UNPAD
PHYSICS

# ACADEMIC GUIDELINES

## STUDY PROGRAM
## BACHELOR OF PHYSICS

FACULTY OF MATHEMATIC AND
NATURAL SCIENCES
UNIVERSITAS PADJADJARAN
2023

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# CHAPTER I

# HISTORY, VISION, MISSION, GOALS AND COMPETENCIES OF GRADUATES PHYSICS STUDY PROGRAM

## a. HISTORY

### 1) HISTORY OF THE FACULTY

The Faculty of Mathematics and Natural Sciences was established based on the Decree of the Minister of PP&K RI Number 102333 / S dated October 22, 1958, originally named the Faculty of Exact and Natural Sciences (FIPIA), by opening the Undergraduate Program of the Department: Mathematics, Physics, Chemistry and Biology. On November 17, 1959 the President of the Republic of Indonesia (Dr. Ir. Soekarno) was inaugurated, and equipped with the Department of Pharmacy, Geology, and Geography, which then in 1964 the Department of Geography was integrated into the University of Indonesia. Based on Unpad Rector's Decree No. 41 / Kep / UNPAD / 63 in 1963, the Department of Statistics was inaugurated. In its development, the faculty changed its name to the Faculty of Exact Sciences and Natural Sciences. Since 1982 until now its name has become the Faculty of Mathematics and Natural Sciences (FMIPA). In 1985, FMIPA also managed the Diploma III Program in Mathematics, Chemistry, Physics, and Biology, which is a program from DIKTI to educate prospective teachers.

In 1992 the Master of Analytical Chemistry and Organic Chemistry Study Programs were opened, which were further merged into one under the name Master of Chemistry. In 1993 opened the Doctoral Study Program in Chemistry, Diploma III Program: Industrial Chemistry, Chemical Analysis, Computer Science, Information Management, Informatics Engineering, Computer Engineering, Electronics, and Instrumentation.

In 2007, FMIPA opened a Master of Applied Statistics Study Program, while the Department of Pharmacy and Geology separated from FMIPA into a separate faculty. In 2010, the Geophysics Undergraduate Study Program was opened, the next year 2011 the Informatics Engineering Study Program, and in 2015 the Electrical Engineering Study Program. In 2015, the Master of Mathematics Study Program and Master of Biology Study Program were established.

In line with the changes in SOTK Universitas Padjadjaran, the existence of the Department becomes parallel to the study program, then starting in 2016 at FMIPA it consists of: 1) the Department of Mathematics has a Bachelor of Mathematics and Master of Mathematics Study Program; 2) The Department of Chemistry has Diploma III Chemical Analysis Study Programs, Bachelor of Chemistry, Master of Chemistry, and Doctor of Chemistry; 3) The Department of Physics has a Bachelor of Physics and Master of Physics Study Program; 4) The Department of Biology has a Bachelor of Biology and Master of Biology Study Program; 5) The Department of Statistics has Bachelor of Statistics, Actuarial and Master of Applied Statistics Study Programs; 6) The Department of Computer Science has a Bachelor Program in Informatics Engineering; 7) The Department of Geophysics has a

Geophysics Undergraduate Study Program; and the Department of Electrical Engineering has a Bachelor Program in Electrical Engineering.

## 2) HISTORY OF STUDY PROGRAMS

The Department of Physics was established in 1959 based on the Decree of the Minister of Education and Culture No. 102333 / S dated October 22, 1958 at the Faculty of Exact and Natural Sciences, Padjadjaran University. Furthermore, based on the Decree of the Director General of Higher Education (DIKTI) No. 217 / DIKTI / Kep / 1996 dated July 11, 1996, the Department of Physics consists of one study program, namely the Physics Study Program located in Bandung and Jatinangor (Appendix 2). Since 1995 the educational activities of the Physics Study Program have been carried out at the Jatinangor Campus with a building area of 2051 m2. Currently, the Physics Study Program has 17 permanent lecturers with educational qualifications, S3, 14 people (4 professors) and S2, 3 people. Since its establishment until now, the Physics Study Program has produced 2040 undergraduate graduates.

Physics Study Program has obtained Accreditation A four times in a row by the National Accreditation Board for Higher Education (BAN-PT). First in 1998 (SK No 00608/Ak-I.1/UPAFGA/VIII/1998, August 11, 1998). Second in 2006 (SK No. 020/BAN-PT/Ak-X/S1/XII/2006, December 16, 2006). Third in 2013 (SK No. 024/SK. BAN-PT/Ak-XV/S/1/2013). And fourth in 2018 (944/SK/BAN-PT/Akred/S/IV/2018, April 3, 2018). In 2023, the Fiska Undergraduate Study Program will receive Excellent accreditation from Lamsama (No. 040/SK/LAMSAMA/Akred/S/XII/2022)

In 2003–2007 the Physics Study Program received the Technological and Professional Skill Development Sector Project (TPSDP) from DIKTI and the Asian Development Bank (ADB) with funds of 9 billion rupiah allocated for improving educational facilities and infrastructure, human resource development and curriculum development through the RAISE ++ Program (Relevance, Academic Atmosphere, Internal Management, Sustainability, Efficiency and Productivity, Leadership, Access and Equity). The project has an impact on improving the quality of PBM, educational facilities and infrastructure, the quality of human resources and the management of Study Programs in accordance with the PT management paradigm developed by DIKTI, namely quality, autonomy, accountability, accreditation and evaluation. In 2016, Sarjada Physics Study Program received a Study Program Excellence Grant (HUPS) which had an impact on curriculum development and teaching material development. In 2020, the Undergraduate Study Program in Physics received an Independent Campus Implementation Grant (HIKAM) to revise the curriculum and encourage the implementation of the independent campus policy.

## b. VISION, MISSION, GOALS AND COMPETENCIES OF STUDY PROGRAM GRADUATES

### 1. Vision:

Become an Excellent Physics Undergraduate Study Program at the International Level in 2024 that focuses on the fields of Energy, Health, and the Environment.

### 2. Mission:

1. Realizing education that produces superior and internationally competitive graduates in the fields of energy, environment and health.
2. Realizing education that produces graduates who master the basic concepts of physics to be applied in the field of engineering.
3. Realizing education that produces graduates who are adaptive to the development of science and technology and have an entrepreneurial spirit
4. Forming academic people who have a culture of RESPECT (Responsibility, Excellence, Scientific, Professionalism, Encouragement, Creative, and Trust)

### 3. Objective:

1. Generating excellent and internationally graduates competitive in the fields of energy, environment and health.
2. Generating graduates who master the basic concepts of physics to be applied in the field of engineering.
3. Generating graduates who are adaptive to the development of science and technology and have an entrepreneurial spirit.
4. Generating graduates who have a culture of RESPECT (Responsibility, Excellence, Scientific, Professionalism, Encouragement, Creative, and Trust).

### 4. Targets of Study Program:

The targets to be achieved until 2024 are:

1. Produce 75% of graduates with a study period of 8 semesters and an average GPA of 3.25;
2. Produce 50% of graduates with a maximum waiting period of 3 months in industry or entrepreneurship;
3. Produce 3% of graduates who have achievements in academic and non-academic fields at national and international levels;
4. Produce 10% of graduates who can continue their studies at Universities of International Reputation or work in international institutions.

## CHAPTER II

## IMPLEMENTATION OF UNDERGRADUATE PHYSICS STUDY PROGRAM EDUCATION

### 1) Graduate Profile

Physical science as one of the basic sciences has a very important role in the development of science and technology (science and technology). Physics Study Program graduates are expected to be able to develop physics to be used in various aspects related to the development of science and technology and its application directly in the community. Thus, the profiles of Physics Study Program graduates are:

1. Have a strong basic knowledge of physics and special skills in the fields of energy, environment and health;
2. Able to adapt (adaftif) to changes in technological advances and information systems as well as various work environments;
3. Able to innovate in developing the basic ability of physics to build society and meet the demands of the world of work as academics, researchers at various research institutions, engineers in industry and entrepreneurs in the field of physics and its applications.
4. Have skills in designing and analyzing systems based on physics, computing and experimentation.
5. Have a personality with comprehensive noble ethics and scientific and cultural ethics.
6. Able to show religious attitude and religious tolerance
7. Able to show a responsible attitude and commit to law enforcement, ethics, norms for community life and environmental sustainability.

Profile Bachelor of Physics graduates will fill the following job positions:

| Graduate Profile | Must-have abilities | Must-have knowledge |
|---|---|---|
| Industry Practitioner | 1. Able to identify physical problems in Industry<br>2. Have skills in designing and analyzing systems based on physics, computing and experimentation.<br>3. Able to adapt (adaptive) to changes in technological advances and information systems as well as various work environments | 1. Knowledge of theoretical concepts of physics<br>2. Knowledge of the principles and applications of physics<br>3. Knowledge of basic physical concepts of technology |
| Researchers | 1. Able to think logically, analytically, systematically<br>2. Able to plan, design and carry out simple research in the field of physics<br>3. Able to make research reports | 1. Knowledge of theoretical concepts of physics<br>2. Knowledge of the principles and applications of physics |
| Academics | 1. Able to think logically, analytically and systematically<br>2. Able to plan, design and implement physics learning | 1. Knowledge of theoretical concepts of physics<br>2. Knowledge of the principles and applications of physics |

| | | |
|---|---|---|
| | 3. Able to convey knowledge well to students | |
| Entrepreneur | 1. Able to innovate in developing basic physical science capabilities to build society<br>2. able to adapt (adaptive) to changes in technological progress<br>3. have skills in designing and analyzing systems based on physical science | 1. Knowledge of theoretical concepts of physics<br>2. Knowledge of the principles and applications of physics |

## 2) Learning Outcomes

Learning outcomes are prepared by referring to Permendikbud no. 3 of 2020 and minimum learning outcomes set by the Indonesian Physics Association (PSI). The learning outcomes of graduates of the Physics Study Program FMIPA Universitas Padjadjaran are as follows:

1. Graduates are able to **identify and** explain the foundations of physics which include classical and modern, computational and experimental and applied physics.
2. Graduates are able to **solve** simple and practical problems by applying theoretical physics, computing and experimental methods in the fields of energy, environment and health.
3. Graduates are able to **analyze** simple and practical problems in one of the fields of theoretical physics, computing or experiments for energy, environmental and health physics.
4. Graduates are able to work on clearly defined scientific tasks and are able to explain the results orally and in writing, in the fields of theoretical physics, applied physics, computing or experiments, as well as their application in the fields of energy, environment and health.
5. Graduates are able to use the principles of lifelong learning principles to improve knowledge and current issues about physical sciences in the fields of energy, environment and health.
6. Graduates are able to demonstrate religious attitudes and tolerance
7. Graduates are able to show a responsible attitude and are committed to law enforcement, ethics, norms for community life and environmental sustainability

The mapping of the learning outcomes of the Physics study program FMIPA Universitas Padjadjaran on the learning camp of physics graduates stipulated in Permendikbud no. 3 of 2020 is as follows:

| CP Code | PL Code | Attitude(s) | | | | | | | | | | | General Skills (KU) | | | | | | | | | | | Specific Skills (KK) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Description | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 | S11 | KU1 | KU2 | KU3 | KU4 | KU5 | KU6 | KU7 | KU8 | KU9 | KU10 | KU11 | KK1 | KK2 | KK3 | KK4 | KK5 |
| **CPL1** | Graduates are able to **identify and** explain the foundations of Physics which include classical and modern physics, computing and experimental and applied | | | | | | | | | | | | | X | | | | | | | | | | X | | | | |
| **CPL2** | Graduates are able to **solve** simple and practical problems by applying theoretical physics, computation and experimental methods in the fields of energy, environment and health; | | | | | | | | | | | | | X | | | | | | | | | | X | X | | | |
| **CPL3** | Graduates are able to **analyze** simple and practical problems in one of the fields of theoretical physics, computing or experiments for energy, environmental and health physics; | | | | | | | | | | | | X | | X | | | | | | | | | X | X | | | |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CPL4** | Graduates are able to work on clearly defined scientific tasks and are able to explain the results orally and in writing, in the fields of theoretical physics, applied physics, computing or experiments, as well as their application in the fields of energy, environment and health; | | | | | | | | | | | | | | | x | x | | | x | | | | | | x | x | |
| **CPL5** | Graduates are able to use the principles of lifelong learning principles to improve knowledge and current issues about physical sciences in the fields of energy, environment and health; | | | | | | | | | | | | | | | | x | | x | x | x | | | | | | x | x |
| **CPL6** | Graduates are able to show a religious attitude and Tolerance | x | x | | | x | | | | x | x | | | | | | | x | | | | | | | | | | |
| **CPL7** | Graduates are able to show a responsible attitude and are committed to law enforcement, ethics, norms for community life and environmental sustainability. | | | | x | | x | x | x | x | | | | | | | | | | | | x | x | | | | |

## Attitudinal Competence (S)

1. Fear God Almighty and be able to show a religious attitude;
2. Uphold human values in carrying out duties based on religion, morals, and ethics;
3. Contribute to improving the quality of life in society, nation, state, and progress of civilization based on Pancasila;
4. Acting as citizens who are proud and love the country, have nationalism and a sense of responsibility to the state and nation;
5. Respect the diversity of cultures, views, religions, and beliefs, as well as the original opinions or findings of others;
6. Work together and have social sensitivity and concern for society and the environment;
7. Obey the law and discipline in social and state life;
8. Internalize academic values, norms, and ethics;
9. Show an attitude of responsibility for work in their field of expertise independently;
10. Internalize the spirit of independence, struggle, and entrepreneurship; and
11. Collaborate on a multidisciplinary spirit in recognizing and interacting with the community

## General Ampoule (KU)

1. Formulate physical symptoms and problems through analysis based on observations and experiments;
2. Produce mathematical models or physical models that are in accordance with hypotheses or forecasts of the impact of the phenomenon that is the subject of discussion;
3. Examine various options for solving existing physical problems and conclude them for appropriate decision making;
4. Take into account the applied potential of physical behavior in technology;
5. Deliver dissemination of the results of the study of problems and physical behavior from simple symptoms in the form of reports or working papers according to standard scientific principles.
6. Have knowledge of occupational safety issues and the surrounding environment;
7. Have acquired competence in scientific methodology in the field of physics and able to apply it in a wider context;
8. Have interdisciplinary and multidisciplinary knowledge and skills;
9. Able to obtain, interpret, and evaluate scientific and technical data, to draw appropriate conclusions, with due regard to scientific, technical and ethical ethics;

10. Solve natural problems scientifically and technically independently, and be able to present the results; and
11. Able to develop lifelong learning.

**Specific Skills (KK)**

1. General scientific skills and laboratory occupational safety
   a. Have basic knowledge of occupational safety and laboratory work safety practices
   b. Have the ability to plan, design, and rationalize an experiment
   c. Have the ability to retrieve data and take good notes
2. General laboratory techniques
   a. Understand the use of basic Physics laboratory equipment correctly and safely to support further practicum implementation.
   b. Understand the use of practicum tools of Classical Physics, Modern Physics, Instrumentation Physics, Computational Physics correctly and safely.
   c. Understand the use, correctly and safely, of the tools used for research.
   d. Understand how to maintain laboratory equipment used in practicum and research.
3. Experimental method
   a. Able to prepare and conduct experiments in Classical Physics, Modern Physics, Instrumentation Physics and Computational Physics
   b. Independently able to prepare and conduct experiments related to research.
4. Data Analysis
   a. Able to process and analyze data and create physical models in accordance with related experiments.
   b. Able to calculate and apply measurement uncertainty and statistical analysis in accordance with experiments
   c. Able to report the results of experiments or research in writing
5. Able to disseminate the results of the study of problems and physical behavior from simple symptoms in the form of reports or working papers according to standard scientific rules.

The mapping of the learning outcomes of the Physics study program FMIPA Universitas Padjadjaran on the learning camp of physics graduates determined by the Association *of Physics Society of Indonesia* (PSI) is as follows:

| CP Code | PL Code | Field of Work Capability (BK) | | | | | Knowledge Mastery (PP) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Description | BK1 | BK2 | BK3 | BK4 | BK5 | PP1 | PP2 | PP3 |
| CPL1 | Graduates are able to **identify and** explain the foundations of Physics which include classical and modern physics, computing and experimental and applied | X | | | | | X | | |
| CPL2 | Graduates are able to **solve** simple and practical problems by applying theoretical physics, computation and experimental methods in the fields of energy, environment and health; | | X | | | | | X | |
| CPL3 | Graduates are able to **analyze** simple and practical problems in one of the fields of theoretical physics, computing or experiments for energy, environmental and health physics; | | | X | | | | | X |
| CPL4 | Graduates are able to work on clearly defined scientific tasks and are able to explain the results orally and in writing, in the fields of theoretical physics, applied physics, computing or experiments, as well as their application in the fields of energy, environment and health; | | | | | X | | | |
| CPL5 | Graduates are able to use the principles of lifelong learning to enhance knowledge and current issues about the physical sciences in the fields of energy, environment and health; | | | | X | | | | X |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **CPL6** | Graduates are able to show a religious attitude and Tolerance | | | | | | | | |
| **CPL7** | Graduates are able to show a responsible attitude and are committed to law enforcement, ethics, norms for community life and environmental sustainability. | | | | | | | | |

**Field of work capability (BK)**

1. Able to formulate physical symptoms and problems through analysis based on observations and / or experiments.
2. Able to apply mathematical models or physical models that are in accordance with hypotheses or forecasts of the impact of the phenomenon that is the subject of discussion.
3. Able to analyze various alternative solutions that exist to fission problems and conclude them for appropriate decision making.
4. Able to predict the potential application of physical phenomena behavior in technology.
5. Able to disseminate the results of the study of problems and physical behavior from simple symptoms in the form of reports or working papers according to standard scientific rules.

**Knowledge Mastery (PP)**

1. Mastering theoretical concepts and basic principles of classical and modern physics
2. Mastering mathematical, computational and instrumentation methods in physics.
3. Mastering knowledge of technology based on physics and its application.

## 3) Supporting Learning Outcomes

Supporting learning outcomes are structured to prepare graduates who are able to face future challenges thanks to advances in digital technology and artificial intelligence technology. The supporting learning outcomes of graduates of the Physics Study Program FMIPA Universitas Padjadjaran are as follows:

1. Have the ability to adapt and reconstruct knowledge spontaneously in many ways (*Cognitive flexilibility*)
2. Have digital literacy skills and *computational thinking* which includes STEM (*Science, Technology, Engineering and Mathematics*) and SMAC (*social, mobile, analytics and cloud*).
3. Able to assess and make decisions.
4. Have emotional and social intelligence.
5. Have a creative and innovative mindset.

