Course Specification

MAC3309 Mathematical Analysis
Division of Mathematics, Faculty of Education, Suan Sunandha Rajabhat University
Semester 2, Academic Year 2022

Section 1 General Information

1. **Course ID:** MAC3309

   Course Title: Mathematical Analysis

2. **Credits:** 3(2-2-5)

3. **Curriculum and Course Category**:

   3.1 Curriculum: Bachelor of Education (Mathematics)

   3.2 Course Category: The Major Elective Course

4. **Lecturer:** Assistant Professor Thanatyod Jampawai, Ph.D.

5. **Contact Location:** 1144 (Building 11) Faculty of Education

   E–Mail thanatyod.ja@ ssru.ac.th

6. **Semester/Year:** Semester 2 / Year 3

7. **Number of students:** Accepted about 70 students

   Section 001 accepted about 35 students

   Section 002 accepted about 35 students

8. **Pre-requisite:** Calculus 2

9. **Co-requisites:** None

10. **Learning Location:** Faculty of Education Building (Building 11)

    Section 001 Room 1132 Tuesday 1 p.m. – 5 p.m.

    Section 002 Room 1132 Tuesday 8 a.m. – 12 a.m.

11. **Last Date for Preparing and Revising this Course:**

    30 November 2022

Section 2 Objectives and Purposes

1. **Course Objectives**
   By the end of this course, the students will be able to

   1.1 prove properties of real numbers and topology on real number by Ordered Filed Axiom ;

   1.2 prove properties of limit theorems for sequences, limit theorems for functions, continuity and series;

   1.3 understand about Math Analysis to apply the suitable pedagogy in teaching mathematical content in Mathematical Analysis in learning management at the fundamental education.

2. **Purposes for Developing/Revising Course (content/learning process/assessment/etc.)**

   None

Section 3 Course Structure

1. **Course Description**
   Real number system; Topology on real lines; Sequence of real numbers; Limit and continuity; Derivatives; Reimann integral and series of real numbers; Applying the suitable pedagogy in teaching mathematical content in Mathematical Analysis in learning management at the fundamental education

2. **Time Length per Semester (Lecture – hours/Practice – hours/Self Study – hours)**

Lecture	Supplementary Classes	Practice/Field Work	Self-Study hours
60 hours	Appropriate	-	85 hours

3. **Time Length per Week for Individual Academic Consulting and Guidance**
   The lecturer provides one hour for individual consultation per week.

   3.1 Individual Academic Consulting and Guidance:
   Room 1144, Faculty of Education

   3.2 Telephone/Mobile phone:
   02-1601056 press 1144 / 086-6008726

   3.3 E-Mail: thanatyod.ja@ssru.ac.th

   3.4 Social Media: www.facebook.com/jampawai

   3.5 Moodle : https://eledu.ssru.ac.th/thanatyod_ja

Section 4 Developing Students' Learning Outcome

1. Ethics and Morals

1.1 Ethics and Morals students need to develop

- ● (1) Love, believe and be proud of the teacher profession. Have a teacher spirit and ideal and behave in accordance with the teacher's professional code of conduct.
- ○ (2) Volunteer, public, patient, repressive. There is sacrifice. Be responsible and faithful to the tasks assigned to them academically and professionally, and be able to continuously improve themselves, behave as role models for students. Family, society and nation, and strengthen sustainable development.
- ○ (3) Democratic values and attributes are respect for rights and respect for others. Be harmonious and work with others. Use reason and wisdom to live and make decisions.
- ○ (4) Courage and moral and ethical expression can diagnose, manage and think about moral and ethical problems with appropriateness to society. Work and environment based on principles reasoning and exercise discretion in values of social norm, the feelings of others and the benefits of society as a whole. Be conscious of maintaining transparency of society and the nation. Anti-corruption and inaccuracy do not use misinformation or plagiarism.

1.2 Method of Teaching

(1) The virtue, ethics, morals, and teachers' code of conduct inserted during every week.

(2) Good exemplary conduct of the instructor.

1.3 Method of Evaluation

(1) Observation of students' learning behavior.

(2) Evaluation of discipline, honesty, personal responsibility, punctuality, cooperation and respect for others during class activities.

