goes to 0.5 for $t \to +\infty$

□ takes both positive and negative values

6. The transfer function $G(s) = \dfrac{s-3}{s(s^2 + 2 + 1)}$

□ is unstable

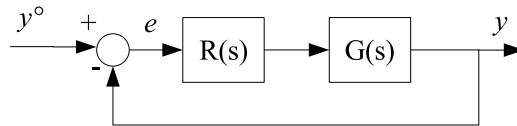□ is minimum phase

□ contains an integrator

7. In the following block diagram

the transfer function $P(s)$ with input d and output e is

☐ $P(s) = -\dfrac{H(s)}{1 + R(s)G(s)}$

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8. Consider the following block diagram

where $R(s) = 10\dfrac{\left(\dfrac{s}{10} + 1\right)}{\left(\dfrac{s}{10000} + 1\right)}$ and $G(s) = \dfrac{1}{\left(\dfrac{s}{10} + 1\right)^2}$. Then

☐ the closed-loop system is unstable

☐ the closed-loop system is asymptotically stable the closed-loop bandwith is, approximatively, 100 rad/s

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9. Consider the block diagram in point 7 and assume $R(s) = 10$, $G(s) = \dfrac{1}{\left(\dfrac{s}{30} + 1\right)^2}$, $H(s) = 0$. Knowing that

the closed-loop system is asymptotically stable, consider how much a sinusoidal signal $n(t)$ is attenuated, asymptotically, on the ouput $y(t)$. One has that

☐ $n(t) = \sin(0.3t)$ is attenuated at least 10 times

☐ $n(t) = \sin(30t)$ is attenuated at least 10 times

☐ $n(t) = \sin(500t)$ is attenuated at least 10 times

2

DATA BASES & OPERATING SYSTEMS (9 questions)

In the relation COURSES, (schema and an instance in the drawing), the following functional dependences are true:

df1:   Code → Name,TeacherID,CFU
df2:   TeacherID → City,TeacherName
df3:   Code,TeacherID→Name,TeacherName,City,CFU

Code	Name	TeacherID	City	TeacherName	CFU
Cod1	Basi Dati	FRRMRC55	Pavia	Ferruzzi	6
Cod2	Programming	ANNCPP48	Mantova	Lorenzi	9

1) If the tuple <Cod3, Computer, FRRMRC55, Mantova, Ferruzzi,9>, is inserted in the relation, which of the following happens:

Insert rejected, because the Code value violates the primary key constraint	
Insert rejected, because it violates df2	
Lnsert rejected, because it violates both df2 and df3	

2) If the data base contains another relation TEACHERS, having TeacherID as its primary key, and if there is a foreign key constraint between COURSES(TeacherID) and TEACHERS, what is the result of the following operation: *COURSES natural join TEACHERS* (|COURSES| indicates the cardinality of COURSES)

A relation with cardinality |COURSES|	
A relation with cardinality |TEACHERS|	
A relation with cardinality MIN(|COURSES|,|TEACHERS|)	

3) Let us assume that the table COURSES has 100 tuples, and the table TEACHERS has 60 tuples, the query:

    SELECT TeacherID,count(*)
    FROM COURSES
    GROUP BY TeacherID

Returns exactly 60 tuples	
Returns at most 60 tuples	
Returns a number of tuples in the range [60-100]	

4) Two relations R1(**A**,B,C) with primary key **A** and R2(**C**,D,F) with primary key **C** are the outcome of the conversion of an ERA fragment. If C in R1 has a foreign key constraint with R2, and E1 and E2 are the entities of the ERA fragment associated to R1 and R2, what is the ERA relationship between E1 and E2 that is translated through the foreign key C ?:

a) 1 to N, with E2 on side 1	
b) M to N, with compulsory participation on side E1	
c) 1 to N with E1 on side 1, or 1 to 1	

5) In a DBMS, the logical schema guarantees:

