



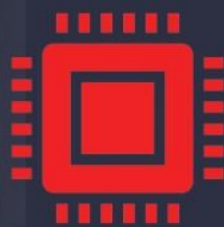
# ELECTRONICS

## INITIAL ASSIGNMENT

Electronics Candidate  
Gadjah Mada Aerospace Team

1. Explain about serial communication (the definition, working principle, and types of serial communication) !
2. Why is MOSFET better than diodes in reverse polarity protection ?
3. Explain how the transistor works (at least 2 transistors) !
4. How do we calculate and measure the battery capacity in electronic circuits ?
5. Design PCB with the following requirements ! :
  - a. System with data acquisition of one to two sensors
  - b. One microcontroller
  - c. Power scheme of the system
6. System is designed with the lightest possible weight so it needs modification in the power circuit. System needs a voltage of 5 volts with long lasting power. The available components are listed below:
  - a. One 5 volt battery with capacity of 1500 mAh and weight of 300 gram
  - b. Two 2,5 volt batteries with capacity of 800 mAh/battery and weight of 100 gram/battery
  - c. MT3608 buck converter with weight of 150 gram

Design a suitable battery configuration for the system and explain the reasons for choosing that configuration !



# HARDWARE PROGRAMMER

## INITIAL ASSIGNMENT

Hardware Programmer Candidate  
Gadjah Mada Aerospace Team

This signifies the start of your first task to become eligible for the role of Hardware Programmer at Gadjah Mada Aerospace Team (GMAT). Each mission query holds its own evaluation significance. Approach it with your best effort and thorough understanding. Refrain from simply duplicating and copy-pasting answers. We will delve deeper into your responses in the future. Last, just chill! Don't force yourself.

**You need to answer basic and advanced questions. For a bonus mission, it is optional.**

### BASIC

The questions provided below aim to evaluate your understanding of fundamental programming concepts and microcontroller operations.

1. Explain what you know about data types in the programming language! Provide a comprehensive explanation!
2. What is your knowledge about microcontrollers? Mention a specific microcontroller you'd like to learn about and why!
3. Which programming language are you interested in learning for microcontroller programming? Give your reasons!
4. Share your insights on various frameworks and tools used in microcontroller programming! What do you know about Arduino IDE, ESP-IDF, Eclipse, and PlatformIO for microcontroller programming? Provide your tier list for these tools and explain why!

### ADVANCE

To excel in the role you applied for, a deeper understanding of various concepts in microcontroller programming is required. This section provides some elements to demonstrate your readiness.

1. Explain about UART, SPI, and I2C communication!
2. List the modules used for wireless data transmission! Create a tier list and provide a brief explanation for the tier list you've made!
3. According to the tier list you've created on question Advance no. 2, what is the top choice for wireless modules? State your reasons for choosing that module as the best! Is the choice you consider the best suitable for future GMAT missions, both for satellite models and vertical landing?
4. Can you provide information on the utilization of filters in processing sensor data? Include an example and an explanation!
5. List different types of control systems and offer brief descriptions for each. Additionally, could you identify the optimal control system from the aforementioned list? Please provide the reasoning behind your choice!



6. Based on the specifications and tasks outlined in the Teknofest Vertical Landing guidebook 2022, do you think the optimal control system that you mentioned in question number 5 is suitable for this mission?

### BONUS MISSION

The bonus mission contains questions about problem analysis and building code for the given problem. This bonus mission provides additional points for your accumulated score. Work on it to the best of your ability and provide a **detailed analysis and clear explanation**.

A captain from a random satellite company received a message from an unknown alien figure. However, due to his lack of knowledge, the captain couldn't read the message provided. The message contains \*GMAT#JUARA\$2024!JAYA@. Help the captain parse this message.

The expected message for the captain is:

- Message 1 = GMAT
- Message 2 = JUARA
- Message 3 = 2024
- Message 4 = JAYA



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# MECHANICS



## INITIAL ASSIGNMENT

Mechanical Candidate  
Gadjah Mada Aerospace Team

**Reminder : Do not use Artificial Intelligence in any form when you are doing this assignment! There will be several consequences if you are caught using it. It is recommended that you do your own research and answer all the questions with your own understanding about the topic.**

### 1. Theoretical Questions

- List and explain the stages of designing a product/tool! (stages can start from needs research/market research)
- When designing a product, the most crucial stage in geometric modeling is creating geometry that doesn't have concentrated stress. Mention ways to minimize stress concentration and explain how these methods can reduce stress concentration!
- Briefly explain and provide examples (attach screenshots) of geometric modeling features in software like Inventor, such as sketch, extrude, revolve, sweep, and loft!
- Explain everything you know about additive manufacturing methods!
- List and explain welding methods, highlighting their advantages and disadvantages!

