Undergraduate Student's Guide Book

FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITAS GADJAH MADA

JUNE 2016

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PREFACE

To achieve the educational objectives in Faculty of Mathematics and Natural Sciences; one of which is to produce graduates with minimum competency as stipulated in the Indonesian National Qualification Framework (KKNI), this Curriculum Document becomes one of the important documents used as a reference in the process of education.

The formulation of this Undergraduate Curriculum Document 2016 had gone through a long process involving many parties. In terms of time, the process took around one year. In terms of process, many stages had been passed. The results in the Undergraduate Document Curriculum is not independent from existing documents, such as UGM Academic Policy, Academic Standard for Learning Process issued by UGM Quality Assurance Office, based on Rector Decree No: 581/P/SK/HT/2010 regarding the general guidelines of curriculum formulation, Decree of the Minister of National Education on Higher Education No. 44 year 2015 regarding the National Standard on Higher Education 2015 which regulates the implementation process of higher education, specifically on the miminum competency standard of undergraduates in Indonesia. Faculty meetings held on 29th October and 5th November 2015 discussed about the general basic courses and compulsory courses in UGM Faculty of Mathematics and Natural Sciences.

With the issuance of this Undergraduate Curriculum Document, it is expected that all involved parties in UGM Faculty of Mathematics and Natural Sciences will pay attention and refer to it during the process of education. On the other hand, this document is a policy that requires further elaboration in its operations. Therefore, the Chairman of the Faculty will complete it with a regulation or a more detailed standard operational procedure.

This Undergraduate Curriculum Document is expected to be applicable within the curriculum validity period and open for revision if it is deemed necessary. The Chairman of the Faculty is obliged to continuously monitor the dynamics and change the Document and its implementation. Therefore, we would like to express our thanks to all parties who have given input during the formulation of this Undergraduate Curriculum Document and also to any input in the future. We would also like to thank the Senate of Faculty of Mathematics and Natural Sciences who have authorized this document to be applied in UGM Faculty of Mathematics and Natural Sciences.

Thank You.

Yogyakarta 28th June 2016.

Authorized   Dean
Chairman of Senate,

Prof. Dr. Supama, M.Si.   Dr. Pekik Nurwantoro, MSi

CHAPTER I. FACULTY

1.1 INTRODUCTION

The Faculty of Mathematics and Natural Sciences at Universitas Gadjah Mada was established on 19th September 1955 with the Minister's Decree Education dated on the 15th September 1955 no. 53759/Kab. In this decree, the faculty is a joint faculty with the Faculty of Engineering called Association of Faculty of Mathematics and Natural Science, and Faculty of Engineering. Since September 1, 1956, the Faculty of Mathematics and Science (abbreviated FIPA) was separated from the Faculty of Engineering.

At the time it was established as the Association of Faculty, the new FIPA had one department at called the Mathematics Department. This department has existed since 1950 as a major in the Department of Civil Engineering, Faculty of Engineering. At the time of the establishment of FIPA as a faculty (1 September 1956), a new department was opened which was then called the Natural Science Department, then on September 1, 1960, Department of Chemistry was added. Starting on December 28, 1982, FIPA is renamed as FMIPA (Faculty of Mathematics and Natural Sciences) and has 3 Departments that is Department of Physics, Department of Chemistry and Department of Mathematics.

At the time of being a joint faculty until the separation from the Faculty of Engineering, office and lecture activities of FIPA are still held in the old Faculty of Engineering building which is located on Jalan Jetisharjo no. 1 Yogyakarta. The activities of basic physics practicum and workshops are still held in the complex of the old Medical Faculty at Mangkubumen.

By November 1960, FIPA occupied its new building in Sekip Unit III. Lectures and faculty offices began to be centered in this building, although some activities were still being held in Jetisharjo and Mangkubumen complex. Gradually, additional buildings were constructed, both to the north of Sekip Unit III building and in the Sendowo area. In 1967, the Basic Physics Laboratory was moved from Mangkubumen to the temporary building at north of Sekip Unit III. In 1970, the Laboratory has moved again with the Electronic Laboratory in semi-permanent buildings at Sendowo, south of the Faculty of Biology. The former building of the Basic Physics Laboratory has since been used for the Analytical Chemistry Laboratory.

Up until the year 1986, Faculty of Mathematics and Natural Sciences has 13,925 m2 of physical infrastructure and a library which has more than 10,529 books of 43,297 titles. In 1987, through the help of World Bank IX Project, library facilities have been upgraded to 13,929 books of 5,954 titles, and an additional 1369 m2 physical infrastructure of faculty office space and 3,764 m2 of Chemistry Laboratory building, thereby bringing the total area to 19,058 m2.

With the establishment of the new Faculty Administration Building and Chemistry Laboratory in Sekip Utara by the help of World Bank IX Project, starting February 1989 FMIPA Administration Office, Department of Physics and Department of Chemistry moved to the new building area in North Sekip. In February 1994 there was a fire incident at Sekip Unit III building. One third of the building, which is around 1,200 m2, was heavily damaged and cannot be used anymore. The entire Organic Chemistry Lab, Computational Laboratory, and the Library of Mathematics Graduate Program along with all of its contents in the form of laboratory equipments, practicum and research materials, books, magazines, journals and others were

burned.

In early academic year of 1995/1996, the new Department of Physics building has been completed, although it was only part of the original plan. Meanwhile, a new building for Mathematics and Chemistry departments has been started. In early 1996, most of the new building construction was already completed and all office activities and almost all academic activities were already in North Sekip.

In early 2003, a three-story building of 1,506.90 m2 was built, bringing the total area of 22,552 m2 of the new building for Lecture, Computer Laboratory, and Student Internet Center.

Since the very beginning until 1980, the Faculty organizes the Baccalaureate education program and Undergraduate education program. The Baccalureate education program takes 3 years and ends with a Baccalaureate's degree. The Undergraduate education program takes 5 years and ends with a Bachelor's degree. Since the stratification of higher education with the Decree of the Minister of Education and Culture no. 0124/U/ 1979, started from academic year of 1980/1981, the Faculty hold Undergraduate Education Program which is an education program 8 to 9 semester with a Bachelor's degree.

By the year 1987 the Baccalaureate education program was stopped. Since 1994, the official title for graduate of Undergraduate FMIPA is Bachelor of Science (S.Si.). Further, since 2000, Computer Science Program undergraduate use S.Kom title.

Up until 1985, the faculty organized three courses of study, each of which is a unified learning plan expressed in a curriculum program. The three courses are Physics, Chemistry, and Mathematics Study Programs, which are each held in each respective departments.

In academic year of 1985/1986, a special program of Diploma program for Mathematics and Natural Science Education was established, aimed to provide teaching authority at Junior High School (SMTP) and Senior High Shool (SMTA) levels, through the establishment of professional competence in the field of Mathematics and Natural Sciences. In accordance with the letter from Director of Academic Facility Development and Directorate of Higher Education No. 695/D2/1991, started in the academic year 1991/1992, FMIPA no longer accepts new students for this particular program. And started in academic year 1994/1995 Diploma program of Biology and Mathematics Education was stopped.

Since 1987/1988, the Department of Mathematics opened two new programs, Statistics Study Program and Computer Science Study Program, as well as the Department of Physics opened two new study programs namely Geophysics Study Program and Electronic Studies and Instrumentation Program.

Since 1998/1999 Diploma in Computer and Information Systems Program was opened in accordance with the decision No. 2.305/DIKTI/KEP/1998, dated August 19, 1998. In 1999/2000 D3 Electronics and Instrumentation was also established. With the opening of Vocational School at UGM in 2009, gradually the management of Diploma Program in FMIPA UGM was transferred to Vocational School.

The Master of Science (S2) program originally covered only the subject of Physics and Chemistry. But starting in the academic year of 1992/1993, Mathematics Study Program was added to the Master Program based on SK. DIKTI No. 128/DIKTI/Kep/1992. The field of physic studies includes Geophysical study. For the field of Mathematics Studies since April 11th, 1992, the Computer Science major was opened. In the academic year of 1999 Faculty of

Mathematics and Natural Sciences also opened the Master Program of Computer Science with SK DIKTI No. 259/DIKTI/ KEP/1999, dated May 27th, 1999.

In 2010, the proposal for the formation of the Department Computer Science and Electronics (JIKE) which was proposed by faculty since 2006 was finally approved by UGM. In the organizational structure, JIKE oversees two Undergraduate study program namely Electronic and Instrumentation, which is moved from the Department of Physics, and Computer Science Program, which is moved from the Department of Mathematics and Computer Science Masters and Doctor of Philosophy (Ph.D.) Program.

In order for a more effective and efficient performance of all units in the environment of UGM and to accelerate the realization of vision and mission of UGM, UGM Rector through the Rector Decree no. 809/P/SK/HT/2015 established a new Organizational Structure and Governance (SOTK), in which in Article 28 is described to use "Department" as a unit under the faculty and to replace the "Jurusan" (Major). Rector, through Decree No. 1619 / P / SK / HT / 2015, specified a special SOTK for FMIPA UGM is shown in Figure 1.1

SOTK Faculty of Mathematics and Natural Sciences UGM
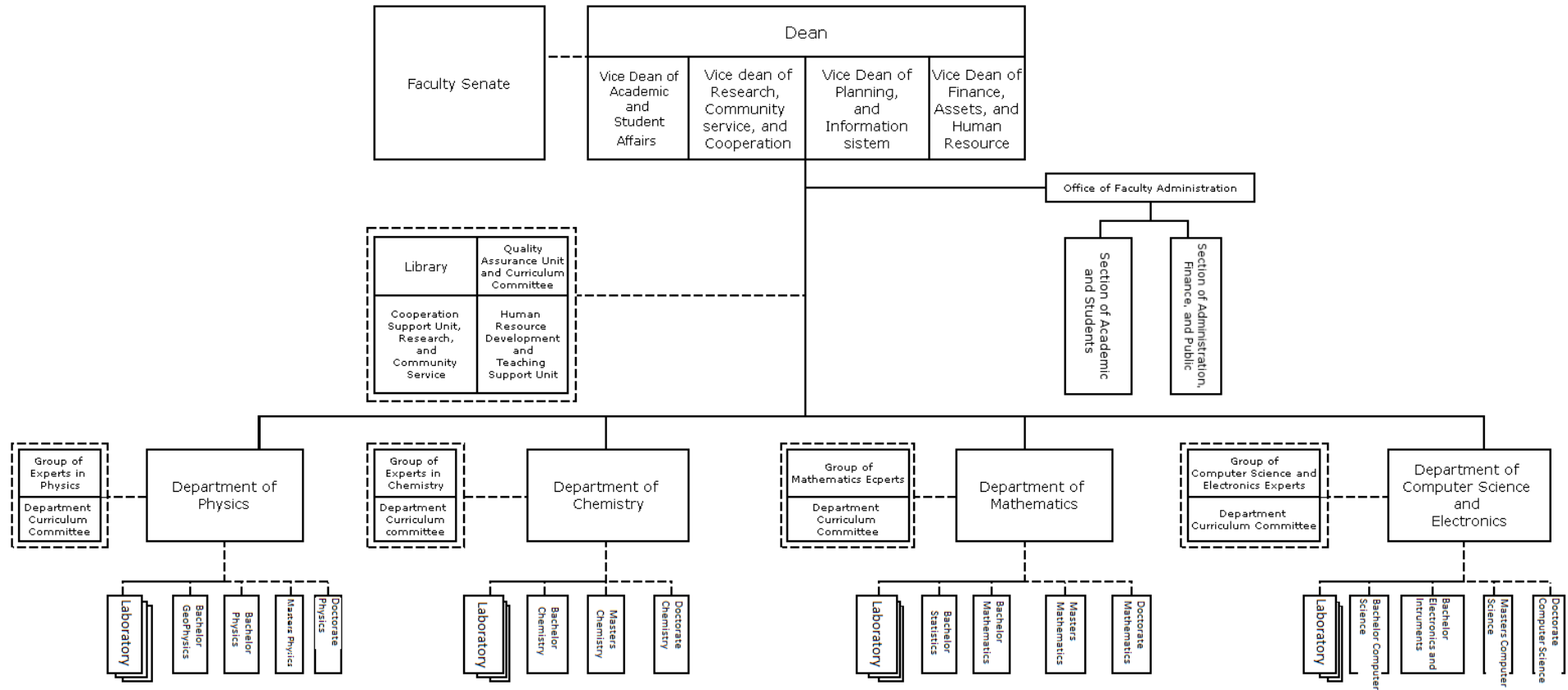
Figure 1.1 SOTK Faculty of Mathematics and Natural Sciences UGM

Curriculum Document 2016 Undergraduate Program of FMIPA UGM

Faculty of Mathematics and Natural Sciences UGM (FMIPA UGM) does not separate with Universitas Gadjah Mada in relation with all applicable policies at the university level. The demand and mandate fort he enhancement of the quality of higher education that is adaptive, responsive and participatory to the dynamics that occur both at the national and global level is well recognized by the Faculty of Mathematics and Natural Sciences.

In order to realize its mandate, FMIPA UGM refers and follows the basic values set by the University as outlined in the Document of strategic Plan of Universitas Gadjah Mada year 2012-2017.

The basic values are as follows:

1. Pancasila values that include value of divinity, humanity, unity, community, and justice.
2. Scientific values that include the value of universality and objectivity of science, academic freedom and academic pulpit, appreciation of reality and truth for civilization, benefit and happiness.
3. Cultural values that include tolerance, human rights, and diversity.

1.2 VISION AND MISSION

Below are the Vision, Mission and Objectives and Goals of FMIPA UGM as stated in Renstra and Renop FMIPA UGM 2012-2017.

Vision of FMIPA UGM

FMIPA UGM as a unit under the University of Gadjah Mada (UGM) has a vision line with UGM vision, which is as a pioneer of world class universities that are superior and innovative, serving the interests of the nation and humanity imbued nation's cultural values based on Pancasila.

Mission of FMIPA UGM

Conducting education, research, and community service as well as preservation of sicence in the field of FMIPA and benefit to the society.

1.3 OBJECTIVE OF FMIPA UGM

The goal to be achieved is the realization of FMIPA UGM as part of Universitas Gadjah Mada to become Faculty that excels in Indonesia with international achievement and reputation through:

1. High quality education in order to produce refined graduates (behavior, mental, attitude, leadership) and competent (knowledge, skills, creativity in problem solving) in the field of Mathematics and Natural Sciences.
2. Field research in MIPA in which the results are recognized as internationally reputable referrals, and able to answer problems in society, nation and country.
3. Devotion to the community that is able to encourage independence and improvement of peoples quality of life based on the excellence of MIPA knowledge that is based on Pancasila to maintain the integrity of The unitary state of the Republic of Indonesia (NKRI).
4. Good, effective, efficient and productive faculty management based on participative, accountable and transparent attitude in resource utilization.
5. Strategic, synergistic and sustainable cooperation with the support of campus alumni, industry, government and community to develop organizational independence and cooperation network to improve the position level of MIPA field.

1.4 GOALS AND STRATEGIES

Tabel 1.1 Goals and Achievement Strategies for target 1: High quality education in order to produce excellent graduates in behaviour, attitude, mental, leadership. Skills, creativity, and competence in knowledge and problem solving.

Table 1.1

Goal and Strategy for High Quality Education

Goal	Achievement Startegy
1. **Enhance the quality and balanced of student (selectivity).**	a) Increase equitable access to education from different regions and social status. b) Implementation of Admission of prospective new students who are orientated to quality, achievement and talent.
2. **The creation of intra, ko-, and extra-curriculum learning system capable of addressing local, national and global challenges.**	a) The application of case study-based learning method is orientated to solving existing problems in the community. b) Development of dynamic and adaptive curriculum for the development of science and technology. c) Improved readiness for graduates in accordance with the needs of stakeholder. d) Development of student
3. **Achieve the reputation of faculty that shows the nation's superiority.**	a) Development of an accredited study program that produce superior graduates based on an international standard curriculum. b) Implementation of curriculum internationalization program.

Table 1.1. Objectives and Achievement Strategies for target 2: Research whose results are being recognized as national referrals of international standing, and responsive to being able to address issues in society, nation and state.

Table 1.2

Goal and Achievement Strategy for Research

Goal	Achievement Strategy
1. **Availability of adequate resources in research development field.**	a) Development and maintenance of research partner funding network. b) Increasing the quality and quantity of facility owned by laboratories, field stations and workshops.
2. **Achieve the quality and quantity of research results relevant to the policy direction of the faculty.**	a) Development of a sustainable strategic research program with roadmap of achievement for the development of science and its application.

Goal	Achievement Strategy
3. Increase the publication amount and results of MIPA research utilized by community/stakeholder.	a) Development of reward system for academic community of FMIPA UGM in order to improve publication. b) Revitalization of an accredited publication media. c) Improvement of research management system and dissemination of research results.

Table 1.3. Objectives and Achievement Strategies for target 3: Community service that is capable of promoting self-reliance and improving quality life utilizing Mathematics and Natural Sciences based on Pancasila to maintain the unity of NKRI.

Table 1.3

Goal and Achievement Strategy for Community Services

Goal	Achievement Strategy
1. Increase the number of Community Service activities.	a) Strengthening management and upgrading of resources for Community Services (PkM) activites. b) Strengthening synergy among department/field of science in PkM activities.
2. Increase the number of academic community involvement and coverage of Faculty of Mathematics and Natural Sciences in community service program.	a) Identifying, documenting, disseminating, and developing a sustainable program of Community Service. b) Increasing the role of academic community through mentoring and empowerment activities for the community.
3. Increase utilization of the results of community service activities.	a) The development of partnership programs in enhancing the usefulness of activities with various stakeholders (communities, local, government, central government, industry, international community) sustainable. b) Facilitation of PkM through cooperation with partners in the development and application of the results of appropriate research in answering local issues and solutions.

Table 1.2. Goals and Achievement Strategies for target 4: Good, effective, efficient and productive faculty management based on participatory, accountable and transparent attitude in resource utilization.

Table 1.4

Goal and Achievement Strategy for Management

Goal	Achievement Strategy
1. Achieve institutional effectiveness, management and regulation.	a) Implementation of information technology according to university standards based on the spirit of integration. b) Organization and governance faculties that meet the criteria of good governance.
2. The implementation of optimal and effective human resources management.	a) Planning and placement of human resources proportionally in accordance with adequate qualifications and capacity.

	b) Development of quality systematic and efficient human resources.
	c) Implementation of a more transparent and just humanity system.
3. Implementation system and financial management.	a) Management of applicable regulatory financial system by applying the principle of good governance.
4. Achieve adequate faculty resource management.	a) Utilization of asset and financial management systems according to governance.
	b) Development, utilization and maintenance of environmentally friendly infrastructure and facilities.
	c) Increasing the capacity and quality of Information, Communication and Technology (ICT) services.

CHAPTER II. DEPARTMENT OF COMPUTER SCIENCE AND ELECTRONICS

2.1   INTRODUCTION

The Departement of Computer Science and Electronics (DCSE) of Universitas Gadjah Mada is the youngest department in the Faculty of Mathematics and Natural Sciences. It was officially established in April 2010. The department is a merger of two S1 study programmes (undergraduate level), and one S2/S3 study programme (graduate and post-graduate programmes). The two undergraduate programmes are *Computer Science* which was previously under the Department of Mathematics, and *Electronics and Instrumentation* which was previously under the Department of Physics. The merging process was quite longstanding as it had been started in 2006. In the beginning of its realisation, the department was named *Jurusan Ilmu Komputer dan Elektronika (JIKE)*, and by the legalization of new university-wide organization structure, the name was then changed into *Departemen Ilmu Komputer dan Elektronika (DIKE)*.

2.2   VISION STATEMENT OF THE DEPARTMENT OF COMPUTER SCIENCE AND ELECTRONICS

The DCSE declared its vision as to become a leading department nationally in the area of computer science and electronics and well-known internationally in the activities of education, research and community services, and also to have alumni who are competitive and leading both nationally and internationally.

2.3   MISSION STATEMENT OF THE DEPARTMENT OF COMPUTER SCIENCE AND ELECTRONICS

The DCSE has formulated its mission as the following:
1. Growing up an education system that guarantees the running of the learning-teaching activities in the area of computer science and electronics leading to international quality results for all level of Indonesian communities who have potentials and motivation to progress.
2. Growing up conducive condition to run international-level research activities (both basic and applied research) in the domain of computer science and electronics supporting the development or advancing sciences and technology for mankind prosperity.
3. Building society's awareness that computer sciences and electronics are parts of sciences and technology that play important roles in improving prosperity and living quality, either materially or spiritually.

2.4   PURPOSE

The DCSE has set its goals as follows:
1. Continuously improving graduates' quality to meet national standards and be internationally competitive.
2. Continuously improving the DCSE's quality to meet or achieve international standards or recognition.
3. Increasing and improving quality of linkages or cooperation, both with national or international institution.
4. Increasing and improving quality of human resources, equipments, and facilities to support the implementation of three roles of higher education (tri dharma perguruan tinggi).

2.5   EDUCATION PROGRAMMES

Education programmes managed by the DCSE are:

Undergraduate/Bachelor Programme (S1):

1. Study programme of Computer Science.
2. Study programme of Electronics and Instrumentation.
3. International Undergraduate Programme in Computer Science.

Graduate and Postgraduate Programmes:

1. Master programme in Computer Science.
2. Doctorate (comparable to Ph.D) programme in Computer Science.

2.6   GOALS AND STRATEGIC OF ACHIEVEMENTS

Objectives, strategies and stages to achieve the DCSE's goals are depicted in the table 3.1:

Table 3.1. Objective and Strategies of Achievement for the qualified higher education in order to produce graduates who are excellent in attitude, leadership, skill, creativity as well as competent in knowledge and problem solution.

Objective	Strategy of Achievement	Stage of Achiement				
		2016	2017	2018	2019	2020
1. **To increase the number of qualified students and balanced (selectivity)**	a) Increasing evenly distribution of educational access from various geographic area and social status. b) Performing the (quality, achievement and talent)-oriented's student recruitment.	1:32	1:38	1:43	1:44	1:48
2. **To create the (intra, co, extra)-curricular learning system that capable of answering local, national and global challenges.**	a) Implementing the method of research-based learning or problem solving-oriented case learning for society problems. b) Developing a dynamic and adaptive curriculum to the development of science and technology. c) Increasing the readiness of graduates that meet the need of stakeholders. d) Developing student organization as a organizational media and the nation character building.		71%	83%	94%	100%
3. **To achieve department reputation showing nation excellence.**	a) Developing an accredited programme that produce excellent graduates based on internationally standard curriculum. b) Performing a program of internationalization curriculum.	0	1	2	2	2

Table 3.2. Objective and Strategies of Achievement for producing researches and publications as national references and have international reputation, also responsive to and are able to answer the society, and national problems.

Objective	Strategy of Achievement	Stage of Achievement				
		2016	2017	2018	2019	2020
1. **To provide adequate resource in order to develop research**	a) Developing and maintain the partner's networking that support research fund b) Increasing quality and quantity of facilities owned by laboratories, field stations, and work shops	2.3 M	3.1 M	4.5 M	8.2M	10.4M
2. **To achieve quality and quantity of research products that relevant to the direction of department policy**	a) Developing a continuous strategic research program with the achievement roadmap for science and application development.	20	30	43	50	60
3. **To increase the number of publications and research products that give advantages to the society and stakeholders.**	a) Developing reward system for department's teaching staff in order to increase their publications. b) Revitalizing the accreditated publication media. c) Improving the management system of research and dissemination of research products.	50	85	125	180	200

Table 3.3. Objective and Strategies of Achievement for performing community service that capable of encouraging self-manage and increasing life quality based on the excellence of computer science and electronics and instrumentation and using Pancasila as foundation to protect and maintain the unity of nation (NKRI).

Objective	Strategy of Achievement	Stage of Achievement				
		2016	2017	2018	2019	2020
1. **To increase the number of activities for community services**	a) Strengthen the management and improvement for resources in community services division. b) Strengthen the sinergy between department (i.e., sience fields) and community service's activities.	50	60	80	90	125
2. **To increase the number of teaching staff's involvements and department's coverage in community services**	a) Identifying, document, disseminate, and develop continuous programs of community services. b) Increasing the roles of teaching staff through activites, such as partnership and empowering for society.	30	48	75	84	110
3. **To increase the advantages of products from community service activities**	a) Developing a continuous partnership programs in order to increase the advantage of activity with several components, such as society, local government,	10	18	25	30	50

		central govenrment, industries, international society, etc.). b) Fasilitating community service through collaboration with partners in order to develop and implement applied research' products in answering the local problems.					

Table 3.4. Objective and Strategies of Achievement for performing a good, effective, efficient, and productive governance of department that are also participative, accountable, and transparant in optimizing resources.

Objective	Strategy of Achievement	Stage of Achievement				
		2016	2017	2018	2019	2020
1. To achieve an effectiveness of organizational, structural, and regulation	a) Implementing information technology in accordance with university standard and is fundamented by the spirit of integration. b) Meeting the criteria of good organization and good governance.	70%	78%	83%	92%	100%
2. To perform an optimal and effective management of human resources	a) Making a plan and placing human resource proportionally in accordance with adequate qualification and capacity. b) Developing human resource quality systematically and efficiently. c) Implementing a human resourcing system that are fairer and more transparant.	75%	80%	90%	93%	100%
3. To implement the financial system and management	a) Managing financial system based on legal rules and implement good governance principles.	80%	85%	90%	95%	100%
4. To achieve an adequate management of faculty resource	a) Exploiting asset and financial management system in accordance with governance. b) Developing, empowering, and maintaining environmental friendly infrastructures. c) Increasing capacity and improving quality of ICT services.	60%	70%	78%	80%	100%

Table 3.5. Objective and Strategies of Achievement for realizing a strategic, synergic, and

accountable collaboration with the supports from campus society, alumni, industry, government and society in order to improve self-manage of organization and collaboration networking to increase the global level position.

Objective	Strategy of Achievement	Stage of Achievement				
		2016	2017	2018	2019	2020
1. To perform a good collaboration governance with both national partners and international partners	a) Implementing a system that guarantees legality, risk management, effectivity and efficience in collaboration. b) Improving sinergy of department inter-collaboration.	5	8	15	22	28
2. To achieve both national and international optimal collaboration in implementing "Tridharma"	a) Developing and guaranteing continuity of strategic collaboration. b) Developing resource in supporting strategic activities in the fileds of "*Tridharma*" (three-role).	10	18	25	34	40
3. To improve productivity of collaboration that give contributions for department funding	a) Developing collaborations between department and alumni and strategic partners. b) Increasing number of collaborations in utilizing research products to support research develpment funding. c) Building and developing collaboration for utilizing research products, methods, prothotypes of research products to support educational activities.	10	18	25	34	40
4. To improve and increase services to alumni	a) Developing communication system between alumni and almamater. b) Developing a supporting system for alumni career development. c) Strengthen alumni networking.	30%	40%	50%	60%	70%
5. To increase the roles and contributions of almni	a) Increasing contribution of alumni in assisting the activities of "*Tridharma*". b) Strengthen the contributions and roles alumni in developing almamater.	30%	40%	50%	60%	70%

2.7 ACADEMIC QUALITY ASSURANCE

To preserve and to improve the academic quality, undergraduate, graduate and post-graduate programmes are periodically (i.e., in every 5 years) accredited by Higher Education National Accreditation Board (*Badan Akreditasi Nasional Perguruan Tinggi*, or BAN PT), and so far the programmes are all granted grade A (very good). Besides, internal audit for the programmes is also routinely carried out by Quality Assurance Office of the Universitas Gadjah Mada. The similar process is also applied to existing laboratories. Findings of such audits were then discussed in Management Review Meeting (*Rapat Tinjauan Manajemen*, RTM), and be followed up in form of actions for improving the quality of the programs. Such follow-up will be monitored and confirmed in the next round of audit.

