PROGRAM INOVASI PENYELIDIKAN SAINS MIRKOGRAVITI
PERINGKAT UNIVERSITI 2012 *(PARABOLIC FLIGHT)*

MOSTI ANGKASA MALAYSIA

REQUEST FOR PROPOSAL (RFP)

Program Inovasi Penyelidikan Sains Mikrograviti Peringkat Universiti 2012 (ParabolicFlight)

ORGANIZED BY:
Agensi Angkasa Negara (ANGKASA)

SUPPORTED BY:
Ministry of Higher Education (MOHE)

RFP SUBMISSION DEADLINE:
20th July 2012

www.angkasa.gov.my

Urus Setia
Program Inovasi Penyelidikan Sains Mikrograviti Peringkat Universiti 2012
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CONTENT

1.0 INTRODUCTION

The program is organized for the 5th time since 2007 by the National Space Agency of Malaysia, Ministry of Science, Technology and Innovation (MOSTI) in collaboration with the Japan Space Exploration Agency (JAXA), Japan.

The objective of this programme is as below:

i) Offering an opportunity for undergraduate students to explore and expand their minds in science and technology as well as to find new methods of experiments as a kind of new challenges; and

ii) To provide students from a diverse range of research fields, including science and engineering fields, with an opportunity to participate in conducting microgravity experiments, to promote greater awareness on the utilization of the space environment, and to develop human resources for future space related development activities.

For the year 2012, this educational program is held in conjunction with *"Tahun Sains dan Gerakan Inovasi Nasional (SGI) 2012"*, in order to promote greater awareness on the utilization of the space environment and to develop human resources for future space related activities. This activity also been supported by the Ministry of Higher Education (MOHE).

The Parabolic Flight competition is designed to promote students with the opportunity to express their creative and innovative ideas in conducting microgravity experiment. Participants are requested to submit research proposals on experiments under microgravity environment which can be performed through a parabolic flight. The programme comprises of writing a mission proposal, including generating design, documentation, presentation and finally getting the opportunity of conducting the microgravity experiment.

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The National Steering Committee Meeting of Microgravity Science will select the best proposal to be awarded as Innovative Science Microgravity Research Award 2012. The selected experiments will be evaluated by Asian KIBO Task Force Meeting and will have the opportunity to be tested under microgravity environment which will be held in Nagoya, Japan in December 2012 through Parabolic Flight by GII Aircraft.

The most important aspect of this programme is that each team will learn many important aspects that could be applied throughout their professional career.

2.0 GENERAL DESCRIPTION

Description of Microgravity Environment Performed Through Parabolic Flight

Many scientific experiments are conducted in outer space by utilizing the most significant characteristic of the space environment -- microgravity, (weightlessness or non-gravity) conditions. While it is not possible on Earth to get microgravity environment for a long period of time, it can be obtained for short periods of time (from several seconds to tens of seconds) by using a free-fall test facility or inside of an aircraft flying in a parabolic arc ("parabolic flight"). The microgravity environment created in parabolic flights is mainly used for brief microgravity experiments, pre-tests of space experiments and verification of equipments to be used in space.

Approximately 20 seconds of microgravity (also referred to as weightlessness) conditions can be performed inside an aircraft through parabolic flight maneuvers. The participants may fly aboard on the parabolic flight and conduct their scientific and technological experiments and/or demonstrations by utilizing this microgravity environment.

The following items are provided to support the students in understanding the overall flight experiment development process: -

a) Dynamics of microgravity (parabolic flight)

Information on the dynamics of simulating microgravity conditions, as provided from the Diamond Air Service (DAS) website http://www.das.co.jp/new_html_e/service/01.html.

b) Summary of the aircraft (G-II)

The aircraft used for this Flight Experiment contest is a Gulfstream II (G-II), owned by DAS. The aircraft has two rear mounted jet engines. A photo of the aircraft is shown in **Figure 1**.

Figure 1: Gulfstream-II (G-II) aircraft

c) Inside view of the aircraft

View of the inside of the aircraft showing the experiment racks and seats is shown in **Figure 2**.