### 2. Study Case

You are doing a drop test on a satellite model. During the test, the landing system parachutes did not open, causing the satellite model to fall freely to the ground. As a result of being hit by the ground, the column/rod that you made from 3D printed PLA broke with all component of the model satellites damaged. So to prevent something similar happen again, your team leader urges you to replace the column (rod) material:

- What material will you use to replace PLA? Explain the advantages and disadvantages of the new material in terms of mechanical properties and cost!
- It turns out that your team's budget is not enough to buy the material, BUT you still have a lot of PLA filament left. Look for ways you can fix the previous problem without having to buy new material. Explain why your solution can solve the problem!

\*Note : a sketch is desirable to explain your answer

In CANSAT USA Model Satellite Competition, you are required to be able to successfully land a Drop Test in front of the judges in order to gain an access to flight with the rocket and that means an automatic disqualification. But during the test, your Model Satellite failed to land a drop test. The reason for that failure is that your separation mechanism does not work as it is supposed to and you are given a chance to do it one last time the next day.

- a) Since you have a very short time to fix that problem, what solution would you take to land the drop test tomorrow? ( If its another separation mechanism, could you specify it by describing your design with reasons, calculations, and a sketch. )
- b) What solution would you suggest in order to prevent that from happening next time?







# SOFTWARE PROGRAMMER



## INITIAL ASSIGNMENT

Software Programmer Candidate

Gadjah Mada Aerospace Team

### Coding Assignment

\* Bahasa pemrograman bebas. Minimum satu soal dijawab menggunakan bahasa Java.

#### 1. Soal 1 : SELEKSI DATA TELEMETRI

##### Deskripsi

Pada perlombaan *model satellite* yang diikuti GMAT, salah satu tugas *Software Programmer* adalah menerima data telemetri yang dikirimkan *model satellite*. Namun, terkadang terdapat *error* sehingga data telemetri yang diterima tidak valid.

Diberikan sebuah string id team  $S$  yang digunakan dan  $N$  baris data berupa string. Suatu data yang valid harus memiliki format sebagai berikut:

id\_team,clock,latitude,longitude,altitude,voltage;

Untuk setiap baris data, tentukan apakah data tersebut valid atau tidak. Suatu data dikatakan valid apabila memenuhi syarat berikut:

- Data dapat dipisah berdasarkan tanda koma menjadi tepat 6 nilai: data[0], data[1], ..., data[5].
- Data diakhiri dengan tanda titik koma (;).
- Nilai data[0] yang merepresentasikan id team harus sesuai dengan id team  $S$  yang digunakan.
- Nilai data[1] yang merepresentasikan clock harus memiliki format “hh:mm:ss”.
- Nilai data[2], data[3], ..., data[5] tidak boleh kosong.

##### Format Masukan

Baris pertama berisi sebuah string  $S$  yang menyatakan id team yang digunakan.

Baris kedua berisi sebuah bilangan bulat  $N$  yang menyatakan banyaknya data.

$N$  baris selanjutnya berisi sebuah string yang merupakan data yang diterima.

##### Format Keluaran

Untuk setiap baris data, keluarkan “VALID” apabila data tersebut valid atau “TIDAK” apabila data tidak valid.