2.8 LIST OF LECTURERS

Teaching staffs of the undergraduate programme of Computer Science and the undergraduate programme of Electronics and Instrumentation belongs to the Department of Computer Science and Electronics. Besides, the programmes are also well supported by the existence of some lecturers from other departments within the faculty, and also from other faculties within the university.

The following is a list of permanent lecturers belong to the Departement of Computer Science and Electronics:

1. Drs. Abdul Ro'uf, M.I.Kom (Assistant Professor, member of the Computer and Network Systems Laboratory, research interest: computer systems and software systems).
2. Afiahayati, S.Kom, M.Cs., Ph.D (Head of Intelligent Systems Lab, member of Intelligent Systems Laboratory, research interest: Bioinformatics, Machine Learning).
3. Dr. Agfianto Eko Putra, M.Si (Secretary of postgraduate programme of Computer Science, member of Computer and Network Systems, research interest: Embedded systems and DSP).
4. Drs., Agus Harjoko, M.Sc., Ph.D. (Associate Professor, Head of the Department of Computer Science and Electronics, member of the Senate of The Faculty, member of Electronics and Instrumentation Research Laboratory, research interest: Computer Vision, Pattern Recognition, Instrumentation, Sensor Network).
5. Dr. Agus Sihabuddin, S.Si., M.Kom (Instructor, member of the Algorithm and Computation Laboratory, research interest: Programming Language Concept, Functional Programming).
6. Dr.-techn Ahmad Ashari, M.I.Kom (Associate Professor, Head of undergraduate Programme of Electronics and Instrumentation, member of the Computer and Networks Systems Laboratory, research interest: Distributed Systems and Grid Computing).
7. Aina Musdholifah, S.Kom., M.Kom., Ph.D (Assistant Professor, the Secretary of Graduate Programme of Computer Science, member ofIntelligent Systems Laboratory, research interest : Generic Algorithm, Fuzzy Logics).
8. Andi Dharmawan, S.Si., M.Cs (S3 UGM) (Instructor, member of the Electronics and Instrumentation Laboratory, research interest : Instrumentation, Control).
9. Aniffudin Aziz, S.Si. M.Kom. (Assistant Professor, member of the Intelligent System Laboratory, research interest : Neural Network).
10. Anny Kartika Sari, S.Si., M.Kom., Ph.D (Instructor, the Secretary of Computer Science Bachelor (Undergraduate) Programme, member of the Algorithm and Computation Laboratory, research interest : Discrete Structure, Ontology).
11. Arif Nurwidyantoro, S.Kom, M.Cs (Instructor, member of the Software Engineering and Data Laboratory, research interest : Bigdata, Datamining, OOSE).
12. Aufaclav Zatu Kusuma Frisky, M.Sc. (Teaching Assistant, member of the Electronics and Instrumentation Research Laboratory).

13. Dr. Azhari, MT. (Associate Professor, the Secretary of Computer Science and Electronics Department), member of the senate of the faculty, member of the Software Engineering and Data Laboratory, research interest: Intelligent Enterprise Systems Semantic Web, Multiagent System, IT Project Management).
14. Bakhtiar Alldino A.S., S.Si, M.Cs (member of the Electronics and Instrumentation Research Laboratory, research interest: Elektronics, Network Systems).
15. Bambang Nurcahyo Prastowo, M.Sc., Drs. (Instructor, member of the Computer and Networks Systems Laboratory, research interest: Information Security and Social Networking).
16. Catur Atmaji, S.Si, M.Cs (member of the Electronics and Instrumentation Research Laboratory, research interest: Electronics, Signal and Systems).
17. Dr. Danang Lelono, S.Si, M.T. (Assistant Professor, member of the Electronics and Instrumentation Research Laboratory, research interest: Electronics, Control).
18. Edi Winarko, Drs., M.Sc. Ph.D. (Associate Professor, Head of the Postgraduate Program of Computer Science, member the Software Engineering and Data Laboratory, research interest: Data mining, Business Intelligence, Big Data).
19. Faizah, S.Kom., M.Kom. (Instructor, member of the Intelligent System Laboratory, research interest: Expert Systems).
20. Faizal Makhrus, S.Kom, M.Sc., Ph.D (Head of the Algorithm and Computation Laboratory, member of the Algorithm and Computation Laboratory, research interest: Applied Computing).
21. Guntur Budi Herwanto, S.Kom, M.Cs. (teaching assistant, member of the Algorithm and Computation Laboratory, research interest: Applied Computing).
22. I Gede Mujiyatna, S.Kom., M.Kom. (Instructor, member of the Software Engineering and Data Laboratory, research interest: Data Communication and Network Management).
23. Ika Candradewi, S.Si, M.Cs (member of the Electronics and Instrumentation Research Laboratory, research interest: Instrumentation, Control).
24. Ilona Usuman, S.Si., M.Kom. (S3 Turki) (Instructor, member of Intelligent Systems Laboratory, research interest: Robotics, Smart Home).
25. Isna Alfi Bustoni, S.T, M.Eng. (teaching assistant, member of the Software Engineering and Data Laboratory).
26. Drs. Janoe Hendarto, M.I.Kom. (Instructor, member of the Algortihm and Computation Laboratory, research interest: Design and Analysis of Algorithm, Computer Graphics, Fractals).
27. Prof. Jazi Eko Istiyanto, M.Sc., Ph.D (Professor, Chief of Nuclear Power Supervisory Agency, member of The Senate of the Faculty, member of the Computer and Network Systems Laboratory, research interest: Embedded Systems and Information Security).
28. Dr.tech. Khabib Mustofa, S.Si., M.Kom. (Assistant Professor, member of the Software Engineering and Data Laboratory, research interest: Semantic Web).
29. Lukman Heryawan, S.T., M.T. (Instructor, member of the Computer and Network Systems Laboratory, research interest: Cloud and Autonomic Computing).
30. M. Idham Ananta Timur, ST. M.Kom (Instructor, member of the Computer and Network Systems Laboratory, research interest: Pervasive and Ubiquitous Computing).
31. Dr. Mardhani Riasetiawan, SE., Akt., MT. (S3 UGM), (member of the Computer and Network Systems Laboratory, research interest: Cloud Computing).
32. Medi, Drs. M.Kom. (Assistant Professor, member of the Algortihm and Computation Laboratory, research interest: Verification and Validation).
33. Dr.-Ing Mhd. Reza M.I.Pulungan, S.Si., M.Sc. (Associate Professor, Vice Dean of Information Systems and Planning, member of the Algorithm and Computation Laboratory, research interest: Formal Methods, Stochastics Analysis, Software Verification and Validation).

34. Moh. Edi Wibowo, S.Kom., M.Kom, Ph.D. (Head of the Computer and Network Systems Laboratory, member of the Algortihm and Computation Laboratory, research interest : Multimedia Analysis).
35. Nia Gella Augoestien, S.Si, M.Cs (member of the Computer and Network Systems Laboratory, research interest: Computer Systems).
36. Dr. Nur Rokhman, S.Si., M.Kom. (Assistant Professor, Head of Department of Services and Medical Information, member of the Algortihm and Computation Laboratory, research interest: Numerical Methods, Parallel Processing, Medical Records Information Management).
37. Panggih Basuki, Drs., M.Si., (Instructor).
38. Raden Sumiharto, M.Kom., S.Si. (Assistant Professor, member of the Electronics and Instrumentation Laboratory, research interest: Instrumentation).
39. Drs. Retantyo Wardoyo, M.Sc., Ph.D. (Associate Professor, member of the Algortihm and Computation Laboratory, research interest: Computation Theory, Management Sciences).
40. Roghib Muhammad Hujja, M.T. (Teaching Assistant, member of the Electronics and Instrumentation Laboratory, research interest: Instrumentation).
41. Dr. Sigit Priyanta, S.Si., M.Kom. (Instructor, Head of the Computer and Information Systems Vocational Programme, member of the Software Engineering and Data Laboratory, research interest : Applied Computing, Text Mining, Natural Language Processing).
42. Prof. Sri Hartati, M.Sc., Ph.D (Professor, Head of the Independent Accrediation Board, Head of the Curriculum Committee of the Department, member of the Senate of the Faculty, member of the Intelligent Systems Laboratory, research interest: Artificial and Computational Intelligence, Decision Support System).
43. Drs. Sri Mulyana, M.Kom. (S3 UGM) (Associate Professor, member of the Senate of the Faculty, member of the Intelligent Systems Laboratory, research interest: Decision Support System, Computer Reasoning, Fuzzy Logics).
44. Dr. Suprapto, M.I.Kom (Associate Professor, Head of the Bachelor Programme of Computer Science, member of the Algortihm and Computation Laboratory, research interest: Computational Logics, Analysis and Design of Algorithm).
45. Dr. Tri Kuntoro Priyambodo, M.Sc. (Associate Professor, Head of Graduate Program of Computer Science, member of the Computer and Network Systems, research interest: Telecommunication and Real-Time Systems).
46. Tri Wahyu Supardi, S.Si (teaching assistant, member of the Electronics and Instrumentation Laboratory, research interest: Electronics, Telecommunication).
47. Triyogatama Wahyu Widodo, M.Kom (Instructor, member of the Computer and Network Systems Laboratory, research interest: Network and Distributed Programming).
48. Wahyono, S.Kom, M.Sc., Ph.D (S3 Korea) (teaching assistant, member of the Algorithm and Computation Laboratory, research interest: Image Processing, Computing Graphics).
49. Dr. Yohanes Suyanto, M.I.Kom (Assistant Professor, secretary of the Bachelor Programme of Electronics and Instrumentation, member of the Computer and Network Systems Laboratory, research interest: Voice Synthesis and Network Programming).
50. Yunita Sari, S.Kom., M.Sc. (S3 Netherland) (member of the Intelligent Systems Laboratory, research interest: Pattern Recognition).

Non-permanent lecturers:
1. Drs. GP. Dalijo, Dipl. Comp.
2. Drs. Widodo Priyodiprojo, M.Sc. EE.
3. Drs. Masiran, M.Si.
4. Dr. Suharto
5. Prof. Suryo Guritno, Drs., M.Stat., Ph.D

2.9   FACILITIES AND INFRASTRUCTURE

1.   Course Facilities and Laboratory

Learning-teaching facilities are provided by the Faculty and managed by the Academic Section, i.e., one of the structural bodies below the faculty. The total area of the available lecture hall is 2130 m^2 consisting of 24 lecture rooms that can accommodate between 40-170 students. Each room is equipped with LCD Projector for digital presentation, OHP and white board. In almost all lecture rooms, there are also air conditioning and audio equipment (microphone-speaker) for the lecturers in presenting their materials.

Undergraduate Programme of Computer Science is supported by five research laboratories or expertise groups, i.e. (i) Computing and Algorithm Research Laboratory, (ii) Intelligent System Research Laboratory, (iii) Computer and Network System Research Laboratory, (iv) Electronic and Instrumentation Research Laboratory, and (v) Software Engineering and Data Research Laboratory, as well as the three basic Laboratories namely (i) Basic Computer Laboratory, (ii) Basic Electronics Laboratory, (iii) Basic Instrumentation Laboratory.

2.   Library

Library facilities that directly support the learning process in the Department of IKE are UGM Central Library, the Faculty's (FMIPA) Library and other libraries at UGM. UGM central library has a collection of excellent libraries, both in the form of print and electronic.

Electronic collection can be accessed through UGM network and non UGM with certain requirements using campus-given credential. The faculty's library covers an area of 450 m^2. There are 3,365 titles of books and journals in the library. In addition there are also a variety of supporting collections such as thesis, dissertation, and research reports.

3.   Internet Facility

All areas in the faculty are now covered with quite good quality hotspots that can be used to access internet wirelessly. All lecturer rooms, classrooms and laboratories are connected, either wirelessly or wired (using LAN)

4.   Research Laboratory of Algorithms and Computing

The scientific laboratory of Algorithms and Computing is a one that provides and develops competence and conducts research in mainly the domain of theoretical and computational aspects of Computer Science. The theoretical aspects of computer science include the basic theories of computer science, computing machines, language, grammar, computational boundaries, complexity theories, basic concepts of algorithms, and the development techniques and analysis of algorithm. While the computational aspects include numerical methods, computational support systems for the fields of mathematics, physics, chemistry, biology, financial economics, natural language, modeling and simulation, and operations research. This laboratory accommodates the studies undertaken on the topics related to but not limited to:

1. Formal Method: research related to theoretical such as: verification, checking, proving, and theory of programming language.

2. Algorithm: research related to the development of algorithms and its design techniques
3. Optimization: research related to optimization theories.
4. Computing models: research related to grid computing, cloud computing, parallel computing and fractals.
5. Computational science: research related to the development of computations in the fields of science (chemistry, physics, and biology, mathematics), and other support systems such as numerical methods.
6. Modeling, analysis and verification of the reactive system: research related to modeling, analysis and formation of methods or algorithms to ensure the validity of the reactive system.

This laboratory also accommodates the studies in the following related topics:
1. Mobile Software Analysis and Design.
2. Information Retrieval (IR): research related to IR model and its efficiency.
3. Data Mining: research related to data mining, ie algorithms and methods to find patterns of various data types, predict, and decisionmaking.
4. Data Integration: research related to data integration from various sources.

Member of Algorithm and Computing Research Laboratory:

Name of Staff	Interest or Expertise
Dr. Agus Sihabuddin, S.Si., M.Kom.	Concept of Programming Language, Functional Programming
Anny Kartika Sari, S.Si, M.Sc, Ph.D	Discrete Structure, Ontology
Faizal Makhrus, S.Kom, M.Sc., Ph.D	Applied Computing, Computational Science
Janoe Hendarto, Drs., M.I.Kom	Analysis and Design of Algorithms, Graphic Computing, Fractals
Medi, Drs., M.Kom	Verification and Validation
Moch. Edi Wibowo, S.Kom., M.Kom, Ph.D	Multimedia Analysis
Dr. Nur Rokhman, M.Kom.	Numerical Method and Operation Research
Retantyo Wardoyo, Drs., M.Sc., Ph.D	Theory of Computing, Management Science
Mhd. Reza Pulungan, Dr.-Ing., M.Sc	Formal Methods, Stochastic Analysis, Software Verification and Validation
Dr. Sigit Priyanta, S.Si., M.Kom.	Applied Computing, Text Mining, Natural Language Computing
Dr. Suprapto, M.I.Kom	Computational Logic, Analysis and Design of Algorithm
Wahyono, S.Kom, Ph.D	Image processing, Computer Graphics

5. Research Laborary of Intelligent Systems

Intelligent System Research Laboratory is oriented to the development of computer reasoning methodology, especially the development of aspects of artificial intelligence which is the state of the art system in the 21st century. It also creates and utilizes new and effective reasoning techniques, modeling and simulation based on biological systems, as well as human brain systems. This field of research includes the development of intelligent systems, knowledge-based and agent-based systems, reasoning systems, artificial neural network systems, DNA computing, membrane computing and evolutionary computing, agent systems, robotics systems, decision support systems, besides knowledge management.
This laboratory also develops methods to produce quality software. This field of research covers all stages of software development, ranging from user requirements, design, implementation and maintenance. Other areas of focus for this laboratory are

the development of information infrastructure, data management systems, and data mining. Data that the focus of attention of this laboratory can be in various forms, such as documents, imagery, sensors, web, biological data.
For more specific, the laboratory accommodates the studies in the following topics:

Artificial Intelligence: the ability of machines to demonstrate intelligent behavior, emulate and simulate methods of acquisition and application of human knowledge and reasoning. It is a research topic that explores ways to organize, represent, store and utilize knowledge appropriately and efficiently to solve problems, design, and build intelligent systems. Some topics in artificial intelligence are: a) agent systems: building systems that act as agents (eg driver agent, project monitoring agents, etc.); B) case-based reasoning systems; C) expert system/knowledge based systems; D) natural language processing; E) pattern recognition; F) finding solutions for searching; G) sensory system (vision system); H) Games

Bioinformatics: utilization of computer science, mathematics and information theory to model and analyze biological systems especially ones involving genetic material.
Computational intelligence: a study on adaptive mechanisms that build intelligent behavior in complex and changing environments. Creating algorithm models to solve complex problems, including artificial neural network paradigm, evolutionary computation, swarm intelligence, fuzzy system, Bayesian reasoning.

Decision Support System/Group Decision Support System: modeling on decision making by utilizing computational intelligence, mathematical model and optimization.
Knowledge management: explicit and systematic management of knowledge, and processes related to the creation, extraction, transformation, storing, incorporation, utilization and development of knowledge in achieving a goal.

Robotics: robotics system engineering by applying the robotic's learning model so as to achieve intelligence level as human beings.

Software Engineering comprises a) Model checking: performs modeling to do validation and verification testing for softwares; b) Software process: stages of software development and maintenance; (c) Software testing: performs testing for software validation and verification; d) Software project management: manages software development; (e) Semantic web and onthologies: performs searching for data or documents based on their semantics.

The Member of Intelligent System Research Laboratory:

Name of Staff	Interest and Expertise
Afiahayati, S.Kom., M.Cs	Bioinformatics, Machine Learning
Aina Musdholifah, S.Kom., M.Kom	Genetic Algorithm, Fuzzy Logic
Anifuddin Aziz, S.Si., M.Kom	Artificial Neural Network
Arif Nurwidyantoro, S.Kom., M.Cs	Natural Language Processing
Drs. Azhari, MT	Intelligent Agent, Semantic Web, Decision Support System, Software Engineering
Drs. Edi Winarko, M.Sc., Ph.D	Data mining
Faizah, S.Kom, M.I.Kom	Expert system
Ilona Usuman, S.Si., M.Kom	Robotics, Smart Home
Khabib Mustofa, S.Si., M.Kom.,	Semantic Web
Prof. Sri Hartati, M.Sc., Ph.D	Artificial and Computational Intelligence, Decision Support System
Drs. Sri Mulyana, M.Kom	Decision Support System, Computer Reasoning,

	Fuzzy Logic
Yunita Sari, S.Kom., M.Sc	Pattern Recognition
Guntur Budi Herwanto, S.Kom., M.Cs.	Data Mining
Isna Alfi Bustoni, S.T., M.T.	Data Mining

6. Research Laboratory of Computer and Network System

The word "networking" is more about activity. Computer system does not discuss about electronics at level of components, such as transistor, etc., but it does only at level of RTL (Register-Transfer Level) and above.

Computer and Network System Laboratory has the following research fields:

1. **Computer systems,** viewing computers as composed of integrated circuits (CPU, RAM, ROM, etc.) and equated with **Computer Systems Engineering** according to CC2005 classification (Computing Curricula 2005) from ACM/IEEE. Issues to be covered include FPGAs (Field-Programmable Gate Arrays), microcontrollers, DSP (Digital Signal Processing) chips, GPGPU (General Purpose Graphic Processing Unit) and their utilization as a computing platform. Computer systems covers computing platforms required to run algorithms/applications developed by other labs. The computer system develops competence of how the computer components can be compiled into an efficient computing platform (using minimal resources, fast, and with minimal cost and processing time). Another issue is the automation using softwares to facilitate the development of computing platforms, for example using VHDL, Verilog, Matlab, LabView, Proteus, and compilers for microcontrollers etc.

2. **System Programming and Networking** is programming at layer under general application. This comprises measuring application (Instrumentation) and computer system management and networking required in achieving performance of computer, also standardization the measurement results. Another interesting issue is standardization the security measurement.

3. **Wireless Sensor Network (WSN)** is utilization of science and computer network also telecommunication technology in measurement and monitoring activities. As a telecommunication media, it is useful in technology of satellite, cellular, telemetri, etc. While as a sensor, it is used in nodes sensor, RFID, and even smart phones. This issue is very strategic in Indonesia, even though security problems might be caused from stealing. The discussion may start from BAN (*Body Area Networking*), for instance monitoring health of human (or animal) body only, also *wide-scale area networking* for monitoring a region, island, continen, etc. An efficient deployment strategic and safe from stealing, vandalism, and sabotage is an interesting research issue. Another interesting issue is utilizing network to facilitate communication during natural dissaster. Smart/intelligent environment.

4. **Network Management and Maintenance** is an activity of computer network management and maintenance. In this sub-activity various algorithms and tools for the management and maintenance of computer networks will be examined to enable network computers working on the desired level of performance. Issues that can be discussed include scalability, fault-tolerance, disaster recovery, business continuity planning and execution, and also sabotage and infiltration (network survivability), etc**.**

5. **Security** will be developed with emphasis on security protocol, access control, and software reliability, as well as social engineering to match the behavior of Indonesians. If necessary, a cryptographic algorithm will be developed, which is not fully independent on the platform where the algorithm is run. For example, not all algorithms are suitable to be embedded in mobile phones or microcontrollers / FPGAs.

6. **Networks and Telecommunications** will examine the various issues on transferring data from one place to another such as modulation, mutiplexing, compression, protocol, etc. Here, at the initial stage, software such as NS-3, Glomosim, Matlab will be used. The characteristics of the faculty (more scientific) will be highlighted by focusing on aspects of algorithm and optimization, not on aspects of device development.

7. **Operating System** will be researched, and also at the same time operating system for special needs and general purpose may be developed, for example Linux, Android, RTOS and NOS.

8. **Social Networking** will be studied and examined as the success of initiative and deployment of infrastructure and computing facilities will not work unless paying attention to social aspects.

9. **Networked and autonomic computing** is a research related to computer systems' capability of managing themselve to cope with the increasing complexity of computer systems and reduce the barriers in developing computer systems.

The member of Computer and Network System Laboratory:

Name of Staff	Interest or Expertise
Drs. Abdul Ro'uf, M.I.Kom	Computer Systems and Systems Software
Dr. Agfianto Eko Putra	Embedded Systems and DSP
Dr. techn., Ahmad Ashari, M.I.Kom	Distributed System and Grid Computing
Drs. Bambang Nurcahyo Prastowo, M.Sc	Information Security and Social Networking
I Gede Mujiatna, S.Kom, M.Kom.	Data Communication and Network Management
Prof. Jazi Eko Istiyanto, Ph.D	Embedded Systems and Information Security
Lukman Heryawan, ST., M.T	Cloud and Autonomic Computing
Dr. Mardhani Riasetiawan, SE., Akt., M.T	Cloud Computing
Muhammad Idham Ananta Timur, M.Kom	Pervasive and Ubiquitous Computing
Nia Gella Augoestien, S.Si, M.Kom	Computer Systems
Dr. Tri Kuntoro Priyambodo, M.Sc	Telecommunication and Real-time Systems
Triyogatama Wahyu Widodo, M.Kom	Network and Distributed Programming
Dr. Yohanes Suyanto, M.I.Kom	Synthesis of Speech and Network Programming
Aufaclaf Zatu Kusuma Frisky, M.Kom	Computer Systems

7. Research Laboratory of Electronics and Instrumentation

Electronic and Instrumentation Laboratory is a research laboratory under the Department with a field of study that covers electronics, instrumentation, sensor networks, including its control systems and its technology. This laboratory supports the implementation of competency-based curriculum, research and community service in the field of electronics, instrumentation, control and sensor network. This laboratory services activities in the following research areas:

1. Electronics
   a. Electronic devices
   b. Measurement Electronics
   c. Medical, Industrial, Power electronics
   d. Communication Electronics
   e. Consumer electronics
2. Instrumentation
   a. Sensors and Transducers Devices
   b. Measurements and Calibrations
   c. Medical, Industrial, and Home Instrumentations

d. Instrumentation for Classification and Identification
e. Image-based Instrumentation
3. Control
   a. Optimal, Robust, and Adaptive Control
   b. Nonlinear, Stochastic controls, Chaos, and Estimation
   c. Discrete Event and Hybrid Control Systems
   d. Intelligent and Robotics Control
   e. Image Based Control
4. Sensor Network
   a. Data Communication for Sensor Network
   b. Radio, Antenna, Modulation and Signal Processing for Sensor Network
   c. Wireless and Mobile Sensors
   d. Radar Image Processing
   e. Distributed Sensors

The member of Electronics and Instrumentation Laboratory:

Name of Staff	Interest or Expertise
Drs. Agus Harjoko, M.Sc., Ph.D *	Instrumentation, Sensor Networks
Dr. Andi Dharmawan, S.Si., M.Cs.	Instrumentation, Control
Bakhtiar Alldino Ardi Sumbodo, S.Si, M.Kom	Electronics, Networks Systems
Catur Atmaji, S.Si, M.Cs	Electronics, Sugnal and Systems
Dr. Danang Lelono, S.Si., M.T.	Electronics, Control
Ika Candradewi, S.Si	Instrumentation, Control
Panggih Basuki, Drs., M.Si.	Instrumentation
Raden Sumiharto, S.Si., M.Kom	Instrumentation
Dr.DEA Suharto,	Instrumentation, Control
Tri Wahyu Supardi, S.Si., M.Cs.	Elektronics, Telecommunication
Roghib M. Hujja, S.Si., M.Cs.	Instrumentation

8. Research Laboratory on Software Engineering and Data

The research laboratory on Software Engineering and Data focuses on the development and discovery of methods or techniques in order to produce efficient, maintainable, reliable, dependable, secure, and acceptable software products. Meanwhile, as individuals and groups increasingly rely on advanced software systems. In addition, software engineering research laboratories and data focus also on approaches such as software reuse, component-based software engineering, distributed software engineering, and aspect-oriented software engineering.

Other areas of concern for the Software Engineering and Data research laboratory are the development of information infrastructure, data management systems, data mining and text mining. Beside, numerical data, data concerned (or considered) can also be in many types (formats), such as documents, imagery, sensors, web document, and biological data.

The Software Engineering and Data research laboratory accommodates and facilitates researches carried out both by lecturers or students whose specialization or main interest is on software engineering and data. The research themes held by the laboratory among others are:
1. Data mining, Opinion mining and analysis, Clasification.
2. Modeling for testing, validation and verification on software, development process.
3. Software project management, IT governance.
4. Semantic web and ontologies: search data or documents based on semantic meaning.