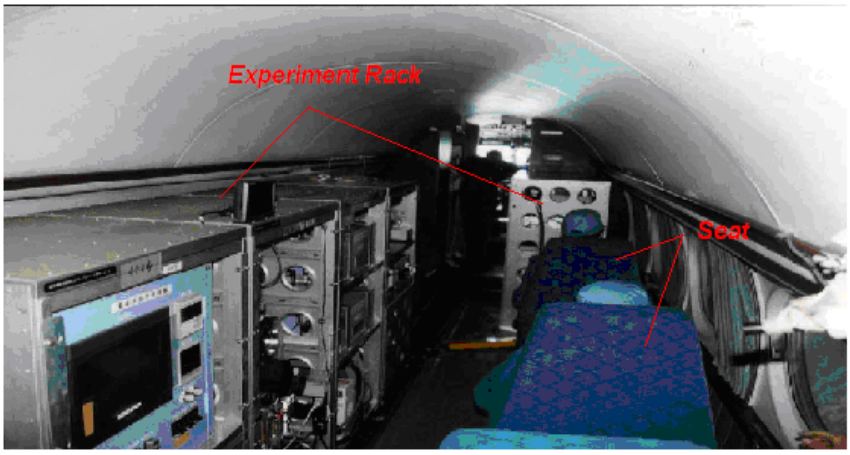

Figure 2: Arrangement inside of the G-II aircraft

d) Spaces for Experiment

The layout inside of the aircraft is shown in **Figure 3**. Since the student's experiments will share space with the researchers from the "Solicitation of Ground-Based Research Related to the Space Environment Utilization", the students will perform their experiments in the experiment rack, while remaining seated in the passenger's seat.

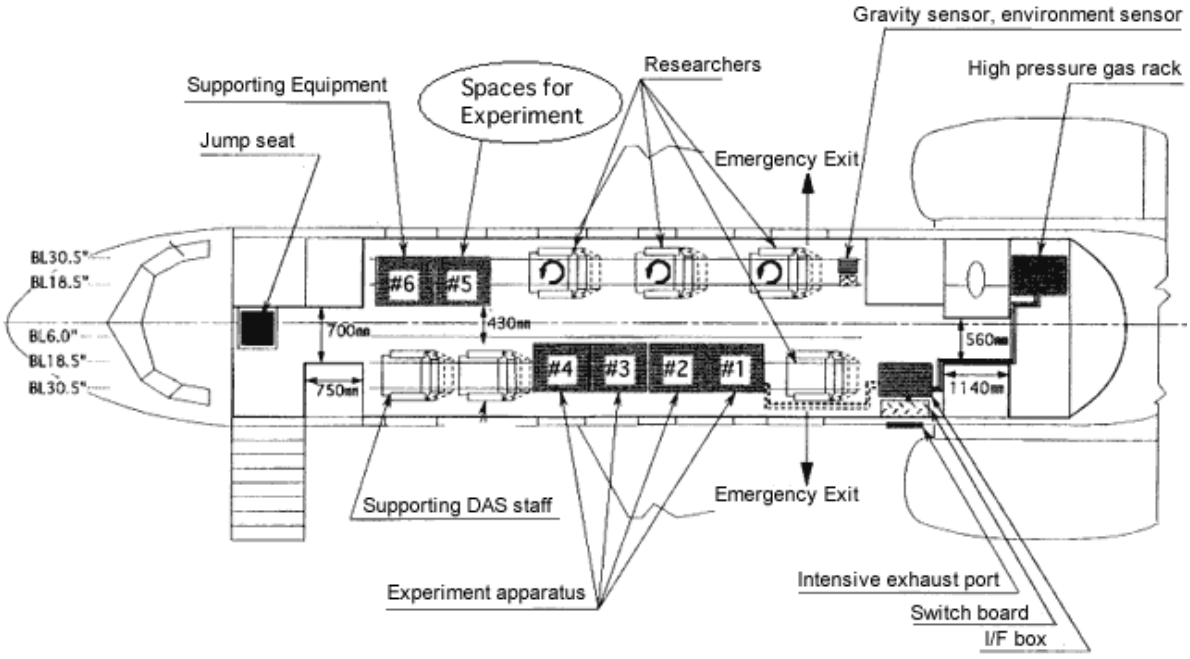

Figure 3: Layout inside of the aircraft

e) The overview of the rack to install the student's experiment apparatus as Figure 4

Figure 4: The experiment rack inside the aircraft.

- The installation space for the student's experiment apparatus is located on the shelf of Rack A

  Width: 600mm

  Depth: 500mm

  Height: 500mm

- The apparatus must be designed so that it can be fit into the space.
- The apparatus should not be installed directly to the rack. Instead, the experiment apparatus should be placed on a platform that DAS will provide.
- The experiment apparatus can be operated only from the front side of the experiment apparatus during the flight.