##### Contoh Masukan

00403

6

00403,12:32:17,7,110,500,12;

00403,12:33:21,8,109,490,12;

00404,12:33:49,7,109,490,12;  
 00403,12:34:23,6,110,480,12;00  
 00403, ,7,110,480,12;  
 00403,12:35:32,7,111,480,12,15;

#### Contoh Keluaran

VALID

VALID

TIDAK

TIDAK

TIDAK

TIDAK

#### Penjelasan

Pada data di baris ke-3, id team 00404 tidak sesuai dengan id team 00403

Pada data di baris ke-4, data tidak diakhiri dengan tanda titik koma (;)

Pada data di baris ke-5, tidak terdapat data clock, sehingga tidak memenuhi format “hh:mm:ss”

Pada data di baris ke-6, barisan data dipisahkan berdasarkan koma menghasilkan 7 nilai

## 2. Soal 2 : ALARM SYSTEM

#### Deskripsi

Pada perlombaan *model satellite*, dapat terjadi kegagalan atau *error* pada mekanisme tertentu pada *model satellite*. Contohnya adalah ketika terjadi kegagalan pada parasut sehingga altitude atau ketinggian *model satellite* menurun secara drastis.

Pada kasus tersebut, tugas *Software Programmer* adalah membuat Interface Alarm System (IAS) yang menampilkan alarm apabila terjadi suatu kegagalan. Data yang menunjukkan terjadinya kegagalan tertentu pada *model satellite* dikirimkan dalam bentuk Error Code. Berikut adalah contoh Error Code dan Alarm Systemnya:

1	2	3	4	5
■	■	■	■	■

ERROR CODE: <01001>

(Science Payload descent rate deviation and release failure)

Berikut adalah peringatan untuk kode error 1 sampai 5:

1. Terjadi kegagalan pada descent rate Container
2. Terjadi kegagalan pada descent rate Science Payload
3. Terjadi kegagalan data posisi Container
4. Terjadi kegagalan data posisi Science Payload

#### 5. Terjadi kegagalan release/separasi

Error Code tersebut digunakan dalam bentuk kode biner, yaitu Error Code bernilai 1 apabila terjadi kegagalan. Meskipun demikian, pada data telemetri, pengiriman Error Code dalam bentuk string biner dinilai kurang efisien, sehingga data Error Code dikirimkan dalam bentuk bilangan bulat, yaitu langsung sebagai bit.

Diberikan sebuah bilangan bulat  $x$  yang merupakan Error Code pada data telemetri. Tentukan apakah ada kegagalan yang akan ditampilkan pada Interface Alarm System. Apabila terjadi satu atau lebih kegagalan, tampilkan pesan peringatan untuk semua kegagalan tersebut. Apabila tidak terjadi kegagalan, tampilkan pesan “Tidak terjadi kegagalan”

##### **Format Masukan**

Masukan terdiri dari satu baris berisi sebuah bilangan bulat  $x$  yang merupakan Error Code pada data telemetri.

##### **Format Keluaran**

Keluaran terdiri dari pesan peringatan untuk semua kegagalan yang terjadi atau pesan “Tidak terjadi kegagalan” apabila tidak terjadi kegagalan.

##### **Contoh Masukan 1**

9

##### **Contoh Keluaran 1**

Terjadi kegagalan pada descent rate Science Payload

Terjadi kegagalan release/separasi

##### **Penjelasan Contoh 1**

Error Code 9 menunjukkan Error Code 01001 dalam bentuk kode biner, maka program mengeluarkan pesan peringatan untuk kode error 2 dan 5.

##### **Contoh Masukan 2**

0

##### **Contoh Keluaran 2**

Tidak terjadi kegagalan

##### **Penjelasan Contoh 2**

Error Code 0 menunjukkan Error Code 00000 dalam bentuk kode biner, maka program mengeluarkan pesan bahwa tidak terjadi kegagalan.

##### **Contoh Masukan 3**

31

##### **Contoh Keluaran 3**

Terjadi kegagalan pada descent rate Container

Terjadi kegagalan pada descent rate Science Payload

Terjadi kegagalan data posisi Container

Terjadi kegagalan data posisi Science Payload

Terjadi kegagalan release/separasi

### Penjelasan Contoh 3

Error Code 31 menunjukkan Error Code 11111 dalam bentuk kode biner, maka program mengeluarkan pesan peringatan untuk kode error 1, 2, 3, 4, dan 5.