## 4) Study Material

Study materials in the Undergraduate Physics Study Program are scientific pillars developed in the Department of Physics in accordance with the development of physical science, both theoretical and application, as well as the competence of lecturer staff. The study materials include:

1. Personality Development (MKDU)
2. Scientific fields (Classical Physics, Modern Physics, Mathematical and Computational Physics)
3. Skills Development (Practicum)
4. Areas of Expertise (Focus on energy, health and environment)

**5) Course Structure**

Along with the policy of the Minister of Education and Culture contained in the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 3 of 2020 concerning the Independent Campus, the Bachelor of Physics Study Program has carried out a curriculum adjustment process so that the concept of the Independent Campus can be implemented. The flow of the 2020 Curriculum Based on the Independent Campus for students of the Undergraduate Study Program in Physics can be seen in Figure 2.1.

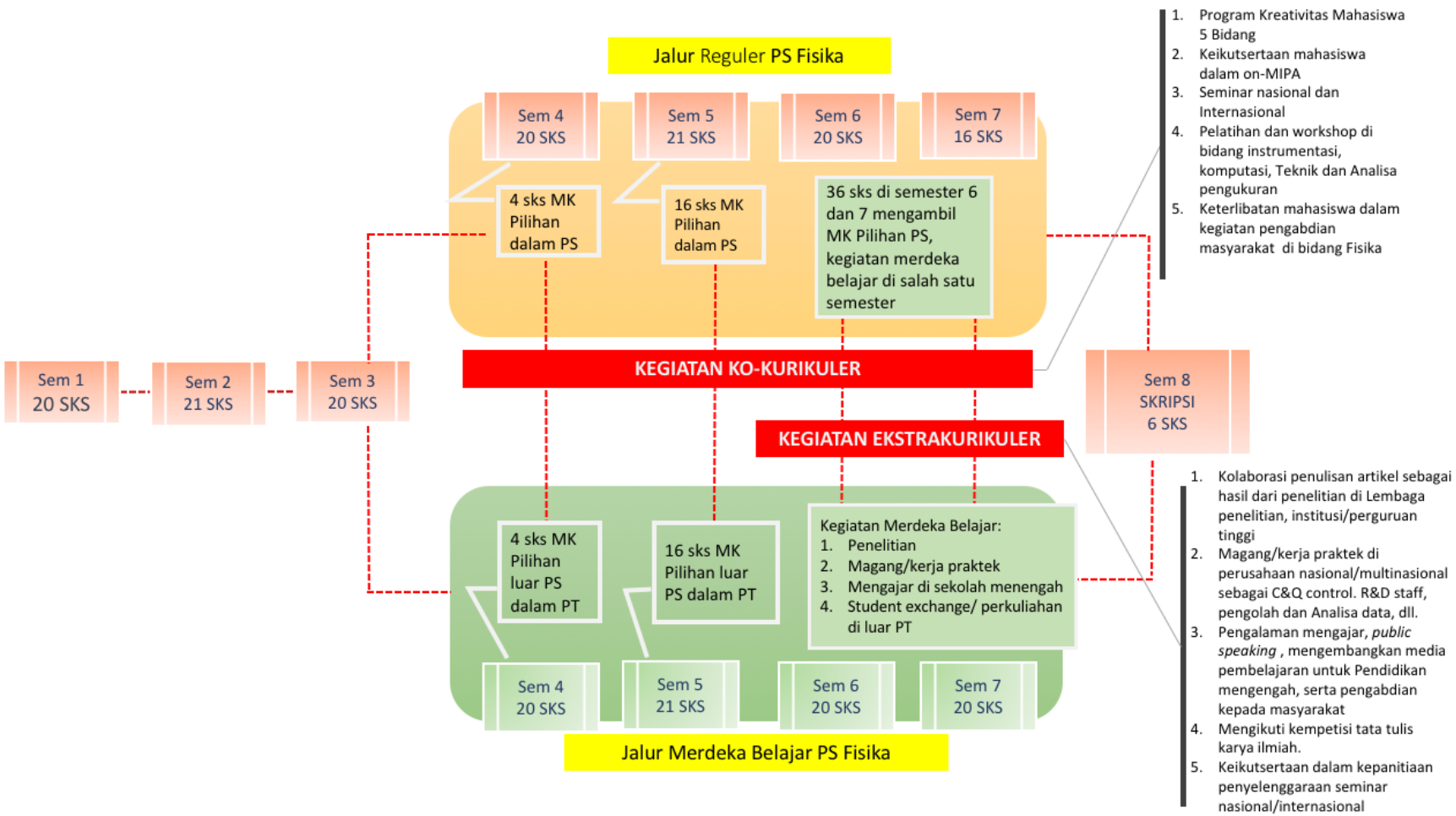


**Figure 2.1.** The 2020 curriculum roadmap is based on the Merdeka Campus, Merdeka Learning in Physics Study Program.

The structure of the 2020 Curriculum Based on the Independent Campus still contains general basic courses (MKDU) set by the University. The general basic course has a total of 14 credits, including KKN (Real Work Lecture). The compulsory MK of the Physics Study Program that must be taken by all Physics students is 76 credits distributed starting from semester 1 to semester 8, namely until the final project activity (thesis writing). Students can take the independent campus program starting from the 5th semester provided that they have passed the compulsory MK Study Program in the previous semester. In this 5th semester, students are only allowed to take independent campus activities in the form of taking MK outside the Study Program inside PT (other study programs at Padjadjaran University). In the 6th semester, students are allowed to take lecture activities outside or inside PT. These types of activities are regulated by SF, which includes 4 main activities as follows:

1. Work internships in industries/SOEs or government/private institutions that already have a memorandum of agreement (MoU) and/or Cooperation Agreement (PKS). This activity can be carried out for a minimum of 1 semester and a maximum of 2 semesters.
2. Research activities in research institutions / institutions inside or outside PT. The research institute/institution already has a memorandum of agreement in cooperation. This activity can be carried out for a minimum of 1 semester and a maximum of 2 semesters.
3. Teaching activities in secondary education, with location arrangements that have been arranged by local governments, universities, and study programs.
4. Student exchange activities to domestic or foreign institutions, which can be carried out for a minimum of 1 semester and a maximum of 2 semesters. Each semester is equivalent to 20 credits.

The structure of the 2020 Independent Campus-Based Curriculum based on course groups is shown in Table 2.1, while the distribution of credits in each semester is shown in Table 2.2.

**Table 2.1** Grouping of courses in the 2020 Independent Campus-Based Curriculum.

| No | Course Group | Load (SKS) |
|---|---|---|
| 1 | General Basic Course (MKDU) | 14 |
| 2 | Compulsory Courses (*Core Physics*) | 76 |
| 3 | Elective Courses/Independent Campus Courses | 54-58 |
| Total amount of load (SKS) | | **144 - 148** |

**Table 2.2** Distribution of credits in each semester in the 2020 Curriculum Based on the Independent Campus.

| No | Course Group | Load (SKS) |
|---|---|---|
| 1 | Semester 1 (MKDU= 11, MKW=9) | 21 |
| 2 | Semester 2 (MKW = 20) | 20 |
| 3 | Semester 3 (MKW = 20) | 20 |
| 4 | Semester 4 (MKDU=3, MKW=10, MKP=6) | 19 |
| 5 | Semester 5 (MKW = 10, MKP = 10) | 20 |
| 6 | Semester 6 (MKP/MKKM = 20) | 20 |
| 7 | Semester 7 (MKP/MKKM = 20) | 18 to 22 |
| 8 | Semester 8 (MKW = 6) | 6 |
| Total amount of load (SKS) | | **144 - 148** |

The complete structure of the 2020 Independent Campus-Based Curriculum is as follows:

**SEMESTER 1**

| No | Course Group | Course Code | Courses | Load (SKS) |
|---|---|---|---|---|
| 1 | General Basic Course (MKDU) | UNX01-001 | Religion | 2 |
| 2 | | UNX01-004 | Indonesian | 2 |
| 3 | | UNX01-006 | Creativity and Entrepreneurship (OKK) | 3 |
| 4 | | UNX01-007 | Pancasila | 2 |
| 5 | | UNX01-008 | Civic Education | 2 |
| 6 | Compulsory Courses (MKW) | D10C20.1001 | Basic Physics I | 4 |
| 7 | | D10C20.1002 | Basic Physics Practicum I | 1 |
| 8 | | D10C20.1003 | Mathematical Physics I | 2 |
| 9 | | D10C20.1004 | Algorithms and Programming | 2 |
| 10 | | D10C20.1005 | Algorithm and Programming Practicum | 1 |
| SUM | | | | **21** |

**SEMESTER 2**

| No | Course Group | Course Code | Courses | Load (SKS) |
|---|---|---|---|---|
| 1 | Compulsory Courses (MKW) | D10C20.2001 | Basic Physics II | 4 |
| 2 | | D10C20.2002 | Basic Physics Practicum II | 1 |
| 3 | | D10C20.2003 | Mathematical Physics II | 3 |
| 4 | | D10C20.2004 | Modern Physics | 2 |
| 5 | | D10C20.2005 | Numerical Computing | 2 |
| 6 | | D10C20.2006 | Numerical Computing Practicum | 1 |
| 7 | | D10C20.2007 | Mechanics | 4 |
| 8 | | D10C20.2008 | Thermodynamics | 3 |
| SUM | | | | **20** |

**SEMESTER 3**

| No | Course Group | Course Code | Courses | Load (SKS) |
|---|---|---|---|---|
| 1 | Compulsory Courses (MKW) | D10C20.3001 | Electronics | 4 |
| 2 | | D10C20.3002 | Electronics Practicum | 2 |
| 3 | | D10C20.3003 | Magnetic Electricity | 4 |
| 4 | | D10C20.3005 | Physics Experiments | 1 |
| 5 | | D10C20.3006 | Mathematical Physics III | 3 |
| 6 | | D10C20.3007 | Scientific Research Methods | 2 |
| 7 | | D10C20.3008 | Wave | 4 |
| SUM | | | | **20** |

**SEMESTER 4**

| No | Course Group | Course Code | Courses | Load (SKS) |
|---|---|---|---|---|
| 1 | General Basic Course (MKDU) | UNX10.050020 | Community Service Program (KKN) | 3 |
| 2 | Compulsory Courses (MKW) | D10C20.4003 | Quantum Physics | 4 |
| 3 | | D10C20.4004 | Introduction to nuclear physics | 3 |
| 4 | | D10C20.4005 | Advanced Physics Experiments | 1 |
| 5 | | D10C20.4007 | Computational Physics | 2 |
| 7 | Elective Courses (MKP) | D10C20. XXXX | MKP / MKKM (6 to 10 credits) | 6 |
| SUM | | | | **19** |

**SEMESTER 5**

| No | Course Group | Course Code | Courses | Load (SKS) |
|---|---|---|---|---|
| 1 | Compulsory Courses (MKW) | D10C20.5001 | Physics Expertise Practicum | 1 |
| 2 | | D10C20.5002 | Introduction to Solid Matter Physics | 4 |
| 3 | | D10C20.5003 | Optics | 2 |
| 4 | | D10C20.5004 | Statistical Physics | 3 |
| 5 | Elective Courses (MKP) | D10C20. XXXX | MKP/MKKM | 10 |
| SUM | | | | **20** |

**SEMESTER 6**

| No | Course Group | Course Code | Courses | Load (SKS) |
|---|---|---|---|---|
| 1 | Elective Courses (MKP) | D10C20. XXXX | MKKM or MKP | 20 |
| SUM | | | | **20** |

**SEMESTER 7**

| No | Course Group | Course Code | Courses | Load (SKS) |
|---|---|---|---|---|
| 1 | Elective Courses (MKP) | D10C20. XXXX | MKKM or MKP | 20 |
| SUM | | | | **20** |

**SEMESTER 8**

| No | Course Group | Course Code | Courses | Load (SKS) |
|---|---|---|---|---|
| 1 | Compulsory Courses (MKW) | | Thesis / Final Project | 6 |
| SUM | | | | **6** |

Elective courses organized by the Bachelor of Physics study program can be taken by students starting from Semester 4 to Semester 7. The elective courses offered are adjusted to the focus of the field of study of the Physics Study Program FMIPA UNPAD, namely in the fields of energy, health and environment. Elective courses can also be substituted with independent campus courses offered by other study programs at UNPAD. Some of the elective courses offered in the Undergraduate Program in Physics are as follows:

**Semester 4**

| No | MK Code | Name MK | Credits |
|---|---|---|---|
| 1 | D10C20.4201 | Environmental Physics | 2 |
| 2 | D10C20.4202 | Energy Conversion | 2 |
| 3 | D10C20.4203 | Heat Transfer | 2 |
| 4 | D10C20.4205 | Robotics | 2 |
| 5 | D10C20.4206 | Data Science | 2 |
| 6 | D10C20.4207 | Introduction to Artificial Intelligence (AI) | 2 |
| 7 | D10C20.4208 | Physics, Anatomy and Physiology | 2 |
| 8 | D10C20.4209 | Atmospheric Physics | 2 |
| 9 | D10C20.4210 | Renewable Energy | 2 |

**Semester 5**

| No | MK Code | Name MK | Credits |
|---|---|---|---|
| 1 | D10C20.5201 | Energy Physics | 2 |
| 2 | D10C20.5202 | Instrumentation Physics | 2 |
| 3 | D10C20.5203 | Material Physics | 2 |
| 4 | D10C20.5204 | Nanoscience | 2 |
| 5 | D10C20.5205 | Material Synthesis Methods | 2 |
| 6 | D10C20.5206 | Digital Signal Processing | 2 |
| 7 | D10C20.5207 | Planning Electronics and Microcontroller Interfaces | 2 |
| 8 | D10C20.5208 | Biomass | 2 |
| 9 | D10C20.5209 | Fluid Dynamics | 2 |
| 10 | D10C20.5210 | Sensors and Actuators | 2 |
| 11 | D10C20.5211 | Radiation Physics and Dosimetry | 2 |
| 12 | D10C20.5213 | Physical System Computing | 2 |
| 13 | D10C20.5214 | Power Plant Asset Management | 2 |

**Semester 6**

| No | MK Code | Name MK | Credits |
|---|---|---|---|
| 1 | D10C20.6202 | Thin Film Technology | 2 |
| 2 | D10C20.6203 | Material Characterization Techniques | 2 |
| 3 | D10C20.6204 | Optical Communication System | 2 |
| 4 | D10C20.6205 | Magnetic and Superconducting Materials | 2 |
| 5 | D10C20.6206 | Functional Material | 2 |
| 6 | D10C20.6207 | Particle Physics | 2 |
| 7 | D10C20.6208 | Battery System | 2 |
| 8 | D10C20.6209 | Medical Instrumentation | 2 |
| 9 | D10C20.6210 | Network Instruments and Data Loggers | 2 |

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|---|---|---|---|
| 10 | D10C20.6211 | Optoelectronics Technology | 2 |
| 11 | D10C20.6212 | Biomaterials and biosensors | 2 |
| 12 | D10C20.6213 | Solar Panel | 2 |
| 13 | D10C20.6214 | Polymer Material | 2 |
| 14 | D10C20.6215 | Semiconductor | 2 |

**Semester 7**

| No | MK Code | Name MK | Credits |
|---|---|---|---|
| 1 | D10C20.7201 | Scientific Writing Techniques | 2 |
| 2 | D10C20.7202 | Measurement Tools and Techniques | 2 |
| 3 | D10C20.7203 | Physical Modeling Design and Systems | 2 |
| 4 | D10C20.7204 | Energy Conservation | 2 |
| 5 | D10C20.7205 | Geothermal Power Plant | 2 |
| 6 | D10C20.7206 | Measurement of Magnetic Properties | 2 |
| 7 | D10C20.7207 | Biophysics | 2 |
| 8 | D10C20.7209 | Liquid Waste Treatment Plant | 2 |
| 9 | D10C20.7210 | Nanoparticle Imaging | 2 |
| 10 | D10C20.7211 | Particle Transport System | 2 |
| 11 | D10C20.7212 | Biomedical Materials | 2 |
| 12 | D10C20.7213 | Preparation and Characterization of Superconducting Materials | 2 |
| 13 | D10C20.7214 | Luminescence Material | 2 |
| 14 | D10C20.7215 | Bioelectric Signal Processing | 2 |
| 15 | D10C20.7216 | Web Programming and Animation | 2 |

**Conversion Course 4 Scheme of Independent Campus Activities in Semester 6**

| No | MK Code | Name MK | Credits |
|---|---|---|---|
| 1 | D10C20.6301 | Techno-Economic Analysis | 4 |

| | | | |
|---|---|---|---|
| 2 | D10C20.6302 | Product Planning and Development | 4 |
| 3 | D10C20.6303 | Industrial and Business Processes | 3 |
| 4 | D10C20.6304 | Operations Management | 3 |
| 5 | D10C20.6305 | Research and Innovation | 3 |
| 6 | D10C20.6306 | R&D facilities and utilities | 3 |
| 7 | D10C20.6307 | Characterization and Analysis Methods | 4 |
| 8 | D10C20.6308 | R&D Planning and Innovation | 4 |
| 9 | D10C20.6309 | IP Management | 3 |
| 10 | D10C20.6310 | Professional Ethics | 4 |
| 11 | D10C20.6311 | Communication and Public Speaking | 4 |
| 12 | D10C20.6312 | Negotiation Strategy | 3 |
| 13 | D10C20.6313 | Critical, Creative and Innovative Thinking | 3 |
| 14 | D10C20.6314 | Management and Leadership | 3 |
| 15 | D10C20.6315 | Adaptation, cooperation and collaboration | 3 |
| 16 | D10C20.6316 | Ethics and Professionalism | 3 |
| 17 | D10C20.6317 | Educational Psychology | 3 |
| 18 | D10C20.6318 | Education Management | 3 |
| 19 | D10C20.6319 | Make a Learning Implementation Plan (RPP) | 3 |
| 20 | D10C20.6320 | Create learning media | 3 |
| 21 | D10C20.6321 | Teaching Techniques and classroom mastery | 4 |