3.0 APPLICATION GUIDELINES

Participants Qualification Requirements

The applicants must be enrolled in local universities and should meet the following requirements:

i. The applicant should be fully responsible for conducting their experiments and for presenting the results throughout the duration of the contest;
ii. The applicant must be able to develop the experimental apparatus by him/herself;
iii. The applicant must comply with the **'RESTRICTIONS'**, "**TECHNICAL DETAILS**" or **any requirements in this RFP documents** as specified below;
iv. The candidates must be Malaysian Citizens and undergraduates in any public and private universities in Malaysia;

v. The team should consist of:
   a. At least two (2) undergraduate students from same or various discipline and compose of year 1 to year 4;
   b. One academic staff (all team entering this programme are requested to have one academic staff as advisor). The advisor shall oversee and be responsible for the conduct of the team at all times during the programme and it is a must to accompany the teams to all briefing or meeting requested by ANGKASA.

Restrictions

The student's experiments will fly along with the Solicited Ground Based Research experiments, which JAXA has commissioned JSF to conduct. For this reason, the following restrictions must be observed.

1. The space and electricity provided from the aircraft for the experiments in the aircraft will be limited. An experiment must not interfere with any other experiments that are sharing the flight.(complete information on the item in '**Technical Details'**)
2. Experimental design must fit into the rack provided; no floating experimental design is allowed.
3. A general caution applies in the aircraft, in that, any experiments that use liquids, such as water or oil, must be contained in a sealed container.

4.0 TECHNICAL DETAILS

Quality of microgravity performed by parabolic flight experiments:

The quality of microgravity in the aircraft is about 10^{-2} G but the duration is about 20 seconds. The quality of only 10^{-2} G is due to air resistance and turbulence in the airspace. The aircraft flies at low altitudes where the air influence can be substantial.

Reasons for choosing aircraft experiment (parabolic flight):

1. Microgravity of long duration (20 seconds for a cycle).
2. Able to ascertain tendency in responses as a phenomenon.
3. Able to change parameters manually while observing the result of the experiments.

Animal Related Experiment

Experiments involving animals, insects or organism should be conducted inside sealed containers. But the experiments are subject to approval from JAXA Ethic Committee which need to be obtained a month before flight.

Conditions of the Experiment

(1) Duration of microgravity conditions:
Approximately 20 seconds achieved through parabolic flight.

(2) Experiment must no be interfered to:

a. Flight systems
b. Other experiments

(3) Number of flights:
Planned 2 flights (One per day, 2 hours in duration)
During one flight (2 hours), approximately 8 to 15 opportunities to conduct microgravity experiments (approximately 20 seconds each) will be possible. This number varies depending on the weather and other conditions.

(4) Participants to fly on board:
One member from each team may fly on board to conduct their experiments per flight.

(5) Resources for Experiments

Working space provided

The installation space for experiment apparatus is located on the shelf of rack (width 600mm x depth 500mm x height 500mm).

Power supply available

A 28 VDC (5 Amp) supply and a 100 VAC (with 60 Hz, 3 Amp (300W)) supply are available to power your rack-mounted equipment. Please be informed that the power supply will stop while the aircraft moves out from the hangar and while starting the engine. If your experimental equipment still needs the power during that period, you will have to include an independent power supply such as a battery to your experimental equipment.

You may use Japanese types of power supply connector (**Figure 5**). You may also use any universal converter plug connector to suite with the Japanese standard requirement for electrical power supply.

Please consider for cable lengths of the on board support equipment.

Figure 5: Japanese types of power supply connector.

Weight Restrictions

Please ensure that the total weight all of the experiment equipment loaded into the aircraft is not more than **50 kg**.

Cameras

2 CCD cameras (ELMO, CC421; Lens focal length 7.5mm and 15mm (2 each)), 2 Video Cameras (SONY Handy Camera TR2000), 2 VTR LCD monitors (SONY LC84RV (8 inch)) etc., may be lent for use (subject to availability and request).

Interface Coordination Items

This section describes the aircraft interfaces that the experimental equipment must follow. Please use this section as a reference before starting to develop your experiment equipment.

Lending of racks

DAS will do a pre assemble of your experimental equipment into an inner rack. This inner rack will be mounted to the outer rack to be fastened (Refer to **Figure 6**).