The Member of Software Engineering and Data Laboratory:

Name of Staff	Interest or Expertise
Drs. Edi Winarko, M.Sc., Ph.D	Data mining
Dr.techn Khabib Mustofa, S.Si., M.Kom	Semantic Web, Ontology
Dr. Azhari SN, M.T	Intelligent Agent, Semantic Web, Decision Support System
Moh Edi Wibowo, S.Kom., M.Kom, Ph.D	Computer Vision, Pattern Recognition
Dr. Suprapto, M.I.Kom	Software testing, Formal Method
Dr.-Ing. Mhd Reza M.I.Pulungan, M.Sc	Parallel Systems, Software Verification and Validation
Anny Kartika Sari, S.Si., M.Kom, Ph.D	Ontology
Dr. Sigit Priyanta, S.Si., M.Kom	Sentiment Analysis, Data Warehouse
Drs. Medi, M.Kom	Software development, Data communication
I Gede Mujiyatna, S.Kom, M.Kom	Mobile Software Engineering
Arif Nur Widiyantoro, S.Kom, M.Cs.	Big Data
Guntur Budi Herwanto, S.Kom, M.Cs	Web Engineering, Data mining
Isna Alfi Bustoni, S.T, M.Eng.	Image Processing, Vexion

9. General Computer Laboratory

Basic Computer Laboratory is a service unit under the Department of Computer Science and Electronics. The primary task of this unit is to provide good laboratory works (practices) and all relevant activities, under the coordination of Computer Science Undergraduate Programme.

Basic Computer Service Unit manages resources, such as computer hardwares, softwares, support equipments, staff and instructor (lecturer) to ensure the running of laboratory works (practices), including preparations (for softwares and hardwares), scheduling (for practices and examinations), assessment as well as anything related to the administration and the unit.

10. General Electronics Laboratory

Basic Electronics Laboratory covers the management system on laboratory facilities and technical resources related to the service of electronics field provided to the customer, consisting of students (practicum activities) and the public who may need services related to electronics lab activities. This function can be considered as bridging and synchronizing between theoretical knowledge obtained from the face-to-face lectures with practice so that it will be easier to understand by studets, and can be useful for the development of science and technology.

11. General Instrumentation Laboratory

The duties and functions of the Basic Instrumentation Laboratory are divided into two areas: First, *internal services*: (a) Providing practicum services in accordance with the request of the relevant study programmes; (b). Providing services related to scientific activities undertaken by students in accordance with the capabilities possessed by the Basic Instrumentation Lab; (c) Providing services to lecturers related to the practicum they taught. Second, *external services*: (a). Workshop; (b) Trainings; (c) Lending of equipment; (d) Equipment calibration; (e) Consulting services; (f) manufacture of instruments; (G) preparing practicum modules.

Some additional facilities of Basic Instrumentation Laboratory:

1. Laboratory modules related to Instrumentation field.
2. Measurement instrumentatisions related to serviced laboraotories.
3. Supporting tools used in laboratory services for instrumentation field are always uptodate.
4. Standard measurement tools as a calibrator to perform instrumentation calibration process.
5. Library providing books, journals, and scientific products related to Instrumentation field.
6. Representative and convinience rooms for learning process, mainly for performing laboratory.
7. Primarily tools and supporting ones that are required to perform their functions and tasks.

2.10   COMPUTER SCIENCE STUDY PROGRAMME

2.10.1 Introduction

The implementation of the Undergraduate Programme of Computer Science (UP-CS) was started in 1987, under the coordination of Mathematics Department of Faculty of Mathematics and Natural Sciences (FMNS), Universitas Gadjah Mada (UGM). Since year of 2010, the UP-CS has been under coordination of the Department of Computer Science and Electronics (DCSE). Currently the Department of Computer Science and Electronics FMNS UGM organizes educational and teaching study programmess in order to prepare 3 (three) levels of computer science expertise, including: (1) Bachelor (or undergraduate) of Computer Science (with degree S.Kom), (2) Master of Computer Science (with degree M.Cs.), and (3) Doctorate in Computer Science (with degree Dr.).

The curriculum of 2016 of the UP-CS, FMNS, UGM, was developed based on the Law of the Republic of Indonesia No. 20 of 2003 on National Education System, and the Regulation of the Minister of Research, Technology and Higher Education, Republic of Indonesia No. 44 of 2015 on National Standards of Higher Education. The curriculum contains a set of plans and rules regarding the content and teaching materials as well as the ways used as guidelines for the implementation of teaching and learning activities developed in accordance with the Decree of the Minister of National Education of the Republic of Indonesia No. 232/U/2000 on Guidelines for the Construction of Higher Education Curriculum and Assessment of Student Results, and the Decree of the Minister of National Education Republic of Indonesia No. 045/U/2002 on Higher Education Core Curriculum.

2.10.2 Vision

The Vision of the Undergraduate Programme of Computer Science (UP-CS), the Department of Computer Science and Electronics, Universitas Gadjah Mada is to be a nationally leading and superior Undergraduate Programme of Computer Science in running the education, research, and community service in the field of information systems and technology.

2.10.3 Mission

The mission of the Undergraduate Programme of Computer Science, Universitas Gadjah Mada, is to develop and improve the quality and process of education on the front line with internationally leveled graduates by:
    12. Developing and improving the quality of academic staff and students as well as

graduates in basic research and applications that support the development of computer science and information technology for the welfare of the nation and humanity.

13. Implementing the Tri Dharma of Higher Education, that is education, research, and community service.

2.10.4 Learning Objective

The objectives of the 2016 Curriculum are:

1. To produce graduates who are able to follow the development of computer science in particular and science and technology in general, able to work and compete in national and international job market, and able to continue study to higher education level.
2. Increase the contribution of study programme in the quality of human resources, environmental conservation, science and technology development, and education.
3. Improve the quality of education and computer science research.
4. Growing computer science to play more important roles in national development.

2.10.5 Curriculum Goals

The target of curriculum development are:

1. Increasing the quality of learning process in the UP-CS, Universitas Gadjah Mada.
2. The availability of curriculum of the UP-CS, Universitas Gadjah Mada which capable of following the latest developments of science and research.
3. The generation of graduates of the programme who have good quality and expertise, so that they can compete in national and international levels.

2.10.6 Basis of Curriculum Changes

The basic laws of curriculum change are as follows:

a. Minister of National Education Decree No. 232 / U / 2000 on Guidelines for the preparation of Higher Education Curriculum and Assessment of Student Results.
b. Minister of Education Decree number 045 / U / 2002 on Core Curriculum of Higher Education.
c. Permendikbud No. 73 of 2013 on the Application of the Indonesian National Qualification Framework for Higher Education.
d. Permenristek Dikti no. 44 of 2015 on National Standards of Higher Education.
e. UGM Rector Decree No. 581 / P / SK / HT / 2010 on the 2010 Curriculum Development Guideline.
f. Result of Senate of Faculty of Mathematics and Natural Sciences, Universitas Gadjah Mada about faculty level joint course.
g. Workshops and meetings on curriculum in the Department of Computer Science and Electronics and in the UP-CS involving Lecturers, Alumni, Students and Users.

2.10.7 Basic and Direction of Curriculum Development Changes

In general, the basic changes and the preparation of the new curriculum are:

a. Meet the changes that occur in the standards of the international curriculum, especially Computer Science Curricula 2013 compiled by The Joint Task Force on Computing Curricula Association for Computing Machinery (ACM) of the IEEE Computer Society.

b. Implementing curriculum based on Indonesia National Qualification Framework (KKNI).
c. Adjusting outcome learning program to meet international standards.
d. Meet the recommendations found in accreditation activities and other audit activities.
e. Adjust the content and syllabus of existing courses, in order to illustrate the growing trend and the latest development of research in the field of computer science.

Based on the changes made, it is expected that:
1. The curriculum of the study program is appropriate and can follow international standards.
2. The quality of the curriculum is enhanced and meets the requirements of national accreditation and is expected to meet international accreditation.
3. The quality of graduates of the study program is increasing. Graduates are also expected to follow the latest trends and developments in research in the field of computer science.

2.10.8 Graduate Employment

Graduates of the UP-CS are able to work among others in the following fields:
1. Computer scientists
2. Software engineers
3. Database Administrators
4. Database analysts
5. Web developers
6. Web animators
7. Desktop/mobile application programmers/developers
8. Computer game designers/programmers
9. Information security specialists
10. System security designer architects
11. Digital forensic examiners
12. Information officers
13. Information technology instructors
14. Information technology project managers
15. Information technology consultants

2.10.9 Graduate Profile

Graduates of the UP-CS have four main profiles:
1. System programmers
2. Network service supervisor
3. Database Administrator
4. Software Engineering

The detail of each profile is described in Table 3.1.

Table 3.1 Graduate's profiles of the UP-CS, DCSE, FMNS, Universitas Gadjah Mada

Graduate Profiles	Descriptions
System Programmer	Persons who capable of creating or repairing an existing system software and produce software that provides services to computer hardware.
Network ServiceSupervisor	Persons who capable of supervising all activities related to installation and service of equipment related to data, computer devices, and networks.
Database Administrator	Persons who capable of creating database design and implementing it, as well as installing configuration, upgrade, adaptation, monitoring and

	maintaining database within an organization.
Software Engineer	Persons who capable of applying software engineering principles in designing, developing, testing and evaluating software and systems

2.10.10 Learning Outcomes

To obtain a graduate profile mentioned before, learning achievements (programme learning outcome - PLO) of the UP-CS had been set. The learning achievements of the programme consist of four elements, namely (1) Attitudes and Values, (2) Mastery of Knowledge, (3) Working Capability, and (4) Managerial Capability. The learning achievements of study programme have fulfilled with the level 6 on KKNI.

2.10.11 Learning Outcomes Details

The following are detailed explanations of each element of learning achievement.

1. Attitude and Values
[PLO1] Having the following attitudes and values:
 a. Be piety to God Almighty.
 b. Have good moral, ethics and personality in completing the task.
 c. Serve as a proud citizen and love the motherland and support world peace.
 d. Able to work together and have high social sensitivity and concern for the society and the environment.
 e. Respect for cultural diversity, views, beliefs, and religions as well as the original opinions / findings of others.
 f. Upholding law enforcement as well as having the spirit to prioritize the interests of the nation and the wider community.

2. Mastery of Knowledge
[PLO2] *Foundational knowledge*: Mastering the foundations of knowledge for computer science, which includes mathematics, logic, electronics, and science.
[PLO3] *Theoretical knowledge*: Mastering the theoretical concepts of computer science, which include algorithms, computation, language, data structures, programming, computer systems, data processing, software, intelligent systems, and numerical analysis.
[PLO4] *Applied knowledge*: Mastering the applied concepts in the field of computer science, which includes methods of modeling, development, verification and validation of software in computer science

3. Working Capability
[PLO5] *Problem solving skills*: Capable of applying the basic, theoretical, and applied knowledge that has been acquired, and adapting state-of-the-art developments to find constructive solutions to problems encountered.
[PLO6] *Ability to do research*: Capable of carrying out literature studies and carrying out independent and group research, in the field of computer science

4. Managerial Capability
[PLO7] *Professional attitudes*: Have good interpersonal skills; capable of working together in teams, and have a sense of responsibility on the job itself, and can be given the task to support the achievement of teamwork.
[PLO8] *Communication skills*: Capable of communicating with stakeholders from diverse backgrounds, and using English; writing scientific papers in accordance with the correct rules.

[PLO9]   *Life-long learning*: Have the skills to follow the state-of-the-art developments in the field of computer science in particular, and to deepen the knowledge gained previously in the framework of lifelong learning

2.10.12   Learning Outcomes and Bloom's Taxonomy

The learning achievements of the UP-CS follow the learning domains based on Bloom's Taxonomy which includes Knowledge, Attitude, and Skills. The relationship between each learning achievement and the learning domain is presented in Table 3.2.

Table 3.2. The relationship of PLOI with the learning domain according to Bloom's Taxonomy

Learning Achievments	Cognitive (Knowledge)	Affective (Attitude)	Psychomotoric (Skills)
PLO1		∨	
PLO2	∨		
PLO3	∨		
PLO4	∨		
PLO5			∨
PLO6			∨
PLO7			∨
PLO8			∨
PLO9			∨

2.10.13   Study Materials

Study materials of the UP-CS curriculum (i.e., 2016 Curriculum) covers various things as follows:
 1. Study materials related to attitudes and values:
     AV-Attitudes and Values
 4. Study materials related to basic knowledge:
        S-Science
        M-Mathematics
        L-Language
 5. Study materials related to the knowledge needed to conduct research.
        R-Research
 6. Core Study Materials of Computer Science tailored to the study materials specified by ACM Computing Curricula 2013, which includes:
        AL-Algorithms and Complexity
        AR-Architecture and Organization
        CN-Computational Science
        DS-Discrete Structures
        GV-Graphics and Visualization
        HCI-Human-Computer Interaction
        IAS-Information Assurance and Security
        IM-Information Management
        IS-Intelligent Systems
        NC-Networking and Communication
        OS-Operating Systems
        PBD-Platform-Based Development
        PD-Parallel and Distributed Computing

PL-Programming Languages
SDF-Software Development Fundamentals
SE-Software Engineering
SF-Systems Fundamentals
SP-Social Issues and Professional Practice

2.10.14 Mapping Subjects with Study Materials, PLO (Learning Outcomes), and Graduate Profile

Table 3.3 shows the mapping of each module with the defined beforehand study materials.

Table 3.3 Mapping modules with study materials

No.	Module	AV	S	M	L	R	AL	AR	CN	DS	GV	HCI	IAS	IM	IS	NC	OS	PBD	PD	PL	SDF	SE	SF	SP
1.	Religion	v																						
2.	Calculus I			v																				
3.	Calculus II			v																				
4.	Physics I		v																					
5.	Physics II		v																					
6.	Chemestry		v																					
7.	Programming I						v													v	v			
8.	Programming I lab						v													v	v			
9.	Programming II						v													v	v			
10.	Programming II lab						v													v	v			
11.	Logics for Computer Science			v																				
12.	Introduction to Computer Science						v														v			
13.	Pancasila	v																						
14.	Elementary Linear Algebra			v																				
15.	Discrete Mathenatics			v						v														
16.	Digital Systems							v																
17.	English				v																			
18.	Microprocessor							v																
19.	Computer Organisation and Architecture							v																
20.	Database													v										
21.	Database Lab																							
22.	Analysis of Algorithms and Complexity						v																	
23.	Probabiliy and Stochastic Process			v																				
24.	Language and Automata						v																	
25.	Computer Graphics										v													
26.	Elementary Differential Equations			v																				
27.	Computer Networks															v								
28.	Computer Networks Lab															v								
29.	Operating Systems																v							
30.	Operating Systems Lab																v							
31.	Advance Algorithm						v													v				
32.	Numerical Methods								v															
33.	Signal and System			v				v																
34.	Artificial Intelligence														v									
35.	Citizenship	v																						
36.	Software Development											v										v	v	
37.	Software Development lab											v										v	v	
38.	Cryptography and Network Security												v											
39.	Research Methods					v																		

No.	Module	AV	S	M	L	R	AL	AR	CN	DS	GV	HCI	IAS	IM	IS	NC	OS	PBD	PD	PL	SDF	SE	SF	SP
40.	Seminars					v																		
41.	Scientific Writing				v	v																		
42.	Phylosophy of Computer Science	v																						
43.	Machine Learning														v									
44.	Entrepreneurship and Success Skills	v																						v
45.	Undergraduate Thesis					v																		
46.	Community Services	v																						v
47.	Distributed Algorithms						v												v					
48.	Digital Image Processing							v																
49.	Model Checking								v															
50.	Management Science								v															
51.	Compiler Development																			v				
52.	Queueing and Simulation								v															
53.	Science Computational								v															
54.	Parallel System and Programming																		v	v				
55.	Bioinformatics														v									
56.	Artificial Neural Networks														v									
57.	Fuzzy Logics														v									
58.	Pattern Recognition														v									
59.	Expert Systems														v									
60.	Decision Support Systems														v									
61.	Information Technology Audit and Control											v												
62.	Data Mining and Business Intellegence											v	v											
63.	Web Programming																	v		v	v			
64.	E-Business																					v		
65.	Geographical Information Systems											v												
66.	Information Technology Project Management																					v		
67.	Information Retrieval Systems											v												
68.	E-Government											v										v		
69.	Digital Forensics											v												
70.	Network Analysis and Optimation															v								
71.	Network and Mobile Device Programming																		v	v	v	v		
72.	Satelite Development																						v	
73.	Telecommunication Networks															v								
74.	Microcontroller						v																	
75.	Internship					v																		v
76.	Capita Selecta on Analysis of Big Data Computational	v							v										v			v		
77.	Capita Selecta on Genetic Algorithm	v													v							v		
78.	Capita Selecta on Social Informatics																							v
79.	Capita Selecta on Computational Logics	v		v					v															
80.	Capita Selecta on Object Oriented Software Development	v										v										v		
81.	Capita Selecta on Enterprise Systems													v								v		

Table 3.4 shows the mapping of each course with each PLO and graduate profile of the UP-CS, DCSE, FMNS, Universitas Gadjah Mada.

Table 3.4 Mapping module[a] with PLO and graduate's profile

No.	Module	PLO[b]									Profile[c]			
		1	2	3	4	5	6	7	8	9	SP	NSP	DA	SE
1.	Religion	S						W		W	∨	∨	∨	∨
2.	Calculus I		S	W						W	∨	∨	∨	∨
3.	Calculus II		S	W						W	∨	∨	∨	∨
4.	Physics I		S	W						W	∨	∨	∨	∨
5.	Physics II		S	W						W	∨	∨	∨	∨
6.	Chemistry		S	W						W	∨	∨	∨	∨
7.	Programming I			S	M	W					∨	∨	∨	∨
8.	Programming I lab			S	M	W					∨	∨	∨	∨
9.	Programming II			S	M	W					∨	∨	∨	∨
10.	Programming II lab			S	M	W					∨	∨	∨	∨
11.	Logics for Computer Science		S	M	W						∨	∨	∨	∨
12.	Introduction to Computer Science	W		M		W	W			W	∨	∨	∨	∨
13.	Pancasila	S						W		W	∨	∨	∨	∨
14.	Elementary Linear Algebra		S	W	W						∨	∨	∨	∨
15.	Discrete Mathematics		W	S	W						∨	∨	∨	∨
16.	Digital Systems			S	W						∨	∨	∨	∨
17.	English						W	W	S		∨	∨	∨	∨
18.	Microprocessor			S	W	W					∨	∨	∨	∨
19.	Computer Organisation and Architecture			S	W	W					∨	∨	∨	∨
20.	Database			S	W	W							∨	
21.	Database lab			S	W	W							∨	
22.	Analysis of Algorithm and Complexity			S	W	W					∨			∨
23.	Probabiliy and Stochastic Processes		S	W	W						∨	∨	∨	∨
24.	Language and Automata			S	W	W					∨	∨	∨	∨
25.	Computer Graphics			S	W	W					∨			∨
26.	Elementary Differential Equations		S	W	W						∨	∨	∨	∨
27.	Computer Networks			S	W	W							∨	
28.	Computer Networks lab			S	W	W							∨	
29.	Operating Systems			S	W	W							∨	
30.	Operating Systems lab			S	W	W							∨	
31.	Advance Algorithms			S	W	W					∨			∨
32.	Numerical Methods			S	W	W					∨			∨
33.	Signal and System		S	W	W						∨	∨	∨	∨
34.	Artificial Intelligence			S	W	W					∨			∨
35.	Citizenship	S						W		W	∨	∨	∨	∨
36.	Software Development			W	S	S	W							∨
37.	Software Development lab			W	S	S	W							∨

No.	Module	PLO[b]									Profile[c]			
		1	2	3	4	5	6	7	8	9	SP	NSP	DA	SE
38.	Cryptography and Network Security			W	S	W						∨		
39.	Research Methods					W	S	W	W	S	∨	∨	∨	∨
40.	Seminars					W	M	W	W	S	∨	∨	∨	∨
41.	Scientific Writing						W	W	S		∨	∨	∨	∨
42.	Philosophy of Computer Science	M					W	W		W	∨	∨	∨	∨
43.	Machine Learning			W	S	W					∨		∨	∨
44.	Entrepreneurship and Success Skills	M				W			W	W	∨	∨	∨	∨
45.	Undergraduate Thesis					S	S	W	W	S	∨	∨	∨	∨
46.	Community Service	S				W		S	W	W	∨	∨	∨	∨
47.	Distributed Algorithms			W	S	W				W	∨	∨	∨	∨
48.	Digital Image Processing			W	S	W				W	∨			∨
49.	Model Checking			W	S	M				W				∨
50.	Management Science			W	S	W				W	∨			∨
51.	Compiler Development			W	S	W				W	∨			∨
52.	Queueing and Simulation			W	S	W				W		∨	∨	
53.	Science Computational			W	S	W				W	∨			
54.	Parallel System and Programming			W	S	W				W	∨	∨	∨	∨
55.	Bioinformatics			W	S	W				W	∨		∨	∨
56.	Artificial Neural Networks			W	S	W				W	∨			∨
57.	Fuzzy Logics			W	S	W				W	∨			∨
58.	Pattern Recognition			W	S	W				W	∨			
59.	Expert Systems			W	S	W				W	∨			∨
60.	Decision Support Systems			W	S	W				W	∨		∨	∨
61.	Information Technology Audit and Control			W	S	W				W		∨		∨
62.	Data Mining and Business Intellegence			W	S	W				W	∨		∨	
63.	Web Programming			W	S	W				W	∨			∨
64.	E-Business			W	S	W				W				∨
65.	Geographical Information Systems			W	S	W				W	∨		∨	∨
66.	Information Technology Project Management			W	S	W				W				∨
67.	Information Retrieval Systems			W	S	W				W	∨		∨	
68.	E-Government			W	S	W				W			∨	∨
69.	Digital Forensics			W	S	W				W				∨
70.	Network Analysis and Optimation			W	S	W				W		∨		
71.	Network and Mobile Device Programming			W	S	W				W	∨	∨		
72.	Satellite Development			W	S	W				W		∨		
73.	Telecommunication Networks			W	S	W				W		∨		
74.	Microcontroller			W	S	W				W		∨		
75.	Internship	W				W		S	W	W	∨	∨	∨	∨
76.	Capita Selecta on			W	S	W				W	v	v	v	v

No.	Module	PLO[b]									Profile[c]			
		1	2	3	4	5	6	7	8	9	SP	NSP	DA	SE
	Analysis of Big Data Computational													
77.	Capita Selecta on Genetic Algorithm			W	S	W				W	v			
78.	Capita Selecta on Social Informatics			W	S	W				W			v	
79.	Capita Selecta on Computational Logics			W	S	W				W	v			
80.	Capita Selecta on Object Oriented Software Development			W	S	W				W	v			v
81.	Capita Selecta on Enterprise Systems			W	S	W				W			v	v

Notes:
1. A module consists of one course having a unity of learning objectives.
2. S = Strong, M = Medium, and W = Weak showing how strong each module supports the PLO in question.
3. Graduate's profiles:
      i. SP: System Programmer
      ii. NSP: Network Service Supervisor
      iii. DA: Database Administrator
      iv. SE: Software Engineer

2.10.15 Graduation Requirements

In order to graduate and obtain the S.Kom degree, the student must have completed 144 credits of courses consisting of 114 credits of compulsory courses and 30 credits of elective courses.

2.10.16 List of Compulsary Courses

The compulsory courses consist of subjects that must be taken by each student, which consist of:
   a. University Compulsory courses (9 credits), consisting of Pancasila (2 credits), Religion (2 credits), Citizenship (2 credits), and Community Service (3 credits).
   b. Faculty compulsory courses (12 credits) consisting of Basic Physics I (3 credits), Basic Chemistry I (3 credits), Calculus I (3 credits), and Programming I (3 credits).
   c. Compulsory courses of study program (93 credits).

The complete list of courses is presented in Table 3.5. Specific for first year students, they are required to take all compulsory courses in semesters 1 and 2 without considering the semester GPA. In addition, students in the first year are not allowed to take courses outside the required in the relevant semester.

Table 3.5. Compulsary courses of the UP-CS, DCSE, FMNS, Universitas Gadjah Mada

No.	Course Code	Name of course	Credit	Sem	Prerequisite	Type[1]
1.	UNU-100X[2]	Religion	2	1	-	MPK
2.	MMM-1101	Calculus I	3	1	-	MKK
3.	MFF-1011	Basic Physycs I	3	1	-	MKK
4.	MKK-1101	Basic Chemestry I	3	1	-	MKK
5.	MII-1201	Programming I	3	1	-	MKK
6.	MII-1202	Practicum of Programming I	1	1	-	MKK
7.	MII-1203	Informatical Logics	2	1	-	MKK
8.	MII-1205	Introduction to Computer Science	3	1	-	MKK
		Subtotal	**20**			
1.	UNU-1010	Pancasila	2	2	-	MPK
2.	MMM-1102	Calculus II	3	2	Calculus I	MKK
3.	MFF-1012	Basic Physics II	3	2	Basic Physycs I	MKK
4.	MII-1003	Elementary Linear Algebra	2	2	-	MKK
5.	MII-1211	Programming II	3	2	Programming I	MKK
6.	MII-1212	Practicum of Programming II	1	2	Programming II*	MKK
7.	MII-1213	Discrete Mathenatics	3	2	Informatical Logics	MKK
8.	MII-1811	Digital Systems	2	2	Informatical Logics	MKK
9.	MII-1001	English	3	2	-	MBB
		Subtotal	**22**			
1.	MII-2601	Microprocessor	2	3	-	MKB
2.	MII-2603	Computer Organisation and Architecture	3	3	Microprocessor *	MKB
3.	MII-2501	Database	3	3	Discrete Mathenatics	MKB
4.	MII-2502	Practicum of Database	1	3	Database*	MKB
5.	MII-2201	Analysis of Algorithm and Complexity	3	3	Discrete Mathenatics	MKB
6.	MII-2203	Probabiliy and Stochastic Process	3	3	Discrete Mathenatics	MKK
7.	MII-2205	Language and Automata	3	3	Discrete Mathenatics	MKK
8.	MII-2207	Computer Graphics	3	3	Calculus II, Elementary Linear Algebra	MKB
		Subtotal	**21**			
1.	MMM-2301	Elementary Differential Equations	3	4	Calculus II*	MKK
2.	MII-2602	Computer Networks	3	4	Discrete Mathenatics	MKB
3.	MII-2652	Practicum of Computer Networks	1	4	Computer Networks*	MKB
4.	MII-2611	Operating Systems	3	4	Computer Organisation and Architecture	MKB
5.	MII-2612	Practicum of Operating Systems	1	4	Operating Systems*	MKB
6.	MII-2211	Advance Algorithm	3	4	Analysis of Algorithm	MKB

					and Complexity	
7.	MII-2213	Numerical Methods	2	4	Elementary Differential Equations*, Elementary Linear Algebra	MKB
8.	MII-2215	Signal and System	2	4	Calculus II*	MKK
9.	MII-2411	Artificial Intelligence	3	4	Calculus II	MKB
		Subtotal	**21**			
1.	UNU-3000	Citizenship	2	5	-	MPK
2.	MII-3501	Software Development	3	5	Database, Programming II	MKB
3.	MII-3502	Prakcicum of Software Development	1	5	Software Development*	MKB
4.	MII-3601	Cryptography and Network Security	3	5	Computer Networks, Discrete Mathenatics	MKB
5.	MII-3003	Research Methods	2	5	minimum 60 fte	MPB
		Subtotal	**11**			
1.	MII-3001	Seminar	1	6	Research Methods	MPB
2.	MII-3005	Scientific Writing	2	6	minimum 80 credits, Research Methods	MPB
3.	MII-3007	Phylosophy of Computer Science	2	6	minimum 60 credits	MPB
4.	MII-3411	Machine Learning	3	6	Artificial Intelligence	MKB
5.	MII-3009	Entrepreneurship and Success Skills	2	6	minimum 60 credits	MPB
		Subtotal	**10**			
1.	MII-4001	Undergraduate Thesis Proposal	2	7	minimum 100 credits, Seminar*	MPB
2.	UNU-4500	Community Service	3	7	minimum 100 credits	MBB
		Subtotal	**5**			
1.	MII-4002	Undergraduate Thesis	4	8	Undergraduate Thesis Proposal *	MPB
		Subtotal	**4**			
		TOTAL	**114**			

2.10.17   List of Elective Courses

Elective courses are divided into 2 groups, i.e., elective courses of Computer Science, and supporting courses. The elective courses of Computer Science are provided by several research laboratories within the Department of Computer Science and Electronics, FMNS, UGM, i.e., Algorithm and Computational Laboratory (AK), Intelligent System Laboratory (SC), Software Engineering and Data (RPLD), Computer Systems and Networks Laboratory (SKJ), and the Electronic and Instrumentation Laboratory (Elins). For certain reasons or technical consideration, the elective course may change its position from an even semester to an odd semester, and vice versa, or put to sleep (make it unavailable) for a while. The list of the UP-CS's courses is presented in Table 3.6.