**Conversion Course 4 Scheme of Independent Campus Activities in Semester 7**

| No | MK Code | Name MK | Credits |
|---|---|---|---|
| 1 | D10C20.7301 | Digital Transformation | 4 |
| 2 | D10C20.7302 | Industrial Process and Operating Models | 4 |
| 3 | D10C20.7303 | Governance and Efficiency of Production Process | 3 |
| 4 | D10C20.7304 | Communication and Marketing Management | 3 |
| 5 | D10C20.7305 | Sumbedaya Management | 3 |

| | | | |
|---|---|---|---|
| 6 | D10C20.7306 | Infrastructure Development | 3 |
| 7 | D10C20.7307 | Product Promotion and Marketing Innovation | 4 |
| 8 | D10C20.7308 | Innovation Systems and Processes | 4 |
| 9 | D10C20.7309 | Technology Transfer | 3 |
| 10 | D10C20.7310 | Communication Management | 3 |
| 11 | D10C20.7311 | Digital Literacy and Information Technology | 4 |
| 12 | D10C20.7312 | Pedagogy | 4 |
| 13 | D10C20.7313 | Learning Process Management | 3 |
| 14 | D10C20.7314 | Learning and Social Psychology | 3 |
| 15 | D10C20.7315 | Teaching Professional Development | 3 |
| 16 | D10C20.7316 | Learning Method Development | 3 |

**Independent Campus Conversion course in Cooperation with Dit. Metrology**

| No | MK Code | Name MK | Credits |
|---|---|---|---|
| 1 | D10C20.5112 | Work Practice | 2 |
| 2 | D10C20.5210 | Sensors and Actuators | 2 |
| 3 | D10C20.5301 | Legal Metrology | 2 |
| 4 | D10C20.5302 | Measurement System | 2 |
| 5 | D10C20.5303 | Calibration and Standardization of Measurements | 2 |
| 6 | D10C20.5304 | Sist Maintenance Management. Instru. | 2 |
| 7 | D10C20.5305 | Occupational Health and Safety | 2 |
| 8 | D10C20.5306 | Industrial Instrumentation Systems | 2 |
| 9 | D10C20.5307 | Metrological Admistration | 2 |
| 10 | D10C20.5308 | Metrology & Instrumentation Workshop Work | 2 |

**Independent Campus Conversion Course Student Creativity Program (PKM)**

| No | MK Code | Name MK | Credits |
|---|---|---|---|
| 1 | D10C20.7317 | Proposal Writing Techniques | 2 |

| | | | |
|---|---|---|---|
| 2 | D10C20.7318 | Project Management | 2 |
| 3 | D10C20.7319 | Innovation Project | 2 |
| 4 | D10C20.7320 | Presentation Techniques | 2 |
| 5 | D10C20.7321 | Entrepreneurship Practice | 2 |
| 6 | D10C20.7322 | Creative Communication | 2 |
| 7 | D10C20.7323 | Energy special topics | 2 |
| 8 | D10C20.7324 | Instrumentation field special topics | 2 |
| 9 | D10C20.7325 | Materials specific topics | 2 |
| 10 | D10C20.7326 | Environment and Health special topics | 2 |

## 6) Meaning of Course Code

The course code is written in the arrangement: **D10CWW. ZYXX**
The meaning of the Code is as follows:

| Code | Meaning | Example |
|---|---|---|
| **D** | Faculty | D : Faculty of Mathematics and Natural Sciences |
| **1** | Ladder | 1: S1; 2: S2 |
| **0** | Class type | 0: Regular; 1: International |
| **C** | Courses | C: Physics |
| **WW** | Curriculum year | 20: Kuruculum in 2020 |
| **Z** | Semester | 2: Semester 2 |
| **Y** | Types of courses | 0 (Compulsory MK); 2 (MK Elective); 3 (MK MBKM Conversion) |
| **XX** | Course code | 02: Course Code Order |

## 7) Learning Methods

The learning method carried out is a learning approach through ***Student Centered Learning*** (SCL). In its implementation, the learning method is carried out in accordance with the characteristics of the course, the method consists of:

1. *Small Group Discussion* (SGD)

2. *Role-Play &; Simulation* (RPS)
3. Case Study (CS)
4. *Discovery Learning* (DL)
5. *Collaborative Learning* (CbL)
6. *Contextual Instruction* (CI)
7. Project *Based Learning* (PjBL)
8. Problem *Based Learning* (PBL)

Each course can use one or a combination of several learning methods.

| **Learning Methods** | | |
|---|---|---|
| Method | Role of Lecturer | Learning Activities |
| *Small Group Discussion* (**SGD**) | Draft discussion materials and discussion rules. Acts as moderator and reviewer of group discussion results | Learning is carried out by small group discussions to answer the material prepared, presenting the results of discussions to all groups in the class. |
| *Role-Play &; Simulation* (**RPS**) | Designing situations or activity models or simulation models with the help of computers. Evaluate/review student performance | Learning is done by carrying out a role in the classroom to get information or practice various computer models that have been prepared |
| *Case Study* (**CS)** | Design a case as an application of the material covered. Evaluate/review student performance | Learning is carried out by solving a given case within a certain time intensively, in detail and in depth. Students provide interpretations or explanations of case. |
| *Discovery Learning* (**DL)** | Prepare data and methods to explore a material that students must learn. Check and review student self-study outcomes | Learning is carried out independently to understand concepts, meanings, and relationships through intuitive processes, starting from searching, collecting and compiling information to getting conclusions and |

| | | |
|---|---|---|
| | | describing the material studied. |
| *Collaborative Learning* (**CbL**) | Prepare/design open-ended tasks. Position yourself as a facilitator and motivator. | Learning is carried out by discussing / completing tasks given in groups and designing the process of completing tasks based on group agreement. |
| *Contextual Instruction* (**CI)** | Explain the basic concepts of the material and give examples. Designing/preparing assignments for students to do | Students listen to the explanation of the basic concepts of the material to understand certain study materials then complete the task according to the explanation of the concepts given. |
| *Project Based Learning* (**PjBL**) | Create systematic assignment designs so that students learn through structured extracting knowledge and skills. Conduct a mentoring and assessment process. | Students do assignments systematically by exploring supporting knowledge. Show / demonstrate project results and present work results in a discussion forum. |
| *Problem Based Learning* (**PBL**) | Design tasks to achieve certain competencies. Make instructions to assist students in solving given problems. | Search for information / supporting materials and utilize this knowledge to solve problems given / designed by lecturers. |

## 8) Forms of Learning

The form of learning used in the Physics Study Program is carried out offline, namely face-to-face in class according to a predetermined schedule. Lecturers provide reference lecture materials in the form of e-books, modules, lecturer notes and learning support videos. The lecture and evaluation process is also carried out through the *Learning Management System* (LMS) facility available on the page: https://reguler.live.unpad.ac.id. For certain courses, responses and tutorials are provided by assistants or students appointed by course lecturers and held outside lecture hours. Practicum activities are carried out in laboratories that have been provided according to

a predetermined schedule. Lecturers as instructors will be assisted by students as practicum assistants.

## 9) Learning Programs

### Course Content

| | | |
|---|---|---|
| **UNX01-001** | **Religion** | **2(2-0)** |
| Delivering students in the development of professions and religious personalities who have faith and piety, knowledge and noble morals and make religious teachings the basis for thinking and behaving in professional development | | |
| **Library:**<br>Book of Preparatory Stage with Unpad | | |

| | | |
|---|---|---|
| **UNX01-004** | **Indonesian** | **2(2-0)** |
| Teaching Indonesian for students is more directed at understanding and mastering good and correct Indonesian in writing a scientific writing concept: writing sentences with the correct SPOK order; development of an idea in sentences and paragraphs; the process of describing an object, literacy ability to process and understand information when carrying out the process of reading and writing; understanding scientific reading, especially in the field of Physics and adding vocabulary and expressions in good and correct Indonesian. Sentence structure (grammar) is given according to the scientific reading. | | |
| **Library:**<br>Book of Preparatory Stage with Unpad | | |

| | | |
|---|---|---|
| **UNX01-006** | **Creativity and Entrepreneurship (OKK)** | **3(1-2)** |
| This course encourages the development of student fitness and creativity in order to foster a sense of love for the alma mater and develop self-character as a student. | | |
| **Library:**<br>Book of Preparatory Stage with Unpad | | |

| | | |
|---|---|---|
| **UNX01-007** | **Pancasila** | **2(2-0)** |
| Delivering students to develop their personalities able to realize the basic values of Pancasila and awareness of nation, state, in applying their knowledge responsibly to humanity with the competence to master the ability to think, be rational, and dynamic, broad-minded as intellectual humans who have; responsible attitude according to his conscience; recognize life and welfare problems and ways of solving them; recognize changes and developments in science and technology; | | |

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| interpreting historical events and cultural values of the nation in order to rally Indonesian unity. |
| **Library:**<br>Book of Preparatory Stage with Unpad |

| **UNX01-008** | **Civic Education** | **2(2-0)** |
|---|---|---|
| Delivering students to develop their personalities as citizens who play an active role in upholding democracy towards civil society and helping students as citizens to be able to realize the basic values of the struggle of the Indonesian nation and awareness of the nation, state, in applying their knowledge responsibly to humanity with the competence to master the ability to think, be rational, and dynamic, broad-minded as intellectuals who have; insight into state consciousness, to defend the country with the behavior of loving the motherland; national insight, national awareness for national resilience; A mindset, a comprehensive attitude is integral to all aspects of national life. | | |
| **Library:**<br>Book of Preparatory Stage with Unpad | | |

| **D10C20.1001** | **Basic Physics I** | **4(4-0)** |
|---|---|---|
| After attending Basic Physics I lectures, students are able to explain the basic concepts of physics and their application in everyday life which include mechanics, thermodynamics and magnetic electricity. The given material consists of particle kinematics, particle dynamics, work and energy, momentum and impulse, angular momentum, rotational motion, rigid body equilibrium, fluid mechanics, heat, Thermodynamic Law I, Thermodynamic Law II, electric force field, electric force, electric potential, capacitor, dielectric, electric current, magnetic field, magnetic impact, and alternating current. | | |
| **Book:**<br>1. Douglas C. Giancoli, Physics for Sci- entists &; Engineers with Modern Physics, 4th edition, Prentice Hall, 2006.<br>2. Marcelo Alonso and Edward Finn, Physics, Revised edition, Addison Physics, Revised edition, Addison Wesley, 1992 | | |

| **D10C20.1002** | **Basic Physics Practicum I** | **1(0-1)** |
|---|---|---|
| After attending Basic Physics Practicum I, students are able to measure and take physical data from physics experiments and analyze them. The material provided consists of basic measurements and uncertainties, the least squares method, the shift coefficient of liquids, free fall motion, voltmeters, and ammeters, lens properties and shadow formation, solid type heat and wheatstone bridges. | | |
| **Library:**<br>Basic Physics Practicum Guide I, Basic Science Service Center, Padjadjaran University, 2009 | | |

| D10C20.1003 | Mathematical Physics I | 2(2-0) |
|---|---|---|
| After attending the Mathematical Physics 1 lecture, students are able to solve physics problems using mathematical physics concepts. In the Mathematical Physics I course, which is a compulsory course for Physics students to learn about basic mathematical constructions, including basic calculus, complex numbers, series, vector calculus and ordinary differential equations (GDP). The content of Mathematical Physics 1 material is the basis for studying physics courses such as Mechanics, Magnetic Electricity, Waves, Modern Physics, and Quantum Physics. In addition, the concepts learned become the basis for computing-based lectures. | | |
| **Library:**<br>1. Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edition, John Wiley & Sons, 2006.<br>2. K. F. Riley, Mathematical Method for Physics and Engineering, 3rd, Cambridge, 2006 | | |

| D10C20.1004 | Algorithms and Programming | 2(2-0) |
|---|---|---|
| After attending Algorithms and Programming lectures, students are able to design algorithms and express them in Python language code to solve simple physics cases. Python programming basics, I/O Operators and Statements, Control Structures, Repetition, 1D Arrays, Functions, Plot Graphs, N-Dimensional Arrays, Symbolic Mathematical Operations and Reading/Writing Files. At the end, a cased-based study was held to find computational solutions to physics problems with the help of Python programs. | | |
| **Library:**<br>1. Python Programming Tutorial 2. Sandy H.S. Hero, WCPL Press, Bandung 2017<br>2. Learn Python The Hard Way 3th Edition, Zed A. Shaw, Addison Wesley 2014 | | |

| D10C20.1005 | Algorithm and Programming Practicum | 1(0-1) |
|---|---|---|
| Equipping students with the skills to write program code using Python language. The material consists of: Python programming basics, I/O Operators and Statements, Control Structures, Repetition, 1D Arrays, Functions, Graph Plots, N Dimensional Arrays, Symbolic Mathematical Operations and Reading/Writing Files. At the end, project-based learning is held, students look for cases in the field of physics and solve them by applying the programming material that has been learned. | | |
| **Library:**<br>1. Algorithm and Programming Practicum Module, Physics Study Program FMIPA Unpad<br>2. Learn Python The Hard Way 3th Edition, Zed A. Shaw, Addison Wesley 2014 | | |

| D10C20.2001 | Basic Physics II | 4(4-0) |
|---|---|---|
| After attending the Basic Physics II lecture, students are able to explain the basic concepts of physics and their application in everyday life which include waves, optics and modern physics. The given matter consists of oscillating motion, waves in elastic media, sound waves, properties and propagation of light, reflection and refraction, interference, diffraction, lattice and spectrum, polarization, special theory of relativity, quantum physics, arrangement of atoms and molecules, and arrangement of atomic nuclei. | | |
| **Library:**<br>1. Douglas C. Giancoli, Physics for Sci- entists &; Engineers with Modern Physics, 4th edition, Prentice Hall, 2006.<br>2. Marcelo Alonso and Edward Finn, Physics, Revised edition, Addison Physics, Revised edition, Addison Wesley, 1992 | | |

| D10C20.2002 | Basic Physics Practicum II | 1(0-1) |
|---|---|---|
| After attending Basic Physics Practicum II, students are able to measure and take physical data from physics experiments and analyze them. The material given consists of electric heat tariff, the characteristics of several electrical elements, determining the modulus of elsaticity, the moment of inertia of an object, the constant of spring force and gravity, diffraction, and light interference, physical pendulum, resonance, and spectrophotometer. | | |
| **Library:**<br>C. Panatarani (ed), Basic Physics Practicum II Guide, Basic Science Service Center, Padjadjaran University, 2009 | | |

| D10C20.2003 | Mathematical Physics II | 3(3-0) |
|---|---|---|
| After attending the Mathematical Physics II lecture, students are able to apply mathematical methods in solving physics cases. The Mathematical Physics 2 course is a compulsory course for Physics students who study matrix algebra, systems of linear equations to the problem of using eigenvalues. Coordinate system, including curved coordinates, cartesian tensor and spherical tensor. The next discussion is partial differential equations. After attending this lecture, students are expected to be able to apply, especially for other Physics courses, including Electricity, Magnetism and Electronics | | |
| **Library:**<br>1. Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edition, John Wiley & Sons, 2006.<br>2. K. F. Riley, Mathematical Method for Physics and Engineering, 3rd, Cambridge, 2006 | | |

| D10C20.2004 | Modern Physics | 2(2-0) |
|---|---|---|
| After attending Modern Physics lectures, students master the concepts of modern physics and know their application to technology. The given material consists of | | |

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| quantum physics, hydrogen atomic models, quantum theories for the arrangement of atoms and molecules, molecular spectra, solids, nuclear transformations |
| Kenneth S. Krane, Modern Physics, 2nd edition, John Wiley & Sons, 1996 |

| **D10C20.2005** | **Numerical Computing** | **2(2-0)** |
|---|---|---|
| After completing the Numerical Computing course, students can use the concept of numerical methods to model physical systems and find numerical solutions of various physical equations. The discussion begins with the basic concepts of numerical methods and numerical errors in the example case of function expressions with Taylor series. Furthermore, the roots of non-linear equations are discussed with the approach of bisection, false position and fixed point iteration methods. The subject matter is a system of linear equations with approaches to the Gauss method of elimination, Jacobi iterations and Gauss-Seidel iterations. The subject matter of vectors and eigenvalues with the approach of the power method and the inverse of the rank. The subject matter of curve matching with interpolation and linear regression approaches. The subject matter of numerical integrals with the approach of the Trapezoid, Simpson and Monte Carlo methods. The subject matter of ordinary differential equations with Taylor series approximations, Euler method and Runge Kutta method. | | |
| **Library:**<br>1. Numerical Methods in Engineering with Matlab, Jaan Kiusalaas, CAMBRIDGE UNIVERSITY PRESS 2010<br>2. Numerical Methods for Engineers 6th, Steven C. Chapra and Raymond P. Canale, McGraw-Hill 2010 | | |

| **D10C20.2006** | **Numerical Computing Practicum** | **1(0-1)** |
|---|---|---|
| Equipping students with physical case solving skills with a numerical method approach. The material studied consists of: basic concepts of numerical methods and numerical errors, roots of non-linear equations with the approach of the bisection method, false position and fixed point iteration. Material systems of linear equations with approaches to Gauss elimination methods, Jacobi iterations and Gauss-Seidel iterations. Vector material and eigenvalues with the approach of power methods and power inverses. Curve matching material with interpolation and linear regression approaches. Numerical integral matter with the approach of the Trapezoid, Simpson and Monte Carlo methods. Ordinary differential equation material with Taylor series approximation, Euler method and Runge Kutta method. | | |
| **Library:**<br>Numerical Computation Practicum Module, Physics Study Program FMIPA Unpad, 2023 | | |

| D10C20.2007 | Mechanics | 4(4-0) |
|---|---|---|
| After completing the Mechanics course, students can demonstrate the concepts of classical mechanics, Lagrange and Hamilton's equations of motion to explain the motion of objects in everyday life correctly. The given material consists of Newton's laws, equations of particle motion, motion of bullets in a medium with resistance, rocket bridle, laws of conservation, particle systems, gravity, linear vibration, vibration with thrust, nonlinear vibration, inert frame of reference, Hamilton asar, general coordinate equation of motion, laws of conservation, canonical equation of motion of Hamilton dynamics, central force motion, planetary motion, Kepler's law, and the kinematics of collisions of two particles, the rules of variation calculus, the mechanics of Lagrange and Hamilton | | |
| Keith R. Symon, Mechanics, 3rd edition, Addison Wesley, 1971 | | |

| D10C20.2008 | Thermodynamics | 3(3-0) |
|---|---|---|
| After attending Thermodynamics lectures, students are able to explain the basic concepts of thermodynamics and apply them to various thermodynamic systems. The given material consists of energy and the first law of thermodynamics, as well as evaluation of the properties and relationships of thermodynamic variables, ideal gas models, internal energy, enthalpy and polytropic processes of ideal gases. Next discusses the second law of thermodynamics, thermodynamic cycles, maximum performance measures of cycles and Carnot cycles. Next discusses entropy and irreversible processes (basic concepts of thermodynamics), thermodynamic relationships. Furthermore, it discusses thermodynamic applications starting with energy and volume analysis, exergy analysis, steam power generation systems, gas power, refrigeration and heat pumps, combustion systems, pure substances and chemical equilibrium. | | |
| **M.**<br>W. Zemansky and Richard H. Dittman, Heat and Thermodynamics, 7th edition, McGraw-Hill, 1996 | | |