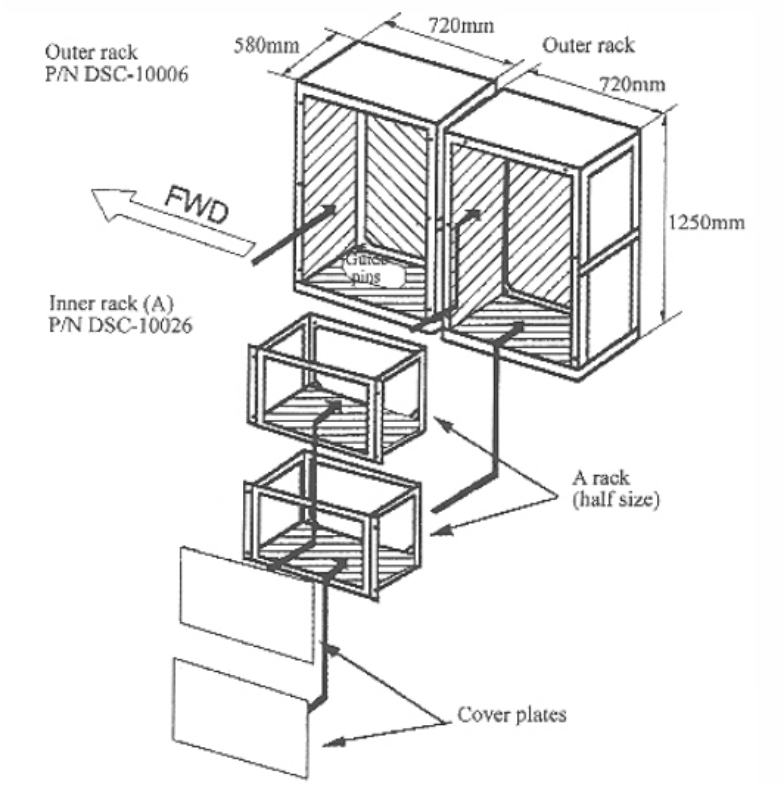

Figure 6: Detail of the experiment rack arrangement inside the G-II aircraft.

Use of external exhaust

This system consisting of two independent subsystems, evacuates unneeded gas out of the aircraft by utilizing the internal-external pressure differential. Gas is released to the atmosphere by opening a shut-off valve. This system must be used when an experiment releases smoke, odor or large amount of atmospheric gas because the inside of the aircraft is sealed. Fabricate experimental equipment so that gas will not circulate inside the aircraft and perform a thorough leakage check before fly.

Safety consideration of experiment

Since the aircraft is pressurized, there is almost no ventilation or exhaust to outside. Fire, smoke, explosion, high temperature, high pressure and oxygen consumption are extremely hazardous to the aircraft operation. To avoid these situations, duplicate and triplicate safety mechanism must be designed into experimental equipment against all possible failure modes.

Use fireproof materials in the fabrication of the experimental equipment. Wherever possible, please avoid materials such as glass that can shatter easily. Place protective covers around lights and CRT monitors to prevent the dispersion of broken glass.

Use electrical wiring with fireproof and heat-resistant sheathing. Select wiring suitable for the power. Use connector and terminals to prevent aircraft vibration or gravitational changes from disconnecting wires or causing poor connections.

Ground-level interface test

Electromagnetic interference (EMI) tests are to ensure that there is no electromagnetic interference equipment on the aircraft (cockpit instruments, communication and navigation systems) or from the aircraft system to the experimental equipment that adversely affects the experiment.

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5.0 MICROGRAVITY EXPERIMENTS OPPORTUNITY

The flight experiment opportunity is as follows:

a) At least two Malaysian students team can make the parabolic flight experiment in December 2012 at Nagoya Airport in Japan.

b) At least 2 flights opportunities are available (1 flight per day) for the Malaysian student team.

c) One team member can fly and perform the experiment in the flight.

d) No additional flight will be allowed even if the experiment data is not obtained due to the negligence or mistake by the Participant.

6.0 SELECTION CRITERIA

The proposals submitted will be evaluated based on the following criteria:

- Whether the experiment fully utilizes the microgravity and hyper-gravity environments. The experiment apparatus must have or be able to have the capability of achieving the proposal's stated goal.
- Experiment's Content: Whether the logic and experiment plan is coherent and matches the purpose of the proposed experiment. In addition, whether the proposed experiment equipment has the potential to produce any significant scientific, cultural or artistic results.
- Team Organization: Whether the structure of the team is appropriate for effectively conducting the experiment.
- Feasibility: Whether the development of the experiment apparatus is possible, and whether the experiment's equipment meets all safety and resource requirement as part of the aircraft's payload requirements.

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7.0 SELECTED TEAM

The target group of participant for this program is local public and private universities. Each university needs to establish a team of at least 2 undergraduate students (maximum of 5 students) from the same or various disciplines and comprises year 1 to year 4 students. However, only one person will be allowed to fly in the parabolic flight. The team should be advised by one research advisor (Academic staff).

8.0 ARRANGEMENT

An implementation arrangement will be executed and exchanged between the University of the Selected Experiments and ANGKASA in order to conduct the experiment.

9.0 DATA ANALYSIS

Discussion of how data analysis will be performed shall be presented. This should include a list of data to be analyzed and hardware and/or software requirement for data analysis.

10.0 EXPERIMENTS RESULTS

The experiment's results must be conveyed in a report and submitted in April, 2013. Students will also be asked to make a presentation on the results in a suitable workshop/seminar organized by relevant agencies.