Supporting courses can be taken from other programmes within FMNS, UGM, as well as other faculties within UGM, in accordance with the guidance by academic supervisors. If a student takes a student exchange at a university abroad and takes a course at the destination university, the course may be recognized by the UP-CS,

provided that the student is active (not taking leave) during the student exchange programme. Elective courses allowed to be taken from outside the Department of Computer Science and Electronics, FMNS, Universitas Gadjah Mada is 9 credits.

Table 3.6. Elective Courses of the UP-CS, DCSE, FMNS, Universitas Gadjah Mada

No.	Course code	Course Name	Credit	Sem	Research Lab	Prequisite	Type[1]
1.	MII-4201	Distributed Algorithm	3	odd	AK	Analysis of Algorithm and Complexity	MKB
2.	MII-4203	Digital Image Processing	3	odd	AK	Programming II	MKB
3.	MII-4205	Checking Model	3	odd	AK	Discrete Mathenatics	MKB
4.	MII-4207	Management Science	3	odd	AK	Numerical Methods	MKB
5.	MII-4211	Compiler Development	3	even	AK	Language and Automata	MKB
6.	MII-4213	Queueing and Simulation	3	even	AK	Probabiliy and Stochastic Process	MKB
7.	MII-4215	Science Computational	3	even	AK	Numerical Methods	MKB
8.	MII-4217	Parallel System and Programming	3	even	AK	Analysis of Algorithm and Complexity	MKB
9.	MII-4220	Capita Selecta Algorithm and Computation	3	odd, even	AK	In accordance with the topic of each capita selecta course, at least 60 credits	MKB
10.	MII-4401	Bioinformatics	3	odd	SC	Programming II	MKB
11.	MII-4403	Artificial Neural Networks	3	odd	SC	Artificial Intelligence	MKB
12.	MII-4405	Fuzzy Logics	3	odd	SC	Artificial Intelligence	MKB
13.	MII-4411	Pattern Recognition	3	even	SC	Programming II	MKB
14.	MII-4413	Expert Systems	3	even	SC	Artificial Intelligence	MKB
15.	MII-4415	Decision Support Systems	3	even	SC	Database	MKB
16.	MII-4420	Capita Selecta Intelligent Systems	3	odd, even	SC	In accordance with the topic of each capita selecta course, at least 60 credits	MKB
17.	MII-4501	Information Technology Audit and Control	3	odd	RPLD	Software Development	MKB
18.	MII-4503	Data Mining and Business Intellegence	3	odd	RPLD	Machine Learning*	MKB
19.	MII-4505	Web Programming	3	odd	RPLD	Programming I	MKB
20.	MII-4507	E-Business	3	odd	RPLD	Software Development	MKB
21.	MII-4511	Geographical Information Systems	3	even	RPLD	Database	MKB
22.	MII-4513	Information Technology Project Management	3	even	RPLD	Software Development	MKB
23.	MII-4515	Information Retrieval Systems	3	even	RPLD	Database	MKB

No.	Course code	Course Name	Credit	Sem	Research Lab	Prequisite	Type[1]
24.	MII-4520	Capita Selecta on Software Engineering and Data	3	odd, even	RPLD	In accordance with the topic of each capita selecta course, at least 60 credits	MKB
25.	MII-4601	E-Government	3	odd	SKJ	Database	MKB
26.	MII-4603	Digital Forensics	3	odd	SKJ	Computer Networks	MKB
27.	MII-4605	Network Analysis and Optimation	3	odd	SKJ	Computer Networks	MKB
28.	MII-2606	Network and Mobile Device Programming	3	even	SKJ	Programming I, Computer Networks*	MKB
29.	MII-4611	Satelite Development	3	even	SKJ	Signal and System	MKB
30.	MII-4613	Telecommunication Networks	3	even	SKJ	Signal and System	MKB
31.	MII-4620	Capita Selecta on Computer and Network Systems	3	odd, even	SKJ	In accordance with the topic of each capita selecta course, at least 60 credits	MKB
32.	MII-1602	Microcontroller	3	even	Elins	Programming I	MKB
33.	MII-4020	Internship	2	odd, even	-	minimal 100 sks	MBB
34.	MII-4621	Capita Selecta on Analysis of Big Data Computational	3	odd	RPLD	Database	MKB
35.	MII-4421	Capita Selecta on Genetic Algorithm	3	odd	SC	Programming I	MKB
36.	MII-4523	Capita Selecta on Social Informatics	3	even	RPLD	-	MKB
37.	MII-4221	Capita Selecta on Computational Logics	3	even	AK	Calculus II, Discrete Mathematics	MKB
38.	MII-4521	Capita Selecta on Object Oriented Software Development	3	odd	RPLD	Software Development	MKB
39.	MII-4522	Capita Selecta on Enterprise Systems	3	even	RPLD	Software Development	MKB

Notes:

Unmarked prerequisite courses * are courses that must previously have been taken by the student until the final examination.

*: Prerequisite courses may be taken simultaneously

[1]: Description of course type (based on Kemendiknas No. 232/U/2000):
1. MPK   : personality development courses
2. MKK   : science and skill courses
3. MKB   : creative skill courses
4. MPB   : creative behaviour courses
5. MBB   : community life courses

[2]: Description of the code:
       UNU-1000   : Islam

UNU-1001   : Chatolic
UNU-1002   : Christian
UNU-1003   : Hindu
UNU-1004   : Budhist
UNU-1005   : Konghucu

2.10.18   Structure of Semester Courses

Table 3.7 describes the composition of each semester's courses and the distribution of credits in each semester of the UP-CS.

Tabel 3.7. Course structure each senester of the UP-CS, DCSE, FMNS, Universitas Gadjah Mada

No.	Semester	Code	Course	Credit
1.	1	UNU-1000	Religion	2
2.		MMM-1101	Calculus I	3
3.		MFF-1011	Basic Physycs I	3
4.		MKK-1101	Basic Chemestry I	3
5.		MII-1201	Programming I	3
6.		MII-1202	Practicum of Programming I	1
7.		MII-1203	Informatical Logics	2
8.		MII-1205	Introduction to Computer Science	3
			Subtotal	**20**
1.	2	UNU-1010	Pancasila	2
2.		MMM-1102	Calculus II	3
3.		MFF-1012	Basic Physics II	3
4.		MII-1003	Elementary Linear Algebra	2
5.		MII-1211	Programming II	3
6.		MII-1212	Practicum of Programming II	1
7.		MII-1213	Discrete Mathenatics	3
8.		MII-1811	Digital Systems	2
9.		MII-1001	English	3
			Subtotal	**22**
1.	3	MII-2601	Microprocessor	2
2.		MII-2603	Computer Organisation and Architecture	3
3.		MII-2501	Database	3
4.		MII-2502	Practicum of Database	1
5.		MII-2201	Analysis of Algorithm and Complexity	3
6.		MII-2203	Probabiliy and Stochastic Process	3
7.		MII-2205	Language and Automata	3
8.		MII-2207	Computer Graphics	3
			Subtotal	**21**
1.	4	MMM-2301	Elementary Differential Equations	3
2.		MII-2602	Computer Networks	3
3.		MII-2652	Practicum of Computer Networks	1
4..		MII-2611	Operating Systems	3
5.		MII-2612	Practicum of Operating Systems	1
6.		MII-2211	Advance Algorithm	3
7.		MII-2213	Numerical Methods	2
8.		MII-2215	Signal and System	2

No.	Semester	Code	Course	Credit
9.		MII-2411	Artificial Intelligence	3
			Subtotal	**21**
1.		UNU-3000	Citizenship	2
2.		MII-3501	Software Development	3
3.		MII-3502	Prakcicum of Software Development	1
4.	5	MII-3601	Cryptography and Network Security	3
5.		MII-3003	Research Methods	2
6.			Elective course 1	3
7.			Elective course 2	3
8.			Elective course 3	3
			Subtotal	**20**
1.		MII-3001	Seminar	1
2.		MII-3005	Scientific Writing	2
3.		MII-3007	Phylosophy of Computer Science	2
4.		MII-3411	Machine Learning	3
5.	6	MII-3009	Entrepreneurship and Success Skills	2
6.			Elective course 4	3
7.			Elective course 5	3
8.			Elective course 6	3
9.			Elective course 7	3
			Subtotal	**22**
1.		MII-4001	Undergraduate Thesis Proposal	2
2.		UNU-4500	Community Service	3
3.	7		Elective course 8	3
4.			Elective course 9	3
5.			Elective course 10	3
			.Subtotal	**14**
1.	8	MII-4002	Undergraduate Thesis	4
			Subtotal	**4**
			TOTAL	**144**

2.10.19 Transitional Rules

The General Rules for the Transition of Curriculum 2011 into the Curriculum 2016 are as follows:
1. Transitional rules of the UP-CS, DCSE, FMNS Universitas Gadjah Mada follows the general transitional rules decided by faculty.
2. The curriculum 2016 is applied to students starting the academic year 2016.
3. The curriculum 2016 is not compulsary for students starting the academic year 2015 and before.
4. The compulsory courses of the Curriculum 2016 but not mandatory in the 2011 Curriculum are not required for students starting the academic year 2015 and before.
5. The compulsory courses (core or interest) in the Curriculum 2011, but not compulsary in the Curriculum 2016, are not required for students starting the academic year 2015 and before.

6. Interest compulsory or elective courses on the Curriculum 2011, and become compulsory in the Curriculum 2016, are not compulsary for students starting the academic year 2015 and before, but are strongly encouraged to take.
7. Compulsory courses in Curriculum 2011 which remains compulsory in the Curriculum 2016, it is compulsory for students starting the academic year 2015 and before.
8. In the case of the determination of a recognized course, the following rules apply:
   a) If the equivalence is of 2 (two) courses in the Curriculum 2011 to 1 (one) course in the Curriculum 2016, then student starting the academic year 2015 and before (1) may choose the combination/pair of courses in the Curriculum 2011 by choosing which grade is the best OR (2) to choose the equivalency course in the Curriculum 2016 entirely and add up the number of credits by taking the elective course OR (3) cancel one of the courses of the course pair in the curriculum 2011 and complete the number of credits by taking the elective course but may not recognize all three courses simultaneously. For example, Cryptography course and Network Security course (NS) in Curriculum 2011 are equivalent to Cryptography and Network Security course (CNS) in the curriculum 2016. Students starting the academic year 2015 and before may choose a pair of courses recognized as Cryptography with CNS or NS With CNS (on the basis of the best combination / value pair), or only CNS, but may not recognize 3 (three) courses, Cryptography, NS, and CNS simultaneously.
   b) If the equivalence is of 1 (one) course in the Curriculum 2011 into 2 (two) courses in the Curriculum 2016, then the student starting the academic year 2015 and before may recognize one or both courses of its equivalent, except for the Final Project. Equivalence for the Final Project is 2 (two) courses, the Undergraduate Thesis Proposal, and Undergraduate Thesis.
9. Students who have taken propsal examination in the Curriculum 2011 are considered to have completed the course of undergraduate Thesis Proposal and its grade is equal to the value of Undergraduate Thesis course in the curriculum 2016, as long as the thesis topic does not change (fixed). Students who change the topic of undergraduate thesis, must repeat the undergraduate thesis proposal course.
10. All disputes arising from the absence of rules in the transitional rules will be resolved by the student with the board of the programme in particular.

2.10.20   Equivalent Courses

Table 3.8 describes course equivalence between the Curriculum of 2011 and the Curriculum 2016 of the UP-CS.

Table 3.8. Course equivalence Curriculum 2011 to Curiculum 2016 of the UP-CS

No.	Course Name (Curriculum 2011)	Credit	Course Name (Curriculum 2016)	Credit
1.	Contemporary Information Technology	2	Introduction to Computer Science	3
	Practicum of Contemporary Information Technology	1		
2.	English	3	English	3
3.	Vector and Matrices Algebra	2	Elementary Linear Algebra	2
4.	Pancasila	2	Pancasila	2
5.	Religion	2	Religion	2
6.	Discrete Mathenatics I	3	Discrete Mathenatics	3

No.	Course Name (Curriculum 2011)	Credit	Course Name (Curriculum 2016)	Credit
7.	Basic Calculus	3	Calculus II	3
8.	Algorithm and Data Structure I	3	Programming I	3
9.	Practicum of Algorithm and Data Structure I	1	Practicum of Programming I	1
10.	Discrete Mathenatics II	3	Probabiliy and Stochastic Process	3
11.	Digital Electronics	3	Digital Systems	2
12.	Computer Organisation and Architecture	3	Computer Organisation and Architecture	3
13.	Elementary Differential Equations	3	Elementary Differential Equations	3
14.	Algorithm and Data Structure II	3	Programming II	3
15.	Practicum of Algorithm and Data Structure II	1	Practicum of Programming II	1
16.	Algorithn Analysis and Design I	3	Analysis of Algorithm and Complexity	3
17.	Operating Systems	3	Operating Systems	3
18.	Practicum of Operating Systems	1	Practicum of Operating Systems	1
19.	Algorithn Analysis and Design II	3	Advance Algorithm	3
20.	Artificial Intelligence	3	Artificial Intelligence	3
21.	Database	3	Database	3
22.	Practicum of Database	1	Practicum of Database	1
23.	Computer Networks	3	Computer Networks	3
24.	Practicum of Computer Networks	1	Practicum of Computer Networks	1
25.	Phylosophy of Computer Science	2	Phylosophy of Computer Science	2
26.	Citizenship	2	Citizenship	2
27.	Numerical Methods	2	Numerical Methods	2
28.	Computer Graphics	3	Computer Graphics	3
29.	Software Engineering	3	Software Development	3
30.	Prakcicum of Software Engineering	1	Prakcicum of Software Development	1
31.	Profession and Business Etique	2	Entrepreneurship and Success Skills	2
32.	Research Methodology in Computer Science	3	Research Methods	2
			Scientific Writing	2
33.	Special Task	1	Seminar	1
34.	Community Service	3	Community Service	3
35.	Final Project	6	Undergraduate Thesis Proposal	2
			Undergraduate Thesis	4
36.	Language Theory and Automata	3	Language and Automata	3
37.	Modeling and Simulation	3	Queueing and Simulation	3
38.	Management Science	3	Management Science	3
39.	Computational Technique	3	Science Computational	3
40.	Cryptography	3	Cryptography and Network Security	3
41.	Fuzzy Logics	3	Fuzzy Logics	3
42.	Artificial Neural Networks	3	Artificial Neural Networks	3
43.	Pattern Recognition	3	Pattern Recognition	3
44.	Decision Support Systems	3	Decision Support Systems	3
45.	Expert Systems	3	Expert Systems	3
46.	Data Mining and Business	3	Data Mining and Business	3

No.	Course Name (Curriculum 2011)	Credit	Course Name (Curriculum 2016)	Credit
	Intelligence		Intelligence	
47.	Enterprise System	3	Capita Selecta Enterprise Systems	3
48.	Information Retrieval Systems	3	Information Retrieval Systems	3
49.	IT Project Management	3	IT Project Management	3
50.	IT Audit and Control	3	IT Audit and Control	3
51.	System and Network Security	3	Cryptography and Network Security	3
52.	Network Management	3	Capita Selecta: Enterprise Network Management	3
53.	Distributed Systems	3	Distributed Algorithm	3
54.	Embedded System OS	3	Capita Selecta on Computer and Network Systems: Embedded System OS	3
55.	Practical Work	2	Practical Work	2
56.	Genetic Algorithma	3	Capita Selecta on Genetic Algorithma	3
57.	Digital Image Processing	3	Digital Image Processing	3
58.	Verification and Validation	3	Checking Model	3
59.	Bioinformatics	3	Bioinformatics	3
60.	Geographical Information Systems	3	Geographical Information Systems	3
61.	Web Programming	3	Web Programming	3
62.	Social Informatics	3	Capita Selecta on Social Informatics	3
63.	Object Oriented Software Development	3	Capita Selecta on Object Oriented Software Development	3
64.	Parallel Systems	3	Parallel System and Programming	3
65.	Network and Mobile Device Programming	3	Network and Mobile Device Programming	3
66.	Microcontroller	3	Microcontroller	3

Notes: The courses in the 2011 Curriculum that are not listed on the eqivalence table are courses that are not equivalent to the Curriculum 2016. The courses in the 2016 Curriculum not listed in the equality table are new courses.

2.10.21   Differences between the 2011 and 2016 Curriculums

Broadly speaking, the changes from the Curriculum 2011 to Curriculum 2016 are as follows:
1. Increase the number of compulsory courses from 106 credits to 114 credits. This is done so that graduates have the ability in accordance with the predefined graduate profile.
2. Elimination of specialization aimed to make students more flexible in determining the focus of their competence.
3. Consolidation of basic mathematical courses for the computer science needs.
4. Adjustment of existing course content and syllabus, in order to describe the latest developments in computer science.
5. Final Project (6 credits) is divided into 2 subjects, namely Undergraduate Thesis Proposal (2 credits) and Undergraduate Thesis (4 credits) in the hope that the student will be better prepared in working on their thesis.

2.10.22 Learning Methods

Learning is conducted by a combination of TCL (Teacher Centered Learning) and SCL (Student Centered Learning). In the TCL method, lecturers become learning centers. Lectures are conducted in general with lectures by lecturers. In most of the basic courses held in the early semesters, the TCL method dominates in the learning process, given that students are still in the process of transition from secondary to higher education. However, there are also combinations with other methods, such as tutorials and discussions. In the SCL method students become learning centers, lecturers only as a facilitator in the classroom. In most of the courses in the following semesters, the SCL method dominates the learning process, where the lectures are conducted with audiences, role plays, presentations by students, and others. Some modules require a lab in the laboratory. This practice becomes an independent course whose assessment is separate from his theoretical courses.

2.10.23 Assesment Methods

The assessment process in the UP-CS, DCSE, FMNS Universitas Gadjah Mada is conducted with two objectives, namely: (i) to assess the ability of students in certain courses, and (ii) to assess the achievement of LO (learning achievement) of study program. Explanations for each assessment process are described below.

Assessment of student's ability in certain courses can be done by various methods, in accordance with the provisions in RPKPS (Program Plan and Semester Learning Activity) for the course. Assessment methods can be tasks (paper, presentation, report), project, test both oral and written, and so on. In RPKPS, it has been determined the composition of the assessment method with the percentage of their contribution to the final value. In accordance with the provisions of the University, the final value of the letters A, A-, A / B, B +, B, B-, C / D, D +, D, and E.

Assessment to evaluate achievement of learning achievement is done using data obtained from each course. In this case, a module mapping table with PLO is used as shown in Table 3.4. For each PLO, the value components of all the courses contributing to the PLO are summed, then calculated on average. Thus, values will be obtained in the range of 0 to 100. The following is the category of PLO achievement based on the average value:
1. Very satisfactory, if 80 ≤ average value ≤ 100
2. Good, if 60 ≤ average value <80
3. Satisfactory, if 40 ≤ average value <60
4. Enough, if 20 ≤ average value <40
5. Less, if the average value is <20.

CHAPTER III. DEPARTMENT OF MATHEMATICS

3.1 INTRODUCTION

Mathematics is a language and tool in analyzing and solving the real problems. The field of mathematics does not usually connote with the numerical calculation, but also learn logic, reasoning, generalization process, abstraction, pattern observation, modeling and others. The role of mathematics in science is very strategic because the strength of the field of mathematics is the ability to model a problem to find its solution.

Recognizing the strategic position of the mathematics, Department of Mathematics of Faculty of Mathematics and Natural Sciences (FMNS) UGM have commitment to excellent in the theory and applicative mastery in applying the results of its research. The potential that already exists and continues to be developed is establish the cooperation with the several faculties in UGM, and cooperation with the other agencies, such as BMKG, the hospitals, the insurance companies, BPS, the IT companies, the financial institutions, BPPT, BIN, and others. In addition, cooperation with the other universities on boths domestically and abroad.

The Mathematics Department provides a venue for self-development of its students, especially in the train of reasoning and analytical skills through its study programmes. In addition, to provide the theoretical materials, the Mathematics Department provides provision for students to solve the problems in daily life, such as issues related to telecommunications, finance, banking, insurance, biology, health (such as disease spread), coding, control, optimization, and others.

According to the academic programme offered, the Department of Mathematics organizes 4 (four) Study Programmes which consist of:
- 2 (two) PS S1 (Undergraduate Study Programmes), that are UP-Math (Undergraduate Programme on Mathematics) and UP-Stat (Undergraduate Programme on Statistics),
- 1 (one) PS S2 Mathematics (MP-Math – Master Programme on Mathematics), and
- 1 (one) PS S3 Mathematics (DP-Math – Doctoral Programme on Mathematics).

According to a growing field of science, the Department of Mathematics has 6 (six) laboratories that are Algebra Laboratory, Analytical Laboratory, Applied Mathematics Laboratory, Statistics Laboratory, Laboratory of Mathematics Computation and Laboratory of Statistics Computation. Analysis Laboratory, Algebra Laboratory, Applied Mathematics Laboratory and Laboratory of Mathematics Computation are the main laboratories which support the curriculum of PS S1 Mathematics. Meanwhile, Statistics Laboratory and Laboratory of Statistics Computation are laboratories that support the main curriculum of UP-Stat.

Department of Mathematics FMIPA UGM is committed to continue to preserve the science that became its part, on both theoretical fields and application. This is in line with the spirit of UGM as a college that committed to preserve that exist sciences.

3.2   VISION STATEMENT OF THE DEPARTMENT OF MATHEMATICS

In 2025, Department of Mathematics becomes an outstanding Study Programme of Mathematics, recognized and leading nationally and internationally in theory and its applications.

3.3   MISSION STATEMENT OF THE DEPARTMENT OF MATHEMATICS

The missions of the Mathematics Department are:

develop innovative educational activities to increase educational quality in the field of mathematics.

develop and produce research for theoretical development as well as to support the research for applied area.

develop in general the role of mathematics in another fields and society.

3.4   OBJECTIVE

Make Department of Matehamtics of Faculty of Mathematics and Natural Sciences UGM as the best place for developing mathematics in Indonesia with international reputation through:

1. qualified mathematics education to produce superior and competent graduates,
2. research results which can be national references for similar fields that responsive with the society, nation and state problems,
3. dedication to the community that could encourage improvement of independence and culture to analyze the problems which critical and responsible,
4. management of department which fair, transparent, participatory, accountable, egalitarian, and inter-field integrated to support effectiveness and efficiency of resources utilization,
5. strategic, synergistic, and sustainable cooperation with domestic and foreign partners on the principle of mutual benefit.

3.5   GOALS AND STRATEGIES

To achieve the objective, the Department of Mathematics of FMIPA UGM set the general strategy as follows:

No	Detail	2016	2017	2018	2019	2020
Objective 1: qualified mathematics education to produce superior and competent graduates,						
1	The number of miter institutions that give the scholarship for students	3	3	4	4	5
2	Percentage of students receiving scholarships from friend's institutions	5.0%	6.0%	7.0%	8.0%	9.0%
3	Percentage of outstanding students accepted in Mathematics	1.0%	1.5%	2.0%	2.5%	3.0%
4	Percentage of research that involve the students	8.0%	10.0%	12.0%	14.0%	16.0%
5	The number of study programme activities in framework of curriculum development by comprehensive with the interest manager	2	3	4	5	6

#						
6	The number of activities within the institutions that absorb the graduations	2	2	3	3	3
7	The number of activities relevant to the increasing the leadership capability, entrepreneurship and softskills of students	2	3	4	5	6
8	Percentage of graduates that got the jobs in suitable field with the their competencies	60%	65%	70%	75%	80%
9	The number of activities of students' organization supervision development	4	6	8	10	12
10	Number of outstanding students	6	8	10	12	14
11	The number of study programmes that accredited on regional or international scale	1	1	2	2	3
12	The number of the double degree, exchange programmes or the join degree	0	1	1	2	2
13	Number of the foreign students that follow the education	0	0	0	1	1
Objective 2: research results which can be national references for similar fields that responsive with the society, nation and state problems,						
1	Number of the miter that participated in research activities	6	7	8	9	10
2	Number of cooperation contract as a follow up of the MoU	0	1	2	3	4
3	Number of laboratories that have quality management systems	0	2	4	6	6
4	Number of thematic research forum	2	3	4	5	6
5	Number of the lecturer publication that suitable with he/her field in the form of books or e-books	1	2	3	4	5
6	Number of international journal that referenced	5	8	10	12	15
Objective 3 Dedication to the community (DC) that could encourage improvement of independence and culture to analyze the problems which critical and responsible						
1	Percentage of lecturer that involved in multidiscipline thematic DC activities	0.0%	0.0%	0.5%	0.8%	1.0%
2	Percentage of lecturer that involved in the DC	40.0%	40.0%	45.0%	45.0%	50.0%
3	Number of the DC activities	3	3	4	5	6
4	Number of stakeholders that found/showed/advised	0	0	1	2	3
5	Number of the miter institution that involved in DC activities	0	0	1	1	2
6	Number of promotion, expo, dissemination, and follow up of the DC results	1	1	2	2	2

	Objective 4 management of department which fair, transparent, participatory, accountable, egalitarian, and inter-field integrated to support effectiveness and efficiency of resources utilization					
1	Number of the implementation of information system applications	5	6	7	8	9
2	Number of the documents of planning of the human resources, lay out and road map of research	1	2	4	6	8
3	Number of lecturers and academic staffs recruited in the applicable systems	5	5	4	3	2
4	Percentage of the human resources that have standard of office competence as a basis for placing human resources	80.0%	80.0%	85.0%	85.0%	90.0%
5	Precentage of HRIS Simaster usage as a data base of human resources	40.0%	45.0%	50.0%	55.0%	60.0%
6	Percentage of lecturers with educator certificate	65.0%	70.0%	75.0%	80.0%	85.0%
7	Percentage of lecturers with doctoral qualification	59.0%	61.0%	65.0%	69.0%	73.0%
8	Percentage of lecturers with professorship	16.0%	18.0%	20.0%	22.0%	24.0%
9	Percentage of academic staff with certificate of competence	0.8%	16.0%	24.0%	30.0%	40.0%
10	Percentage of documentation of management system and utilization of information and communication technology (ICT) consistently	50.0%	60.0%	70.0%	80.0%	90.0%
11	Percentage of ICT management systems that meet standards especially for network security and data management	70.0%	75.0%	80.0%	85.0%	90.0%
12	Percentage of lectures using e-learning	20.0%	25.0%	30.0%	35.0%	40.0%
13	Number of socialization and assistance of ICT activities	0	1	2	3	4
	Objective 5 : strategic, synergistic, and sustainable cooperation with domestic and foreign partners on the principle of mutual benefit.					
1	The number of MoUs that are followed up with the MoA and do not have the potential to cause legal problems	1	2	3	4	5
2	The number of MoAs that do not have the potential to cause legal problems	1	2	3	4	5
3	The number of *Focus Group Discussion* (FGD) cooperative inisiation that involve the unit diversity and potentially to perform the cooperation group	2	4	6	8	10

4	Number of the consortium with the outside parties	1	1	2	2	3
5	Number of sustainable cooperation	4	4	5	5	6
6	Number of alumnus meeting that coordinated by Department of Mathematics	2	2	3	3	4
7	Number of associations involved in career development and alumnus experience	1	1	2	2	2
8	Number of alumnus that can be absorb by the stakeholders through fellowship programme	3	5	7	9	10
9	The number of the alumnus involved in curriculum formulation, education process and learning, profession/ certification, provision of scholarships, and development of educational facilities activities	6	10	12	14	16
10	Number of development activities involving alumni's role in financing, facility development, publication and downstream of research activities	2	3	4	5	6

The strategies for achieving these objectives are as follows:
  a. Create a conducive academic atmosphere with the intention of encouraging lecturers to conduct research, especially in the form of collaboration with various parties.
  b. Provide financial support and give lecturers the opportunity to disseminate research results in scientific forums and reputable journals.
  c. Expand cooperation networks with various parties to impact on the rising quality of research and education and the opening of opportunities for graduates to enter the workforce.
  d. Create a relevant curriculum to the development of science and the period requirement.
  e. Provide the financial support and opportunities for the lecturers to perform the activities of dedication to community.
  f. Establish systematic, efficient, effective, integrated and democratic governance of the department through the use of IT, means of communication and discussions optimally.
  g. Complete adequate facilities and infrastructure for research, education, human resources and student needs by means of continuous improvement, maintenance and rejuvenation.