| D10C20.3001 | Electronics | 4(4-0) |
|---|---|---|
| The Electronics course provides an understanding of the principles of analog electronics and digital electronics and is able to apply them in the design of simple and cutting-edge electronic systems. The material provided consists of equivalent circuits, transient currents, alternating currents, semiconductor theory, diodes, grounded base amplifiers, grounded emitter amplifiers, grounded collector amplifiers, FET amplifiers, how JFET works, JFET characteristics, MOSFET transistors, electronic circuit design and analysis, operational amplifier circuits, feedback circuits, oscillator circuits, analog circuits and digital circuits. | | |
| **Library:**<br>Sutrisno, Elektronika, volume 1: basic theory and its application, 1986 | | |

| D10C20.3002 | Electronics Practicum | 2(0-2) |
|---|---|---|
| After attending the Electronics Practicum, students are proficient in RLC Circuits, Characteristics of Diodes and Transistors, Rectifier Circuits, Power Supply. Transistor amplifier circuit, op-amp characteristics, op-amp applications, oscillator amplifier, digital circuit, flip-flop conventer ADC &; DAC, counter. | | |
| **Library:**<br>1. Electronics Practicum Module, Physics Study Program FMIPA Unpad<br>2. Sutrisno, Elektronika, volume 1: basic theory and its application, 1986 | | |

| D10C20.3003 | Magnetic Electricity | 4(4-0) |
|---|---|---|
| After attending Magnetic Electricity lectures, students are able to solve physics cases related to electricity and magnetism. The material provided consists of vector analysis, static electric field, Gauss's law, discrete and continuous charge distribution, electric potential, Laplace transform, shadow method, dielectric material, static magneto field, magnetic material, Maxwell's equation, electromagnetic wave equation in air and in material. | | |
| **David**<br>J. Griffith, Introduction to Electrodynamics, 3rd edition, Prentice Hall, 1999 | | |

| D10C20.3005 | Physics Experiments | 1(0-1) |
|---|---|---|
| The Physics Experiment course is a compulsory practicum course for 4th semester Physics students, which supports other compulsory Physics courses (core physics). Practicum topics in this course include topics in mechanics, magnetic electricity, and thermodynamics. For the topic of mechanics, students will conduct experiments such as Harmonic Rotator, and Heat Mechanical Tara. To better understand the concept of electricity-magnetism, students will conduct experiments such as the Biot-Savart law, the Faraday effect, the Pockel effect and the trajectory of electrons in magnetic fields. As for the topic of thermodynamics, observations of liquid expansion and water anomalies, as well as water vapor pressure below 100 ° Celsius. | | |
| **Library:**<br>1. Experimental Physics Practicum Module, Physics Study Program FMIPA UNPAD<br>2. Adrian C. maelissinos, Jim Napolitano, Experimentation in Modern Physics, 2nd Edition, Academic Press, 2011 | | |

| D10C20.3006 | Mathematical Physics III | 3(3-0) |
|---|---|---|
| After attending the Mathematical Physics III lecture, students are able to apply mathematical methods in solving physics cases related to special functions and complex function algebra. After attending this lecture, students are expected to be able to recognize special functions and use them to determine solutions to differential equations. In addition, students are expected to be able to manipulate differential and integral calculus in complex functions. | | |

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| **Library:**<br>1. Mary L. Boas, Mathematical Methods in the Physical Sciences, 3rd edition, John Wiley & Sons, 2006.<br>2. K. F. Riley, Mathematical Method for Physics and Engineering, 3rd, Cambridge, 2006 |

| **D10C20.3007** | **Scientific Research Methods** | **2(2-0)** |
|---|---|---|
| After attending the Research Method I lecture, students are able to make proposals for the Student Creativity Program (PKM). The material provided consists of scientific writing methods, literature search, research ethics, program design and planning and PKM proposal writing rules. | | |
| **Library:**<br>C. Dawson, Practical Research Method, How to Books, United Kingdom, 2002 | | |

| **D10C20.3008** | **Wave** | **4(4-0)** |
|---|---|---|
| After attending Wave lectures, students are able to apply the concepts and principles of vibration and waves in solving simple and complex physics cases. The given material consists of spring and pendulum oscillations, transverse wave equation, free wave equation oscillations, propagation rate, energy propagation, impedance, pressure wave, reflection, impedance matching, linear superposition, wave analysis with Fourier series, Fourier transform, wave pulse analysis, wave packet, signal with Delta Dirac representative, wave modulation: DSB, AM, FM and pulse modulation. Electromagnet wave equation solution of electromagnetic wave equation, flat wave, transverse wave polarization, energy and momentum propagation, flat wave in conductive medium, wave reflection and refraction. Insulating dipole radiation, radiation and moving charge. Propagation in dielectric waveguides, propagation in conductor tubes and crystals. | | |
| **Library:**<br>1. Pain, H.J., The Physics of Vibrations and Waves 4th edition, John Wiley and Sons, 1992.<br>2. Tjia, M.O. Wave, Dabara Publisher, 1994 | | |

| **D10C20.4003** | **Quantum Physics** | **4(4-0)** |
|---|---|---|
| The Quantum Physics course provides students with an understanding of the basic concepts of quantum physics and their application to simple quantum systems such as hydrogen atoms. The material given consists of wave packets and uncertainty principles, Schrodinger wave equations, one-dimensional problems, operator methods, three-dimensional problems, electron spin and angular momentum summation, N particle systems and time-free pertubation theory. | | |
| **Library:**<br>S. Gasiorowicz, Quantum Physics 2nd Ed., John Wiley & Sons, Inc., 1996 | | |

| D10C20.4004 | Introduction to Core Physics | 3(3-0) |
|---|---|---|
| The Introduction to Core Physics course provides students with an understanding of the properties of atomic nuclei and nuclear reactions as well as the benefits or applications of nuclear physics. The given material consists of Rutherford scattering, nuclear properties, binding energy, connective fraction, surface effect, separation energy, nuclear radius, semiempirical mass formula, nuclear spin, nuclear electric moment, nuclear momenmagnetic, nuclear instability, radioactivity, nuclear models, nuclear reactions and nuclear force. | | |
| Kenneth S. Krane, Introduction to Nuclear Physics, 2nd edition, John Wiley & Sons, 1988 | | |

| D10C20.4005 | Advanced Physics Experiments | 1(1-0) |
|---|---|---|
| The Advanced Physics Experiment course is a compulsory practicum course for 5th semester Physics students, which supports compulsory Physics courses such as Modern Physics and Waves. For the topic of Modern Physics students will conduct experiments such as determining Stefan Boltzman's constant on blackbody radiation, Franck Hertz's experiment, and the Spectrum of Hydrogen Atoms. As for the topic of waves, students observe and analyze wave phenomena in several experiments including Determination of Visible Light Wavelengths, the concept of diffraction and interference in double gaps / lattices, Ripple Tanks, and Polarizers. | | |
| **Library:**<br>1. Adrian C. maelissinos, Jim Napolitano, Experiment in Modern Physics, 2nd Edition, Academic Press, 2011<br>2. Advanced Experimental Physics Practicum Module, Physics Study Program FMIPA Unpad | | |

| D10C20.4007 | Computational Physics | 2(2-0) |
|---|---|---|
| After attending Computational Physics lectures, students are able to apply numerical methods to solve physics cases using C or matlab software. The given material consists of solving ordinary differential equations, spring oscillation cases, pendulums, magnetic electricity, partial differential equations, chaotic pendulum cases, Laplace equations, Poisson equations, Diffusion equations, Wave equations, and Monte Carlo methods | | |
| **Richard**<br>Fitzpatrick, Computational Physics, Texas University, Austin | | |

| D10C20.5001 | Physics Expertise Practicum | 1(0-1) |
|---|---|---|
| The Physics Expert Practicum has 14 practicium modules consisting of 4 material physics modules and 5 Energy Physics and Instrumentation modules each. The Physics Expertise Practicum is specifically intended as an enrichment of the compulsory courses Energy Physics, Material Physics and Instrumentation Physics and is given in the sixth semester. The material provided consists of: (1) Sensors | | |

| |
|---|
| and Transducers; (2) Analog and Digital Measurements; (3) Signal Conditioner; (4) signal processing; (5) Kendal System; (6) Hydrogen Fuel cell (Hydrogen Formation Rate and Working Principle of Fuel Cell); (7) Thermoelectric converter, utilization of the Seebeek and Peltier effects for energy generation; (8) Solar cells; (9) Radiation measurement with gamma spectrometer (activity measurement as a function of distance, measurement of detector efficiency as a function of energy); (10) Working principle and measurement of power and efficiency of steam power plants; (11) Determination of GaN bandgap by spectroscopic technique; (12)Determination of PBG width of photonic crystal model (Photonic bandgap simulation); (13) The effect of solvents on material conformation by absorption and emission spectroscopy; (14) ATR simulation to determine refractive index and thin layer thickness. |
| **Library:Physics**<br>Practicum Module Expertise, Physics Study Program FMIPA Unpad |

| **D10C20.5002** | **Introduction to Solid Matter Physics** | **4(4-0)** |
|---|---|---|
| The Introduction to Solid Matter Physics course provides students with an understanding of the basic concepts of solid matter physics for the physical characteristics of materials. The given material consists of crystal structure, geometry and types, reciprocating lattice, vibration lattice, phonon and heat types, surface fermi, zone scheme (Brillouin zone) | | |
| Charles Kittel, Introduction to Solid State Physics, 8 Edition, Wiley, 2004 | | |

| **D10C20.5003** | **Optics** | **2(2-0)** |
|---|---|---|
| This course provides students with an understanding of the basics of optics in materials. Ideal dielectric materials, EM wave equations in optical materials, the way to study and understand the properties or optical and electronic characteristics of a material is to understand the interaction between electromagnetic (EM) waves and materials: Reflection and Refraction of Field Waves. An interesting property of EM waves, is when they propagate through homogeneous material (waveguide). | | |
| **Library:**<br>1. E. Hecht, "Optics", 4th Edition, Addison Wesley Publ. San Francisco USA, 2002.<br>2. P. Yeh (1988), Optical Waves in Layered Media, John Wiley, New York. | | |

| **D10C20.5004** | **Statistical Physics** | **3(3-0)** |
|---|---|---|
| Statistical Physics is a core physics course given in the seventh semester. The materials provided include: Statistical Physics Approach, Canonical Ensemble, Large Canonical Ensemble, Quantum Gas, Fermi-Dirac Statistics, Bose-Einstein Statistics | | |

**Frederick**
Reif, Fundamentals of Statistical and Thermal Physics, 1st edition, McGraw-Hill, 1965

## Elective Courses:

**Environmental Physics (2-0) – D10C20.4201**

This course is a free elective course for all students who are interested in exploring environmental issues. It is expected that after attending this course students will be able to understand the application of physics in the environmental field. This course explains the calm environment and the Physical Environment. Components and Properties of the Physical Environment: Air, Water, Soil. Atmosphere and Radiation: Gas composition in the atmosphere (Residence Time, Photochemical Pollution, Atmospheric Aerosols, Ozone and ozone holes, water in the atmosphere), Terrestrial Radiation (Earth as a Black Body, Greenhouse Effect, Greenhouse Gases, Climate Change and Global Warming. Energy and the Environment: Energy Flows, Material Cycle and Renewable Energy. Environmental Impacts: Initial Hues and Important Impacts in the Physical Environment, Pollution and its Impact in the Physical Environment.

**Book:**

1. Clare Smith, 2001, Environmental Physics, British Library Cataloguing in Publication Data
2. John Monteith, Mike Unsworth, 2013, Principles of Environment Physics

**Energy Conversion (2-0) – D10C20.4202**

The energy conversion course is a compulsory course for all students. After attending this lecture, students are expected to be able to understand the application of physics in the field of energy conversion from various energy sources. In this lecture discussed about; classification of energy sources, main fuel energy conversion, thermal energy production, fossil fuel systems, nuclear reactor design and operator, mechanical energy production, electrical energy production, energy storage systems, basic generation from conventional energy resources as well as new and renewable energy which includes solar energy, wind energy, biomass energy, marine energy, geothermal energy, thermionic converters, thermo electric converters, battery energy, fuel cells, magneto hydro dynamics, fusion energy and the basics of energy conversion in electrical machines

**Book:**

1. Principles of Energy Conversion. Archie W. Culp, Jr., Ph.D. Erlangga Publishers 1991.
2. UI Press.; B. M. Weedy. 1988. Electric Power System, Third Edition Revised, Singapore: John

**Heat Transfer (2-0) – D10C20.4203**

The heat transfer course is a free elective course for students who are interested in taking a concentration in the field of energy. After following this course, students are expected to be able to understand the basic concepts of heat transfer conduction, convection, radiation and their application to tools. The heat transfer course discusses about; 1D, 2D steady-state conduction heat transfer, Unsteady-state conduction heat transfer, Convection heat transfer, Natural convection heat transfer Forced convection heat transfer, Radiant heat transfer Heat transfer (continued), Condensing heat transfer, Boiling heat transfer, Heat exchanger, Cooling tower

Book:

1. Heat Transfer, JP. Holman
2. Engineering Heat Transfer, William S. Janna

**Robotics (2-0) - D10C20.4205**

This subject is an instrumentation specialization elective course that contains discussions of various concepts, types and classifications of robots according to their functions. Various robotic system hardware. Introduction of software for robotic control systems. The basics of sensors and actuators in robots. Review of the approach to mathematical models in robots. Functional Robot Manufacturing Project.

**Book:**

1. Robotics: Fundamental Concept and Analysis, Oxford University Press, Second reprint, 2008
2. Bruno Siciliano and Oussama Khatib, Springer Handbook of Robotics, 1st Eds., 2008, 978-3-540-30301-5.
3. Richard M. Murray, A Mathematical Introduction to Robotic Manipulation 1st Edition, 1994 - CRC Press, ISBN 9780849379819

**Data Science (2-0) - D10C20.4206**

After attending this course, students are expected to be able to define well the initial steps to handle and analyze science data. Understand data collection methods, with a systematic approach to collecting relevant information from various sources. Able to analyze data quality that will produce accurate data by considering the mean, mode, and median values. Able to make modeling to formulate each step and gather the necessary techniques to obtain solutions. Able to communicate the results of data processing in an easy-to-understand way, so that stakeholders can make follow-up plans from the results of data analysis.

**Book:**

1. David Donoho, 50 years of Data Science, Sept. 18, 2015, Version 1.00.
2. Fionn Murtagh,and Keith Devlin, The Development of Data Science: Implications for Education,Employment, Research, and the Data Revolution for Sustainable Development, Big Data Cogn. Comput. 2018, 2, 14

**Introduction to Artificial Intelligence (2-0) - D10C20.4207**

After attending this lecture, students are targeted to be able to know and understand the concept of artificial intelligence in general to solve mathematical and practical solutions using the concept of interaction of agents and their environment. Able to design graphs and trees for the best solution search process. Able to understand and design uninformed and informed search methods for certain cases. Able to understand and design Machine Learning and Neural Network concepts. Able to understand and design the concept of Evolutionary Algorithm

**Book:**

1. Russel, Norvig. 1995. Artificial Intelligence: A Modern Approach
2. Tim Jones. 2008. Artificial Intelligence: A System Approach

**Physics, Anatomy and Physiology (2-0) - D10C20.4208**

The course explains the level of organelles--> cells-->tissues--> organs--> organ systems--> species (individuals) have complex structures that support the process of biophysical and biochemical processes supporting life. Physics students who are familiar with both classical and modern physical theories, with various studies (optics, electronics, mechanics, informatics) need basic knowledge of how the structure of living things and how phenomena / processes work if they intend to apply physical theories to biology. This lecture is an introduction to the anatomy (structure) and physiology (process) of several examples of levels in the physical part of living things.

**Book:**

1. Plonsey & Barr, Bioelectricity A Quantitative Approach, Third Edition, Springer
2. Cotterill, Biophysics an Introduction, John Willey and Son

**Atmospheric Physics (2-0) - D10C20.4209**

This course is an elective course that provides the basics of understanding atmospheric physics. After attending this lecture, students are targeted to be able to understand the composition and properties of the earth's atmosphere, the application of the laws of thermodynamics to the atmospheric system, the processes of electromagnetic radiation in the atmosphere, the concept of cloud formation and its effects and understand the factors that affect climate and its changes.

**Book:**

1. Wallace, J. M. and Hobbs P. V., Atmospheric Science an Inttroductory Survey, 2nd edn: ELsevier, 2006
2. Andrews, D. G., An Introduction to Atmospheric Physics, 2nd edn: Cambridge University Press, 2010

**Renewable Energy (2-0) - D10C20.4210**

After taking this course, students will understand the scope of renewable energy lectures and be able to mention the types of renewable energy. Students know the types of renewable energy, comparisons with fossil energy, and problems that occur in its development. Able to understand the concept of wind energy and how Wind Power Plants work and their calculations, understand the concept of solar energy and

how Solar Power Plants work and their calculations. Able to understand the concept of water energy and how Hydroelectric Power Plant works and its calculations. Able to understand the concept of geothermal energy and how Geothermal Power Plants work and their calculations. Able to understand the concept of biomass energy and its calculations. Students understand the concept of nuclear energy and how Nuclear Power Plants work and their calculations, understand the concept of Energy Storage Technology and how it works. Students can understand mini-grid technology and examples of its application in everyday life.

**Book:**


1. Rosa, A.V.da (2005). Fundamentals of Renewable Energy Processes, California. ELSEVIER Academic Press.
2. Renewable Energy Handbook. Contaned Energy Indonesia.


**Energy Physics (2-0) - D10C20.5201**

Energy Physics course is an elective course which is an advanced course. After attending this course, students are expected to understand the basics of energy physics and its applications. In this lecture discussed Mechanical Energy, energy conservation, heat and work, residential energy conservation and heat system control, solar energy, fossil energy, air pollution, global warming and thermal pollution, electricity, circuits and superconductors, electricity and magnetization, electricity from the sun, wind and water, atoms and nuclei, nuclear plants, fission reactions, effects of radiation use, fusion reactions (future alternative energy), biomass and geothermal.