11.0 FINANCIAL SPONSORSHIP

ANGKASA will sponsor **accommodation and airfare tickets** of **2 students and 1 research advisor** to Japan. ANGKASA will also sponsor up to **RM 10,000.00 per team** of the top two selected winning proposal for research material & supply including experiment development cost. JAXA will provide flight experiment opportunity on the Diamond Air Service Gulfstream II (G-II) aircraft at Nagoya Airport.

For travel expenses within Japan and insurance, JAXA will pay travel expenses and insurance for up to three people for traveling within Japan to conduct the flight experiment. For teams with members greater than three, the additional team member(s) will be responsible for and must pay for all of their own expenses.

12.0 NOTIFICATION OF SELECTED PROPOSAL (STUDENT TEAM)

The National Steering Committee Meeting of Microgravity Science will select the best three proposals to be awarded as Innovative Young Scientist Microgravity Research Awards 2012.

The selected experiment will be evaluated by Asian KIBO Task Force Meeting and will have the opportunity to be tested under microgravity environment which will be held in Nagoya, Japan in December 2012 through Parabolic Flight by GII Aircraft. The candidate will be notified whether go or no go for the mission flight in September 2012.

13.0 OWNERSHIP, USE OF RESEARCH AND DEVELOPMENT (R&D) AND PUBLICATION

All R&D equipment purchased under the project will belong to the university in which the student teams are selected. The maintenance of such equipment should be borne by the university. However, such equipment is not for exclusive use of the university only but ought to be shared with other research organizations.

The result of the experiment will be used for publications in which the publishing parties (JAXA, ANGKASA and the University) shall add a statement to the publication which indicates, as appropriately, that the results have been obtained from the cooperation between both parties. The parties shall coordinate with each other in advance concerning the publications which have relation to the other's activities.

14.0 MONTHLY REPORT

Each selected team is required to submit a Monthly progress report of experiment (including the design and the ground experiment result) to the ANGKASA parabolic flight programme secretariat at the address below:

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Lot 2233, Kg. Sg. Lang,
47200 Banting, Selangor
(U.P: En. Mohd Helmy Bin Hashim)
(helmy@angkasa.gov.my)

15.0 CONDUCTING THE EXPERIMENT

- Anyone flying on board the aircraft must undergo a medical check-up and submit the medical results. The results will be used to confirm that he/she meets all health requirements for flying on board the aircraft. The form for medical check-up is attached in **Appendix 3**.

- The applicant will be required to prepare the experimental apparatus to be flown in the aircraft and to perform pre-experiments at the institute he/she is affiliated with. Safety approval must be obtained for the experimental apparatus from the Civil Aviation Bureau of the Ministry of Land, Infrastructure and Transport, for which JAXA will provide technical support.

- The three parties, Researchers from the Solicited Ground Based Researches, JAXA and the students team members will make the necessary interface adjustments (i.e., eliminate interference between the experiments, emergency response, operation framework, etc.) amongst each other and define each party's responsibilities. The Solicited Ground Based Researches is the primary party conducting this flight's experiments and the students' experiments will be sharing the flight's unoccupied space.

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16.0 EXECUTION PLAN

Subject to changes

NO.	ACTIVITIES	DEADLINE	REMARKS
	PHASE I		
1.	Call For Experiment Proposal (announcement of Opportunity)	18 June	
2.	Proposal Submission Closing date	20 July (11:59 pm)	
3.	National Steering Committee Meeting of Microgravity Science (NSCMMS)	August	Top Three Selection
4.	Notify the best three candidates (National Level)	August	Notification letter by ANGKASA
	PHASE II		
5.	Submission of the three best proposals to Asian KIBO Task Force (AKTF) for final parabolic flight selection and decision on crew requirement to conduct the experiment onboard.	Sept.	
6.	Agreement Conclusion	Sept. (TBD)	**If Malaysia is selected**
7.	Notify the selected proposal candidates	Sept. (TBD)	Notification letter by ANGKASA
8.	Selected team's proposal to be presented in front of National Steering Committee Meeting	Sept. (TBD)	
9.	ANGKASA to fund the cost for experiment fabrication to university (selected team's proposal)	Sept. (TBD)	**RM 10,000.00 to selected proposal for**

			development of experimental kit
10.	Selected team's proposal to be presented in detail and also the progress of experiment fabrication in front of National Steering Committee Meeting.	Oct. (TBD)	
11.	Interface coordination meeting at team's home country.	October (TBD)	
12.	Innovative of young scientist Microgravity Research Award.	October (TBD)	
13.	Interface confirmation meeting at team's home country.	Nov. (TBD)	
14.	Transportation of experiment equipments to Japan.	TBD	
15.	Malaysian team to Nagoya Airport for flight (ANGKASA dispatches at least two students, one advisor, and one ANGKASA staff)*	Dec. (TBD)	
16.	**PARABOLIC FLIGHT EXPERIMENT IN JAPAN**	**MID DEC.** (TBD)	
17.	Transportation of experiment equipments back to Malaysia.	End of Dec. (TBD)	
18.	Analysis of the experiment result.	Jan – March 2013 (TBD)	
19.	Summary of this programme. Submission of the report from the students team.	April 2013 (TBD)	
20.	Presentation at International conference.	2013 (TBD)	