3.6   FACILITIES AND INFRASTRUCTURE

Teaching and learning activities in the Department of Mathematics Faculty of Mathematics and Natural Sciences UGM are supported by good physical facilities. In addition, the Department of Mathematics' reference facilities, the Library of the Faculty, and the University Library have a large collection of varied literature that can support the educational and research process. Laboratory of Computational Mathematics and Laboratory of Computational Statistics have good computers and software to be utilized maximally in several compulsory and preferred subjects. Library can be access online containing various online journals including database archive of undergraduate thesis for undergraduate programme, master thesis for master programme and dissertation for doctoral programme.

In general, facilities related to information systems for all academic community in the Department of Mathematics are internet connecting facility (sharing all faculties at UGM) and continuously improved. Software and hardware for the learning process in the Department of Mathematics is sufficient. The learning process of several courses using computers in the Computer Laboratory, which amounted to 3 laboratories with a total of 67 units of computers. For laboratory activities, it is endeavored to use open source software, so it can be obtained free of charge, but some lab activities also use licensed software. Software installed in every computer in 3 units of Computer Laboratory Department of Mathematics with sufficient amount.

The academic staff of the Department of Mathematics until 2017 is 48 academic staff, based on rank can be seen in the following list.

Professor* :
1. Subanar, Drs., Ph.D., Prof.
2. Sri Wahyuni, S.U., Dr, Prof.
3. Sri Haryatmi, M.Sc, Dr., Prof. (Head of Laboratory of Statistics)
4. Widodo, M.S., Dr., Prof.
5. Supama, M.Si, Dr. Prof. (Head of Academic Senate Faculty of Mathematics and Natural Sciences, Head of Master Programme on Mathematics)
6. Dedi Rosadi, S.Si., M.Sc., Dr.rer.nat., Prof. (Head of Laboratory of Computational Statistics)
7. Ch. Rini Indrati, Dra., M.Si., Dr., Prof. (Head of Undergraduate Programme of Mathematics)
8. Salmah, M.Si., Dr., Prof.

Associates Professor* :
1. Yusuf, Drs., M.A.Math.
2. Zulaela, Drs., Dipl. Med., M.Si.
3. Diah Junia Eksi Palupi, Dra., M.S., Dr. (Head of Laboratory of Algebra)
4. Lina Aryati, Dra., M.S.,Dr.rer.nat.
5. Budi Surodjo, Dr., M.Si.
6. Abdurakhman, S.Si., M.Si., Dr. (Head of Undergraduate Program of Statistics)
7. Gunardi, M.Si., Dr. (Vice Dean of Finance, Assets and Human Resources)
8. Ari Suparwanto, M.Si, Dr.rer.nat (Head of Department of Mathematics, Head of Doctoral Program on Mathematics)
9. Sumardi, Drs, M Si., Dr. (Head of Laboratory of Computational Mathematics)
10. Atok Zulijanto S Si, M Si., Ph.D. (Secretary of Doctoral Program on Mathematics)
11. Indah Emilia W., S.Si., M.Si ,.Dr.rer.nat (Secretary of Department of Mathematics)
12. Imam Sholekhuddin, S.Si., M Si. (Head of Laboratory of Analysis)

Assistant Professor* :
1. Sutopo, S Si , M Si. (taking Doctoral Programme in UGM)
2. Indarsih S Si, M Si., Dr.
3. Danardono, Drs., M.Ph., Ph.D. (Secretary of Master Programme on Mathematics)
4. Herni Utami, S.Si., M.Si., Dr. (Secretary of Undergraduate Programme of Statistics)
5. Adhitya Ronnie Effendie, S.Si. M Sc. Dr.
6. Fajar Adi Kusumo, S.Si. M Si., Dr. (Head of Laboratory of Applied Mathematics)
7. Yeni Susanti, S.Si. M Si., Dr. (Secretary of Undergraduate Programme of Mathematics)

8. Solikhatun, S Si. M.Si., Dr.

Instructor* :
1. Al. Sutjijana, Drs., M.Sc., Dr.
2. Irwan Endrayanto Aloysius, S.Si., M.Sc., Dr.
3. Dwi Ertiningsih,S.Si., M.Si. (taking doctoral programme in Leiden University the Netherlands)
4. Danang Teguh Qoyyimi, S.Si., M.Sc., Dr.
5. Umi Mahnuna Hanung, S.Si.,M.Si. (taking Doctoral Programme in University of Amsterdam the Netherlands)
6. Yunita Wulan Sari, S.Si., M.Sc.

Instructor :
1. Nur Khusnussa'adah, S.Si., M.Sc.
2. Dewi Kartika Sari, S.Si., M.Sc. (taking Doctoral Programme in NIE-NTU Singapore)
3. Nanang Susyanto, S.Si., M.Sc., Dr.
4. Noorma Yulia Megawati, S.Si., M.Sc. (taking Doctoral Programme in University of Groningen the Netherlands)
5. Hadrian Andradi, S.Si., M.Sc (taking Doctoral Programme in NIE-NTU Singapore)
6. Zenith Purisha, S.Si., M.Sc (taking Doctoral Programme in University of Helsinki Finland)
7. Vemmie Nastiti Lestari, S.Si., M.Sc
8. Rianti Siswi Utami, S.Si., M.Sc.
9. Uha Isnaini, S.Si., M.Sc (taking Doctoral Programme in NIE-NTU Singapore)
10. Rudi Adha Prihandoko, S.Si., M.Si
11. Ari Dwi Hartanto, S.Si., M.Sc.
12. Iwan Ernanto, S.Si., M.Sc.
13. Sekar Nugraheni, S.Si., M.Sc.
14. Rika Fitriani, S.Si., M.Sc
 *) certified by Letter of decision of Ministry of national Education

List of retired lecturer who are required to teach in the Department of Mathematics:
1. Soeparna Darmawijaya , Dr., Prof.
2. Suryo Guritno, Drs., M.Stats.,.Ph.D., Prof.
3. Bambang Soedijono, Dr., Prof.,
4. Sardjono, Drs., S.U. ,
5. Moch. Tari, Drs., M.Si.

In addition, communication with lecturers can be done via email. Meanwhile, lecture assignments and teaching materials can be accessed online via the internet, available in the form of E-learning (http://elisa.ugm.ac.id) which is freely accessible to students.

3.7   ACADEMIC QUALITY ASSURANCE

The system of quality assurance in the Department of Mathematics is carried out during the learning process and at the end of each semester in the process of internal quality audit (AMI-Audit Mutu Internal) conducted by Quality Assurance Office (KJM-Kantor Jaminan Mutu UGM). The quality assurance process is carried out in the Plan-Do-Check-Action circle of the education process in the Department of Mathematics to obtain a continuous improvement.

To improve the management of learning, which impact on quality assurance of learning outcomes, it has been attempted to monitor and provide feedback to students in direct form through discussion between lecturers and students in the TKS (Tim Koordinasi Semester) established by the Department for each Undergraduate Programme for each academic level. The TKS team consists of lecturers and students representing students per class group. The inputs from the TKS team will be the input of the programme managers, department managers, and faculty managers for the quality assurance process.

In addition, the quality of lecturers of the Department of Mathematics is also conducted to conduct research, publication of research results, and to cooperate with partners in domestic and abroad. The Plan-Do-Check-Action process for research is also well conducted, ranging from proposal submission and proposal review process, and the process of conducting research and monitoring, as well as the process of reporting and reviewing the final research results. Implementation of the evaluation of research conducted by teams that depend on the funder.

In conducting standard quality measurement, the undergraduate programme, master programme, and doctoral programme in the Department of Mathematics use parameters such as: quality textbooks used in lectures, curriculum of UP-Mathematics and UP-Statistics, master program on Mathematics and doctoral programme on Mathematics courses from several institutions both from domestic and abroad, the quality of the teaching and learning process, the success of graduates of UP-Mathematics and UP-Statistics, master programme on Mathematics and doctoral program on Mathematics in publicizing his work in international journals, and becoming an invited speaker at domestic and abroad.

The results of internal evaluation each semester is used to improve the learning process and the process of preparing the final project of undergraduate programme in the next semester, which leads to the development of the curriculum of the study programme. External evaluation by the National Accreditation Board of Higher Education (BAN PT) is always done and the result has been shown by always getting the value of "A" for all study programmes on each submission of accreditation of study programme. Following the Program Quality Assurance Office (KJM UGM), in addition to accreditation by the national accreditation body, the Mathematics Study Programme in 2015 has also been accredited by AUN - QA (ASEAN University Network - Quality Assurance) and earned good grades. Currently Undergraduate Programme Mathematics and Statistics S1 is preparing an international accreditation document that will be submitted to ASIIN to gain international recognition in accordance with its vision and mission to become an international standard study programme. Besides, cooperation and partnership in collaboration research is also done. The results obtained are used for curriculum improvement, learning process and handling of infrastructure and supporting facilities, as well as improvement of administrative system, supported by continuous research. Collaborative activities with partners are conducted with colloquium activities, workshops for both research development and learning process.

3.8 MATHEMATICS STUDY PROGRAM

3.8.1 Introduction

The Curriculum 2016 of the Undergraduate Programme of Mathematics UGM (UP-Math) is based on
1. Curriculum 2011 of UP-Math.
2. Government regulations and stakeholders.
3. Evaluation from the Semester Coordination Team (TKS), which is performed at least twice each semester. The TKS involves representatives of lecturers and students.
4. General evaluation of the UP-Math, which is done every 5 years.
5. Curriculum benchmarking of some similar mathematics study programmes of institutions in the country and abroad.
6. Input from alumni and graduate users.
7. General ASIIN Criteria.

The preparation of the Curriculum 2016 of UP-Math was conducted in several stages. The first stage was done by several meetings at the study programme level and followed by a meeting at the department level. The results of the meeting at the department level were continued to the faculty level where he final results were submitted to the faculty senate for study and approval.

3.8.2 Vision

In 2025, the UP-Math becomes an outstanding Study Programme of Mathematics, recognized and leading nationally and internationally in theory and its applications.

3.8.3 Mission

To fulfill the vision, UP-Math has four missions, namely
1. Develop learning activities through new innovations to improve the quality, efficiency and relevance of mathematics learning.
2. Develop the research culture in groups of expertise to support mathematical research and its applications.
3. Develop the role and applications of mathematics in various fields, to make a mutually beneficial cooperation between the UP-Math and mathematics user.
4. Make UP-Math as a study programe that has a credible, transparance, accountable, responsible, and fair management system.

3.8.4 Programme Education Objectives (PEO)

To produce graduates who
have profound knowledge in theory of (pure) mathematics as the core and able to apply the theory to solve problems related to differential equations and optimization.
are adaptive and able to continue to the next programme in mathematics or in other fields related to Mathematics.
are literate in information technology and excellent in mathematical computational and have ability to follow the development of sciences and technology.
have responsibility, confidence, emotional mature, ethics, and lifelong learner principle.

The Programme Educational Objectives of UP-Math have been formulated by considering the framework of National curriculum as stated in Level 6 of the Indonesian Qualifications Framework (IQF) /KKNI (Kerangka Kualifikasi Nasional Indonesia), i.e.,
1. Capable to apply science, technology and art within her/his expertise and adaptable to various situations faced during solving a problem.

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2. Mastering in-depth general and specific theoretical concepts of a certain knowledge and capable to formulate related problem solving procedure
3. Capable to take strategic decision based on information and data analysis and provides direction in choosing several alternative solutions.
4. Responsible for her/his own job and can be assigned to take responsibility of the attainment of organization's performances

Mapping of the Programme Objectives of UP-Math and IQF Level 6

IQF Level 6 / PEO	IQF 1	IQF 2	IQF 3	IQF 4
PEO 1	H	H	M	L
PEO 2	M	H	H	M
PEO 3	H	L	M	L
PEO 4	L	L	M	H

H = High, M = Medium, L = Light

3.8.5 Curriculum Goals

1. Making improvements and adjustments to the relevance, competence, and efficiency of UP-Math continuously.
2. Improving services to the community in the field of research, training, consultation, service, and others.
3. Able to produce national and international publications.
4. Establishment of a national and international accredited study programme management system.

3.8.6 Strategies to Achieve Learning Objectives

1. Making improvements and adjustments to the relevance, competence, and efficiency of UP-Math continuously. It is done by:
   a. The efforts to increase the CGPA of Graduates, the increase of the percentage of on-time graduation, the percentage increase of the number of graduates with CGPA≥3.00, and the decrease of the average length of study through:
      i. Improvement of teaching-learning process and final task supervision
      ii. Improvement of learning facilities
      iii. Assessment standardization.
      iv. Tutorials for important courses and graders for basic courses.
      v. Excavation of lecturer-student feedback.
      vi. Enhancement of supervision intensity.
   b. Encouraging lecturers to become the members of mathematical organizations in related to their research fields (HPA, Kamindo, etc.), national organization of mathematical profesion (IndoMS), and international organizations.
   c. Encouraging lecturers to attend seminars, workshops and conferences, both national and international.
   d. Providing funding provides funding for participation in scientific forums through the Departemen of Mathematics.
2. Improving services to community such as, training, consultation, service, and others related to the research field.
3. Improving cooperation with other institutions.
4. Improving the community service as the mathematical user.
5. Able to produce national and international publications.

6. Encouraging lecturers to publish their research in national and international journals on mathematics.
7. Encouraging lecturers to attend national and international seminars by providing financial support.
8. Providing incentive of scientific publications through the Departement of Mathematics.
9. Establishment of a national and international accredited study programme management system.
10. Preparing facilities and infrastructure in English that support learning process.
11. Applying international accreditation (ASIIN).
12. Re-applying national accreditation through BAN PT or LAM.
13. Implementing quality culture through Internal Quality Audit (AMI) KJM UGM.
14. Coorporating with university in the country and abroad to improve the quality of study programme.

Target within the next 5 years in improving academic efficiency.

	2016	2017	2018	2019	2020
Average CGPA	3.08	3.10	3.12	3.14	3.15
Average length of study (years)	5.20	5.15	5.10	5.05	5.00
On-time graduation	3.00%	4.00%	5.00%	5.50%	6.00%
CGPA ≥ 3	60%	62.5%	65%	67.5%	70%

3.8.7 Basis of Curriculum Changes

By taking the SWOT (Strength, Weakness, Opportunity, and Threat) into account, UP-Math continuously upgrades curriculum by improving RAISE (Relevance, Academic atmosphere, Internal management and organization, Sustainability, Efficiency and productivity).

Furthermore, based on Programme Educational Objective and Programme Learning Outcomes, UP-Math upgraded Curriculum 2016, which is a competency-based curriculum. The curriculum upgrading was done by considering:

1. Guidelines of Higher Education Curriculum and Assessment of Learning Outcomes (Minister of National Education No. 232 / U / 2000).
2. Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia No. 44 of 2015 about National Standard of Higher Education.
3. Minister of Education and Culture of the Republic of Indonesia: Regulation of the Minister of Education and Culture of the Republic of Indonesia No.73/2013 about Indonesian Qualifications Framework.
4. Government Regulation no. 19/2005, Decree of Minister of National Education No. 045/2002 about core curriculum of Higher Education and Decree of Rector of UGM No. 581 / P / SK / HT / 2010 concerning guidances of curriculum development 2016 for undergraduate level.
5. Results of FMNS UGM Senate meeting at the faculty level about common courses, i.e., Basic of Mathematics and Natural Sicence Courses, which include Calculus I, Basic Chemistry I, Basic Physics I, and Programming I in Semester I with 3 credits each.
6. Foresighting of science development of FMNS UGM 2016.
7. Alumni Feedback, Users, and Students in compulsory and elective courses along with the learning process.

3.8.8 Graduates Employment

Considering the universality of mathematics, profession/graduate employment quite diverses. Based on alumni trace, it was known that they work in the field of education (teacher and lecturer), research (researches), government agency (ministries), banking (BNI, BRI, Mandiri, etc.), Actuary, IT (Packet System, IBM , Jati Solution, Gameloft, etc.), company (ASTRA, ELNUSA, IPCO-International in coal mining, etc.), BMKG, BPPS, and several companies abroad.

3.8.9 Graduates Profile

In general, the Graduate Profile of UP-Math is expected to work as:
1. Academics.
2. Assistant Researcher
3. Consultant
4. Practitioners (Industry, Service, Government)

3.8.10 Learning Outcomes/Graduates Qualifications

Based on UP-Math's programme objectives, it is formulated nine (9) Programme Learning Outcome (PLO), which is done by considering:
1. Document **"Undergraduate Programs and Courses in the Mathematical Sciences: CUPM Curriculum Guide 2004"** published by MAA http://www.maa.org/sites/default/files/pdf/CUPM/cupm2004.pdf
2. Document **"CUPM Discussion Papers about Mathematics and the Mathematical Sciences in 2010: What Should Students Know?"** published by MAA http://www.maa.org/sites/default/files/pdf/CUPM/math-2010.pdf
3. Document "2015 CUPM Curriculum Guide to Majors in the Mathematical Sciences" published by MAA
4. http://www.maa.org/sites/default/files/pdf/CUPM/pdf/CUPMguide_print.pdf
5. Document **"The SIAM Report on Mathematics in Industry 2012"** published by SIAM http://www.siam.org/reports/mii/2012/report.php
6. Document **"Rekomendasi Capaian Pembelajaran serta Struktur Curriculum Minimal untuk Program S1 Matematika"** 2006 which was revised in September 2013 by The Indonesian Mathematical Society (IndoMS).
7. SK Kepmendiknas No. 232/U/2000 and 045/U/2002 about curriculum and assessment at the university.
8. Recommendations from alumni and stakeholders (users) through **"Policy Study"** (PHK A3 2005-2007).
9. Direct networking through meetings or via email correspondence (2008 - 2016).
10. Documented benchmarking results with
   a. Mathematics Study Programme abroad: Nanyang Technological University (NTU), National Institute for Education (NIE), University of Graz (Uni. Graz), and University of Wollongong, Australia, University of Twente, The Netherland, and University of Waterloo, Amerika.
   b. Mathematics Study Programme in the country: Universitas Indonesia (UI) Jakarta and Institut Teknologi Bandung (ITB) Bandung.
   c. Results of visits to ASIIN Accreditation Board (http://www.asiin-ev.de/pages/en/asiin-e.-v.php) (Proyek WCRU 2009) and training ASIIN 25 – 27 May 2016.
   d. Document AUN and General Criteria ASIIN.
   e. Document BAN PT (http://ban-pt.kemdiknas.go.id/).

Programme Learning Outcomes/PLO of UP-Math have been formulated as follows.

PLO 1:	devote to God Almighty, Pancasila minded, and aware of the interest of the nation.
PLO 2:	are able to recognize mathematics-related problems, assess their solvability and solve them within a specified time frame.
PLO 3:	are able to develop their logic and mathematical thinking. They are in particular able to formulate mathematical hypotheses and have an understanding of how such hypotheses can be verified or falsified using mathematical methods.
PLO 4:	have sufficient knowledge in information technology and have ability it to support the teaching-learning and research process.
PLO 5:	have comprehensive knowledge in mathematical modelling and able to create mathematical models, both in mathematics, in other fields, and in real problems. They are in particular able to solve and determine the strategy how to solve the problems.
PLO 6:	have generalization and abstraction abilities and are able to recognize analogies and basic patterns.
PLO 7:	are able to communicate in mathematical language, oral and writing, concisely, clearly, and well-organized.
PLO 8:	have responsibility, confidence, emotional mature, ethics, and lifelong learner principle.
PLO 9:	have ability to apply their mathematics ability in their carrier related to mathematics and to continue their programme in master and doctoral programme.

PLO Mapping and Bloom's Taxonomy

Mapping of PLO for the suitability achievements of Skill, Competence, and Analysis in Bloom's Taxonomy is presented in the following table.

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9
Knowledge		v	v	v	v				
Skill		v		v	v	v	v		v
Competence	v	v	v		v	v		v	v

3.8.11 Study Materials

The consideration refers to the recommendations of IndoMS 2015 and the condition of UP-Math UGM. In running the curriculum, UP-Math FMNS UGM is supported by 4 (four) Laboratories (Research Groups) in the Department of Mathematics and other Laboratories outside the Department of Mathematics, including the Departments, and Faculties at UGM, and the other related universities.

Four Laboratories in Mathematics Department of FMNS UGM are:
1. **Laboratory of Analysis** which is responsible for the courses content of Calculus, Introduction to Real Analysis, Complex Variable Functions, and Geometry as well as the related elective courses.
2. **Laboratory of Algebra** which is responsible for the courses content of Mathematical Logic, Linear Algebra, Introduction to Abstract Algebra, and Discrete Mathematics as well as the related elective courses.

3. **Laboratory of Applied Mathematics** which is responsible for courses content of Mathematical Model, Differential Equation (Elementary Differential Equation, Partial Differential Equation, Introduction Problem of Boundary Requirement, System Theory, Control Theory, Dynamic System, etc.), and Optimization (Linear Programming, Operation Research , Theory of Optimization), along with the courses of related elective courses.
4. **Laboratory of Computational Mathematics** which is responsible for Computational Mathematics courses, including Numerical Analysis and Computational Differential Equation, Optimization, and Algebra. Convergence Algorithm Analysis, Error Estimation. The obtained algorithm is implemented in the programme on the laboratory work.

Whereas, the Laboratory in the Department of Mathematics, the Department in the FMNS outside the Department of Mathematics, the Faculties at UGM, and the universities that support UP-Math are:
   a. **Laboratory of Statistics,** Department of Mathematics, FMNS UGM.
   b. Department of Computer Science and Electronics Instrumentation, Department of Physics and Chemistry Department.
   c. Other related faculties / Universities.