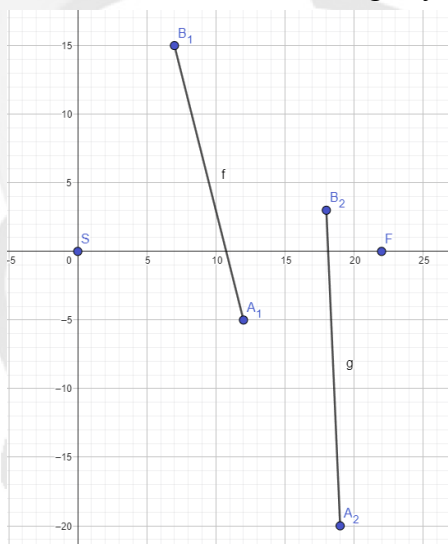
## 3. Soal 3 : ROBOT PATHFINDING

### Deskripsi

Pada perlombaan Aerospace Robot Programming Challenge, *Software Programmer* bertugas untuk membuat program yang mengendalikan robot Astrobees untuk mencapai target dan menghindari rintangan tertentu.

Pada kasus ini, diberikan  $N$  rintangan berupa segmen garis pada bidang dua dimensi. Kita ingin menentukan jalur dengan jarak minimum untuk menggerakkan robot Astrobees dari titik start  $S$  hingga titik finish  $F$  tanpa menabrak rintangan.

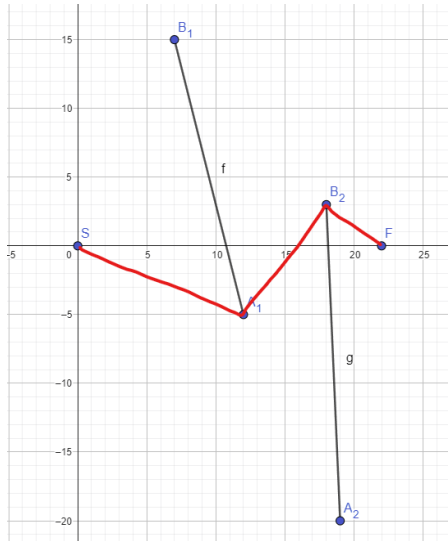
Berikut adalah contoh rintangan yang diberikan:



Titik  $S$  dan  $F$  menunjukkan titik start dan titik finish robot Astrobees yang diinginkan. Segmen garis  $f$  dan  $g$  pada gambar tersebut menggambarkan contoh rintangan.

Berikut adalah jalur dengan jarak minimum yang dapat dilalui oleh robot Astrobees pada contoh tersebut:





Pada contoh tersebut, koordinat-koordinat titik start, finish, dan segmen garis rintangan diberikan sebagai berikut:

$S(0, 0)$

$F(22, 0)$

$A_1(12, -5)$  dan  $B_1(7, 15)$

$A_2(19, -20)$  dan  $B_2(18, 3)$

Maka, jalur dengan jarak minimum yang tidak menabrak rintangan adalah jalur yang berturut-turut melalui titik  $S$ ,  $A_1$ ,  $B_2$ , lalu  $F$ . Yaitu dengan jarak:

$$\begin{aligned}
 & \text{Panjang } SA_1 + \text{Panjang } A_1B_2 + \text{Panjang } B_2F \\
 &= \sqrt{(12-0)^2 + (-5-0)^2} + \sqrt{(18-12)^2 + (3-(-5))^2} + \sqrt{(22-18)^2 + (0-3)^2} \\
 &= \sqrt{12^2 + 5^2} + \sqrt{6^2 + 8^2} + \sqrt{4^2 + 3^2} \\
 &= 13 + 10 + 5 \\
 &= 28
 \end{aligned}$$

Jadi, jalur dengan jarak minimum adalah jalur dengan jarak 28 satuan.

### Format masukan

Baris pertama berisi dua bilangan bulat  $S_x$  dan  $S_y$  yang menyatakan koordinat x dan y titik  $S$

Baris kedua berisi dua bilangan bulat  $F_x$  dan  $F_y$  yang menyatakan koordinat x dan y titik  $F$

Baris ketiga berisi sebuah bilangan bulat  $N$  ( $1 \leq N \leq 10$ ) yang menyatakan banyaknya rintangan

Kemudian  $N$  baris selanjutnya masing masing berisi empat buah bilangan bulat  $A_x$   $A_y$   $B_x$   $B_y$  yang berturut-turut menyatakan koordinat x dan y titik  $A_i$  dan  $B_i$  yang menyatakan segmen garis rintangan ke- $i$ .

Koordinat x dan y untuk setiap titik memenuhi  $-10^3 \leq x, y \leq 10^3$ .