*** Crew may not always be obligatory needed for conducting experiment onboard.**

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17.0 APPLICATION FORM

Please refer to Appendix 1.

APPENDIX 1

APPLICATION FORM

Parabolic Flight Competition

Prepared by:

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PUSAT ANGKASA NEGARA

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47200 BANTING, SELANGOR

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INSTRUCTION

The following outline for the application form is to be used by each team. Following this outline is important in ensuring fair and equal scoring by the judges by providing standard expectations that will be presented by each team. The outline also provides the team with a list of the information which is expected to be presented.

PROPOSAL FOR THE SCIENCE MICROGRAVITY COMPETITION

A. EXPERIMENT TITLE:

Keyword:

Project Leader:

B. TEAM NAME:

C. ORGANIZATION:

University:

Address:

Tel:

Fax:

E-mail:

Co-Applicant 1

Name:

Sex:

NRIC:

Designation: Student (Undergraduate)

Faculty:

Department:

Year:

Address:

Tel. (Mobile):

Tel. (Fixed Line):

Fax:

E-mail:

Co-Applicant 2

Name:

Sex:

NRIC:

Designation: Student (Undergraduate)

Faculty:

Department:

Year:

Address:

Tel. (Mobile):

Tel. (Fixed Line):

Fax:

E-mail:

Co-Applicant 3

Name:

Sex:

NRIC:

Designation: Student (Undergraduate)

Faculty:

Department:

Year:

Address:

Tel. (Mobile):

Tel. (Fixed Line):

Fax:

E-mail:

Co-Applicant 4

Name:

Sex:

NRIC:

Designation: Student (Undergraduate)

Faculty:

Department:

Year:

Address:

Tel. (Mobile):

Tel. (Fixed Line):

Fax:

E-mail:

Co-Applicant 5

Name:

Sex:

NRIC:

Designation: Student (Undergraduate)

Faculty:

Department:

Year:

Address:

Tel. (Mobile):

Tel. (Fixed Line):

Fax:

E-mail:

Academic Staff (Supervisor)

Name:

Designation:

Address:

Tel. (Mobile):

Tel. (Fixed Line):

Fax:

E-mail:

D. PROPOSAL - DETAILED DESCRIPTION

1. EXPERIMENT TITLE

2. CATEGORY OF THE RESEARCH FIELD FOR THE EXPERIMENT

<Chemistry> / <Physics> / <Biology> / <Medical> / <Science and technology> <Culture> / <Art> / <Others: please state>

3. PURPOSE AND OUTLINE OF THE EXPERIMENT/ PROJECT SUMMARY:

(State the purpose of the experiment, hypothesis which the experiment is based on, the expected results and the relevance of microgravity to the project).

4. PROCEDURE OF THE EXPERIMENT

Write the experiment apparatus (with diagram), expected procedures and methods for the experiment. (State the items to be observed and measured, and their methods, be as specific as possible.)

i) Mechanical interface / structure overview

The mechanical /structure overview section shall present the preliminary design of the experiment structure, materials, mass & recovery system where appropriate. The mechanical overview shall present:

- Design consideration and requirements - design consideration and/or requirement driving the mechanical /structure design of the experiment should be presented.

- Mechanical / structure layout – the preliminary design of technical of technical / structural system layout of the experiments layout shall be suggested. The design should include drawing of the structure and components and components layout, and a list of materials and component selection.

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- Preliminary mass budget - allocation of the estimated masses and size of the experiments to the various components in a tabular forms (**max: 50 kg**).

ii) Electrical overview / interface

The electrical subsystem overview shall include:

- Electrical system block diagram overview description and diagram for the electrical system shall be provided. This diagram shall define major components of the electrical systems with identification of components connections. Diagram should be accompanied by a list of components selected.

- Power budget – a preliminary power budget shall be provided in a tabular form. The power budget shall list the power consumption for each components/sub system/systems.