Basic Capabilities and study materials

No.	Basic capabilities	Study materials
1	Basic Mathematics	Set
		Relation and Function
		Logic
		Proving Method
		System of Natural, Integer, and Rational Numbers
2	Differential Calculus and Integral	System of Real Numbers
		Function
		Limit
		Continuity
		Derivative
		Integral
		Sequence
		Series
		Vector-valued functions
		Two or more variables functions
		Partial derivative
		Double and triple integrals
3	Ordinary Differential Equations	Ordinary differential equations
4	Elementary Linear Algebra	Sistem of linear equations
		Matrices
		Vector space
		Linear transformations
		Orthogonalizations
		Eigen value and eigen vector
		Diagonalization and decomposition

		Quadratic form
5	Basic Optimizations	Linear Programming
6	Geometry	Field and space geometry
7	Basic Statistics	Data
		Descriptive statistics
		Measures of center and distribution
		Probability
		Distribution and probability
		Sampling distribution
		Introduction to hypothesis test
		Confidence interval
		Analysis of simple linear regression
8	Discrete Mathematics	Combination and Permutation
		Three fundamental principles
		Basic of graph theory
9	Basic computer and programming	Operation system
		Office
		Introduction to mathematics/statistics software (Matlab, SPSS, etc.)
		Basic programming
10	Basic of Mathematics and Natural Sicences	Calculus I
		Basic Physics I
		Basic Chemistry I
		Programming
11	Basic of ethics and general sciences	Religion
		Pancasila
		Civic
		Introduction to Philosophy of Sciences
		English
		Community Development Participation

Advance Capabilities

No.	Advance capabilities	Study materials
1	Partial Differential Equations	Theory and method of differential equations (Ordinary and partial differential equations)
		Special functions
		Boundary value problem
2	Numerical Analysis	Introduction to numerical analysis
		Computational mathematics
		Numerical linear algebra

No.	Advance capabilities	Study materials
3	Abstract Algebra	Group
		Ring
		Linear Algebra
4	Real Analysis	Theory of calculus, differential, and integral
5	Complex function	Analytic functions
		Integral
		Residue
6	Geometry	Generalization of geometry
7	Probability theory and stochastic	Probability theory
		Stochastic
8	Optimization	Operation research
		Non-linear optimization
		Network
9	Modelling	Mathematical modelling
10	Undergraduate Thesis	Undergraduate Thesis: Literature Study
		Undergraduate Thesis: Skripsi
11	Graph, Coding, and Cryptography	Graph
		Combinatorics
		Coding
		Cryptography
12	Dynamical system	Continuous dynamical system
		Discrete dynamical system
13	System and control theory	Introduction to game theory
		Introduction to system theory
		Introduction to control theory
14	Analysis Track	Introduction to functional analysis
		Introduction to topology
		Introduction to measure theory and Lebesgue integral
		Introduction to differential geometry
		Capita selecta analysis
15	Algebra Track	Introduction to semigroup
		Applied linear algebra I
		Applied linear algebra II
		Introduction to module theory
		Capita selecta algebra
16	Applied Track Mathematics	Capita selecta applied mathematics
17	Computational Track Mathematics	Capita selecta computational mathematics
18	Statistical Inference	Explorative data analysis
		Applied regression analysis
		Sample survey method
19	Actuary	Basic Micro Economy

No.	Advance capabilities	Study materials
		Basic Macro Economy
		Introduction to Statistical Theory
		Introduction to financial mathematics
20	Statistics for Government	Statistics for Government

Table of Linkage between compulsory and elective courses with study materials

No.	Basic capabilities	Courses to reach study materials	Courses Status
1	Basic Mathematics	Introduction to Mathematical Logic	Compulsory
		Set Theory	Compulsory
2	Calculus Diferensial and Integral	Calculus I	
		Calculus II	Compulsory
		Multivariable Calculus I	Compulsory
		Multivariable Calculus II	Compulsory
		Advanced Calculus	Compulsory
		Vector Analysis	Elective
3	Ordinary Differential Equations	Ordinary Differential Equations	Compulsory
4	Elementary Linear Algebra	Elementary Linear Algebra	Compulsory
		Numerical Linear Algebra	Elective
5	Basic Optimization	Linear Programming	Compulsory
6	Geometry	Geometry Analytic	Compulsory
		Geometry Transformations	Compulsory
7	Basic Statistics	Statistical Method I	Compulsory
		Statistical Method II	Elective
8	Discrete Mathematics	Discrete Mathematics I	Compulsory
		Discrete Mathematics II	Compulsory
9	Basic computer and programming	Programming I	
		Programming I Laboratory	Compulsory
		Programming I	Elective
		Programming I Laboratory	Elective
10	Basic of Mathematics and Natural Sicences	Calculus I	Compulsory
		Basic Physics I	Compulsory
		Basic Chemistry I	Compulsory
		Programming	Compulsory
11	Basic of ethics and general sciences	Religion	Compulsory
		Pancasila	Compulsory
		Civic	Compulsory
		Introduction to Philosophy of Sciences	Compulsory
		English	Compulsory

No.	Basic capabilities	Courses to reach study materials	Courses Status
		Community Development Participation	Compulsory
		Entrepreneurship	Elective
		Internship	Elective

No.	Advance capabilities	Courses to reach study materials	Courses Status
1	Partial Differential Equations	Introduction to Partial Differential Equations	Compulsory
		Introduction to Theory of Differential Equation	Elective
		Introduction to Boundary Value Problem	Elective
2	Numerical Analysis	Introduction to Numerical Analysis	Compulsory
		Computational Mathematics	Compulsory
		Numerical Linear Algebra	Elective
3	Abstract Algebra	Introduction to Abstract Algebra I	Compulsory
		Introduction to Abstract Algebra II	Compulsory
		Linear Algebra	Compulsory
		Finite Group Theory	Elective
4	Real Analysis	Introduction to Analysis I	Compulsory
		Introduction to Analysis II	Compulsory
5	Complex function	Function of Complex Variables I	Compulsory
		Function of Complex Variables II	Compulsory
6	Geometry	Geometry	Elective
		Geometry in n-dimensional Euclidean Space in n-dimensional space	Elective
		Introduction to Fractal Geometry	Elective
7	Probability theory and stochastic	Introduction to Probability Theory	Compulsory
		Stochastic	Compulsory
8	Optimization	Operation Research	Elective
		Introduction to Optimization	Elective
9	Modelling	Introduction to Mathematical Modelling	Compulsory
		Biological Mathematics	Elective
10	Undergraduate Thesis	Undergraduate Thesis : Literature Study	Compulsory
		Undergraduate Thesis : Skripsi	Compulsory

No.	Basic capabilities	Courses to reach study materials	Courses Status
11	Graph, Coding, and Cryptography Cryptographhy	Introduction to Graph Theory	Elective
		Introduction to Combinatorics	Elective
		Introduction to Coding Theory	Elective
		Introduction to Cryptography Theory	Elective

No.	Advanced capabilities	Courses to reach study materials	Courses Status
12	Dynamical System	Dynamical System	Elective
		Introduction to Ergodic Theory	Elective
13	System and control theory	Introduction to Game Theory	Elective
		Introduction to System Theory	Elective
		Introduction to Control Theory	Elective
14	Analysis Track	Introduction to Functional Analysis	Elective
		Introduction to Topology	Elective
		Introduction to Theory of Measure and Lebesgue Integral	Elective
		Introduction to Differential Geometry	Elective
		Capita Selecta in Analysis	Elective
15	Algebra Track	Introduction to Semigrou	Elective
		Applied Linear Algebra II	Elective
		Applied Linear Algebra II	Elective
		Introduction of Module Theory	Elective
		Capita Selecta in Algebra	Elective
16	Applied Track Mathematics	Capita Selecta in Applied Mathematics A	Elective
		Capita Selecta in Applied Mathematics B	Elective
17	Computational Track Mathematics	Capita Selecta in Computational Mathematics	Elective
18	Statistical Inference	Explorative Data Analysis	Elective
		Applied Regression Analysis	Elective
		Sample Survey Method	Elective
		Quality of Statistics Controlling	Elective
19	Actuary	Introduction to financial mathematics I	Elective
		Introduction to Actuarial Accounting I	Elective
		ntroduction to Statistical Mathematics I	Elective
		Introduction to Micro Economy	Elective
		Introduction to financial mathematics II	Elective

No.	Basic capabilities	Courses to reach study materials	Courses Status
		Introduction to Macro Economy	Elective
		ntroduction to Statistical Mathematics II	Elective
		Introduction to Actuarial Accounting II	Elective
		Introduction to time series	Elective
		Introduction to Actuarial Mathematics I	Elective
		Introduction to Theory of Actuarial Risk I	Elective
		Introduction to Theory of Actuarial Risk II	Elective
		Analysis Data Survival	Elective
		Introduction to Actuarial Mathematics II	Elective
20	Statistics for Government	Statistics for Government	Elective

The structures of the UP-Math curriculum are as follows

Kelompok mata kuliah	Nama mata kuliah terkait
University level Courses (11 Credits)	Compulsory courses: Religion (2 Credits), Pancasila (2 Credits), Civic (2 Credits), Introduction to Philosophy of Sciences (2 Credits), Community Development Participation (3 Credits).
Faculty level Courses (12 Credits)	Compulsory courses: Calculus I (3 Credits), Basic Physics I (3 Credits), Basic Chemistry I (3 Credits), Programming I (3 Credits).
Department level Courses (5 Credits)	Compulsory courses: English (2 Credits) and Introduction to Stochastic Process (3 Credits).
Generic Study Programme level Courses (76 Credits)	Compulsory courses that are not University and Faculty courses, including Undergraduate Thesis (6 Credits) and courses in the field: • Analysis (24 Credits: Calculus, Geometry, Compex Function, and Introduction to Analysis); • Algebra (Introduction to Mathematical Logic, Set Theory, Discrete Mathematics, Elementary Linear Algebra, Introduction to Abstract Algebra, and Linear Algebra); • Applied Mathematics (12 Credits: Ordinary and Partial Differential Equations, Linear Programming, Introduction to Mathematical Modelling); • Computational Mathematics (7 Credits: Laboratory Work of Programming 1,

	Introduction to Numerical Analysis, Computational Mathematics), and
	• Statistics (6 Credits: Statistical Method 1, Introduction to Probability Theory).
Non-generic Study Programme level Courses (Minimal 40 Credits)	Elective Courses: Students choose elective courses based on their interest. There are four tracks: Analysis, Algebra, Applied Mathematics, and Computational Mathematics.

3.8.12 List of Courses

In the Curriculum 2016, some courses are accompanied by laboratory work. It is different with the Curriculum 2011, where we merge the theory and laboratory work credits. The Curriculum 2016 of UP-Math is divided into 2 (two) Groups of Courses, i.e.,:
  a. Compulsory Courses with 104 credits in total and
  b. Elective Courses that are weighted at least 40 Credits that can be selected from the available elective courses at UP-Math or other study programmes/ Departmental/ Faculty/Universities.

The Curriculum 2016 is completed by some courses that are used in the Certification of Equality with the Association of Indonesia Actuaries (PAI: Persatuan Aktuaris Indonesia). Name of those courses are marked by code ♦.

Below are given some descriptions of the symbol and abbreviations in the list of courses.

  a. For prerequisite courses

Symbol	Meaning
*	has been taken and taken the final exam
**	can be taken simultaneously
without *	at least get grade D

  b. Every course completed by laboratory work is marked by course credit (1). For instance, course of Linear Programming 3 (1) means the course weighs 3 Credits and completed by laboratory work.

  c. For elective courses

Symbol	Meaning
♥	directed courses of applied mathematics track
♦	courses for sertification of equality with PAI

LIST OF COMPULSORY COURSES

Sem.	Nr.	Code	Course	Credits	Prerequisite	Remark	PIC
I:	1	MMM-1101	Calculus I	3			Department of Mathematics
	2	MFF-1011	Basic Physics I	3			Department of Physics
	3	MKK-1101	Basic Chemistry I	3			Department of Chemistry
	4	MII-1201	Programming I	3			Department of Computer science and Electronics

	5	MII-1202	Programming I Laboratory	1			Department of Computer science and Electronics
	6	MMM-1208	Introduction to Mathematical Logic	3			Lab. of Algebra
	7	UNU-100x	Religion	2		**UNU-1000 Islam UNU-1001 Katolik UNU-1002 Kristen UNU-1003 Hindu UNU-1004 Budha UNU-1005 Konghucu**	University
	8	MMS-1404	Statistical Methods I	3 (1)		with laboratory work	UP-Stat
		Total Credits		**21**			
II	1	MMM-1102	Calculus II	3	MMM-1101*		Lab. of Analysis
	2	MMM-1106	Analytical Geometry	3	MMM-1101*		Lab. of Analysis
	3	MMM-1202	Elementary Linear Algebra	3			Lab. of Algebra
	4	MMM-1206	Discrete Mathematics I	2	MMM-1208*		Lab. of Algebra
	5	MMM-1203	Introduction to Algebraic Structure I	3	MMM-1208*		Lab. of Algebra
	6	MMM-1204	Set Theory	2	MMM-1208*		Lab. of Algebra
	7	MMM-1001	English	2			Department of Mathematics
	8	UNU-1010	Pancasila	2			University
		Total Credits		**20**			
III	1	MMM-2109	Multivariable Calculus I	2	MMM-1102* MMM-1106*		Lab. of Analysis
	2	MMM-2201	Introduction to Algebraic Structure II	3	MMS-1203*		Lab. of Algebra
	3	MMM-2301	Elementary Differential Equations	3	MMM-1102*		Lab. of Applied Mathematics
	4	MMS-2410	Introduction Probability Models	3	MMM-1102*		Lab. of Statistics
	5	MMM-2207	Discrete Mathematics II	2	MMM-1206*		Lab. of Algebra
	6	MMM-2114	Transformation Geometry	2	MMM-1106*		Lab. of Analysis
	7	MMM-2312	Linear Programming	3 (1)	MMM-1202*	with laboratory work	Lab. of Applied Mathematics and Lab of Mathematical Computation
		Total Credits		**18**			

IV	1	MMM-2110	Multivariable Calculus II	2	MMM-2109* (PS S1 Matematika), MMS-2428* (PS S1 Statistika)		Lab. of Analysis
	2	MMM-2111	Advanced Calculus	2	MMM-1102*		Lab. of Analysis
	3	MMM-2112	Function of Complex Variables I	2	MMM-2109*		Lab. of Analysis
	4	MMM-2202	Linear Algebra	3	MMM-1202* MMM-2201*		Lab. of Algebra
	5	MMM-2401	Introduction to Numerical Analysis	3 (1)	MMM-2301*	with laboratory work	Lab of Mathematical Computation
	6	MMM-2310	ntroduction to Partial Differential Equations	3	MMM-2109* MMM-2301*		Lab. of Applied Mathematics
		Total Credits		**15**			
V	1	MMM-3101	Introduction to Analysis I	3	MMM-2111*		Lab. of Analysis
	2	MMM-3401	Computational Mathematics	3 (1)	MMM-2310* MMM-2401*	with laboratory work	Lab of Mathematical Computation
	3	MMM-3106	Function of Complex Variables II	2	MMM-2112*		Lab. of Analysis
	4	MMM-3303	Introduction to Mathematical Models	3	MMM-2310** MMS-2410*		Lab. of Applied Mathematics
	5	MMM-3002	Introduction to Stochastic Process	3	MMS-2410*		Department of Mathematics
	6	MMM-3001	Introduction to Philosophy of Sciences	2	≥80 Credits		University (Faculty of Philosophy)
		Total Credits		**16**			
VI	1	MMM-3102	Introduction to Analysis II	3	MMM-3101*		Lab. of Analysis
	2	UNU-3000	Civic	2	≥ 60 Credits		University
	3	UNU-4500	Community Development Participation	3	≥100 Credits		University
		Total Credits		**8**			
VII/ VIII	1	MMM-4097	Undergraduate Thesis : Literature Study	2	≥ 120 Credits, IPK ≥ 2.0, without grade E, percentage of total credit with grade D less than or equal 25%.		UP-Math
	2	MMM-4098	Undergraduate Thesis : Skripsi	4	Studi Literatur**		UP-Math
		Total Credits		**6**			
		Total Credits of compulsory courses		**104**			

List of Elective Courses

Elective Courses "SP "

No.	Sem	Code	Course	Credits	Prerequisite	Remark	PIC
1	V	MMM-3003	Entrepreneurship	2	≥80 Credits		UP-Math
2	VI/ VII/V III	MMM-4001	Internship	3	≥ 100 Credits, IPK ≥3.00, without grade E, percentage of total credit with grade D less than or equal 25%.		UP-Math

Elective Courses "Analysis and Geometry"

No.	Sem	Code	Course	Credits	Prerequisite	Remark	PIC
1	II	MMM-1105	Introduction to Number Theory	3	MMM-1208*		Lab. of Analysis
2	III	MMM-2113	Geometry	3	MMM-1106* MMM-1208*		Lab. of Analysis
3	III	MMM-2115	Geometry in n-dimensional Euclidean Space in n-dimensional Space	3	MMM-1106*		Lab. of Analysis
4	V	MMM-2105	Vector Analysis	2	MMM-2109*		Lab. of Analysis
5	VI	MMM-3108	Introduction to Topology	3	MMM-3102**		Lab. of Analysis
6	VI	MMM-3103	Introduction to Theory of Differential Equation	3	MMM-3102**		Lab. of Analysis
7	VI	MMM-3105	Introduction to Theory of Measure and Lebesgue Integral	3	MMM-3102**		Lab. of Analysis
8	VI	MMM-3107	Introduction to Differential Geometry	3	MMM-2109*		Lab. of Analysis
9	VII	MMM-4102	Introduction to Functional Analysis	3	MMM-3102*		Lab. of Analysis
10	VII/ VIII	MMM-4149	Capita Selecta in Analysis	3	MMM-3101		Lab. of Analysis

Elective Courses "Algebra and Discrete Mathematics"

No	Sem	Code	Course	Credits	Prerequisite	Remark	PIC
1	III	MMM-2210	Applied Linear Algebra I	2	MMM-1202*		Lab. of Algebra
2	III	MMM-2208	Finite Group Theory	2	MMM-1203*		Lab. of Algebra
3	IV	MMM-2209	Introduction to Combinatorics	3	MMM-2207*		Lab. of Algebra
4	IV	MMM-2206	Introduction to Graph Theory	3	MMM-2207*		Lab. of Algebra
5	V	MMM-3206	Introduction to Coding Theory	3	MMM-2202*		Lab. of Algebra
6	VI	MMM-3210	Introduction to Semigroup Theory	3	MMM-1203*		Lab. of Algebra
7	VI	MMM-3209	Applied Linear Algebra II	2	MMM-2202*		Lab. of Algebra
8	VII	MMM-4207	Introduction of Module Theory	3	MMM-2202*		Lab. of Algebra
9	VII	MMM-4206	Introduction to Cryptography	3	MMM-2202*		Lab. of Algebra
10	VII/ VIII	MMM-4249	Capita Selecta in Algebra	3	MMM-2202*		Lab. of Algebra

Elective Courses "Applied Mathematics"

No	Sem	Code	Course	Credits	Prerequisite	Remark	PIC
1	III	MMM-2308	Introduction to Game Theory	3			Lab. of Applied Mathematics
2	IV	MMM-2303	Biological Mathematics	3	MMM-2301*,MMS-2410*		Lab. of Applied Mathematics
3	V	MMM-3310	Introduction to Theory of System♥	3	MMM-2202*, MMM-2301*		Lab. of Applied Mathematics
4	V	MMM-3311	Introduction to Boundary Value Problem	3	MMM-2310*		Lab. of Applied Mathematics
5	VI	MMM-3306	Dynamical System♥	3	MMM-1202*, MMM-2301*		Lab. of Applied Mathematics
6	VI	MMM-3312	Introduction to Control Theory	3	MMM-3310*		Lab. of Applied Mathematics
7	VII	MMM-4303	Introduction to Ergodic Theory	3	MMM-3306*		Lab. of Applied Mathematics
8	VII/VIII	MMM-4349A	Capita Selecta in Applied Mathematics A	3	MMM-3303*		Lab. of Applied Mathematics
9	VII/VIII	MMM-4349B	Capita Selecta in Applied Mathematics B	3	MMM-3303*		Lab. of Applied Mathematics

Elective Courses "Mathematical Computation"							
No	Sem	Code	Course	Credits	Prerequisite	Remark	PIC
1	VI	MMM-4449	Capita Selecta in Computational Mathematics	3	MMM-3401*		Lab of Mathematical Computation
2	VII	MMM-4401	Introduction to Fractal Geometry	3	MMM-2112*		Lab of Mathematical Computation

Elective Courses "Algebra and Mathematical Computation"							
No	Sem	Code	Course	Credits	Prerequisite	Remark	PIC
1	V	MMM-3208	Numerical Linear Algebra	3 (1)	MMM-2202*	with laboratory work	Lab. of Algebra and Lab of Mathematical Computation

Elective Courses "Applied Mathematics and Mathematical Computation"							
No	Sem	Code	Course	Credits	Prerequisite	Remark	PIC
1	IV	MMM-2311	Operation Research	3 (1)	MMM-2312*,	with laboratory work	Lab. of Applied Mathematics and Lab of Mathematical Computation
2	VI	MMM-3309	Introduction to Theory of Optimization♥	3 (1)	MMM-2312*	with laboratory work	Lab. of Applied Mathematics and Lab of Mathematical Computation

Elective Courses "Statistics"							

No	Sem	Code	Course	Credits	Prerequisite	Remark	PIC
1	II	MMS-1410	Explorative data analysis	3 (1)	MMS-1404*	with laboratory work	UP-Stat
2	II	MMS-1409	Statistical Method II	3(1)	MMS-1404*	with laboratory work	UP-Stat
3	III	MMS-2481	Survey sample method	2	MMS-1404*		UP-Stat
4	III	MMS-2418	Introduction to financial mathematics I♦	3	MMM-1102*		UP-Stat
5	III	MMS-2492	Introduction to Actuarial Accounting I♦	3		PAI	UP-Stat
6	III	MMS-2421	Applied Regression analysis♦	3 (1)	MMS-1409*	PAI with laboratory work	UP-Stat
7	III	MMS-2420	Introduction to Statistical Mathematics I♦	3	MMM-1102*	PAI	UP-Stat
8	III	MMS-2493	Introduction to Micro Economy♦	3		PAI	UP-Stat
9	IV	MMS-2419	Introduction to financial mathematics II♦	3	MMS-2418*	PAI	UP-Stat
10	IV	MMS-2497	Introduction to Macro Economy♦	3	MMS-2493*	PAI	UP-Stat
11	IV	MMS-2483	Introduction to Statistical Mathematics II♦	3	MMS-2420*	PAI	UP-Stat
12	IV	MMS-2425	Statistical Quality Control	3 (1)	MMS-1404*	with laboratory work	UP-Stat
13	IV	MMS-2496	Introduction to Actuarial Accounting II♦	3	MMS-2492*	PAI	UP-Stat
14	V	MMS-3429	Introduction to time series♦	3 (1)	MMS-2420*	PAI with laboratory work	UP-Stat
15	V	MMS-3438	Introduction to Actuarial Mathematics I♦	3 (1)	MMS-2418*	PAI with laboratory work	UP-Stat
16	V	MMS-3432	Introduction to Theory of Actuarial Risk I♦	3		PAI	UP-Stat
17	VI	MMS-3434	Introduction to Theory of Actuarial Risk II♦	3	MMS-3432*	PAI	UP-Stat
18	VI	MMS-3443	Survival Data Analysis ♦	3 (1)	MMS-1409*	PAI with laboratory work	UP-Stat
19	VI	MMS-3477	Introduction to Actuarial Mathematics II♦	3	MMS-3438*	PAI	UP-Stat
20	VI	MMS-3488	Official Statistics	2			UP-Stat

Elective Courses "Computer science"							
No	Sem	Code	Course	Credits	Prerequisite	Remark	PIC
1	II	MII-1211	Programming II	3	MII-1201*		UP-CS
2	II	MII-1212	Programming II Laboratory	1	MII-1202* MII-1211**		UP-CS

3.8.13 General Regulations and Transitional Rules

1. **General Regulations**
   a. Compulsory courses in Semester I and Semester II are the packages that must be taken by all first year students
   b. Students who have GPA on Semester I more than 3.00 are allowed to take additional elective courses until the total maximum Credits in Semester II is 23 Credits.
   c. The elective courses outside the list of courses in the Curriculum 2016 UP-Math can be taken by the students with maximum total of 9 Credits. Nevertheless, out of those 9 Credits, it is not allowed for the students to take the courses with equivalent contents, such as Entrepreneurship in UP-Math and Entrepreneurship in other study programmes, etc.
   d. Students who are going to take or taking Undergraduate Thesis with topic in Applied Mathematics are required to take at least one directed elective course of Applied Mathematics (marked by ♥) that fits to the topic of the Undergraduate Thesis : Dynamical System, Introduction to Optimization Theory, and Introduction to System Theory. The minimum grades of those courses are C.
   e. The location of internship is determined and found by students with the direction from the study programme management. Internship will be supervised by the advisory team. Credits of internship must be registered to the KRS Semester VI or VII or VIII. Guidance of taking internship is provided in a separate document.

2. **Graduation Requirements (Study Burden)**
   To complete undergraduate education in UP-Math, students are required to complete at least 144 Credits of courses containing (96 to 106 Credits, including the Undergraduate Thesis and Community Development Participation) and elective courses. Requirements of graduation follow the rules of the FMNS UGM.

3. **Rules and Grades of Retaking Courses**
   Students have a right to improve their CGPA by retaking the courses to meet the minimum graduation requirements or to achieve a certain CGPA.

   a. Students who enroll the Undergraduate Thesis : Literature Study of the academic year 2018/2019 and thereafter, the Undergraduate Thesis is the last course. The exam of the Undergraduate Thesis is the last semester for them.
   b. Students who enroll the Undergraduate Thesis : Literature Study of the academic year 2017/2018, retaking of courses may be done at most one semester after the exam of the Undergraduate Thesis .
   c. Students who enroll the Undergraduate Thesis : Literature Study of the academic year 2016/2017 and earlier, retaking of courses may be done at most one year after the exam of the Undergraduate Thesis .
   d. Grade of a retaking course is the best one among all grades of that course.
   e. At the time of the judicium, the status of the courses Set Theory, Introduction to Mathematical Statistics I, and Stochastic Process follow the semester of the courses taken with the best grade proposed.

4. **Compulsory Courses**
   Compulsory courses must be taken by every student. In addition, to take a course, it is required certain requirements (prerequesite, corequesite or other requirements). Therefore, students are expected to pay attention to this matter.

5. **Elective Courses**
    a. Elective courses consist of directed elective courses and free elective courses.
    b. By default, students are free to choose the available elective courses each semester. However, in order to have an adequate ability, the students have to consider amd fulfill the required requirements (prerequesite, corequesite or other requirements) as well as consult and consider the advice from their Academic Advisors when choosing elective courses.
    c. For some reason, the elective courses may change its position from Semester II to Semester II and vice versa. Free elective courses may be inactive/not available for a while.
    d. Beside the available elective courses, students can take the other available courses at the Study Programme at the FMNS by considering the prerequisites of the courses.

If a credit transfer system between faculties or universities is available, students may take elective courses from other Faculties/Universities, by consulting with their Academic Advisors.

The number of maximum Credits of elective courses that are allowed from outside UP-Math that are not listed in the Curriculum 2016 UP-Math FMNS UGM is 9 Credits. It has to follow the related study programme rules of the courses taken, has to be approved by the Academic Advisors, and gets permit from the study programme that organizes the taken course. For courses from outside the FMNS, permission is made between faculties.

6. **Undergraduate Thesis**
  a. Undergraduate Thesis Format
     The Undergraduate Thesis of students in the form of undergraduate Thesis has a weight of 6 Credits and must be taken by every student of UP-Math. Undergraduate Thesis aims to:
       i.   sharpen the ability of thinking critically, logically and analytically.
       ii. practice the ability to write scientific papers comprehensively
       iii. practice independence in developing a scientific career.
       iv. prepare to continue studying, going to the community, or the employment.
       v.   practice the ability to argue scientifically.
       vi. practice communication skills and interpersonal relationship.
  b. Supervisor of Undergraduate Thesis : The number of supervisor of final project is maximum 2 people.
  c. Requirements of taking Undergraduate Thesis
  d. Students who will take the Undergraduate Thesis have to fulfill the following requirements:
       i.   The CGPA of all courses taken has been greater than or equal to 2.00.
       ii. Have taken at least 120 Credits (without grade E and percentage of credits with grade D is at most 25%).
       iii. Have taken/are taking courses supporting the topic of the Undergraduate Thesis .
       iv. Include Undergraduate Thesis in KRS and register it to the Secretariat of UP-Math no later than one week after the KRS submission.
  e. Undergraduate Thesis Implementation

In practice, the Undergraduate Thesis is supervised by one or two lecturers. Undergraduate Thesis consists of Literature Study and Skripsi under the following conditions.

i. Undergraduate Thesis : Literature Study can be done by students independently or in a group.
ii. At the end of the Undergraduate Thesis : Literature Study, students are required to attend additional lecture (no weight of Credits) about the method of writing Final Taks from UP-Math.
iii. Undergraduate Thesis : Skripsi is done by students independently.
iv. Topic of the Undergraduate Thesis : Literature Study and Skripsi must be the same. If the topic of Undergraduate Thesis changes, the students must repeat the Undergraduate Thesis : Literature Study even though they have passed the Undergraduate Thesis : Literature Study with the previous topic.
v. The supervisor of Undergraduate Thesis : Literature Study is also for Undergraduate Thesis : Skripsi. If required, students/supervisors may propose an additional supervisor for Undergraduate Thesis : Skripsi.
vi. Undergraduate Thesis : Literature Study and Undergraduate Thesis : Skripsi can be in one semester. If they are taken at different semesters, it must be taken in 2 (two) consecutive semesters. If within 2 (two) semesters the results obtained are not significant, the supervisor may propose to discontinue the supervision andvice versa the students may also apply for a replacement supervisor. In the event of a supervisor's replacement, the topic of the Undergraduate Thesis is from the new supervisor, not the topic from the former supervisor. Replacement of supervisor can only be done a maximum of 1 time.
vii. Students have to meet their supervisors at most a week after announcement of their supervisors. If the students do not meet their supervisors more that one week, the supervisors may refuse to them.
viii. If the students are not active in supervision when taking the Undergraduate Thesis Literature Study, the supervisors may propose to discontinue supervision at the final evaluation of the semester at the time of completing the assessment form.

f. Undergraduate Thesis Assessment
    i. Undergraduate Thesis : Literature Study is assessed by supervisor.
    ii. Undergraduate Thesis : Skripsi is assessed by a team of examiners consisting of four to five lecturers: supervisor(s), two lecturers from the same field and one lecturer from outside the field.