2. Knowledge

2.1 Knowledge students need to master

- ○ (1) Be well-versed in principle. concept theory, professional content of teachers such as teacher values, morality, ethics, ethics, teacher spirit, teacher philosophy, teacher philosophy. Psychology for teachers developmental psychology of learning to manage, learn and help problem solved. Promote and develop learners curriculum and learning management science innovation and information and communication technology education and learning measuring, evaluating, studying and learning research and innovation development for learner development and communication language for teachers communication and teaching skills, technology and digital skills, research and assessment skill. Creative collaboration skills, and 21st century skills, knowledge, understanding of integrating knowledge with practicality and cross-integration, such as teaching integration (TPACK), STEM teaching, learning communities (PLC), and knowledge of applications.
- ● (2) Be well-versed in principle concept of the theory, the content of the subjects taught, can analyze the knowledge and content of the subjects taught in depth. It can track the advancement of science and apply it to the development of learners, with learning outcomes and standardized content of knowledge outcomes of each discipline according to the appendix.

- ○ (3) Knowledge and understanding of life, community in the world and coexistence based on cultural differences. Able to face and keep up with the changes in society and be able to apply the philosophical concept of sufficiency economy to live and develop oneself. Develop work and develop learners.
- ○ (4) Knowledge and ability to use Thai and English for communication according to the standards.
- ○ (5) Recognize and appreciate the importance of the King's Science for sustainable development and apply it to self-development, learner development, job development and community development.

2.2 Method of Teaching

(1) Demonstrations, lectures, discussions, practices and presentation of knowledge processing.

(2) Let students present mathematics content to apply the suitable pedagogy in teaching mathematical content in Mathematical Analysis in learning management at the fundamental education.

2.3 Method of Evaluation

(1) Evaluation of the simulated practices for Assignments (1-13).

(2) Knowledge Achievement Test (Evaluation through quizs, midterm and final examination).

3. **Cognitive Skills**

3.1 Cognitive skills students need to develop

- ○ (1) Think, find, analyze facts, and knowingly evaluate information, media, and information from a variety of sources. Be an awake citizen with a universal sense of being able to face and keep pace with changes in the digital age, cross-platform technology and the future. It can be applied in the implementation and diagnosis, problem solving and development of work creatively, taking into account knowledge, theoretical principles, practical experience, values, concepts. National policies and strategies, social norms and potential impacts.
- ● (2) Be an intellectual leader, able to take initiatives and develop creatively. Have academic and professional leadership. Be strong and ethically courageous, able to guide and transmit knowledge to learners academy. Creative community and society
- ○ (3) Create and apply knowledge from research and create or co-create innovations to improve learners' learning and develop learners to be creators or co-innovators as well as the transfer of knowledge to the community and society.

3.2 Method of Teaching

(1) Interactive Lecture.

(2) Students engage in a reading activity to interpret and understand the main idea in a given dialogue.

3.3 Method of Evaluation

(1) Based on workload Presentation of search results and participation in commentary.

(2) Tested by individual practice.

4. **Interpersonal Skills and Responsibilities**

4.1 Interpersonal Skills and Responsibilities students need to develop

- (1) Recognize and understand the feelings of others. Have a positive mindset, emotional and social maturity.
- (2) Collaborate with others work as a team, be a good leader and follower. Have a good relationship with the learner partner parents and community members. Be responsible for the economy society and environment
- (3) Be responsible for your duties to yourself per learner to colleagues and to the community, to help and solve their own problems. Group and intergroup creatively.

4.2 Method of Teaching

(1) Interactive Lecture
(2) Participative learning through action
(3) Share leadership
(4) Reflective thinking

4.3 Method of Evaluation

(1) Measured and evaluated based on cooperative learning outcomes.
(2) Evaluation of individual and group work.

5. **Numeral Analysis, Communication and Information Technology Skills**

5.1 Numeral Analysis, Communication and Information Technology Skills students need to develop

- (1) Numerical analysis for data and information, whether statistical or mathematical, to understand knowledge or problems quickly and accurately.
- (2) Communicate effectively with learners, individuals and groups in a variety of ways, including speaking. Writing and presenting in different formats using the right technology and innovation.
- (3) Use information technology ready-made programs necessary for learning, learning management, work, meetings, management and retrieval of information, receiving and transmitting information with good discretion to verify the reliability of information. It is also aware of copyright violations and plagiarism of works.

5.2 Method of Teaching

(1) Group discussion
(2) Monitoring, analyzing, and presenting key educational issues from the article. Newspaper news, publications and information media
(3) Researching and presenting key educational issues using information technology

5.3 Method of Evaluation

(1) Evaluation of students information technology skill.
(2) Measure and evaluate the results of searches and present reports on key issues in education using information technology.