**Book:**


1. Abdul Kadir, Energy, UI Press.1982.
2. Energy: Its Use and the Environment Fifth Edition Roger A. Hinrichs and Merlin Kleinbach Publisher, Physics and Astronomy: Charles Hartford. 2013.
3. John A. Duffie and William A. Beckman. Solar Engineering of Thermal Processes, John Willey and Sons.1980.


**Instrumentation Physics (2-0) - D10C20.5202**

This elective course is the basis of the enrichment of Instrumentation Physics in the S1 Physics Study Program which is given in the fifth semester. After getting the Instrumentation Physics course, students of the Physics Study Program are expected to have basic knowledge about the basic principles of instrumentation systems. To strengthen the understanding of Instrumentation Physics, students are also required to take part in the Physics Expertise Practicum given in the sixth semester. Instrumentation Physics lecture material contains static and dynamic characteristics of instrumentation, working principles of sensors and trandusters, analog and digital measurements, microprocessors, signal conditioning and data communication

**Book:**


1. Measurement Systems: Application and Design (Doebeli, E.O., 1990, McGraw-Hill),
2. Sensors and Signal Conditioning (Pallas, R., 1991, John Willey &; Sons)

**Material Physics (2-0) - D10C20.5203**

The Material Physics course is an elective course for all Physics students in semester 5 which discusses the basic concepts of Materials.The topics covered in the lecture start from the basic theory of substances, namely atomic structure and bonds between atoms, solids, grouping of materials including metals, polymers, ceramics, and composites. In addition, students will study the properties and characteristics of materials including electrical, thermal, mechanical, and optical properties. After attending the Introduction to Material Physics lecture, students are able to analyze the atomic/molecular structure of materials and their relationship with physical properties which include mechanical properties, electrical properties, thermal properties, optical properties, and magnetic properties.

**Book:**


1. William D. Callister, Jr., David G Rethwisch, Materials Science and Engineering an Introductions, 3rd edition, John Wiley & Sons, 2009
2. Schaffer, J.P., et.all The science and Design of Engineering Materials, 2nd Edition, McGraw-Hill, 1999


**Nanoscience (2-0) - D10C20.5204**

Introduction to nanotechnology (definition, history, Nobel Prize (from the dream to reality), world nanotechnology roadmap, national nanotechnology roadmap), synthesis, properties and applications of various nanometer-sized materials0D, 1D, 2D, nanoscale material phenomena, synthesis technology, nanomaterial characterization tool technology (FE-SEM, TEM, AFM, XRD, etc.) and application technology (textile, medicine, pharmacy, automobile, electronics, cosmetics, environment, etc.).

**Book:**


1. J.A. Rodrigues and M.F. Garcia (Eds), Synthesis, Properties and Application of Oxide Nanomaterials, John Wiley &; Sons, Canada, 2007.
2. G. Schmid (ed) Nanoparticels, Wiley VCH, 2004.


**Material Synthesis Method (2-0) – D10C20.5205**

This course studies synthesis methods ranging from organic materials including polymers and inorganic materials. The material in this course includes methods of synthesis of organic materials including chemical thermodynamics, molecular structure, chemical kinetics, synthesis mechanisms (addition, elimination, substitution, condensation, rearrangement, reduction-oxidation, perycyclic reactions), stereochemistry; In addition, polymer synthesis methods are also discussed, including chemical polymerization, electrochemical polymerization, light-assisted polymerization (photo-polymerization), and thermal energy-assisted polymerization (thermo-polymerization). In addition, methods of synthesis of inorganic materials are also discussed, including: solids reaction, synthesis of solids from the gas phase, synthesis of solids from solutions, synthesis of porous materials, and synthesis of nano materials.

**Book:**

1. J.M. Coxon and R.O.C. Norman, Principles of Organic Synthesis, 3rd Edition, Blackie Academic &Pro., 1993.
2. Eduardo Vivaldo-Lima and Enrique Saldivar-Guerra, Handbook of Polymer Synthesis, Characterization, and Processing, 1st Edition, John Wiley and Sons, Inc., 2013.

**Digital Signal Processing (2-0) - D10C20.5206**

This course is an instrumentation specialization elective course that contains the subject matter of discrete time signals, linear systems and time-invariants, series representation in the Fourier transform. Continuous time signal sampling. Analysis of the transformation of the Invariant Linear Time system: frequency response, the system in the form of a linear difference equation with constant coefficients, the all-pass system, the minimum phase system. Z-transformation, convergence region, z-transformation inverse, z-transformation properties. The structure of discrete-time systems: direct, cascade, parallel, transpose forms. FIR filter design: windowing technique. IIR filter design: analog filter, impulse-invariance design, biliniary transform Discrete Fourier Transform, Inverse Discrete Fourier Transform, Fast Fourier Transform, Inverse Fast Fourier Transform.

**Book:**

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications. McGraw-Hill College., 2001
2. K. Sanjit, and Mitra, Digital Signal Processing. McGraw-Hill International Editions.,2008
3. Ludeman, and Lonnie, Fundamentals of Digital Signal Processing. Prentice Hall., 2005

**Electronic Planning and Microcontroller Interface (2-0) – D10C20.5207**

PCB planning/designing, assembly, testing and manufacturing systems; analog, digital and combined circuit planning both using software; use of test instruments including testing patterns; Hardware and software integration.

**Book:**

1. Horotitz, P., & Hill, W., 1989, The Art of Electronics, Cambridge.
2. Williams, T., 2005, The Circuit Designer's Companion, Newnes.

**Biomass (2-0) - D10C20.5208**

This course is a free elective course for all students who are interested in exploring the study of renewable energy sourced from biomass. After attending this course, students are expected to master the concept of processing biomass into energy sources. The biomass course explains the definition of biomass, biomass characteristics, types of biomass, biomass conversion process carbonization, pyrolysis and gasification. Application of carbonization, pyrolysis and gasification. Biobriquette manufacturing process, biobriquette pellets, biobriquette stove design and analysis.

**Book:**

1. Biomass Gasification and Pyrolysis Practical design, Prabir Basu. Published by Elsevier Inc. All rights reserved. 2010.
2. Biomass Briquetting: Technology and Practices, P.D. Grover and S.K. Mishra

**Fluid Dynamics (2-0) - D10C20.5209**

The fluid dynamics course is a free elective course. After attending this course, students are expected to be able to understand the formulation of physics about mass transfer. This course explains the concept of mass transfer which includes; The concept of volume set in fluid applications, Volume Control Applications, Hk. Newton II and pers.momentum in fluid dynamics, Understanding and decreasing pers. continuity or press. Energy (Bernoulli), Application of pers.continuity and press. Energy in fluid flow analysis, Application of pers.continuity and momentum in calculating the energy produced by fluid collisions, Application in venturimeter measuring instruments, Principles of closed channel flow, Energy and hydraulic lines, Pers.continuity and energy in closed channels, Application of pers.continuity and energy in closed channel flow and venturimeter, Pers.conservation of energy due to energy loss, Major and Minor losses in pipeline flow, Application of energy loss in pipeline flow, Branched pipe flow analysis, Series pipeline flow analysis, Parallel pipeline analysis, Network pipeline analysis, Basic principles in dimensional analysis, Dimensions and units, Buckingham number.

**Book:**

1. Practical Fluid Mechanics for Engineering Application, John M. Bloomer
2. Fluid Mechanics, Frank M. White

**Sensors and Actuators (2-0) - D10C20.5210**

Sensor and actuator courses are elective courses for students of the undergraduate physics study program. This course has 2 credits and is held starting from semester 5. In this lecture, students will learn starting from the characteristic elements of sensors, the basic principles of sensors, electronic circuits, sensor calibration processes, several types of actuators along with the integration of sensors and actuators.

**Book:**

1. Y.L. Lin, "Smart Sensors and Systems", Springer, 2015
2. S. Soloman, "Handbood Sensors", 2nd, Mc Graw Hill, Newyork, 2009
3. Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs, and Applications", Fourth Edition, Springer, New York, 2010

**Radiation Physics and Dosimetry (2-0) - D10C20.5211**

After attending this lecture, students are expected to be able to identify and understand the types of radiation and their properties. Students are able to understand the processes that cause nuclear and atomic radiation, are able to understand the interaction of each type of radiation with matter, are able to understand the concept of

measuring the amount of radiation, and are able to understand the concept of how radiation detectors work.

**Book:**

1. Podgorsak, E. B. Radiation Physics for Medical Physicists, 2nd edn: Springer, 2010
2. Podgorsak, E. B. Radiation Oncology Physics: a Handbook for Teachers and Students: IAEA 2005

**Asset Integrity Management of Steam and Gas Power Plant Facilities (2-0) - D10C20.5212**

After attending this lecture, students are expected to be able to know the physics underlying facilities and Power Plant Equipment, be able to know the Design Concept of Power Plant Equipment and be able to know the Design Concept of Power Plant Equipment. Students are expected to be able to understand the mechanism of damage and equipment failure mode, be able to understand the mechanism of damage and equipment failure mode, be able to understand inspection procedures and characterization of power plant equipment, be able to analyze calculations and analyze the remaining life and remaining power of power generation equipment.

**Book:**

1. William J, Callister Jr. &; David G. Rethwisch, Materials Science and Engineering, An Introduction, John Wiley &; Sons, Inc. 2018.
2. Dr. Peter McClean Millar, Asset Integrity Management Handbook (Free eBook).2015.

**Thin Film Technology (2-0) - D10C20.6202**

This course studies the technology of making thin layers (thin films) of organic and inorganic materials. Some techniques for making thin layers of organic materials that will be discussed include: solution casting techniques, dip-coating, doctor blading, spin-coating, screen printing, self-assembled monolayer, Langmuir-blodgett. Some techniques for making thin layers of inorganic materials include Evaporation, Sputtering (Magnetron Sputtering, Ion Sputtering), Pulsed Laser Deposition (PLD), Chemical Vapor Deposition (Mechanical Organic-CVD, Physical Vapor Deposition (PVD), Plasma Enhanced-CVD), and Molecular Beam Epitaxy (MBE).

**Book:**

1. Milton Ohring The Materials Science of Thin Films, academic Press Sanden, 1992
2. Thin Film Deposition: Principles and Practise. Smith, Donald Leonard. McGrow-Hill, 1995

**Material Characterization Techniques (2-0) – D10C20.6203**

Material Characterization Engineering is one of the free elective courses in the S1 Physics study program, Padjadjaran University.This course aims to provide students with knowledge about the basic physical principles of material characterization techniques and the basics of interpretation. The lecture materials presented are UV-Vis and FTIR spectroscopy techniques, TEM and SEM electron microscopy

techniques, TGA and DTA thermal analysis techniques, four-line / point probe techniques, Hall effect techniques, potentiostat and galvanostat techniques, EIS electrochemical impedance techniques. This lecture is given as many as 16 meetings in one semester, each meeting lasts for 100 minutes. Material Characterization Engineering lectures are carried out through a mixture of lectures, questions and answers, and student center learning methods.

**Book:**


1. Laurence M. Harwood, Timothy D.W. Claridge, 1997, Introduction to Organic Spectroscopy, Oxford University Press.
2. Mool Chand Gupta, 2001, Atomic and Molecular Spectroscopy, New Age International (P) Limited, Publishers.


**Optical Communication Systems (2-0) - D10C20.6204**

This course provides students with an understanding of the basics of optical communication which is currently widely used in communication technology. The subjects given consist of: Laser light, Maxwell's equation and wave equation, interaction of EM radiation and matter, refractive index of dielectrics and metals. Isotropic single layer, total internal reflection formulation, conventional optical fibers, evanescent waves, surface plasmons. Periodic layered medium (1D photonic crystal), Bragg reflector.

**Book:**


1. A. Yarif and P. Yeh (1984), Optical Waves in Crystals, John Wiley, New York.
2. P. Yeh (1988), Optical Waves in Layered Media, John Wiley, New York.


**Magnetic and Superconducting Materials (2-0) - D10C20.6205**

This course discusses various structures, properties and spin behaviors in magnetic and superconducting materials. The concepts discussed in this lecture include the subject matter of magnetic fields, magnetic moments, magnetic measurements, diamagnetic and paramagnetic materials, ferromagnetic materials, ferrimagnetic materials and superconducting subjects. This lecture begins with an explanation of important concepts in the discussion of magnetism, namely about magnetic fields, magnetic induction, magnetization and the concept of magnetic moments and magnetic poles. Then an overview of the classification of magnetic materials and their characteristics will guide students to understand various magnetic materials including diamagnetic materials, paramagnetic materials, ferromagnetic materials and ferrimagnetic materials and their various applications that have been and will be enjoyed in the future. This lecture ends by studying the properties, characteristics and applications of superconductors.

**Book:**


1. D. Jiles (1998), Introduction to Magnetism and Magnetic Materials, Chapman & Hall/CRC.
2. Risdiana (2013), Diktat Lecture on Magnetic and Superconducting Materials, Department of Physics.

**Functional Material (2-0) – D10C20.5206**

This course is expected to provide students with an overview of the relationship between the structure and properties of materials related to technology applications. Some of the properties to be discussed include electrical conduction properties, dielectric properties, optical properties, electromagnetic properties, and magnetic properties of materials. Some examples that will be discussed in this course include conductive polymers, organic-inorganic hybrid polymers, and carbon-based materials.

**Book:**

1. Deborah D L Chung, Functional Materials: Electrical, Dielectric, Electromagnetic, Optical and Magnetic Applications, , World Scientific (2010).
2. Banerjee & Tyagi, Functional Material: Preparation, Processing and Applications 1st Ed, Elsevier (2011)

**Particle Physics (2-0) - D10C20.6207**

This course is a free elective course in the S1 Physics study program. The main purpose of this course is to provide an introduction to the fundamental particles that make up matter, the properties of these particles and the types of fundamental interactions between these particles. Basic knowledge of fundamental particles and the latest developments in this field will enrich students' insight into physics concepts at the most basic level and their ongoing developments. In addition, a strong basic knowledge of particle physics is a requirement for students who want to pursue further studies (S2 and S3) in the field of high energy physics or theoretical physics.

**Book:**

1. David J. Griffiths, 2008, Introduction to Elementary Particles, 2nd edition, Wiley.
2. Francis Halzen, Alan D. Martin, 1984, Quarks and Leptons: An Introductory Course in Modern Particle Physics, 1st edition, Wiley.

**Battery System (2-0) - D10C20.6208**

Battery System is an elective course that aims to provide insight and understanding of battery working principles and the latest battery technology developments. The material provided consists of the basic concept of batteries, battery electrochemical reactions, factors affecting battery performance, battery performance testing methods, types of batteries, examples of primary and secondary batteries, working principles of lithium-ion batteries and working principles of metal/air batteries.

**Book:**

1. T.R. Crompton, Battery Reference Book 3th edition, Newnes 2000
2. Reiner Korthauer, Lithium-Ion Batteries: Basics and Applications, Springer 2018

**Medical Instrumentation (2-0) - D10C20.6209**

The Medical Instrumentation course is a free elective course offered every even-numbered semester. This course provides additional knowledge about instrumentation systems used in the medical field. The instrumentation system applied to humans is very different because it must prioritize the safety and comfort of humans who are

being measured. Medical Instrumentation lecture materials include: commonly used sensors, biopotential electrodes and amplifiers, blood flow and respiratory system measurements, biosensors and clinical laboratory instrumentation.

**Book:**

1. Medical Instrumentation: Application and Design (Webster, 1992, Houghton Mifflin)
2. Biophysical Measurements (Strong, P., 1970, Tektronix)

**Network Instrumentation and Datalogger (2-0) - D10C20.6210**

Protocols and architecture, data communication (transmission and transmission media, data encoding, data communication interfaces, data-link control, multiplexing), asynchronous transfer modes and frame relays, wireless LAN and dataloggers.

**Book:**

Stalling, W., 2007, Data and Computer Communication, Prentice Hall.

**Optoelectronic Technology (2-0) - D10C20.6211**

After attending this course, students are expected to be able to analyze the structure and working principles of optoelectronic devices, be able to design integrated optoelectronic devices, and be able to identify the latest technology in flexible optoelectronics devices. The subject matter of this course consists of: Roadmap for Optoelectronics Technology Development Beyond 2020, Light Emitting Diode (LED / OLED), Display, Photodetector, Thin Film Transistor, Solar Cells, Integrated optoelectronic devices, Printed Optoelectronics Devices Technology.

**Book:**

1. Simon M. Sze, Ming-Kwei Lee, "Semiconductor Devices: Physics and Technology- International Student Version", 3rd Edition, Wiley, 2012,
2. S.D. Brotherton, "Introduction to Thin Film Transistors: Physics and Technology of TFTs", Springer, 2013,
3. S. Ahmad, S. Kazim and M. Grätzel, "Perovskite Solar Cells: Materials, Processes, and Devices", Wiley-VCH Weinheim Germany, 2022,
4. Colin Tong, "Advanced Materials for Printed Flexible Electronics", Springer, 2022.

**Biomaterials and Biosensors (2-0) - D10C20.6212**

After attending this lecture, students are expected to be able to explain the importance of biomaterials for various applications, be able to identify criteria and types, be able to identify the essential properties of biomaterials, and be able to report the results systematically. Students can study the potential of a material as a biosensor material and apply the principles of measurement instrumentation to the properties of materials that have the potential as biosensors (optical, electronic). The subject matter of this course consists of: Introduction, Implant &; Biocompatibility, Materials: Metals, Ceramics, Polymers, Composites as biomaterials, Review of material synthesis

methods and their characterization, Sensing, transducers, and Characterization of materials and biosensors,

**Book:**

1. Vasif Hasirci, Nesrin Hasirci, Fundamentals of Biomaterials, Springer NY
2. Chandran Karunakaran, Kalpana Bhargava, Robson Benjamin, Biosensors and Bioelectronics, Elsevier

**Solar Panel (1-1) - D10C20.6213**

This subject is an elective course with a weight of 2 credits (1/1) offered to 6th semester students. The target to be achieved after attending this lecture is that students are able to explain the solar energy conversion device, solar energy radiation to the earth, working principles of solar cells (silicon solar cells), solar panel system configuration, solar panel modules and arrays, DC and AC loading and solar panel application components. In addition, students are also able to carry out solar panel maintenance procedures and troubleshooting or repairing solar panel wiring and being able to make a simple solar panel monitoring system.

**Book:**

1. Solar Energy (Fundamentals, Technology and Systems), Klaus Jager, Olindo Isabella, Delft University of Technology, 2014
2. Solar Energy Conversion, Richard C Neville, Northern Arizona University College of Engineering &; Technology, USE Elsevier, 1995

**Polymer Material (1-1) - D10C20.6214**

This subject is an elective course with a weight of 2 credits (1/1) offered to 6th semester students. The target to be achieved after attending this lecture is that students are able to identify monomers and polymers from common polymers, students can explain and discuss the basic principles of polymerization, students can discuss basic polymer characterization techniques to determine polymer properties, students can discuss the correlation between polymer structure and properties, students can explain polymer processing, and students can mention examples of polymer applications in industry automotive, construction, electronics industry, fashion, biomedical, energy, and others.