5. RELEVANT / PAST RESEARCH (IF ANY)

No.	Research title	Institute/ University	Status/ published

6. JUSTIFICATION OF EQUIPMENT(S)/ MATERIALS(S) WILL BE USED AND THE STATUS:

No.	Equipment/ Materials	Status/ Description	Cost (RM), if any	From which allocation
1.	**e.g**. Stepper motor	Built in house	1000	Universities
2.	Special liquid	Need to buy /Status: new	1500	ANGKASA grant
3				
	OVERALL TOTAL			

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7. PROJECT ACTIVITIES / PLANNING (MILESTONE)

The schedule overview shall present the experiment development. The schedule should include a list of major milestone, completion and required resources (if any).

8. PLACE TO CONDUCT ANY GROUND EXPERIMENT:

No.	Institution/ University	Address	Contact Number

9. REQUESTED SUPPORT EQUIPMENTS (IF NECESSARY):

10. HAZARDOUS MATERIAL USED IN THE EXPERIMENT (E.G. ACID):

11. REQUEST TO FLY ABOARD THE AIRCRAFT TO CONDUCT THE EXPERIMENT?

(Yes or No)

12. SPECIAL NOTES

*** [DISCLAIMER] The Government of Malaysia will not responsible for any injury or death of the participants in conducting and performing the experiment with regards to this program.**

*** * Not for commercial based.**

E. PROPOSAL SUBMISSION

FORMAT AND SIZE

1. All proposals should be typed on **Microsoft Word-version**, in <**Arial**>, **font size 12** with **1.5 spacing** on standard **A4 paper.** The **hard copy** of completed proposals should be put in an envelope and to be sent to the following address:

Urus setia,
Program Inovasi Penyelidikan Sains Mikrograviti Peringkat Universiti 2012,
Agensi Angkasa Negara (ANGKASA),
Pusat Angkasa Negara,
Lot 2233, Kg. Sg. Lang,
47200 Banting, Selangor
(u.p.: Mohd Helmy Bin Hashim)

2. Applicants are also requested to submit the proposal as **e-mail attachment** in **Microsoft Word** format via the following address:

helmy@angkasa.gov.my

3. All proposals must be written in **English**.

TITLE AND COVER PAGE

1. The title should be **capitalized** and **centered at the top of the first page** of your cover page.
2. If you choose to have a subtitle, it should be capitalized and centered directly below the main title.
3. **Emblem** followed by the **University** at the center of the cover page
4. Supervisor's name, faculty and title.
5. Student's name, faculty, year and course.

HEADINGS

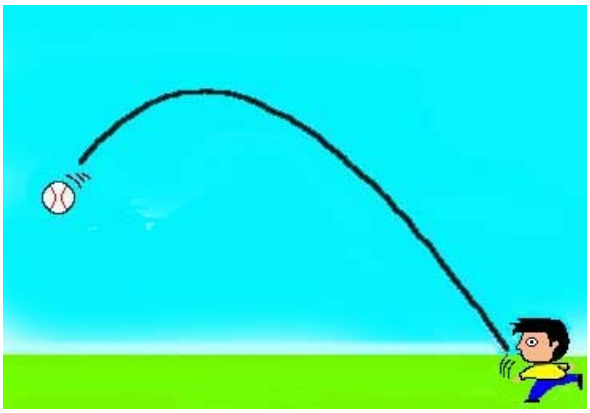
1. Headings and subheadings must be **capitalized** and **left justified**.
2. Use double 1.5 lines spacing **after the headings**, **before starting the next paragraph**.
3. Font size of the main **heading should be 14 and sub heading of 12**.