7. Community Development Participation (KKN: Kuliah Kerja Nyata)

KKN may only be taken by students who have completed 100 Credits of courses with CGPA of ≥ 2.00. In addition, when taking KKN in a regular semester, students are only allowed to take one of the following:
a. Finishing of the Undergraduate Thesis .
b. Taking one course.

8. Internship (KP: Kerja Praktek)

Terms and conditions of KP:
    a. Already taken at least 100 Credits (all grades have been announced, without grade E, percentage total credits with grade D is at most 25%).
    b. CGPA at submission is at least 3.00.
    c. Time: every semester VI / VII / VIII

d. Location of KP: Students determine and find for themselves.

e. KP must be registered to the KRS Semester VII or VIII.

Standard Operational Procedures (SOP) and Completeness KP:

After the students get the location for KP,

a. Students take and fill out the forms in the Secretariat of UP-Math.

b. Students ask signature to the management of the study pogram and the department through the Secretariat of UP-Math.

c. Students submit the form to the Faculty (Second Floor Faculty Building).

d. Students wait for the permit (several days).

e. Students carry the permit to the location of KP.

f. Students execute the KP and make a report under the guidance of supervisors.

g. Students request assessment from supervisor and institution where the KP is done.

h. Students submit the KP report to Secretariat of UP-Math (CD and photocopy of Approval Page) and to Faculty Library (Hardcopy and CD), and to institution where KP was done.

3.8.14 Implementation and Transitional Rules For Students Batch 2015 or Before

The Curriculum 2016 of UP-Math FMNS UGM is enacted from the first semester of academic year 2016/2017.

Particularly, in the academic year 2016/2017, the courses of Introduction to Partial Differential Equations is specifically held in each semester.

Specially, in Semester I of the academic year 2016/2017, the course of Introductory to Partial Differential Equations and Computational Mathematics c can be taken simultaneously.

Students of batch 2015 and earlier follow the transitional rules as follows.

1. Students of batch 2015 and earlier are not required to take Basic Chemistry I and Set Theory.

2. Students of batch 2015 and earlier are not required to take courses in the Curriculum 2016 that are equivalent to the compulsory courses in the Curriculum 2011 that they have taken. See Equivalence Section.

3. Students of batch 2014 and earlier who have not passed the course of Introduction to Philosophy of Science, History, and Mathematical Ethics must take courses Introduction to Philosophy of Science.

4. In the absence of the common faculty courses 2011: Contextual Mathematics, Physical Concept, Contextual Chemistry, and Contemporary Information Technology, students of batch 2015 and earlier whose obtained a maximum of grade B may remove those courses. Specifically, this removal is not taken into account in the removal of the maximum 10% courses in the FMNS rules.

5. Students of batch 2015 or earlier may be graduated if they have completed at least 144 Credits, consisting of 96 to 106 Credits of compulsory courses and 38 to 46 Credits of elective courses.

6. In the following table, there are several possibilities that can be selected by the students who have passed the courses listed on the table. If the course marked W is chosen as a compulsory course, then the course marked P may be chosen as an elective course.

Description of Symbols

L : have passed

TL   : have not passed
WA   : must be taken
TWA   : may not be taken

No.	Curriculum 2011			Curriculum 2016	
1	**Discrete Mathematics (3 Credits)**		=	**Discrete Mathematics I (2 Credits)**	**Discrete Mathematics II (2 Credits)**
	TL			WA	WA
	Specially, in Semester I of the academic year 2016/2017: for students who have taken Discrete Mathematics in semester II of the academic year 2015/2016 or earlier and have not passed, Discrete Mathematics becomes to be the prerequisite of taking Discrete Mathematics II.				
2	**Algorithm and Data Structure I (3 Credits)**	**Laboratory Work of Algorithm and Data Structure I (1 Credits)**	=	**Programming I (3 Credits)**	**Laboratory Work of Programming I (1 Credits)**
	L	TL		TWA	WA
	TL	L		WA	TWA
	TL	TL		WA	WA
3	**Mechanics A (2 Credits)**			**Basic Physics I (3 Credits)**	
	TL			WA	

3.8.15 Equivalent Courses in the 2011 and 2016 Curriculums

Compulsory and Elective Courses in "Analysis and Geometry" Track

No.	Curriculum 2011				Curriculum 2016		
	Code	Course	Credits		Code	Course	Credits
1	MMM-1103	Geometry Analytic A	3	=	MMM-1106	Geometry Analytic	3
2	MMM-3104	Topology	3	=	MMM-3108	Introduction to Topology	3
3					MMM-3107	Introduction to Differential Geometry	3

No.	Curriculum 2006				Curriculum 2016		
	Code	Course	Credits		Code	Course	Credits
1	MMS-3105	Geometry in n-dimensional Space	3	=	MMM-2115	Geometry in n-dimensional Euclidean Space in *n*-dimensional Space	3

Compulsory and Elective Courses in "Algebra and Discrete Mathematics" Track

No.	Curriculum 2011				Curriculum 2016		
	Code	Course	Credits		Code	Course	Credits

	Code	Course			Code	Course	
1	MMM-1201	Introduction to Mathematical Logic and Set	3	=	MMM-1208	Introduction to Mathematical Logic	3
2	MMM-1205	Discrete Mathematics	3	=	MMM-1206	Discrete Mathematics I	2
					MMM-2207	Discrete Mathematics II	2
3	MMM-2204	Applied Linear Algebra	2	=	MMM-2210	Applied Linear Algebra I	2
4	MMM-3205	Teori Semigrup	3	=	MMM-3210	Introduction to Semigroup	3
5	MMM-3203	Teori Grup Hingga	2	=	MMM-2208	Teori Grup Hingga	2
6	MMM-3204	Numerical Linear Algebra	2	=	MMM-3208	Numerical Linear Algebra	3
7	MMM-3254	Laboratory Work of Numerical Linear Algebra	1				
8				=	MMM-3209	Applied Linear Algebra II	3
9	MMM-3207	Module Theory	3	=	MMM-4207	Introduction to Module Theory	3
10				=	MMM-4206	Introduction to Cryptographhy	3
11	MMM-4204	Introduction to Combinatorics	3	=	MMM-2209	Introduction to Combinatorics	3

Compulsory and Elective Courses in "Applied Mathematics" and "Computational Mathematics" Tracks

No.	Curriculum 2011				Curriculum 2016		
	Code	Course	Credits		Code	Course	Credits
1	MMM-2302	Linear Programming	2	=	MMM-2312	Linear Programming	3
2	MMM-2352	Laboratory Work of Linear Programming	1				
3	MMM-2306	Introduction to Numerical Analysis	2	=	MMM-2401	Introduction to Numerical Analysis	3
4	MMM-2356	Laboratory Work of Introduction to Numerical Analysis	1				
5	MMM-3302	Introduction to Partial Differential Equations	3	=	MMM-2310	Introduction to Partial Differential Equations	3
6	MMM-2307	Operation Research	2	=	MMM-2311	Operation Research	3
7	MMM-2357	Laboratory Work of Operation Research	1				
8	MMM-3304	Optimization Theory	2	=	MMM-3309	Introduction to Optimization Theory	3
9	MMM-3354	Laboratory Work of Optimization Theory	1				
10	MMM-3301	System Theory	3	=	MMM-3310	Introduction to System Theory	3
11	MMM-4304	Discrete Dynamical System	3	=	MMM-4303	Introduction to Ergodic Theory	3
12	MMM-3307	Boundary Value Problem	3	=	MMM-3311	Introduction to Boundary Value Problem	3

13	MMM-3308	Control Theory	3	=	MMM-3312	Introduction to Control Theory	3
14	MMM-2306	Introduction to Numerical Analysis	2		MMM-2401	Introduction to Numerical Analysis	3
15	MMM-2356	Laboratory Work of Introduction to Numerical Analysis	1	=			
16					MMM-3002	Introduction to Stochastic Process	3
17					MMM-4401	Introduction to Fractal Geometry	3
18					MMM-4449	Capita Selecta in Computational Mathematics	3

Compulsory and Elective Courses in "Statistics" Track

No.	Curriculum 2011				Curriculum 2016		
	Code	Course	Credits		Code	Course	Credits
1	MMS-1423	Statistical Method I	2	=	MMS-1404	Statistical Method I	3
2	MMS-1453	Laboratory Work of Statistical Method I	1				
3	MMS-1425	Statistical Method II	2	=	MMS-1409	Statistical Method II	3(1)
4	MMS-1455	Laboratory Work of Statistical Method II	1				
5	**MMS-2411**	Introduction to Mathematical Statistics I	3	=	MMS-2420	Introduction to Mathematical Statistics I	3
6	**MMS-3469**	Introduction to Mathematical Statistics II	3	=	MMS-2483	Introduction to Mathematical Statistics II	3
7	**MMS-1406**	Explorative Data Analysis	2	=	MMS-1410	Explorative Data Analysis	3 (1)
8	**MMS-1456**	Laboratory Work of Explorative Data Analysis	1				
9	MMS-2403	Sample Survey Method	3	=	MMS-2481	Sample Survey Method	2
10	MMS-3427	Research Metodology	3	=	MMS-3488	Official Statistics	2
11					MMS-2418	Introduction to Financial Mathematics I♦	3
12					MMS-2419	Introduction to Financial Mathematics II♦	3
13					MMS-2492	Introduction to Actuarial Accountancy I♦	3
14					MMS-2496	Introduction to Actuarial Accountancy II♦	3
15	MMS-2423	Statistical Quality Controlling	2	=	MMS-2425	Statistical Quality Controlling	3 (1)
16	MMS-2453	Laboratory Work of Statistical Quality Controlling	1				
17	MMS-3402	Applied Regression Analysis	2	=	MMS-2421		3 (1)

		Curriculum 2011					Curriculum 2016		
18	MMS-3452	Laboratory Work of Applied Regression Analysis	1				Applied Regression Analysis ♦	
19	MMS-3472	Introduction to Actuarial Mathematics I	2			MMS-3438	Introduction to Actuarial Mathematics I ♦	3 (1)
20	MMS-3492	Laboratory Work of Introduction to Actuarial Mathematics I	1	=				
21	MMS-3473	Analysis Data Survival	2			MMS-3443	Analysis Data Survival ♦ di A 50 Analysis Data	3 (1)
22	MMS-3493	Laboratory Work of Analysis Data Survival	1	=				
23	MMS-3402	Applied Regression Analysis	2			MMS-2421	Applied Regression Analysis ♦	3(1)
24	MMS-3452	Applied Regression Analysis	1	=				
25	MMS-3471	Introduction to Time Series	2			MMS-3429	Introduction to Time Series ♦	3 (1)
26	MMS-3451	Laboratory Work of Introduction to Time Series	1	=				
27	MMS-3417	Applied Analysis of Variance	2			MMS-2424	Applied Analysis of Variance	3 (1)
28	MMS 3457	Laboratory Work of Applied Analysis of Variance	1	=				
29						MMS-3432	Introduction to Theory of Actuarial Risk I	3
30						MMS-3434	Introduction to Theory of Actuarial Risk II	3
31						MMS-2493	Introduction to Micro Economy ♦	3
32						MMS-2497	Introduction to Macro Economy ♦	3

The equivalence of the Statistics courses which are not provided in the table, can be referred in the curriculum of the undergraduate programme of statistics of Depertment of Mathematics FMNS UGM (UP-Stat).

Compulsory and Elective Courses in "Computer Science" Track

No.	Curriculum 2011					Curriculum 2016		
	Code	**Course**	**Credits**			**Code**	**Course**	**Credits**
1						MII-1211	Programming II	3
2						MII-1212	Laboratory Work of Programming II	1

Course Wajib Yang Lain

No.	Curriculum 2011					Curriculum 2016		
	Code	**Course**	**Credits**			**Code**	**Course**	**Credits**
1	UMM-1001	English	2	=		MMM-1001	English	2
2	UNU-2010	Pancasila	2	=		UNU-1010	Pancasila	2

3	UNU-1000	Religion	2	=	UNU-100x	Religion	2
4	UMM-3001	Introduction to Philosophy of Sciences, History, and Mathematical Ethics	3	=	MMM-3001	Introduction to Philosophy of Sciences	2
5	MIB-1000	Contemporary Information Technology	2				
6	MIK-1251	Algorithm and Data Structure I	3	=	MII-1201	Programming I	3
7	MIK-1252	Laboratory Work of Algorithm and Data Structure I	1	=	MII-1202	Laboratory Work of Programming I	1
8	MFB-1000	Physical Concept	2				
9	MKB-1000	Contextual Chemistry	2				
10					MKK-1101	Basic Chemistry 1	3
11	MMM-1118	Mechanics A	2	=	MFF-1011	Basic Physics I	3
12	MMB-1000	Contextual Mathematics	2				

Equivalence of Courses outside the list of the Curriculum 2016 of UP-Math that are not regulated here follows equivalence rules at sudy programme where the courses are held.

Cooperation UGM with PAI (Persatuan Aktuaris Indonesia)
Some courses that held by UP-Stat can be used to obtain sertification of PAI exam subjects up to ASAI level (Associate of Society of Actuaries of Indonesia). Equivalence of PAI exam subjects held by UP-Stat is provided in the following table.

PAI exam subject	Matakuliah PS Statistika UGM
A.10. Financial Mathematics	Introduction to Financial Mathematics I
	Introduction to Financial Mathematics II
A.20. Probability and Mathematical Statistics	Introduction to Mathematical Statistics I
	Introduction to Mathematical Statistics II
A.30. Accountancy	Introduction to Actuarial Accountancy I
	Introduction to Actuarial Accountancy II
A.40. Economics	Introduction to Micro Economics
	Introduction to Macro Economics
A.50. Statistical Methods	Applied Regression Analysis
	Survival Data Analysis
	Introduction to Time Series
A.60. Actuarial Mathematics	Introduction to Actuarial Mathematics I
	Introduction to Actuarial Mathematics II
A.70. Modelling and Risk Theory	Introduction to Theory of Actuarial Risk I
	Introduction to Theory of Actuarial Risk II

The process for submitting PAI certification is done collectively through the Administration of the Department of Mathematics FMNS UGM. Further information on this cooperation can be obtained at the Department of Mathematics FMNS UGM. Requirements of grade equivalence are:

For one PAI exam subject which is equivalent to two UGM courses, grades must be A and A/B or both A.

For one PAI exam subject which is equivalent to three UGM courses, grades must be two A\Bs and A or A\B and two As, or three As.

3.8.16 Learning and Assesment Methods

In the learning process, the lecturers at UP-Math are expected to apply the Student Centered Learning (SCL) method. The most appropriate SCL method to be appled to several courses in UP-Math is Collaborative Learning (CbL), Problem-Based Learning (PBL) or combination of both. However, if the SCL method is supposed to be unsuitable, UP-Math does not force to use it in the learning process.

Teaching Methods: Lectures, Discussions, Programmed Instruction, Study Assignment, Tutorials, Seminars, Demonstrations, Buzz Group, Brainstorming, Role Play.

No.	*Programme Learning Outcome* (*PLO)*	Courses and Teaching Methods	*Assessment Methods*
1	devote to God Almighty, Pancasila minded, and aware of the interest of the nation.	Religion (S): Lectures; Discussions, presentation	*Locally developed exam*; Direct Observation
		Pancasila (M): Lectures; Discussions, presentation	*Locally developed exam*; Direct Observation
		Civic (L): Lectures; Discussions	Direct Observation, *Locally developed exam;*
		Introduction to Filsafat Ilmu: Lectures; Discussions	Direct Observation, *Locally developed exam;*
2	are able to recognize mathematics-related problems, assess their solvability and solve them within a specified time frame	All courses and the courses mentioned at Point 1.: Lectures, Discussions, *Study Assignment*	Class Activity (Homeworks, reports), Presentation, *Capstone Project*, Tasks, Performance, Direct Observation, *Locally developed exam*.
3	are able to develop their logic and mathematical thinking. They are in particular able to formulate mathematical hypotheses and have an understanding of how such hypotheses can be verified or falsified using mathematical methods	Calculus I: Lectures, Discussions, *Study Assignment*	Class Activity (Homeworks, reports), Presentation, *Capstone Project*, Tasks, Performance, Direct Observation, *Locally developed exam*.
		Introduction to Mathematical Logic: Lectures, Discussions, *Study Assignment*	Class Activity (Homeworks, reports), Presentation, *Capstone Project*, Tasks, Performance, Direct Observation, *Locally developed exam*.

No.	Programme Learning Outcome (PLO)	Courses and Teaching Methods	Assessment Methods
		Elementary Linear Algebra: Lectures, Discussions, *Study Assignment*	Class Activity (Homeworks, reports), Presentation, *Capstone Project*, Tasks, Performance, Direct Observation, *Locally developed exam*.
		Statistical Method I: Lectures, Discussions, *Study Assignment*	
		Calculus II: Lectures, Discussions, *Study Assignment*	
		Discrete Mathematics I: Lectures, Discussions, *Study Assignment*	
		Introduction to Abstract Algebra I: Lectures, Discussions, *Study Assignment*	
		Linear Programming: Lectures, Discussions, Study Assignment	
		Multivariable Calculus I: Lectures, Discussions, *Study Assignment*	
		Introduction to Abstract Algebra II: Lectures, Discussions, *Study Assignment*	
		Discrete Mathematics II: Lectures, Discussions, *Study Assignment*	
		Geometry Transformation: Lectures, Discussions, *Study Assignment*	
		Multivariable Calculus II: Lectures, Discussions, *Study Assignment*	
		Advance Calculus : Lectures, Discussions, *Study Assignment*	
		Complex Variable Function I: Lectures, Discussions, *Study Assignment*	
		Linear Algebra: Lectures, Discussions, *Study Assignment*	
		Introduction to Numerical Analysis: Lectures, Discussions, *Study Assignment*	

No.	Programme Learning Outcome (PLO)	Courses and Teaching Methods	Assessment Methods
		Introduction to Analysis I: Lectures, Discussions, *Study Assignment*	
		Computational Mathematics: Lectures, Discussions, *Study Assignment*	
		Introduction to Stochastic Process: Lectures, Discussions, *Study Assignment*	
		Introduction to Mathematical Modelling **:** Lectures, Discussions, *Study Assignment*	
		Introduction to Analysis II: Lectures, Discussions, *Study Assignment*	
		Undergraduate Thesis : Literature Study	
		Undergraduate Thesis : Skripsi	
4	have sufficient knowledge in information technology and have ability it to support the teaching-learning and research process	Basic Physics I: Lectures, Discussions, *Study Assignment*	*Locally developed exam*
		Basic Chemistry I: Lectures, Discussions, *Study Assignment*	*Locally developed exam*; Class Activity (Homeworks, reports).
		Programming I: Lectures, Discussions, *Study Assignment*	*Locally developed exam*; Class Activity (Homeworks, reports).
		Statistical Method I: Lectures, Discussions, *Study Assignment*	Simulation; *Focus group*; *Class assignment*; Tasks, Performance;
		Linear Programming: Lectures, Discussions, *Study Assignment*	*Locally developed exam*; Class Activity (Homeworks, reports).
		Introduction to Numerical Analysis: Lectures, Discussions, *Study Assignment*	Tasks, Performance; Ujian Standard *Locally developed exam*; Interview
		Computational Mathematics: Lectures, Discussions*, Study Assignment*	
5	have comprehensive knowledge in mathematical modelling and able to create	Introduction to Stochastic Process: (M) Lectures, Discussions, *Study Assignment, Buzz Group*.	*Locally developed exam*; Class Activity, Presentation

No.	Programme Learning Outcome (PLO)	Courses and Teaching Methods	Assessment Methods
	mathematical models, both in mathematics, in other fields, and in real problems. They are in particular able to solve and determine the strategy how to solve the problems	Undergraduate Thesis : Literature Study: (S) Discussions, *Study Assignment, Brainstorming*.	Direct Observation, Presentation, Tasks, Performance
		Undergraduate Thesis : Skripsi (S): Discussions, *Study Assignment, Brainstorming*.	Theses papers.
		KKN: (M): Discussions, Study Assignment, Brainstorming. Demonstration	Tasks, Performance; Direct Observation *Locally developed exam*; Interview
6	have generalization and abstraction abilities and are able to recognize analogies and basic patterns	Programming I: Lectures, Discussions, *Study Assignment*	*Locally developed exam*; Class Activity (Homeworks, reports).
		Laboratory Work of Programming I: Lectures, Discussions*, Study Assignment*	*Locally developed exam*; Class Activity (Homeworks, reports).
		Basic Physics I: Lectures, Discussions, *Study Assignment*	*Locally developed exam*; Class Activity (Homeworks, reports).
		English: Lectures, Discussions, *Study Assignment*	
		Multivariable Calculus I: Lectures, Discussions, *Study Assignment*	
		Ordinary Differential Equations: Lectures, Discussions, *Study Assignment*	
		Multivariable Calculus II; Lectures, Discussions, *Study Assignment*	
		Advance Calculus : Lectures, Discussions, *Study Assignment*	
		Complex Variable Function I: Lectures, Discussions, *Study Assignment*	
		Introduction to Numerical Analysis: Lectures, Discussions, *Study Assignment*	
		Computational Mathematics: Lectures, Discussions, *Study Assignment*	

No.	Programme Learning Outcome (PLO)	Courses and Teaching Methods	Assessment Methods
7	are able to communicate in mathematical language, oral and writing, concisely, clearly, and well-organized	English: Lectures, Discussions, *Study Assignment*	
		Undergraduate Thesis : Literature Study	Theses papers. exam; Class Activity, Presentation
		Undergraduate Thesis : Skripsi	Theses papers.
8	have responsibility, confidence, emotional mature, ethics, and lifelong learner principle	All courses, in particular Pancasila, Civic, Introduction to Philosophy of Sciences, Undergraduate Thesis : Lectures, Discussions, *Study Assignment*, *Buzz Group*.	Class Activity (Homeworks, reports), Presentation, *Capstone Project*, Tasks, Performance, Direct Observation, Ujian Standard, *Locally developed exam*, Simulation,
9	have ability to apply their mathematics ability in their carrier related to mathematics and to continue their programme in master and doctoral programme	Basic Physics I: Lectures, Discussions, *Study Assignment*	*Locally developed exam*; Class Activity (Homeworks, reports).
		Basic Chemistry I: Lectures, Discussions, *Study Assignment*	*Locally developed exam*; Class Activity (Homeworks, reports).
		Programming I: Lectures, Discussions, *Study Assignment*	*Locally developed exam*; Class Activity (Homeworks, reports).
		Statistical Method I: Lectures, Discussions, *Study Assignment*	Class Activity (Homeworks, reports); Studi Kasus; *Focus group* Presentation, *Capstone Project*, Tasks, Performance, Direct Observation, *Locally developed exam*, Simulation)
		Calculus II: Lectures, Discussions, *Study Assignment*	
		Geometriy Analytic : Lectures, Discussions, *Study Assignment*	
		English: Lectures, Discussions, *Study Assignment*	
		Ordinary Differential Equations: Lectures, Discussions, *Study Assignment*	
		Introduction to Numerical Analysis: Lectures, Discussions, *Study Assignment*	
		Introduction to Pers. Diferensial Parsial: Lectures, Discussions, *Study Assignment*	

No.	Programme Learning Outcome (PLO)	Courses and Teaching Methods	Assessment Methods
		Introduction to Analysis I: Lectures, Discussions, *Study Assignment*	
		Computational Mathematics: Lectures, Discussions, *Study Assignment*	
		Complex Variable Function II: Lectures, Discussions, *Study Assignment*	
		Introduction to Mathematical Modelling **:** Lectures, Discussions*, Study Assignment*	
		Introduction to Stochastic Process: Lectures, Discussions, *Study Assignment*	
		Introduction to Analysis II: Lectures, Discussions, *Study Assignment*	
		Civic: Lectures, Discussions, *Study Assignment*	
		Undergraduate Thesis : Literature Study: Discussions, *Study Assignment*	
		Undergraduate Thesis : Skripsi : Discussions, *Study Assignment*	

In the evaluation of the PLO for the courses in UP-Math the following conditions are applied.

    a. The assessment components include Tasks (independent or group, Homeworks), Quiz, Mid Exam (UTS: Ujian Tengah Semester) and Final Exam (UAS: Ujian Akhir Semester). At the first meeting, the lectures announce the assessment components and their percentages.

    b. If the student does not take the final exam of a course, the grade must be given (can not be empty). The grade is not automatically E, depending on the percentage of the assessment components given at the beginning of the lecture.

    c. In principle, UTS can be held more than once. If the UTS of a course is conducted more than once, then its schedule beyond the faculty schedule is determined by the lecturer of the course.

    d. For courses with parallel classes, questions in the UTS and UAS should be the same for all classes.

Assessment Methods: Class Activity (paper, presentation, report), Capstone Project, Tasks, Performance, Direct Observation, Portfolio, External Examiner, Standard Exam, Locally developed exam, Certification and licensure exams, Simulations, Theses/Senior

papers, Surveys: Student surveys, alumni surveys, user surveys, national surveys, interviews, Focus groups, case studies.

Students who have TOEFL grade not less than 450 are not required to follow the English course. However, students must include English course in KRS and to obtain English grade, students are required to submit photocopy of TOEFL certificates Lecturer who is appointed to teach English. The certificate must be submitted at least one day before mid exam. Conversion of TOEFL grade to Mathematical English grade is:

TOEFL grade	Mathematical English grade
450 – 499	B
500 atau lebih	A

The recognized Language Institute are UGM Language Institute or minimum is equivalent, i.e., ELTI, EF, and LIA.

Specifically, for Undergraduate Thesis**, the assessment is regulated as follows.**
1. Undergraduate Thesis : Literature Study
   a. Assessment is done by supervisors at the end of the semester.
   b. Assessment is based on mastery of the material and the supervision process (activeness, enthusiasm, seriousness, and fighting spirit).
2. Undergraduate Thesis : Skripsi
   a. Undergraduate Thesis : Skripsi exam is done after the Undergraduate Thesis : Literature Study has been anncounced.
   b. Undergraduate Thesis : Skripsi examiner is the supervisor(s) and three lecturers (2 lecturers from the laboratory which is suitable with the topic of the Undergraduate Thesis and 1 lecturer from another field/laboratory).
   c. Assessment is based on manuscript (material, methodology, scientific writing, and language) and presentation (mastery of material and performance).
   d. The Undergraduate Thesis : Skripsi exam is regulated in the Manual Procedure of Undergraduate Thesis exam of UP-Math.
   e. **Time limit of revision is 2 months** after Undergraduate Thesis exam. If until the deadline, the revision has not been completed, then the student must repeat the Undergraduate Thesis exam.
   f. Minimal grade to pass the Undergraduate Thesis : Literature Study and Skripsi is C.