**Book:**

1. W. D. Callister, Materials Science and Engineering: An Introduction (John Wiley 1999, 5th edition)
2. Cowie, J.M.G., Polymers Chemistry and Physics of Modern Materials (3rd. ed.), CRC Press, Boca Raton, 2008

**Semiconductor (2-0) - D10C20.6215**

This course discusses the basics of semiconductor materials including energy bands, intrinsic and extrinsic carrier charges, carrier charge transport properties and semiconductor-based electronic devices (diodes, transistors and solar cells). The lecture method used is contextual instruction. In this method, students discuss the

working principle of semiconductor devices based on p-n / p-i-n connections, such as diodes, transistors and solar cells.

**Book:**

1. Simon M. Sze, Ming-Kwei Lee, "Semiconductor Devices: Physics and Technology", 3rd Edition, John Wiley & Sons Inc., 2012.
2. Donald A. Neamen, "Semiconductor Physics and Devices: Basic Principles", 4th Edition, McGraw Hill, 2003.

**Scientific Writing Techniques (2-0) – D10C20.7201**

After attending the Research Methods II lecture, students are able to make a research proposal proposal for a thesis. The material provided consists of basic research concepts in the exact field, research design, research ethics, technical writing (proposals, final project reports, journals, etc.) and technical presentations.

**Book:**

C. Dawson, Practical Research Method, How to Books, United Kingdom, 2002

**Measurement Tools and Techniques (2-0) – D10C20.7202**

After attending this lecture, students are able to master applying the basics of measurement tools and techniques. The material provided is in the form of Basic Principles of Measurement, Units (units), Deviation (error), Electromechanical Display, Galvanometer (DC Ammeter), DC Voltmeter, Ohm meter, Measurement of Spatial variables (displacement, thickness, position, location, altitude), Measurement of time and frequency, Measurement of mechanical variables of solids (mass, density, strain, torque), Measurement of mechanical variables of liquid objects (pressure, flow, viscosity, surface tension), Measurement of thermal quantities (temperature, conductivity thermal, heat flow, thermal imaging, energy)

**Book:**

The Measurement, Instrumentation and Sensor (Handbook), John G Webster, CRC Press 1999

**Physical Systems Design and Modeling (2-0) – D10C20.7203**

The Physical System Design and Modeling course equips students with the ability to translate physical systems into mathematical models so that they can design physical systems and analyze their outputs. The material provided consists of mathematical models of discrete and continuous systems, modeling and simulation of discrete systems, queuing systems, probability distributions, random number generators, data analysis for single systems, modeling and simulation of continuous systems, formulation of discrete state equations of continuous state equations, discrete integrators as transfer elements, operational methods for simulation of stationary linear systems, and application of operational methods to nonlinear systems and systems that time varying

**Book:**

1. Joseph S. Rosko, 1972, Digital Simu- lation of Physical Systems, Addison Wesley Publ. Co.
2. Jon M. Smith, 1976, Mathematical Mod- eling and Digital Simulation for Engineers and Scientists, John Wiley & Sons.

**Energy Conservation (2-0) – D10C20.7204**

This course is a free elective course for students who are interested in exploring energy conservation. After attending this course, students are expected to be able to explain physics concepts related to energy conservation. This course explains the introduction to Energy Conservation Principles, Renewable Energy Sources, Energy Control Strategies. Heating System: Concept and Types of Heating Systems, High Efficiency in Combustion Systems, Steam and Hot Water Systems. Cooling System: Air Conditioning System, Refrigeration System Application, Split System, Cooling System Components, Efficiency in Cooling System, Room Air Quality. Electric Lighting and Motors: Characteristics and Types of Lighting, Lighting Planning, Dimmer Systems. Electric power production system, electric load estimation, electric generator, on-site electric power generator, direct current power system, power distribution system, electric power control. Energy Costs, Economic and Environmental Analysis.

**Book:**

1. Patrick, Dale R., 2007, Energy conservation guidebook, The Fairmont Press, Inc.
2. Frank Kreith and D. Yogi Goswani, Energy management and concervation Handbook.2008
3. Y. P Abbi, 2000, Handbook on Energy Audit and Environment Management

**Geothermal Power Plant (2-0) – D10C20.7205**

This course weighs 2 credits given to students who are interested in studying the use of geothermal resources for various uses, especially power plants. Students who take this course are required to have taken courses in thermodynamics and heat transfer systems. In this lecture discussed about the characterization of geothermal sources, power generation systems, geothermal dry systems, single flash, double flash and binary systems, advanced / futuristic generation systems, exergy analysis in power systems. Utilization of direct use from geothermal sources. Special topic studies: various geothermal plants, dry steam kamojang, water dominated Gunung Salak, mini geothermal power generation system (< 5 MW), integrated system.

**Book:**

1. Geothermal Power Plant, Ronald in Pippo. Second edition, elsivier, B. H Publisher May 2007.
2. Geothermal energy system, edited by Evust Heugent, Geothermal. Wiley-CVH, 2010.

**Magnetic Properties Measurement (2-0) - D10C20.7206**

This course discusses various measurement concepts to determine the magnetic properties of a material. The concepts discussed in this lecture include the subjects of

Magnetic Field Measurement, Induction Coil Magmetometer, and SQUID Magnetometer. This lecture begins with an explanation of important concepts in the discussion of magnetism that have previously been made in the lecture on Magnetic Materials and Superconductors, namely about magnetic fields, magne induction and magnetization. Then the next discussion is a review of physical quantities that will determine the characteristics of a magnetic material. After knowing the amount of fission that needs to be known to determine the magnetic properties of a material, the next discussion is a discussion of magnetic material characterization techniques such as magnetic field measurement, induction coil magnetometer and SQUID magnetometer.

**Book:**


1. D. Jiles (1998), Introduction to Magnetism and Magnetic Materials, Chapman & Hall/CRC.
2. Risdiana (2013), Diktat Lecture on Magnetic and Superconducting Materials, Department of Physics.


**Biophysics (2-0) - D10C20.7207**

The Biophysics course is an elective course with a weight of 2 credits, containing the basic principles of Physics and its relation to physiological systems and functions in living things. The material studied consists of Biomechanics, Biofluids, Bioacoustics, Biooptics, Radiology, Thermodynamics of biological systems, membrane systems and the structure and reproduction of viruses.

**Book:**


1. Biophysics, Dadan Rosana, Yogjakarta State University
2. Wiliam Bialeck, Searching and Principle Biopysics, 2011


**Particle Transport System (2-0) - D10C20.7211**

The particle transportation system course is an elective course for undergraduate students of Physics in semesters six and seven with a weight of 2 credits. This course discusses the synthesis of nanocore applications in catalysts and drug delivery. The subject matter consists of nanoparticle review, magnetite structure (inverse spinnel), amphiphilic, hydropilic and hycriphobic compounds, Lewis bases, ligands, surface modification, encapsulation, FTIR analysis, Raman analysis, NMR analysis, magnetic characteristics analysis, time relaxation analysis and the principle of drug delivery release and treatment. The benefit of this course is for students to understand the application of magnetic nanoparticles in the medical world. Lectures are conducted using the *Small Group Discussion (*SGD) method, and *Discover Learning* (DL)

**Book:**


1. Handbook of Magnetic Materials: Synthesis, Properties and Application of Magnetic nanoparticles. Ed. K.H.j. Buschow, Elsevier Press).
2. Composite Materials: Processing, Application, Characterization. Springer

**Preparation and Characterization of Superconducting Materials (1-1) - D10C20.7213**

Superconducting Preparation and Characterization courses include elective courses for VII semester students in the Physics study program, FMIPA UNPAD. The prerequisite for attending this lecture is to have attended the Introduction to Solid Matter Physics course. The Superconducting Preparation and Characterization course studies starting from the concept of superconductors, preparation techniques and characterization analysis of superconducting materials. Lectures are carried out using the method of *Discovery Learning, Small Group Discussion, Contextual Instruction,* experiments where students before lectures will be asked to study the upcoming lecture material and discuss it in groups. Furthermore, students are asked to present it in front of the class to reach a conclusion together. Students will also gain experience to synthesize superconducting materials and analyze the properties of these materials.

**Book:**


1. Risdiana, Introduction to Superconducting Materials Basic Properties and Characteristics. Sumedang: Unpad Press, 2015
2. E.W. Carlson, V.J. Emery, S.A. Kivelson, and D. Orgad, Concept in High-Temperature Superconductivity, Cond-mat/0206217v1, arXiv:cond-mat/0206217v1 [cond-mat.supr-con] 12 Jun 2002


**Material Luminescence (1-1) - D10C20.7214**

This subject is an elective course with a weight of 2 credits (1/1) offered for Semester 7 students. The material discussed includes luminescence materials from theory to application. The scope of this course includes luminescence phenomena (photoluminescence, electroluminescence, chemoluminescence, bioluminescence, triboluminescence etc.), characteristics that must be carefully considered in selecting and developing materials to ensure optimal performance according to the needs and specifications of applications that play a role in the energy field (efficient lighting, solar cells, energy storage); health (medical diagnostics, photodynamic therapy, biological tagging); and the environment (air pollution, environmental sensors, biodiversity investigation) and the synthesis of luminescence material samples.

Learning is managed using the Regular Live platform with synchronous and asynchronous learning, both offline and online. Learning is carried out for 16 weeks with the number of face-to-face meetings as much as 1x in one week. The evaluation carried out to assess student success is carried out by looking at student activities during lectures and practicum activities in the form of attendance, class discussions, and presentations.

**Book:**


1. G. Blasse, B.B.Grabmaier, Luminescent Materials, Springer Berlin, Heidelberg, 1994.
2. Camellia Panatarani, Science and Technology of luminescence materials, Unpad Press, Bandung, 2016.

3. William M. Yen, Shigeo Shionoya, Hajime Yamamoto (Eds), Phosphor handbook, 2nd ed.,The CRC Press Laser and Optical Science and Technology Series, CRC Press Taylor &; Francis Group, Boca Raton, 2007

**Bioelectrical Signal Processing (1-1) - D10C20.7215**

This subject is an elective course with a weight of 2 credits (1/1) offered to 7th semester students. The target to be achieved after attending this lecture is that students know and understand the processing of bioelectrical signals derived from living things, especially humans. Bioelectric signals that are the subject of discussion include: ERG, EMG, EEG and ECG. The lecture material consists of three main parts, namely: (1) bioelectric signal sources in humans, (2) bioelectric signal tapping techniques in humans and (3) techniques for conditioning, processing and analyzing bioelectric signals.

**Book:**

1. Medical Instrumentation: Application and Design (Webster, 1992, Houghton Mifflin). (2) Biophysical Measurements (Strong, P., 1970, Tektronix).
2. Digital Signal Processing: a practical approach, Ifeachor & Jervis, Addison-Wesley, 1995.
3. Analog and Digital Signal Processing (Ambardar, A., 1999, Brooks/Cole Publishing)

**Web Programming and Animation (1-1) - D10C20.7216**

In this lecture, basic concepts of web design with html and CSS (Cascading Style Sheet) are learned, introduction to PHP programming language and MySQL database. Learn techniques for creating graphs and displaying them on the web with python language and techniques for making simple animations with python programming language.

**Book:**

1. MySQL/PHP database Applications, Jay Greenspan and Brad Bulger, M&T Books, 2001
2. Learn Python The Hard Way 3th Edition, Zed A. Shaw, Addison Wesley 2014

## 10) Permanent Lecturer

| No | Full Name &; title | NIP |
|---|---|---|
| 1 | Prof. Dr. I Made Joni, M.Sc. | 19720601 200112 1 001 |
| 2 | Prof. Dr. Risdiana, M. Eng | 19750505 199903 1 016 |
| 3 | Prof. Dr. Camellia Panatarani | 19740303 200312 2 002 |
| 4 | Prof. Dr.rer.nat. Ayi Bahtiar | 19701029 199702 1 002 |
| 5 | Dr. Fitrilawati, M.Sc. | 19650208 199412 2 001 |
| 6 | Dr. Sahrul Hidayat, M.Si. | 19730730 199803 1 002 |

| | | |
|---|---|---|
| 7 | Dr. Togar Saragi | 19680826 199603 1 001 |
| 8 | Lusi Safriani, S.Si., M.Si., Ph.D. | 19730310 199803 2 001 |
| 9 | Dr. Andri Abdurochman, MT | 19740526 200312 1 002 |
| 10 | Dr. Annisa Aprilia | 19820411 200604 2 002 |
| 11 | Dr. Otong Nurhilal, M.Si. | 19690828 199512 1 001 |
| 12 | Norman Syakir, Drs., MSc | 19590616 198603 1 016 |
| 13 | Liu Kin Men, M.Si. | 19690323 199903 1 002 |
| 14 | Setianto, M.Si. | 19730804 199903 1 004 |
| 15 | Nowo Riveli, Ph.D. | 19821129 201604 3 001 |
| 16 | Dr. Budi Adiperdana, M.Si | 19820517 201809 3 001 |
| 17 | Ferry Faizal, Ph.D | 19820531 201903 3 001 |
| 18 | Dr. Cukup Mulyana, M.S | 19550209 198601 1 001 |

# CHAPTER III

# GRADING SYSTEM AND ASSESSMENT REPORT

Evaluation of student learning outcomes in a course is at least a combination of 3 (three) types of assessments:

4.1. Midterm Exam (UTS)

4.2. Final Semester Exam (UAS)

4.3. Other values include: assignments (homework, papers, referats, and translations); quizzes (both scheduled and unscheduled), practicum result reports, stages, participation, fieldwork, laboratory, or practicum/practical exams.

The weight of each type of assessment used can be set the same or different, depending on the weight of the questions / tasks given by the Course Caregiver Lecturer.

## 1. Final Grades

Assessment of mastery of material for students of Applied Undergraduate Education, Undergraduate Education and Postgraduate Education is carried out on cognitive, psychomotor, and affective aspects. The Quality letters obtained by students are based on the following table:

| Quality Letter (HM) | Quality Score (AM) |
|---|---|
| A | 4 |
| B | 3 |
| C | 2 |
| D | 1 |
| E | 0 |

## 2. The letter T (Incomplete Assessment Component)

A student is declared to have obtained the Quality Letter T if he meets the following conditions:

a. Given to students who have not fulfilled one of the student learning outcomes evaluations conducted at the end of the semester;

b. After the evaluation in point 1 is fulfilled by students within 2 (two) weeks from the UAS of the relevant course, the Quality Letter T must be changed to the grade according to its acquisition on a scale of 0-100;

c. If the evaluation in point 1 is not fulfilled within the time limit of 2 (two) weeks, then the quality letter becomes Quality Letter E (with a quality score of 0); or Course supervisors can process according to the weight of each specified evaluation section, so as to produce other quality scores;

d. The letter Quality T cannot be changed to the letter Quality K, unless the student cannot take the follow-up UAS (through remedial) on the basis of justifiable reasons (illness, accident, or disaster that requires long treatment).
e. Quality letters T and K are not used in GPA calculations, where the Quality Letter T must be changed according to the grade gain within two weeks after the Quality Letter T is announced.

**3. The letter K (No Grading Component)**

A course can be declared with the letter K if it meets the following conditions:

a. Students withdraw from lecture activities after passing the KRS change deadline (2 (two) weeks after academic activities run) for justifiable reasons and proven by the Dean's Certificate;
b. Imposed on 1 (one) or several courses in the semester concerned in the event that students cannot take part in UAS on the basis of justifiable reasons so that they cannot take part in follow-up UAS (through remedial);
c. Given in the Final Project Report or Thesis course that is not completed in 1 (one) semester.
d. Justifiable reasons for giving the Quality Letter K are: illness or accident that requires treatment or a long healing process, which is stated by a certificate from the specialist doctor or hospital that treats it; family disasters that require students to leave their learning activities for a long time, with the necessary certificate corroborated;
e. Another justifiable reason for giving a Quality Letter K is an abnormal childbirth condition or other reasons that can be justified by the Dean beyond the two reasons in point d above, but the student is considered to have temporarily stopped his studies for 1 (one) semester with the permission of the Dean;
f. Courses that have a Quality Letter K, are not used for calculating social studies or GPA;
g. For students who obtain the K Quality Letter for the entire study load in the semester concerned, it is taken into account in the study time limit and is not considered as a temporary termination of study;
h. If point e above occurs for the second time, then the semester concerned is considered as a temporary termination of study with the permission of the Dean, so that it will reduce the student's allotment to apply for a temporary termination of study;
i. If point e above occurs for the third time (consecutively or separately), then the semester concerned is considered as a temporary termination of study with the permission of the Dean for the second time. This is not taken into account in the time limit of their studies, but invalidates the student's right to the opportunity to terminate their studies with the permission of the Dean;
j. Temporary termination of study after passing the period in point g above for reasons such as in point d, is allowed, but taken into account in the study time limit;
k. If the course that obtained the K Quality Letter has been taken again in another semester, then the Quality Letter can change according to its acquisition;
l. The provisions as above, do not apply to e-learning learning.

**4. Value Correction**

Value correction can be done:

a. If students improve the quality letters E, D, and C, then the GPA calculation used is the best Quality Letter.
b. If students improve the grade letter B, then the GPA calculation used is the last Quality Letter.
c. Improvement of E grades is carried out by retaking the relevant courses in the next semester.
d. Improvement of Quality Letters E and D can be done by remedial in the current semester or by retaking the relevant courses and listing the courses in KRS.

**5. Performance Index (IP)**

Grade point average (IP) is a number that shows student achievement or learning progress in one semester. IP is calculated at the end of each semester. The calculation formula is as follows (rounding down when less than 0.05, rounding up when equal/more than 0.05):

$$\text{IP} = \frac{\text{Jumlah (AMxSKS)}}{\text{Jumlah SKS}}$$

**6. Grade Point Average (GPA)**

Grade Point Average (GPA) is a number that shows student achievement or learning progress cumulatively starting from the first semester to the last semester that has been taken. GPA is calculated at the end of each semester. The calculation formula is as follows (rounding down when less than 0.05, rounding up when equal/more than 0.05):

$$\text{IP} = \frac{\text{Jumlah (AMxSKS) seluruh semester yang ditempuh}}{\text{Jumlah SKS seluruh semester yang ditempuh}}$$

GPA is used to determine the study load of the next semester.