**Format keluaran**

Keluarkan sebuah bilangan yang menyatakan jarak minimum dari jalur yang dapat ditempuh Astrobee untuk mencapai titik  $F$  dari titik  $S$  tanpa menabrak rintangan.

Jawaban dianggap benar apabila selisih absolut dengan solusi asli tidak lebih dari  $10^{-6}$ .

**Contoh Masukan 1**

0 0

22 0

2

12 -5 7 15

19 -20 18 3

**Contoh Keluaran 1**

28.000000

**Penjelasan Contoh 1**

Contoh 1 merupakan contoh kasus yang terdapat pada deskripsi soal

**Contoh Masukan 2**

2 2

6 3

1

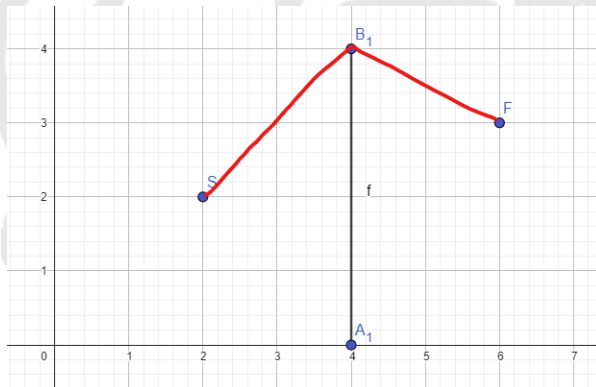
4 0 4 4

**Contoh Keluaran 2**

5.064495

**Penjelasan Contoh 2**

Berikut adalah jalur dengan jarak minimum untuk contoh 2



Jarak pada jalur tersebut adalah

$$\begin{aligned}
 & \text{Panjang } SB_1 + \text{Panjang } B_1F \\
 &= \sqrt{(4-2)^2 + (4-2)^2} + \sqrt{(6-4)^2 + (3-4)^2} \\
 &= \sqrt{4+4} + \sqrt{4+1} \\
 &= \sqrt{8} + \sqrt{5} \\
 &\approx 5.064495
 \end{aligned}$$

*Hint: Jawaban dapat menggunakan algoritma Dijkstra.*



# TELEMETRY



## INITIAL ASSIGNMENT

Telemetry Candidate  
Gadjah Mada Aerospace Team

Answer each question as completely as you are able to. Make sure to answer all the questions. You can use any source reference, so feel free to ask Google, books, journals are also allowed.

Please answer in English, in case you are unsure about the composition or the context you can use Indonesian after your English answer.

Good Luck!!

### A. Theoretical Assignment

1. What do you know about telemetry?

#### Question about antenna in general

2. Explain about antenna and mention (no need to explain) antenna parameters!
3. Mention 3 omnidirectional antennas and 3 directional antennas
4. The wavelength ( $\lambda$ ) of an antenna that has a frequency of 433 MHz is ...m
5. The best SWR (Standing Wave Ratio) value is...
6. For achieving the best SWR (and therefore gaining maximum transfer power), the impedance of the antenna and the transmitter must be...

#### Question about Yagi-Uda Antenna

7. Explain what the driven, dipole, and reflector of Yagi-Uda antenna and their function!
8. If we want to increase the gain of the Yagi-Uda antenna, what should we do?
9. In case, when yagi uda antenna design software doesn't give the best SWR in application. What should we do to fix it?

#### Question about Coax and Connector

10. What do you know about coaxial cable?
11. Name 3 coaxial cable that has 50 $\Omega$  impedance!
12. What do you know about SMA and RP-SMA connectors?
13. Explain the difference between SMA and RP-SMA Connectors

#### Question about VNA analyzer

14. What do you know about VNA analyzers?
15. In GMAT, we use RigExpert™. What is the meaning of AA-1000 and AA-600? What will happen if we test 2.4GHz with RigExpert AA-1000?

16. Why is calibration important in a VNA analyzer?

### **Question about LoRa**

17. What do you know about LoRa and how does it work?

18. Explain the differences between LoRa and LoRaWAN

Answer each question as completely as you are able to. Make sure to answer all the questions. You can use any source reference, so don't be afraid to ask google, books, journals are also allowed.

Please answer in English, in case you are unsure about the composition or the context you can use Indonesian after your english answer.

Good Luck!!