3.9 STATISTICS STUDY PROGRAM

3.9.1 Introduction

Curriculum revision is a routine activity that must be undertaken by a Study Programme in order to develop quality, competitive excellence and conformity with market needs. This curriculum is a standard reference for the organization of Statistics Study Programme (UP-Stat) Universitas Gadjah Mada (UGM). In accordance with Presidential Regulation of Republic of Indonesia (RI) No. 8 year 2012 about Indonesian Qualifications Framework (IQF), UP-Stat curriculum has been formulated based on the graduate learning achievements which refer to IQF. Those learning achievements include 4 elements: Work Ability, Mastery of Knowledge, Managerial Capabilities, as well as Attitudes and Values Vision

In 2025, the UP-Math becomes an outstanding Study Programme of Mathematics, recognized and leading nationally and internationally in theory and its applications.

3.9.2 Vision

To be an outstanding programme that is well recognised internationally and leading nationally in statistics education, produce competent graduates with high capability in their field, information technology literacy, entrepreneurial spirit and competitiveness both in national and international level around the year of 2025.

3.9.3 Mission

1. Develop the up-to-date learning process in order to increase its quality of the learning process.
2. Develop the quality and quantity of research and publication.
3. Increase the learning process and research cooperation between UP-Stat and its colleagues national as well as international.
4. Increase the education, research, training, and consultation services in statistics and its application.

3.9.4 Programme Education Objectives (PEO)

After finish the study, students are:
1. able to master the theoretical concepts and methods of statistics and formulating them for problem solving;
2. able to develop statistics for the utilization and development of science and technology;
3. able to apply statistics on education, research and community services that benefit for the institution, community, nation and state;
4. able to make the right decisions based on analysis of statistics;
5. able to communicate scientific, cooperation as well as the responsibility of individuals and organizations.

Generic Description of Human Resource Qualification Level 6 of IQF for D-IV or undergraduate programme's graduates are those who are:

1. Capable to apply science, technology and art within her/his expertise and adaptable to various situations faced during solving a problem.
2. Mastering in-depth general and specific theoretical concepts of a certain knowledge and capable to formulate related problem solving procedure.
3. Capable to take strategic decision based on information and data analysis and provides direction in choosing several alternative solutions.

4. Responsible for her/his own job and can be assigned to take responsibility of the attainment of organization's performances.

Table 1. Relationship between PEO - IQF Level 6

IQF Level 6 / PEO	IQF 1	IQF 2	IQF 3	IQF 4
PEO 1	M	H		
PEO 2	H	H		
PEO 3	H	H		M
PEO 4			H	
PEO 5				H

H = High, M = Medium, L = Light

3.9.5 Curriculum Goals

1. Improve the appropriate learning process and evaluation system through Quality Assurance Cluster.
2. Increase utilization of Information Technology by students in order to improve the quality of graduates.
3. Provide an up-to-date and varied curriculum of UP-Stat to produce graduates who are able to work in various areas of statistical interest.
4. Increase popularity of UP-Stat in the community in order to get high quality student candidates.
5. Increase capacity of human resources and facilities in UP-Stat periodically.
6. Increase utilization of Information Technology for research and management of UP-Stat.

3.9.6 Basis of Curriculum Changes

In formulating curriculum, UP-Stat refers to
1. Ministerial Decree of Ministry of Research, Technology and Higher Education No. 44, 2015 about the national standard for higher education.
2. Law of the Republic of Indonesia number 12 year 2012 on Higher Education, article 35 about curriculum.
3. Document of "The Recommendation for The Minimal Curriculum for Undergraduate Programme in Statistics" which is published in 2012, in Malang, and in 2013, in Pontianak, by The Indonesian Statistical Society (Forstat), in which UP-Stat plays an important role in the document formulation.
4. The recommendations given by alumni and some stakeholders (user of the alumni) in a form of "Policy Study Document" (a result of survey by KJM and UP-Stat in 2012, "Alumni Meeting" in 2014 and 2015).
5. Document of the benchmarking resulted from
   a. BAN PT (http://ban-pt.kemdiknas.go.id/)
      b. Undergraduate programme in Statistics outside the country such as:
         1. Department of Statistics and Actuarial Sciences university of Waterloo, Canada
         2. Department of Statistics, University of Wisconsin
   c. Curriculum Guidelines for Undergraduate Programs in Statistical Science from American Statistical Association (ASA).

3.9.7 Graduates Employment

UP-Stat graduates' employment are as follows:
- Data Analyst on various fields
- Research Consultant
- Actuaries
- Research Manager
- Data Management
- Investment Manager
- Quality Control Manager
- Capital Market Analyst
- and many others.

3.9.8 Graduates Profile

In general there are two major groups of graduates' profile in UP-Stat, namely:
1. Academician

An academician is a highly educated person and work as a teacher or researcher at a college, university, or an institution of higher degree education
2. Statistical Practitioner

A Statistical practitioner is an activist or person doing work using statistical methods.

3.9.9 Learning Outcomes/Graduates Qualification

By referring to the competence of IQF and Forstat, Vision, Missions and objectives, UP-Stat has formulated the Programme Learning Outcomes (PLO)

After the completion of the Bachelor's Degree Programme, students will:	
PLO-1	have strong basic statistics and mathematics in problem solving analysis
PLO-2	have statistical thinking and able to develop
PLO-3	have a good ability to utilize technology and statistical software in research
PLO-4	have experience in working on real cases in the field of statistics
PLO-5	have a good ability to communicate statistics in writing and oral
PLO-6	have ability to further studies, and or lifelong learning
PLO-7	have professional ethics, and soft skill

Based on the vision, mission, PEO, and the objectives described above, then the standard of graduates of UP-Stat have the following abilities:

A. Knowledge and understanding:
1. Have a strong basic statistical concept
2. Have knowledge to identify problems and determine the appropriate problem solving methods
3. Have knowledge of the development of Statistics in other related fields.

B. Intelectual (thinking) skills:
1. Able to think analytically, logically, in problem solving
2. Able to pursue a higher degree in related fields
3. Able to adapt to other science fields
4. Able to work independently, fully motivated and creative.

C. Practical skills:
1. Able to work in Statistical field
2. Proficient in various statistical techniques and numerical computations
3. Able to design and implement a statistical research.

D. Transferable skills:
1. Able to deliver ideas in statistical work
2. Able to deliver the results of statistical analysis by written or oral.

E. Attitude skills:
1. Devote to God Almighty and practicing Pancasila
2. Having an international perspective
3. Able to adapt to work environment
4. Have good professional ethics and soft skills.

3.9.10 Study Materials

To support the achievement of the objectives of the study programme, the curriculum 2016 includes subjects:

1.Basic Mathematics:
Calculus I, Calculus II, Linear Algebra for Statistics, Multivariable Calculus for Statistics, Elementary Differential Equations, Advanced Calculus.

2.Statistical Computation:
Programming I, Programming I Laboratory, Statistical Computation I.

3.Basic Statistics:
Statistical Methods I, Statistical Methods II, Exploratory Data Analysis, Survey SamplingMethods, Applied Regression Analysis, Introduction to Mathematical Statistics I, Introduction to Mathematical Statistics II, Introduction to Probability Models, Introduction to Sampling Theory, Introduction to Stochastic Processes, Introduction to Measurement and Probability Theory, Introduction to Time Series, Applied Multivariate Statistics, Introduction to Experimental Design, Introduction to Big Data, etc.

4.Application:
Introduction to Financial Mathemathics I, Introduction to Financial Mathemathics II, Introduction to Actuarial Mathematics I, Introduction to Actuarial Mathematics II, Survival Data Analysis, Introduction to Queueing and Simulation Theory, Quantitative Risk Management, Introduction to Investment Management, Biostatistics and Epidemiology, Introduction to Decision Theory, Statistical Quality Control, etc.

3.9.11 Matrix mapping between courses and learning outcome

Course	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
Statistical Methods I	S		L	S	S	M	S
Calculus I	S					S	
Basic Physics I	S						
Basic Chemistry I	S						
Programming I	S		S				
Religious study							S
Pancasila State's Ideology							S
English					S		
Statistical Methods II	S		S				
Calculus II	S					S	
Exploratory Data Analysis	S		S	S			
Discrete Mathematics and Combinatorics	S						
Linear Algebra for Statistics	S					S	
Philosophy of Science and Professional Ethics Statistics				S			S
Survey Sampling Methods	S						
Multivariable Calculus for Statistics	S					S	

Course	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
Elementary Differential Equations	S					S	
Introduction to Experimental Design	S	S			M		
Applied Regression Analysis	S	S	S	M	S	S	
Introduction to Mathematical Statistics I	S	S					
Introduction to Mathematical Statistics II	S	S					
Introduction to Probability Models	S	S					
Advanced Calculus	S					S	
Introduction to Sampling Theory	S	M		S			
Statistical Computation I	S		S				
Applied Multivariate Statistics	S	S	S				
Introduction to Time Series	S	S	S				
Introduction to *Big Data*	S	S	S	S			
Introduction to Measurement and Probability Theory	S						
Official Statistics	S			S			
Citizenship							S
Internship			S	S	S		S
Seminar	S	S					
Introduction to Stochastic Processes	S						
Community Services	S						S
Final Project		S		M	S		

To realize the PLO, UP-Stat formulates curriculum consisted of courses which Course Outcomes (CO) support PLO.

3.9.12 List of Compulsory Courses

No	Code	Course	SKS	Prerequisite
Semester I				
1.	MMS-1404	Statistical Methods I	3(1)	
2.	MMM-1101	Calculus I	3	
3.	MFF-1011	Basic Physics I	3	
4.	MKK-1101	Basic Chemistry I	3	
5.	MII-1201	Programming I	3	
6.	MII-1202	Programming I Laboratory	1	
7.	UNU-100x	Religious study	2	
8.	UNU-1010	Pancasila State's Ideology	2	
			20	
Semester II				
1.	MMS-1409	Statistical Methods II	3(1)	MMS-1404*
2.	MMM-1102	Calculus II	3	MMM-1101*
3.	MMS-1410	Exploratory Data Analysis	3(1)	MMS-1404*
4.	MMS-1481	Discrete Mathematics and Combinatorics	2	
5.	MMS -1479	Linear Algebra for Statistics	3	

6.	MMS -1480	Philosophy of Science and Professional Ethics Statistics	2	
7.	MMM -1001	English	2	
			18	
Semester III				
1.	MMS -2481	Survey Sampling Methods	2	MMS-1404*
2.	MMS-2428	Multivariable Calculus for Statistics	2	MMM-1102*
3.	MMM-2301	Elementary Differential Equations	3	MMM-1102*
4.	MMS -2405	Introduction to Experimental Design	3	MMS-1409*
5.	MMS -2421	Applied Regression Analysis	3(1)	MMS-1409*
6.	MMS -2420	Introduction to Mathematical Statistics I	3	MMM-1102*
7.	MMS-2410	Introduction to Probability Models	3	MMM-1102*
			19	
Semester IV				
1.	MMS -2483	Introduction to Mathematical Statistics II	3	MMS-2420*
2.	MMM-2111	Advanced Calculus	2	MMM-1102*
3.	MMS-2485	Introduction to Sampling Theory	2	MMS 2481*
4.	MMS-2422	Statistical Computation I	3(1)	
			10	
Semester V				
1.	MMS-3421	Applied Multivariate Statistics	3(1)	MMS-2420*
2.	MMS-3429	Introduction to Time Series	3(1)	MMS-2420*
3.	MMS-3404	Introduction to Measurement and Probability Theory	3	MMM-1102*
4.	MMM-3002	Introduction to Stochastic Processes	3	MMS-2410*
5.	MMS-3489	Internship	2	100 SKS
			14	
Semester VI				
1.	MMS-3488	Official Statistics	2	
2.	UNU-3000	Citizenship	2	60 SKS, IPK>2
4.	MMS-3437	Seminar	1	100 SKS
3.	MMS-3487	Introduction to Big Data	2	MMS-3421*
			7	
Semester VII				
1.	UNU-4500	Community Development Participation/Community services	3	100 SKS
			3	
Semester VIII				
1.	MMS-4099	Final Project	6	110 SKS
			6	
		Total credit of compulsory courses	**97**	

Note :
1. SKS n(1) means n credits for lecture and 1 credit for laboratory work.
2. Final Project is held in each semester.
3. Final Project duration is set to be 2 semester.
4. Seminar becomes a prerequisite of Final Project defense.
5. Students who have TOEFL score at least 500 will get grade A automatically.
6. Codes for Religious course:
   UNU-1000: Islam
   UNU-1001: Catholic
   UNU-1002: Christian
   UNU-1003: Hindu

UNU-1004: Buddha
UNU-1005: Confucius

3.9.13 Elective Courses

No	Code	Course	SKS	Prerequisite
Semester III				
1	MMS-2418	Introduction to Financial Mathemathics I	3	MMM-1101*
2	MMS-2492	Introduction to Insurance Accounting I	3	
3	MMS-2493	Introduction to Microeconomics	3	
			9	
Semester IV				
1.	MMS-2424	Applied Analysis of Variance	3(1)	MMS-1409*
2.	MMS-2415	Demography	3	MMS-1404*
3.	MMS-2425	Statistical Quality Control	3(1)	MMS-1404*
4.	MMS-2419	Introduction to Financial Mathemathics II	3	MMS-2418*
5.	MMS-2426	Categorical Data Analysis	3(1)	MMS-1409*
6.	MMS-2496	Introduction to Insurance Accounting II	3	MMS-2492*
7.	MMS-2497	Introduction to Macroeconomics	3	MMS-2493*
8.	MMS-2427	Forecasting Methods	3(1)	MMS-1409*
			24	
Semester V				
1.	MMS-3438	Introduction to Actuarial Mathematics I	3(1)	MMS-2418*
2.	MMS-3439	Introduction to Queueing and Simulation Theory	3(1)	MMS-2410*
3.	MMS-3424	Quantitative Risk Management	3	MMS-2420*
4.	MMS-3441	Biostatistics and Epidemiology	4(1)	MMS-1409*
5.	MMS-3442	Statistical Computation II	3(1)	MMS-2422*
6.	MMS-3432	Introduction to Actuarial Risk Theory I	3	
			19	
Semester VI				
1.	MMS-3431	Nonparametric Statistical Method	3	MMS-1409*
2.	MMS-3477	Introduction to Actuarial Mathematics II	3	MMS-3438*
3.	MMS-3443	Survival Data Analysis	3(1)	MMS-1409*
4.	MMS-3433	Introduction to Investment Management	3	MMS-2418*
5.	MMS-3434	Introduction to Actuarial Risk Theory II	3	MMS-3432*
6.	MMS-3435	Structural Equation Modelling	3	MMS-3421*
7.	MMS-3445	Introduction to Econometrics	3(1)	MMS-1409*
			21	
Semester VII				
1.	MMS-4415	Introduction to Response Surface	3	MMS-1409*
2.	MMS-4449	Capita Selecta in Statistics A	3	MMS-2483*
3.	MMS-4416	Introduction to Panel Data Analysis	3	MMS-2420*
4.	MMS-4421	Introduction to Decision Theory	3	MMS-1404*
5.	MMS-4422	Introduction to Pension Fund Valuation	3	MMS-3438*
			15	
Semester VIII				
1.	MMS-4402	Reliability	3	MMS-2420*
2.	MMS-4494	Spatio-Temporal Modelling	3	MMS-3429*
3.	MMS-4403	Sequential Methods	3	MMS-1409*
4.	MMS-4423	Capita Selecta in Statistics B	3	
			12	

No	Code	Course	SKS	Prerequisite
		Total credit of elective courses	**100**	

*   : has been taken

For students from year intake 2016, the total required credits needed to graduate from UP-Stat is at least 144 SKS with 97 SKS of compulsory courses and at least 47 SKS of elective courses.

Elective Course of Stream
Information:
1. Elective courses of stream are courses directed to be taken by the students completely on a certain stream.
2. Elective course of stream can be taken by students from other study programs.
3. Students are directed to determine at least one stream in the early of the second year.
4. Final Project topic must correspond to one of the stream (the stream which all elective courses have been taken).

Actuarial Science Stream
Actuarial science is the discipline that applies mathematical and statistical methods to assess risk insurance, finance, and other industries. Actuarial science can be seen as a mixed discipline of probability theory, mathematics, statistics, finance, economics, and computing. A professional who has expertise in actuarial science called actuary. Usually actuaries unite in a professional association. In Indonesia, we have Persatuan Aktuaris Indonesia (PAI-Society of Actuaries of Indonesia). To be an actuary, a candidate has to pass various exams. They devided into two levels of them: Associate of Society of Actuaries of Indonesia (ASAI) and Fellow of Society of Actuaries of Indonesia (FSAI). To be accredited in ASAI level, a candidate should pass financial mathematics (A10), probability and statistics (A20), economics, accountancy, statistical method, actuarial mathematics, risk theory and modeling exams. All of them have been arranged to the exemption programme in our undergraduate degree programme. For those who passed certain courses in our curriculum with certain minimal mark they are elligible to get an exemption for PAI subject exam. Graduate of this stream may work in insurance company, pension plan, department of finance, OJK, etc. The following are the courses for actuarial science stream:

No	Course
1	Introduction to Financial Mathemathics I
2	Introduction to Financial Mathemathics II
3	Introduction to Actuarial Mathematics I
4	Introduction to Actuarial Mathematics II
5	Survival Data Analysis

Biostatistics stream
Biostatistics is application of statistics in various topics in biological sciences (health sciences, medicine, pharmacy, biology and agriculture). Biostatistics studies about experimental design, especially in health and agriculture. Professions in biostatistics are much needed in such areas as: Research Institute, Educational Institution, Drug and Pharmaceutical Industry, Government Institution in health or hospital, Consultant and others. Here are 10 SKS of elective courses in Biostatistics stream.

No	Course
1	Categorical Data Analysis

No	Course
2	Biostatistics and Epidemiology
3	Survival Data Analysis

Business and Industrial Stream

Statistics is very important for business and industry because it helps decision makers in a company in the monitoring process, prediction, estimation, and decision making. The use of Statistics will reduce the risks of errors, both systemic and natural risks, in decision making. Bachelor of Statistics from business and industrial stream are able to work in banking, service and goods companies, agribusiness and mining companies, government departments, and others. Here are 15 SKS of elective courses in Business and Industrial stream.

No	Course
1	Statistical Quality Control
2	Categorical Data Analysis
3	Applied Analysis of Variance
4	Introduction to Decision Theory
5	Introduction to Big Data

Finance Stream

Finance stream are designed for students who have particular interest in statistical modeling for finance. In this stream, various topics about finance are studied included pricing, hedging, portfolio, and risk assessment of financial products, both deterministic and stochastic. Graduates from finance stream will have ability to apply statistics in solving finance industry problems. They are also encouraged to develop computation and communication skills. They may work in financial sector and government institution such as: Banking, Financial consulting company, Department of Finance, and others. Here are 12 SKS of elective courses in finance stream.

No	Course
1	Introduction to Financial Mathemathics I
2	Introduction to Financial Mathemathics II
3	Quantitative Risk Management
4	Introduction to Investment Management

3.9.14 General Rules, Transitional Rules, and Equivalent Courses

In the transition periods, we have rules and equivalence of courses as the following:

1. Lab work course in 2011 curriculum and before will be implanted in the course where they belong to before in the 2016 curriculum. Those courses still have lab works but we don't separate the course and its lab work course. The activity of lab work will be done as it should be, and its mark will be a component of the total mark of the course.
2. The mandatory course in the previous curriculum that are not shown in current curriculum (2016) can be considered as compulsory courses.
3. For courses that move from odd/even semester, we will offer them in each semester in 2016/2017.
4. Students of UP-Stats are not allowed to take some courses that are equivalence, such as Professional ethics in computer science and professional ethics in chemistry, etc. If so they can be considered as just one course.
5. If students take the compulsory course that require prerequisite course(s) then they

have to also include those prerequisite course(s) in their intention to graduate (yudisium).

Example 1: A student got C for Introduction to Mathematical Finance I and got A for Introduction to Mathematical Finance II. If this student will include the Introduction to Mathematical Finance II in his/her intention to graduate then he/she should also include that Introduction to Mathematical Finance I.

Example 2: Someone got A in the Introduction to Mathematical Finance I and C for the Introduction to Mathematical Finance II, he/she may include only that Introduction to Mathematical Finance I in his/her intention to graduate form and cancel the Introduction to Mathematical Finance II.

6. Things that have not been shown in this rule, will be decided in the Study Program level.
7. Students of 2015 and before can follow the following transitions:

Equivalency between Curriculum 2011 and Curriculum 2016

Previous Name		New Name	
Code	Course	Code	Course
MMS-2403	Survey Sampling Methods (3 sks)	MMS-2481	Survey Sampling Methods (2 sks)
MMS-3427	Research Methodology	MMS-3488	Official Statistics
MMM-1202	Elementary Linear Algebra	MMS-1479	Linear Algebra for Statistics
MMS-1408	Discrete Mathematics and Combinatorics (3 sks)	MMS-1481	Discrete Mathematics and Combinatorics (2 sks)
MMM-2109	Multivariable Calculus I	MMS-2428	Multivariable Calculus for Statistics
MMS-3474	Biostatistics and Epidemiology I	MMS-3441	Biostatistics and Epidemiology
MMS-3494	Biostatistics and Epidemiology I Laboratory		
MMS-3475	Biostatistics and Epidemiology II		
MMS-1423	Statistical Methods I	MMS-1404	Statistical Methods I
MMS-1453	Statistical Methods I Laboratory		
MMS-1425	Statistical Methods II	MMS-1409	Statistical Methods II
MMS-1455	Statistical Methods II Laboratory		
MMS-3469	Introduction to Mathematical Statistics II	MMS-2483	Introduction to Mathematical Statistics II
MMS-1406	Exploratory Data Analysis	MMS-1410	Exploratory Data Analysis
MMS-1456	Exploratory Data Analysis Laboratory		
MMS-2423	Statistical Quality Control	MMS-2425	Statistical Quality Control
MMS-2453	Praktikum Statistical Quality Control		
MMS-3402	Applied Regression Analysis	MMS-2421	Applied Regression Analysis
MMS-3452	Applied Regression Analysis Laboratory		
MMS-3472	Introduction to Actuarial Mathematics I	MMS-3438	Introduction to Actuarial Mathematics I
MMS-3492	Introduction to Actuarial Mathematics I Laboratory		
MMS-3473	Survival Data Analysis	MMS-3443	Survival Data Analysis
MMS-3493	Survival Data Analysis Laboratory		
MMS-3471	Introduction to Time Series	MMS-3429	Introduction to Time Series
MMS-3451	Introduction to Time Series Laboratory		
MMS-3417	Applied Analysis of Variance	MMS-2424	Applied Analysis of Variance
MMS 3457	Applied Analysis of Variance Laboratory		
MMS-1000	English	MMM-1001	English
MMS-3415	Statistical Computation	MMS-2422	Statistical Computation I

Previous Name		New Name	
Code	**Course**	**Code**	**Course**
MMS-3455	Statistical Computation Laboratory		
MMS-3422	Introduction to Stochastic Processes	MMM-3002	Introduction to Stochastic Processes
MMS-4401	Internship	MMS-3489	Internship
MMS-2455	Categorical Data Analysis	MMS-2426	Categorical Data Analysis
MMS-2495	Categorical Data Analysis Laboratory		
MMS-3430	Forecasting Time Series Data	MMS-2427	Forecasting Methods
MMS-3450	Forecasting Time Series Data Laboratory		
MMS-3416	Introduction to Queueing and Simulation Theory	MMS-3439	Introduction to Queueing and Simulation Theory
MMS-3456	Introduction to Queueing and Simulation Theory Laboratory		
MMS-4409	Introduction to Econometrics	MMS-3445	Introduction to Econometrics
MMS-4459	Introduction to Econometrics Laboratory		
MMS-3476	Introduction to Decision Theory	MMS-4421	Introduction to Decision Theory

3.9.15 Cooperation between UGM and PAI

Several courses in UP-Stat can be used to get ASAI level in PAI's exam topic certifications as listed below (with certain prerequirement):

PAI's Exam Topic	UP-Stat's Course
A.10. Financial Mathematics	Introduction to Financial Mathemathics I
	Introduction to Financial Mathemathics II
A.20. Pobability and Mathematical Statistics	**Introduction to Mathematical Statistics I**
	Introduction to Mathematical Statistics II
A.30. Accounting	**Introduction to Insurance Accounting I**
	Introduction to Insurance Accounting II
A.40. Economics	**Introduction to Microeconomics**
	Introduction to Macroeconomics
A.50. Statistical Methods	Applied Regression Analysis
	Survival Data Analysis
	Introduction to Time Series
A.60. Actuarial Mathematics	**Introduction to Actuarial Mathematics I**
	Introduction to Actuarial Mathematics II
A.70. Modeling and Risk Theory	**Introduction to Actuarial Risk Theory I**
	Introduction to Actuarial Risk Theory II

The process of submitting PAI certification is done collectively through the Administration of Mathematics Department. Further information about this cooperation can be obtained from Mathematics Department. Terms of grade for certification are as follows:
Starting in 2016, the equivalence of an exam topic of PAI with two or three courses in UGM, must meet the average grade of > 3.5.
Students who had passed the course before the curriculum 2016 applied, should follow the old rules.

3.9.16 Comparison between Curriculum 2011 and 2016

Curriculum 2016 of UP-Stat attemps to overcome the weaknesses of curriculum 2011 by the following methods:
a. incorporation of laboratory credit (in curriculum 2011) with its theoretical courses based on these considerations:
    1. separation of laboratory credit from theory credits, they must be taken together conditionally, gives difficulty to UGM academic information system (SIA) because there are students who take advantage from the weakness of SIA by only taking theory credits
    2. very high/good laboratory grades are considerably different from theory grades which are relatively normal
b. holding comprehensive course
c. completion of PAI actuarial courses which are equivalent to PAI's exam topics.

3.9.17 Learning Methods

To achieve the formulated graduates' competence, students of UP-Stat are given teaching centered learning method for basic and theoretical courses and student centered learning method for applied and computational courses, included:
1. the lecture system is based on the philosophy of cognitivism, connectionism, behaviorism, and constructivism
2. several abilities are developed during the lectures, such as: presentation, writing scientific papers, cooperative, collaborative, creative, and innovative
3. IT based activities, bilingual (English - Indonesia) delivery, and cross fertilization principle are included in the lectures
4. lectures practice character education (discipline, responsibility, honest, meticulous, tenacious, never give up).

3.9.18 Assessment Methods

Assessment consists of two forms: process assessment and product assessment. Process assessment is done observasionally by lecturers in the classroom included skills, participation, presentation, and attitude of students during the lecture activity. Product assessment consists of written or oral exam results, and work assignments. Each assessment aspect has its own weight.