GPA range and the maximum number of credits students are allowed to take in the next semester:

| GPA Range | Maximum number of credits |
|---|---|
| 3,00 – 4,00 | 24 |
| 2,50 – 2,99 | 21 |
| 2,00 – 2,49 | 18 |
| 1,50 – 1,99 | 15 |
| < 1.50 | < 12 |

**7. Graduation Requirements**

Students are declared to have completed and graduated from an undergraduate program if they meet the following conditions:

1. Pass all courses within the set cumulative study load;
2. Have a GPA of at least 2.75;
3. There is no letter of quality E;

4. D grade letter does not exceed 20% (twenty percent) of the cumulative study load of Undergraduate Education;
5. Have completed the preparation and writing of a thesis or the like, and declared worthy of the test by the Supervisor;
6. Pass the Thesis Trial Examination as the final examination of Undergraduate Education consisting of a Thesis course exam or Final Project Report, and a comprehensive examination or the like, by obtaining a Quality Letter of at least Quality Letter C (quality score 2.00);
7. Have compiled or written a Thesis; and
8. Especially for students who already have at least 1 (one) scientific article with accepted status in reputable international journals or accredited national journals, in accordance with the provisions of the Rector's Regulation on Final Project Writing at the Undergraduate and Professional Education Levels within Padjadjaran University, the students concerned are not required to continue the process of writing a Thesis, Comprehensive Exam, Thesis Trial Examination and Final Education Examination or similar exams, and scientific articles are assessed with a Quality Letter A.

**8. Temporary Study Termination**

Conditions for temporary termination of studies:

1. For Undergraduate Education students, the maximum number of temporary study terminations is 2 (two) semesters, either consecutively or separately.
2. Mechanism for applying for temporary study termination permit:
   a. Students submit an application letter to the Head of Study Program, which is known to the guardian lecturer/academic supervisor by signing their signature.
   b. The application letter is submitted no later than 2 (two) weeks before the lecture activity.
   c. After considering the academic aspect (GPA and amount of credit savings), the Study Program forwarded the application to the Dean.
   d. If the Dean gets permission, then during the period of temporary study termination, students are exempt from BPP.
   e. Temporary suspension of study is not taken into account in the maximum time limit of the student's study period.
   f. The flow of procedures for obtaining a Temporary Study Termination Permit (IPSUS) is regulated in the Rector's Decree.
   g. Students who are granted permission to temporarily suspend their studies are not entitled to academic services.
3. Temporary termination of studies without the permission of the Dean is subject to the following sanctions:
   a. To re-register must submit a written application to the Rector, through the Dean.
   b. The period of temporary termination of study without the permission of the Dean is taken into account in the maximum time limit of his Study Program.
   c. Pay the outstanding BPP, and for the next semester payment is charged in accordance with the applicable tariff decree.

4. Stopping studies (including not doing herregistration) for 2 (two) semesters either consecutively or separately without permission, is subject to termination of study.
5. Stopping study for 2 (two) consecutive semesters or separately, for reasons as mentioned in point 3 after the previous semester obtained the letter K for all semester loads, is considered to temporarily stop studying with the permission of the Dean for 2 (two) semesters; Thus, the student concerned is no longer allowed to stop his studies temporarily.
6. For all levels of study, temporary termination of study should not be made on:
   a. Semester I (first), and/or
   b. Semester II (second), and/or
   c. 1 (one) and/or 2 (two) semesters before the permitted study deadline. Thus, students are not allowed to stop their studies temporarily, either with or without permission: semester XIII (eighth) and/or semester XIV (fourteenth) in Undergraduate Education and Applied Undergraduate Education. Students who temporarily stop their studies without permission in the above semesters are considered to have resigned.

**9. Termination of Study**

1. Termination of study is imposed on Undergraduate Education students if:
   a. at the end of the fourth (fourth) semester have a GPA below 2.00 and/or;
   b. credit savings (the number of courses that have a Quality Letter D and above) does not reach 48 credits;
2. Termination of study is imposed on Undergraduate Education students if:
   a. at the end of semester VI (sixth) have a GPA below 2.00, and/or;
   b. credit savings (the number of courses that have Quality Letter D and above) does not reach 72 credits;
3. Termination of study is imposed on Undergraduate Education students if they exceed the stipulated study time limit.

# CHAPTER IV

# ACADEMIC SANCTIONS

## 1. Academic Sanctions

1. Students who have registered administratively in the first (first) or second (second) semesters may be subject to termination of study if:
   a. fill in KRS but do not participate in teaching and learning activities;
   b. does not fill KRS.
2. Students who have registered or re-registered administratively, but do not fill in the KRS (not participating in teaching and learning activities) without justifiable reasons are subject to sanctions in the form of warnings by the system and the abandoned semester is taken into account in the maximum time limit for completing their studies and if this action is repeated again, both in the next semester and in other semesters, students are subject to termination of study.
3. Students who withdraw from one or more courses after the KRS change deadline passes without justifiable reasons (for example, illness, accident, or disaster) will be warned by the system, and then the course left behind is declared not to have passed (given a Quality Letter E, with a quality score of 0).
4. The letter Quality E obtained according to point 3 is used in calculating GPA.
5. The semester left as in point 3 is taken into account in determining the maximum deadline for completion of their studies.
6. Foreign students who violate immigration regulations are subject to sanctions in accordance with applicable laws and regulations.

## 2. Sanctions for Non-Academic Violations

1. Students who commit criminal violations are subject to special sanctions in the form of academic suspensions during the legal process, after discussion with the Faculty Senate, while the handling of criminal matters is handed over to the authorities.
2. Students who violate the law and have been determined legally guilty by a court that has permanent legal force, will be subject to sanctions in the form of termination of study by the Rector in accordance with applicable regulations.
3. Students who violate moral ethics, profession (examining patients/clients without supervision, making prescriptions, conducting consultations without supervision, etc.), forging signatures and the like, will be subject to sanctions in the form of academic suspension by the Dean until termination of study by the Rector.
4. Students who violate academic ethics, including cheating, plagiarizing (papers, reports, Final Project Reports, Thesis, Dissertation, and so on), plagiarism, leaking questions or the like will be subject to sanctions in the form of academic suspension by the Dean until termination of study by the Rector.
5. All activities that disturb public order and immoral acts in the campus environment are subject to sanctions in the form of warnings until the termination of study.
6. In certain cases, the Faculty may issue its own decisions that do not conflict with the provisions of the law or regulations above.

# CHAPTER V

# FACILITIES AND INFRASTRUCTURE

The Physics Study Program already has a building consisting of lecture halls, educational laboratories, research laboratories, libraries, lecturer rooms, seminar rooms, administration rooms, common rooms and other infrastructure with adequate area and good quality. In addition, for learning basic courses, study programs use shared building facilities at PPBS Unpad.

The lecturer's workspace has Area of about 6 - 8 m2 for each lecturer. Each lecturer room has been facilitated with internet network access. Physics Study Program has six lecture rooms, each with a capacity of 40 people. Each lecture room is equipped with LCD facilities *Projector*, *motorized screen*, air conditioning, and internet network. Laboratory rooms are also available with adequate area and good equipment. Educational laboratories consisting of Basic Physics Laboratory, Computer Laboratory, Experimental Physics Laboratory and Electronics Laboratory serve practicum supporting physics core courses, the use of which averages 15 hours / week. While the research laboratory (group of expertise) serves practicum related to study courses and its use averages 9 hours / week, and is also used for student and lecturer research activities. PS also provides good library room facilities equipped with reading room facilities, computers, internet access and air conditioning. The library is equipped with textbooks, scientific papers, journals, proceedings, and theses / theses / dissertations with a total of 4,118 titles and 6,911 copies.

The Physics Study Program provides laptop facilities that are used for the implementation of lectures, Study Program seminars, and student seminars. Almost every lecturer room has been equipped with computer facilities and internet access to support the learning and research process. Each lecture room has also been equipped with an LCD projector and motorized screen that supports the learning process. To support the learning process, the Physics Study Program has an adequate number of computer laboratories and is equipped with licensed software. The laboratory at KBK also has computer facilities that are used for practicum and research. The Physics Study Program has two server units that are used for simulation/modeling research activities. To support the learning and research process, the Physics Study Program provides internet access for students which is available through hotspot facilities that can be accessed in all areas of the Physics Study Program building.

Lecture facilities and laboratories available in the Physics Study Program can meet the needs of the teaching and learning process and practicum. For the implementation of PBM, the Physics Study Program has six lecture rooms with a capacity of 40 students each and the average area per student is around 1.2 m2. The availability of practicum rooms has been sufficient, currently gradually the Physics Study Program is trying to complete practicum equipment adapted to the lecture material. In addition, the Physics Study Program already has a special room for student activities (*Student Center*) and lecturer research activities, although it is still insufficient.

Especially for the implementation of basic courses, it is carried out in an integrated manner with other study programs in the Unpad PPBS building which can accommodate 1,500 students per semester. Each PPBS lecture room is equipped with LCD *projector facilities*, computers, and *motorized screens*.

# CHAPTER VI

# RESEARCH, PPM AND COOPERATION

Research and Community Service (PPM) as stated in the Tri Dharma of Higher Education, is an important part that is very closely related in improving the overall quality of education. Research conducted by lecturers is encouraged to always involve students as part of research for student theses in an effort to support the improvement of the achievement of the study period on time.

With good support and cooperation, the amount of research conducted by lecturers of the Physics Study Program is quite a lot which is funded both from domestic funding sources through the Ministry of Research, Technology and Higher Education and Unpad Internal Grants (HIU), as well as from abroad which are offered competitively and research funds from cooperation. The amount of research funding obtained by the Physics Study Program always increases every year.

In addition to research, PPM activities of Physics Study Program lecturers also support the educational process, namely by involving students in implementing the results of lecturer research directly to the community. Strong financial support from Unpad through the Directorate of Research, Community Service and Innovation (DRPMI) by providing PPM Prioritas grants has supported the implementation of PPM in the Physics Study Program. In 2016, as many as 17 PPM activities were funded by Unpad, while in 2017 there were 8 activities that received funds for the implementation of PPM activities in various regions in West Java.

In line with the vision and mission of the Faculty and University, the Physics Study Program collaborates with various institutions both at home and abroad by involving the entire academic community of the Study Program. This collaboration includes higher education tridharma activities, both in the fields of education, research, and community service. The cooperation is outlined in various Memorandums of Understanding (MoU) or Letters of Agreement (LoA), with various activities such as *Student Exchange*, *Lecturer Exchange*, *Research Collaboration*, *Joint Publication*, implementation of thesis guidance, and others. Table 5.2 shows the cooperation between the Physics Study Program and several domestic institutions both government and private / industry, while in Table 5.3 shows the cooperation of the Physics Study Program with several foreign institutions.

**Table 6.1** Domestic Cooperation of Physics Study Program

| No. | Instance Name | Types of Activities | Benefits That Have Been Obtained |
|---|---|---|---|
| 1 | PT. Grafindo Nusantara | Graphite processing and analysis | * Employment |
| | | | * Additional research facilities |
| | | | * Student internship |
| | | | * Increased research networks with industry |
| 2 | PT. Trans Java Sulawesi | Graphite processing and analysis | * Employment |
| | | | * Additional research facilities |
| | | | * Student internship |
| | | | * Increased research networks with industry |
| 3 | PT. Mekongga Sejahtera | Graphite processing and analysis | * Employment |
| | | | * Additional research facilities |
| | | | * Student internship |
| | | | * Increased research networks with industry |
| 4 | Eagle Rich Nusantara | Graphite processing and analysis | * Employment |
| | | | * Additional research facilities |
| | | | * Increased research networks with industry |
| 5 | PT. IoL | Material analysis | * Increased research networks with industry |
| 6 | Corrosion Lab, Sepuluh Nopember Institute of Technology | Material processing research | * Sharing research facilities |
| | | | * Sharing experts |
| | | | * Improved research network |
| 7 | PT. Control System | Research collaboration in the field of instrumentation | * Employment |
| | | | * Student internship |
| | | | * Increased research networks with industry |
| 8 | PT. Semesta Teknologi Indonesia | Research collaboration in the field of instrumentation | * Employment |
| | | | * Increased research networks with industry |
| 10 | PT. Indowira Putra | Cooperation in the field of paint material engineering | * Provision of paint research materials and industrial-scale paint testing |
| 11 | CV. Abdi Insan Mandiri | Research collaboration on the application of micro/nano bubble technology to increase the productivity of catfish crops in the recirculating aquaculture system (RAS) | * Provision of industrial-scale research facilities |
| 12 | BATAN | Student thesis, student internship, guest lecturer, joint publication, joint seminar organization, research | * Employment |
| | | | * Provision of research facilities |
| | | | * Student internship |
| | | | * Increased research network |
| 13 | LIPI | Student thesis, student internship, guest lecturer, joint | * Employment |
| | | | * Provision of research facilities |

| | | | |
|---|---|---|---|
| | | publication, joint seminar organization, research | * Student internship |
| | | | * Increased research network |
| 14 | BPPT | Student thesis, student internship, guest lecturer, joint publication, joint seminar organization, research | * Employment |
| | | | * Provision of research facilities |
| | | | * Student internship |
| | | | * Increased research network |

**Table 6.2** Foreign Cooperation of Physics Study Program

| No. | Instance Name | Types of Activities | Benefits That Have Been Obtained |
|---|---|---|---|
| 1 | Okuyama Lab, Hroshima University, Japan | Material processing | * Use of research facilities |
| | | | * Sending lecturers for further studies |
| 2 | Owada Lab, Waseda University, Japan | Mineral processing | * Use of mineral analysis facilities |
| 2 | Lenggoro Lab, Tokyo University of Agriculture Technology, Japan | Material processing | * Use of research facilities |
| | | | * Sending alumni for further studies with scholarships from TUAT |
| 3 | Ohkawara Kakohki Co., Ltd., Japan | Powder processing | * Overseas industry cooperation network |
| 4 | Makino Mfg.Co.,Ltd, Japan | Powder processing | * Overseas industry cooperation network |
| 5 | Tokuju Corporation, Japan | Powder processing | * Overseas industry cooperation network |
| 6 | Eriez Magnetics Japan Co.Ltd | Powder processing | * Overseas industry cooperation network |
| 7 | The physical and Chemical Research Institute (RIKEN), Wako Japan (Dr. I. Watanabe) | Material Science, Use of RIKEN-RAL Muon Facility | * Research facilities |
| 8 | Graduate School of Advanced Science and Engineering, Waseda University, Japan (Prof. Y. Furukawa) | Research Collaboration on Organic Solar Cells | * Research facilities |
| 9 | Tohoku University, Japan (Prof. Y. Koike) | Research Collaboration on Superconducting and Magnetic Materials and Student Exchange | * Research facilities<br>* Student exchange |
| 10 | Saitama University, Japan (Prof. Taniguchi) | Superconducting Materials | * Research facilities<br>* Student exchange |
| 11 | Max-Plnack Institute for Polymer Research, Germany (Prof. C. Bubeck) | Graphene oxide | * Research facilities |
| 12 | National University of Singapore (Dr. Andrivo Rusydi and Dr. Ariando) | Research collaboration on oxide materials | * Research facilities |

# CHAPTER VII

# STUDENT AFFAIRS AND ALUMNI

## A. Student

Student activities at the Physics Study Program level are accommodated by the Physics student association (HIFI) organization, which is chaired by an association leader consisting of all Physics students. At the national level, the Physics student organization is accommodated in the Indonesian Physics Student Association Association (IHAMAFI) and in 2010 the chairman of the Physics Association was the coordinator of the West Java branch branch. At the Study Program level, extracurricular activities are coordinated by HIFI. Activities held consist of activities in the fields of talent interest, organization, reasoning, welfare, religion and social service. Activities in the field of talent interest are in the form of increasing student interests and talents such as art, sports, festivals, participating in various competitions. In addition, students of the Physics Study Program also have an annual agenda, namely holding a national seminar in collaboration with the Physics Study Program. Some other activities carried out are as follows:

1. Robocop Group, specialization in Robotics – Physics Unpad
2. Journalism packaged in Calibration containers, scientific magazines
3. Physics English Conversation *Club* (PECC)
4. Photography Lovers Group
5. Futsal Football Sports Group
6. Muslim Family of Physics (KAMUFI)
7. Participated in various Scientific Writing Competitions
8. Attended various National/International Seminars
9. *Student Exchange* to Tohoku University through JYPE (Japan Youth Program in English)

## B. Alumni

The Physics Study Program already has an alumni association organization, namely the Physics Alumni Association (IKA Physics). Automatically, every graduate of the Physics Study Program becomes a member of IKA Physics Unpad. Although the existence of IKA members of the Physics Study Program is spread throughout Indonesia and abroad, for coordination and communication IKA Physics has mailing lists and groups on social networking sites Facebook, WA, etc. Grand meeting activities attended by almost all members are held regularly every three years. The agenda in the meeting was in addition to developing networks between IKA members, also to establish more intensive communication between the Physics Study Program and alumni.

For the progress of the Physics Study Program, so far IKA Physics has held several activities that help students in developing scientific insights and practices in the field as resource persons. Events such as workshops and seminars are regularly held every semester. In addition, some alumni often provide final project vacancies and internships specifically for students of the Physics Study Program.

## ATTACHMENT

### Appendix I: Internship/internship program

### A. Internship/Internship Program Implementation Flow


**Figure 1.** Internship/Internship Program Flow.

### B. SOP for Internship/Internship Program Implementation

1. **PURPOSE**
   The readiness of prospective graduates in facing the real world of work armed with mastery of theoretical and applied knowledge, in order to prepare Bachelor of Physics graduates who not only master physics in theory but also application

2. **SCOPE**
   Includes: registration of internships / work practices and implementation of internships / work practices. This procedure will be effective if accompanied by active participation from students, supervisors, field supervisors/supervisors, academic staff, and department administration staff.

3. **RELATED DOCUMENTS**
   UNPAD Education Implementation

   Guidelines for Preparing and Writing Internship/Work Practice Reports

4. **DEFINITION**
   Internship is part of job training, internship is carried out by level students as one of the main requirements to complete the educational process.