For more information, please visit:
http://www.angkasa.gov.my

APPENDIX 2

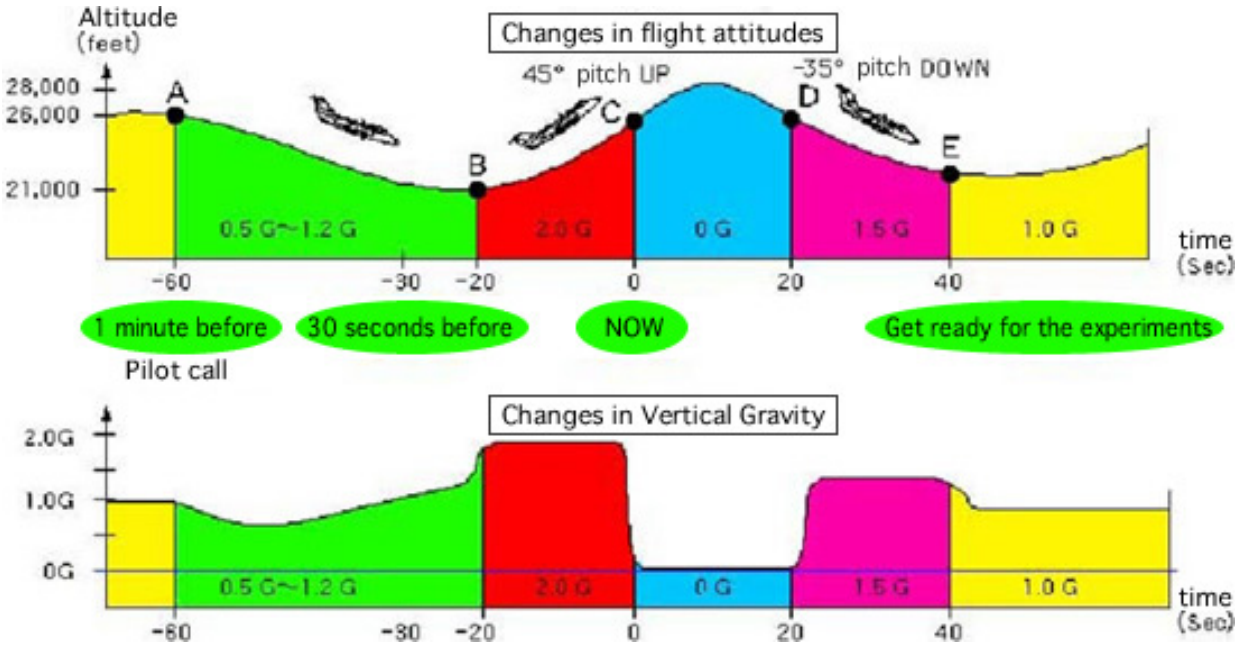
THE DYNAMICS OF MICROGRAVITY EXPERIMENT

When an object is moving, acted upon and pulled only by the force of gravity, the microgravity environment appears inside of that object. A good example of this phenomenon is when you are descending inside of an elevator. The acceleration of the elevator is less than the gravitational acceleration, hence you may experience feeling like being lifted up, for a brief moment. Now, what will happen when the cable holding the elevator is cut? The elevator will fall extremely fast. While falling, the elevator is pulled down under the influence of gravitational acceleration, and the person inside the elevator will feel not just "being lifted up for a moment", but will actually float in midair since their weight would become “zero”.



Falling is not the only movement acted upon by gravity. As example is when you throw a ball forward and upwards. At the moment the ball is thrown, the ball’s initial acceleration is forward and upwards. After that, the ball is acted upon by the force of gravity (strictly speaking, the ball is also acted upon by the friction of air). The ball flies a parabolic path and eventually falls to the ground. During this parabolic arc movement, is the inside of the ball in a condition of microgravity? During the conducting of the student’s experiments inside of the aircraft, the aircraft is piloted to follow a parabolic path and thus creating a microgravity environment inside the aircraft. The aircraft must

fly efficiently in order to simulate a microgravity environment for a longer period of time. The following figure shows such a parabolic flight pattern flown by the aircraft.



In this flight procedure, known as a “parabolic flight”, as a greater velocity and climbing angle is required at point C in the figure above (which analogous to the release point of the ball), the aircraft maneuvers to achieve maximum velocity by point B and the nose of the aircraft is pulled up rapidly. The gravity on the aircraft between points B and C is 2G, twice the force of normal gravity. From point C, the aircraft will fly a parabolic path. If the aircraft maintains the parabolic flight path, the aircraft will reach the peak of ascent and begin the descending acceleration movement, which will eventually exceeds the aircraft’s velocity limits. Therefore, the parabolic flight is terminated at point D, where the aircraft can be safely recovered at a pitch of -35 to -40 degrees. The Microgravity condition is simulated while the aircraft is flying between Points C and D. The time duration between Points C and D depends on the type of aircraft used: approximately 20 seconds for regular commercial jet aircraft, approximately 10 seconds for propeller aircraft, and approximately 40 seconds for a super sonic fighter aircraft.

APPENDIX 3

MEDICAL EXAMINATION REPORT

Company Name:

Examination Date:

Sex: Male/Female

Name:

Date of Birth:

Age:

Examined Item	Examination Results	Criteria
Blood Pressure	mmHg	(Systolic blood pressure: 95 to below 160 mmHg, diastolic blood pressure: 50 to below 95 mmHg, no orthostatic hypotension)
Pulse Rate	beats/minute	(Pulse rate: 90 beats/min or less)
Pulse Irregularities	Yes/No	(No pulse irregularities)
Urine Sample	Protein () Sugar ()	(No proteins or sugars)
Heart, Lung, or Internal Organ Defects	Yes/No	(No discernable heart, lung, or internal organ defects)
Diagnosis		(No other discernable irregularities)

I hereby certify that the patient has been examined as given above.

Address:

Name of Medical Doctor:

Signature