DEGGENDORF INSTITUTE OF TECHNOLOGY

Campus Cham

Exemplary Contents with Sample Tasks in Preparation for the Admission Test of the **Master Degree Programme Mechatronic and Cyber-Physical Systems**

The following collection of sample tasks shall give applicants the opportunity to familiarize themselves with the **exemplary contents** and **level** of the admission test for the Master Programme Mechatronic and Cyber-Physical Systems at the Deggendorf Institute of Technology - study site Campus Cham. Additionally, these tasks represent the range of basic subjects deemed to show elementary, prerequisite knowledge to perform successfully in this master programme. Overall, applicants can obtain a maximum of 90 points within the framework of the aptitude assessment.

Mathematics

A.1 Derivatives

Let $a, x \in \mathbb{R}, a \neq 0$. Calculate the derivative of

$$f(x) = \underbrace{\frac{1}{4a^3\sqrt{2}} \ln\left(\frac{x^2 + a\,x\sqrt{2} + a^2}{x^2 - a\,x\sqrt{2} + a^2}\right)}_{=:g(x)} + \underbrace{\frac{1}{2a^3\sqrt{2}} \arctan\left(\frac{a\,x\sqrt{2}}{a^2 - x^2}\right)}_{=:h(x)}$$

and simplify as far as possible. Hint: The final expression is surprisingly simple. Approximately, half of the points are for simplifying. Differentiate and simplify g(x) and h(x) separate as far as possible. ln means, the natural logarithm.

A.2 Partial Fractions

Expansion into partial fractions.

Let $x \in \mathbb{R}$, $x^2 \neq 1$. Determine the real coefficients A, B, C, D such that

$$\frac{6x^3 + 2x^2 + 2x - 6}{(x^2 - 1)(x^2 + 1)} = \frac{A}{x-1} + \frac{B}{x+1} + \frac{Cx+D}{x^2+1}.$$

Hint. The answers for A, B, C, D are elements of $\{0, \pm 1, \pm 2, \ldots, \pm 9\}$.

A

B

C

D

A.3 Extremum Points

A.4 Integral Calculus

A.5 Matrix, Eigenvalues

Determine to the matrix $\mathbb{A} = \begin{pmatrix} 1 & 2 \\ 0{,}5 & 3 \end{pmatrix}$ the inverse matrix $\mathbb{A}^{-1}$ (4P)

Select one:

a. $\mathbb{A}^{-1} = \begin{pmatrix} 1 & 0{,}5 \\ 2 & 3 \end{pmatrix}$

b. $\mathbb{A}^{-1} = \begin{pmatrix} 1 & -0{,}5 \\ -2 & 3 \end{pmatrix}$

c. $\mathbb{A}^{-1} = \begin{pmatrix} 1{,}5 & -1 \\ -0{,}25 & 0{,}5 \end{pmatrix}$

d. $\mathbb{A}^{-1} = \begin{pmatrix} 1{,}5 & 0{,}25 \\ 1 & 0{,}5 \end{pmatrix}$

e. $\mathbb{A}^{-1} = \begin{pmatrix} 1{,}5 & -0{,}25 \\ -1 & 0{,}5 \end{pmatrix}$

Physics

B.1 Velocity

A projectile is launched from level ground with an initial speed v_0 at an angle α with the horizontal. If air resistance is negligible, how long will the projectile remain in the air?

Select one:

a. $\frac{v_0 \sin \alpha}{g}$

b. $\frac{v_0 \cos \alpha}{g}$

c. $\frac{2v_0 \sin \alpha}{g}$

d. $\frac{2v_0}{g}$

e. $\frac{2 \cdot v_0 \cdot \cos \alpha}{g}$

B.2 Distance, Mass, Velocity

A 300-Watt electric wheelchair has a mass of 50 kg, and carries its 50 kg occupant at constant velocity up a long ramp. About how much time does it take the wheelchair to reach the top of the 10-meter high ramp?

Select one:

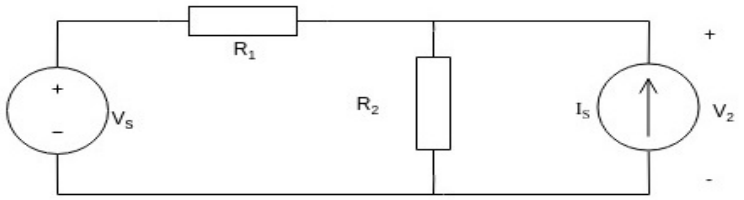
- a. 50 s
- b. 100 s
- c. 33 s
- d. 20 s
- e. 10 s

Electrical Engineering

C.1 Electrical Circuits

Consider the following circuit.

where: $V_s = 12$ V $I_s = 4$ A $R_1 = 3\ \Omega$ $R_2 = 1\ \Omega$



Find Voltage V_2.

Select one:

- a. 4 V
- b. 2 V
- c. 4 A
- d. 6 V
- e. 8 V

System Theory

D.1 Periodic Time Signals

Which of the signals described below is a periodical time signal?

Select one:

- a. $x(t) = t^2$
- b. $x(t) = a\,t + b$
- c. $x(t) = a0 \sin \omega t$
- d. $x(t) = K$

Control Engineering

E.1 Control Loops

A control loop transfer function has the form:

$$F(s) = \frac{1}{s^2/\omega 0 + 2D/\omega 0\, s + 1}$$

In which value range of the parameter D (damping) does the transient response of the controlled variable y show no oscillating behaviour?

Select one:

- a. $0 < D < 1$
- b. $D > 1$
- c. $D < 0$

F.1 Model-View Controller

What is the "Model-View-Controller"?

Select one:

- A design pattern.
- It is used to model databases.
- A machine learning technique.
- A programming language.

F.2 Algorithm Calculation

F.3 Binary Trees

F.4 Time Complexity

$n^4 + 100 * n^2 + 2^n$ is

Select one:

- $O(2^n)$
- $O(1)$
- $O(n^4)$
- $O(100)$

F.5 Programming Languages and Expressions

Solution Key for Sample Tasks

A.1

Final answer: $g'(x)=\frac{1}{2\,a^2}\frac{a^2-x^2}{a^4+x^4}$, $h'(x)=\frac{1}{2\,a^2}\frac{a^2+x^2}{a^4+x^4}$, $f'(x)=\frac{1}{a^4+x^4}$

A.2

A: 1, B: 3, C:2, D: 4

A.5

c)

B.1

c)

B.2

c)

C.1

d)

D.1

c)

E.1

a)

F.1

a)

F.4

a)


Good Luck!