5. **PERSON IN CHARGE**
   Head of Study Program, Internship/Work Practice Supervisor

## 6. DETAILED PROCEDURES/PROCESSES

| No | Actions/Activities | Person in Charge |
|---|---|---|
| 1 | • Register for an Internship / Work Practice at TUJ, by meeting the administrative completeness requirements<br>• Registered as an active Physics Study Program Student<br>• Have passed 110 credits<br>• Have taken internship/work practice support courses<br>• Students enroll in courses at KRS<br>• Students fill out Form A and signed by the Head of Department<br>• Students fill out Form B and signed by the Company Supervisor / Supervisor<br>• Students fill out Form C and signed by the Study Program Supervisor<br>• Students fill out Form D to request Validation/approval to the Company's Supervisor/Supervisor (along with the clear name and position of the Company's Supervisor/Supervisor)<br>• Students fill out Form E (Form grade from the Company Supervisor)<br>• Students fill out Form F (Form indigo from Study Program Supervisor)<br>• Students fill out Form H<br>• Students MUST take part in the Internship/Work Practice Debriefing<br>• Students take part in the Internship/Work Internship Program<br>• Every week students participating in the Internship / Work Practice MUST submit a daily report / logbook filled with the Trello Application<br>• Every period of time, students make reports and submit them to the Company Supervisor / Supervisor and Study Program Supervisor and conduct the necessary discussions<br>• Students make reports and make presentations<br>• Students understand and are willing to comply with various regulations that apply to Internship / Work Practice activities | Student |
| 2 | • Check the completeness and verify statements with the Integrated Academic Information System ( SIAT)<br>• Process Form A to be signed by the Head of Study Program and then make a cover letter to the Partner Company | Secretary of Study Program |
| 3 | • Prepare Facilities and Infrastructure for Test activities (If any/needed)<br>• Receive a Research Letter and submit it to the Study Program<br>• Receive Form E submitted by Company Advisor | Secretary of Study Program |

| | | |
|---|---|---|
| | • Receive Form F submitted by Study Program Supervisor<br>• Receive Form H (Report Writing Form)<br>• Converting and Acknowledging Credits<br>• Reporting to SIAT and PD DIKTI | |
| 4 | • Conducting Guidance to each student<br>• Provide final grade of Internship/Work Practice to each student<br>• The Corporate Advisor signs Form B submitted by the student<br>• The Company's supervisor provides approval/validation in Form D<br>• The Company's Supervisor gives a grade after all evaluation processes are complete, and returns Form E to the Study Program | Company Supervisor/Advisor |
| | • Conducting Guidance to each student<br>• Provide final Research grade to each student<br>• The Study Program Supervisor signs Form C submitted by the student<br>• The Study Program Supervisor gives grades after all evaluation processes are complete, and returns Form F to the Study Program | Supervisor<br><br>Courses |
| 5 | • Study Program makes PKS with Partner Companies<br>• Study Program conducts Selection<br>• The Study Program determines Internal Supervisors | Head of Study Program |
| 6 | • Receive Form H given by TU Department (complete)<br>• Recapitulates all administrative files and provides a recap of grades and is included in the SIAT | Department Secretary |

## Appendix II: Research Program

### A. Flow of Research / Research Implementation

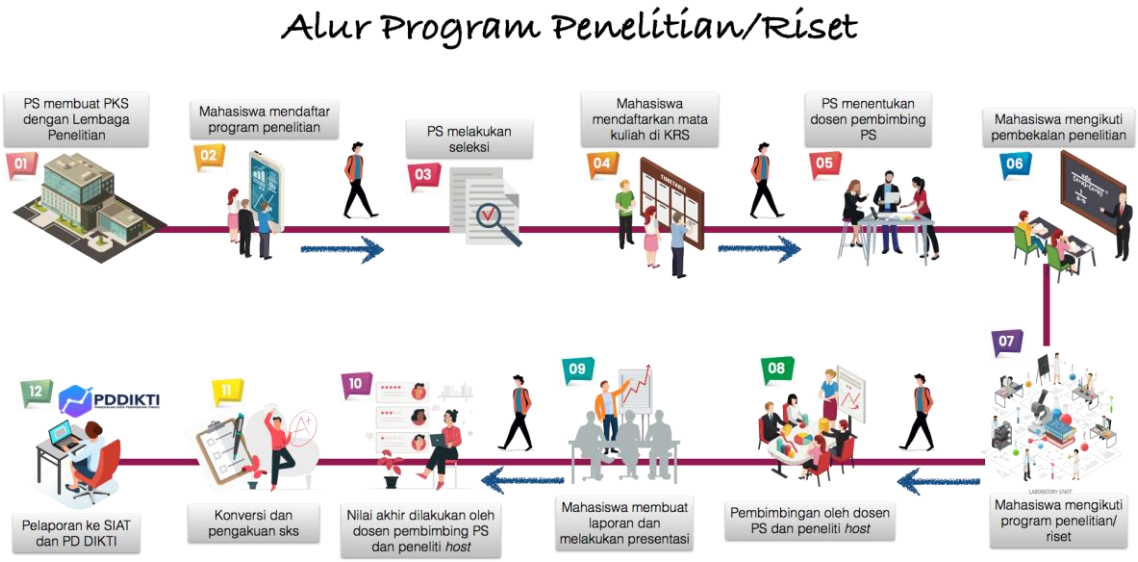


**Figure 2.** Flow of Research / Research Program.

### B. SOP for Research Program Implementation

1. **PURPOSE**
   With research, students are honed to be able to identify and formulate problems and solve problems to find solutions. The process that students go through in a research will be an important experience in forming a critical thinking framework that is expected to improve the quality of students.

2. **SCOPE**
   Includes: registration of Research / Research and implementation of Research / Research. This procedure will be effective if accompanied by active participation from students, supervisors, researchers/hosts, academic staff, and administrative staff of the department.

3. **RELATED DOCUMENTS**
   UNPAD Education Implementation

   Guidelines for Preparing and Writing Research Reports

4. **DEFINITION**
   An application of the scientific approach in a problem study in obtaining useful information and the results obtained can be accounted for. (According to Donald Ary)

5. **PERSON IN CHARGE**
   Head of Study Program, Research / Research Supervisor

6. **DETAILED PROCEDURES/PROCESSES**

| No | Actions/Activities | Person in Charge |
|---|---|---|
| 1 | • Register for Research at TUJ, by meeting the administrative completeness requirements<br>• Students fill out Form A as registration for the Research / Research course<br>• Students fill out Form B signed by the Researcher/Host<br>• Students fill out Form C signed by the Study Program Supervisor<br>• Students fill out Form D to request Approval/Validation to the Researcher/Host<br>• Students fill out Form E (Form grade from the Researcher/Host)<br>• Students fill out Form F (Form indigo from Study Program Supervisor)<br>• Students fill out Form H<br>• Registered as an active Physics Study Program Student<br>• Have completed 110 credits of compulsory and elective courses<br>• Have taken elective courses relevant to the topic of study as much as 10-14 credits<br>• Students enroll in courses at KRS<br>• Students conduct Research / Research for 6 months / 1 semester equivalent to 20 credits or 1 year / 2 semesters equivalent to 40 credits<br>• Students take part in Research Debriefing<br>• Students take part in the Research Program<br>• Students make reports and make presentations<br>• Students understand and are willing to comply with various regulations that apply to Research / Research activities | Student |
| 2 | • Check the completeness and verify statements with the Integrated Academic Information System ( SIAT)<br>• Process Form A to be signed by the Head of Study Program and then make a cover letter to the Research Institute | Secretary of Study Program |
| 3 | • Prepare Facilities and Infrastructure for Test activities (If any/needed)<br>• Receive a Research Letter and submit it to the Study Program<br>• Receive Form E submitted by Researcher/Host<br>• Receive Form F submitted by Study Program Supervisor<br>• Receive Form H (Report Writing Form)<br>• Converting and Acknowledging Credits<br>• Reporting to SIAT and PD DIKTI | Secretary of Study Program |
| 4 | • Conducting Guidance to each student<br>• Provide final Research grade to each student<br>• The Researcher/Host signs Form C submitted by the student<br>• The Researcher/Host gives approval/validation in Form D | Study Program Supervisor and Researcher/Host |

| | | |
|---|---|---|
| | • The Researcher/Host assigns a grade after all evaluation processes are complete, and returns Form E to the Study Program<br>• The Study Program Supervisor gives grades after all evaluation processes are complete, and returns Form F to the Study Program | |
| 5 | • Study Program makes PKS with Research Institute<br>• Study Program conducts Selection<br>• Study Program determines Study Program Supervisor | Head of Study Program |
| 6 | • Receive Form H given by TU Department (complete)<br>• Recapitulates all administrative files and provides a recap of grades and is included in the SIAT | Secretary of Study Program |

## Appendix III: *Student Exchange Program*

### A. Student Exchange *Program Implementation Flow*

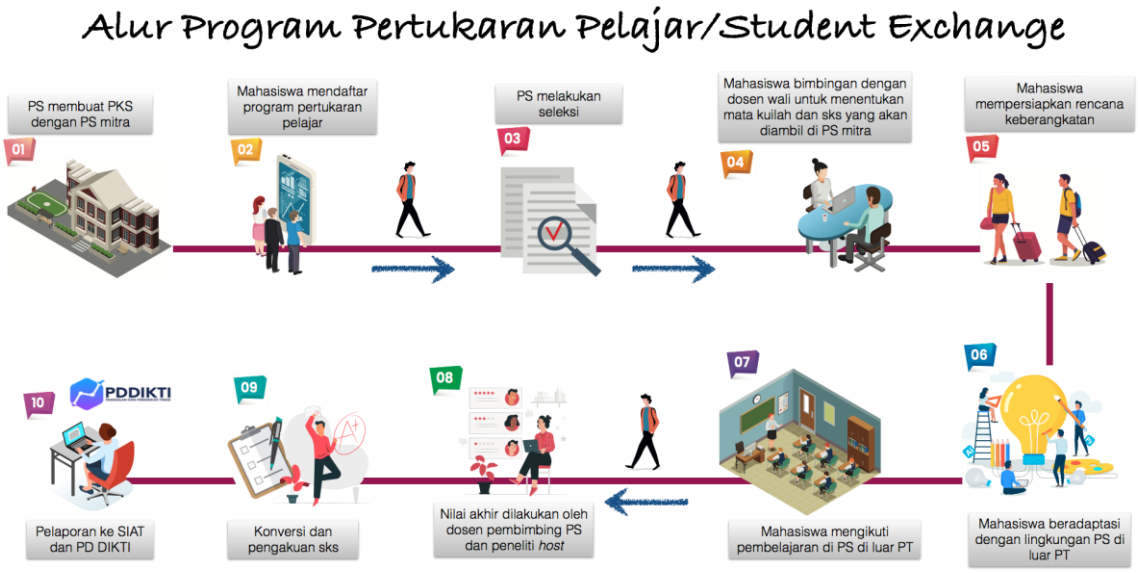


**Figure 3.** Student Exchange Program Flow.

### B. SOP for Student Exchange Program Implementation

1. **PURPOSE**
   Study exchange programs will provide benefits for students to broaden their horizons, provide opportunities to study in different environments, expand networks by getting to know students from other universities or countries and can strengthen personalities, increase confidence and foster a global perspective in students.

2. **SCOPE**
   Includes: student exchange registration / study exchange and implementation of student exchange / study exchange. This procedure will be effective if accompanied by active participation from students, guardian lecturers, Mitra Study Program supervisors, academic staff, and department administration staff.

3. **RELATED DOCUMENTS**
   UNPAD Education Implementation

   Guide to Preparing and Writing Student Exchange Reports

4. **DEFINITION**
   It is a program that provides opportunities for students to experience studying in other schools and schools abroad, absorbing various disciplines and technology, and as a place for cultural exchange.

5. **PERSON IN CHARGE**
   Head of Study Program, Guardian Lecturer

## 6. DETAILED PROCEDURES/PROCESSES

| No | Actions/Activities | Person in Charge |
|---|---|---|
| 1 | • Register for Student Exchange / *Study Exchange* at TUJ, by meeting the administrative completeness requirements<br>• Registered as an active Physics Study Program Student<br>• Have passed 110 credits<br>• Students fill out Form A and signed by the Head of Department<br>• Students fill out Form B and signed by the Partner Advisor<br>• Students fill out Form C and signed by the Study Program Guardian Lecturer<br>• Students fill out Form H<br>• Students are guided by the Study Program Guardian Lecturer to determine the courses and credits to be taken in the Partner Study Program<br>• Students preparing for departure<br>• Students participate in learning activities in Study Programs outside of Higher Education<br>• Students can take part in Student Exchange activities / *Study Exchange* 1 or 2 semesters (with a total credit load between 20-24 credits)<br>• Every period of time, students MUST provide a study progress report through a written report or consult with the Study Program Guardian Lecturer<br>• Students understand and are willing to comply with various regulations that apply to Student Exchange / *Study Exchange activities* | Student |
| 2 | • Check the completeness and verify statements with the Integrated Academic Information System ( SIAT)<br>• Process Form A to be signed by the Head of Study Program and then make a cover letter to the intended Study Program | Secretary Courses |
| | • Check completeness and verification with the Integrated Academic Information System (SIAT)<br>• Prepare facilities and infrastructure for student exchange test activities: rooms, LCDs, and others. | |
| 3 | • Sign Form C<br>• Guardian lecturers give consideration in taking courses<br>• Every period of time, students MUST provide a study progress report through a written report or consult with the Study Program Guardian Lecturer | Guardian Lecturer |
| 4 | • Study Program makes PKS with PS Partners<br>• Study Program conducts Selection<br>• Sign Form A as a condition for student exchange registration / *Study Exchange* | Head of Study Program |
| 5 | • Receive Form H given by TU Department (complete)<br>• Recapitulates all administrative files and provides a recap of grades and is included in the SIAT | Secretary of Study Program |

## Appendix IV: Teaching Assistance Program

### A. Flow of Implementation of the Teaching Assistance Program


**Figure 4.** Teaching Assistance Program Flow.

### B. SOP for Teaching Assistance Program Implementation

1. **PURPOSE**
   Students have experience in teaching which is expected to motivate students to continue learning in their scientific fields and hone their abilities in transferring their knowledge

2. **SCOPE**
   Includes: registration and implementation of Teaching Assistance. This procedure will be effective if accompanied by active participation from students, study programs, supervisors, accompanying teachers, schools, academic staff, and administrative staff of the department.

3. **RELATED DOCUMENTS**

4. **DEFINITION**
   The Teaching Assistance Program provides opportunities for students who are interested in the field of Education to participate in improving the quality of primary and secondary education.

5. **PERSON IN CHARGE**
   Head of Study Program, Teaching Assistance Supervisor

## 6. DETAILED PROCEDURES/PROCESSES

| No | Actions/Activities | Person in Charge |
|---|---|---|
| 1 | • Register for Teaching Assistance at TUJ, by meeting the administrative completeness requirements<br>• Registered as an active Physics Study Program Student<br>• Have passed 110 credits<br>• Have taken internship/work practice support courses<br>• Students enroll in courses at KRS<br>• Students fill out Form A and signed by the Head of Department and a Letter of Introduction is made to the intended School<br>• Students fill out Form B and are signed by the School Accompanying Teacher<br>• Students fill out Form C and signed by the Guardian Dose of the Study Program<br>• Students fill out Form D to request Validation/approval from the School Accompanying Teacher (along with the clear name and position of the School Accompanying Teacher)<br>• Students fill out Form E (Form grade from the School Teacher Leader)<br>• Students fill out Form F (Form indigo from Study Program Supervisor)<br>• Students fill out Form H<br>• Students MUST take part in the Teaching Assistance Briefing<br>• Students take part in the Internship/Work Internship Program<br>• Every week students participating in Teaching Assistance MUST submit a daily report / logbook filled with the Trello Application<br>• Every period of time, students make reports and submit them to the School Assistance Teacher and Study Program Supervisor and conduct the necessary discussions<br>• Every period of time, students make progress reports that are sent to the supervisor after approval by the School Accompanying Teacher.<br>• Students make reports and make presentations<br>• Students understand and are willing to comply with various regulations that apply to Teaching Assistance activities. | Student |
| 2 | • Check the completeness and verify statements with the Integrated Academic Information System ( SIAT)<br>• Process Form A to be signed by the Head of Study Program and then make a cover letter to the intended School | Secretary<br><br>Courses |
| 3 | • Prepare Facilities and Infrastructure for Test activities (If any/needed) | Secretary<br><br>Courses |

| | | |
|---|---|---|
| | • Receive a Teaching Assistance Letter and submit it to the Study Program<br>• Receive Form E submitted by the School Accompanying Teacher<br>• Receive Form F submitted by Study Program Supervisor<br>• Receive Form H (Report Writing Form)<br>• Converting and Acknowledging Credits<br>• Reporting to SIAT and PD DIKTI. | |
| 4 | • Conducting Guidance to each student<br>• Provide the final grade of Teaching Assistance to each student<br>• The School Accompanying Teacher signs Form B submitted by the student<br>• The School Accompanying Teacher gives approval/validation on Form D<br>• The School Accompanying Teacher gives grades after all evaluation processes are complete, and returns Form E to the Study Program | Teacher<br><br>School Companion |
| 5 | • Conducting Guidance to each student<br>• Provide final Research grade to each student<br>• The Study Program Supervisor signs Form C submitted by the student<br>• The Study Program Supervisor gives grades after all evaluation processes are complete, and returns Form F to the Study Program | Supervisor<br><br>Courses |
| | • Study Program makes PKS with Education Unit (SD, SMP, SMA/SMK)<br>• Study Program conducts Selection<br>• Study Program determines Study Program Supervisor | Head of Study Program |
| | • Receive Form H given by TU Department (complete)<br>• Recapitulates all administrative files and provides a recap of grades and is included in the SIAT | Secretary of Study Program |

**Appendix V: Course Conversion Rules for Student Creativity Program**

| No | Criterion | Proof | Conversion courses |
|---|---|---|---|
| 1. | Proposal Passes stage 1 | PKM Proposal, Proof of Submitting proposal/or proof of passing stage 1 | Proposal Writing Techniques |
| 2. | Proposal Funded by DIKTI | Proposal, proof of funding/proof of contract | Proposal Writing Techniques, Innovation Projects |
| 3. | Pass PIMNAS | Proposal, proof funded, proof of passing PIMNAS | Proposal Writing Techniques, Innovation Projects, Presentation Techniques |
| 4. | Won Bronze Medal | Proposal, proof of funding, proof of passing PIMNAS, Proof of medal achievement | Proposal Writing Techniques, Innovation Projects, Presentation Techniques, Special Topics or Creative Communication |
| 5. | Silver Medal Won | Proposal, proof of funding, proof of passing PIMNAS, Proof of medal achievement | Proposal Writing Techniques, Innovation Projects, Presentation Techniques, Project Management |
| 6. | Gold Medal Winner | Proposal, proof of funding, proof of passing PIMNAS, Proof of medal achievement | Can be converted A maximum of 20 credits including can be converted as a substitute for thesis |