Independence of applications from the logical structure of the data base	
Independence of applications from the physical structure of the data base	
Independence of applications from concurrent accesses from multiple users	

6) A Unix file system uses a multilevel inode pointer structure for:

memorizing the content of a file	
memorizing the addresses of the first blocks used by the file	
memorizing all the addresses of the blocks used by the file	

7) The working set model relies on:

the segmented memory	
the locality of memory access of a running process	
the priority of the process	

8) If we use a monitor to synchronize two processes that share a variable:

there exists a single critical section for each user	
a process out of the critical section cannot stop the other	
both processes can enter simultaneously in the critical section	

9) Two threads of two different processes

do not share the same stack	
do not share the same memory page	
do not share the same open file	

PROGRAMMING (9 questions)

1. What is the right statement among the following:

every possible problem can be solved by an algorithm	
every possible problem can be solved by an algorithm, but the solution of some problems have not been discovered yet	
none of above statements is correct	

2. What is the difference between a recursion and a loop?

there is no difference: both are used to repeat a set of instructions	
recursion is performed by calling a function within the same function, while a loop simply repeats the set of instructions using jumps	
a loop requires a counter, while recursion does not	

3. When is a variable allocated into memory for the execution of a C program?

at compile time	
at run-time	
while writing the program using the editor	

4. What is one of the benefits of using two's complement to represent negative numbers?

there is one and only one representation of the number 0 (zero)	
it is the only method to represent negative numbers using binary digits	
there are no specific benefits	

5. What is the purpose of the Arithmetic-Logic Unit (ALU) within a microprocessor?

it contains the Program Counter and regulates the program execution	
it only checks the correctness of an instruction before execution	
it executes mathematical and logical operations	

6. Please indicate the specific characteristic of a static array (for example: *int vector[10]*):

it is always allocated in contiguous portions of memory	
it has no fixed size, and its size can change at run-time	
an array can be composed by integer types only	

7. The Members of a Class are:

attributes and Methods	
types and Abstractions	
algorithms and Constants	

8. In any Software Development Model, Validation is always an important step. Indeed, it is:

the time when code is shown to customers	
the time of planning	
the time of testing, where debugging is used to solve any bug in the code	

9. In Object Oriented programming, an interface:

cannot be referenced by any module not being in the same folder	
cannot be instantiated, since it is not the definition of an object; a class implementing that interface will be able to be instantiated	
cannot be extended	

HARDWARE SYSTEMS AND COMPUTER NETWORKS (9 questions)

1) In the IEEE-754 standard floating points number representation the denormalized numbers:

as for "0" they are a particular representation case	
feature the "1" hidden bit	
are used to represent ∞	

2) When the data bus bit number increases:

memory capacity increases	
more peripherals can be addressed	
memory and peripherals addressability do not change	

3) If A e B are two binary words with the same length, calculating A <= A XOR B then B <= A XOR B and then A <= A XOR B, the final value for A is:

A	
0	
B	

4) The Petrick function is used to find the minimum cost expression for a specific commutation function. In particular it finds:

The prime implicants	
The minimum cost coverage of all the minterms and the maxterms	
The second canonical expression	

5) For non completely specified functions the minimum cost chart relative to sums of products and products of sums:

Is always the same	
Is always different	
Can change or not	

6) When do critical races happen?

In asynchronous sequential networks if internal states weren't correctly specified	
In synchronous sequential networks if not adequate flip flops are used	
If shift registers do not work as expected	

7) Flow control algorithm implemented in TCP protocol regulates transmission frequency based on:

receiver's buffer dimension	
receiver's receive window dimension	
an estimate of receiver's congestion based on packet loss	

8) Multiple access protocols are needed

in broadcast networks, to determine when a node can transmit	
in point-to-point networks, to determine when a node can transmit	
everytime a node has to transmit, independently on the network type	

9) The number of addresses in network 119.28.1.0/28 is:

16	
28	
4	