6. Learning Management Skills

6.1 Learning Management Skills students' needs to develop

- ○ (1) Proficient in managing learning with patterns. A variety of approaches with a focus on learners. Able to design and create coursework in class. Plan and design content and learning management activities, manage classes. Use media and communication technology and digital technology and evaluate to develop learners appropriately and creatively.
- ○ (2) The ability to apply psychological knowledge to analyze individual learners, to design, organize material, administer classes, and organize activities to assist. Address and promote the development of learners according to the interests and aptitudes of learners in a variety of ways based on interpersonal differences, both regular learners and learners with special needs.
- ○ (3) Organize activities and design learning arrangements for learners to learn from experience. Learn through hands-on and work in real-world situations, promoting the development of thinking. Operation management coping, practicing, doing, thinking, pretending by integrating work with learning and morality and ethics, can apply knowledge to prevent, solve problems, and develop with integrity. Be disciplined and responsible to learners by taking learners first and foremost.
- ○ (4) Create an atmosphere and provide environment, learning materials, science resources, technology, culture and wisdom both inside and outside the school premises for learning. Have the ability to coordinate and build partnerships with parents. Parents and individuals in the community of all parties to facilitate and collaborate to develop learners to be well-versed. Have wisdom, think, and constantly aspire to reach their full potential.
- ○ (5) Apply 21st century skills and technology to manage learning to develop learners and develop themselves, such as learning skills, literacy skills and life skills, cooperative work skills, and living according to the philosophy of sufficiency economy.

6.2 Method of Teaching

(1) Interactive lecture

(2) Teach using lectures to analyze and discuss together. Present the events that take place in the class according to real conditions.

6.3 Method of Evaluation

(1) Evaluation of students' group work.

(2) Evaluate the results of the design of the learning management plan.

Remarks

- ● means the main responsibilities
- ○ means the secondary responsibilities

It appears in a map that shows the distribution of responsibilities, standards, learning outcomes from curriculum to course (Curriculum Mapping).

Section 5 Lesson Plan and Assessment

1. Lesson Plan

Week	Objectives/Topics/Details	Hours	Learning Activities/Media	Assessments
1	• Able to prove properties of real numbers by ordered filed axiom. 1. **Ordered Filed Axiom** -Filed Axiom/Ordered Axiom -Absolute value 2. **Well-Ordering Principle**	4	**ONLINE** -Course orientation -Lecture by media commentary -Group discussion (Assignment 1) **Slide:Intro-Math Analysis**	-Evaluation of students' group work -Evaluation of the interactive lecture
2	• Able to prove suprema, infima of sets and determine invertible functions. 1. **Completeness Axioms** -Supremum/Infimum -Density of reals 2. **Functions**	4	**ONSIDE** -Lecture by media commentary -Group discussion (Assignment 2) **VDO:Sup/Inf**	-Evaluation of students' group work -Evaluation of the interactive lecture
3	• Able to prove limts of sequences by definition and find limit by limits theorems. 1. **Limit of Sequences** 2. **Limit Theorems** -The squeeze theorem -Properties of Limit	4	**ONSIDE** - Quiz 1 -Lecture by media commentary -Group discussion (Assignment 3) **VDO:Seq/Limit**	-Evaluation of students' group work -Evaluation of the interactive lecture -Knowledge test
4	• Able to prove limits of divergence, monotone and Caucy sequences. 1. **Divergence** 2. **Monotone** -Increasing/Decreasing 3. **Caucy sequence**	4	**ON DEMAND (1)** -Learning yourself with grouping -Presentation after week (Assignment 4) **Slide:Cauchy**	-Evaluation of students' group work -Evaluation of the presentation
5	• Able to prove properties of topology on reals and limit of function. 1. **Topology on $\mathbb{R}$** -Open and Closed sets -Limit points 2. **Limit of Functions**	4	**ONSIDE** - Quiz 2 -Lecture by media commentary -Group discussion (Assignment 5) **VDO:Limit of Function**	-Evaluation of students' group work -Evaluation of the interactive lecture -Knowledge test
6	• Able to prove limits of divergence, monotone and Caucy sequences. 1. **Limit Theorems of functions** 2. **One-sided functions** 3. **Infinite Limits** -Convergence/Divergence	4	**ON DEMAND (2)** -Learning yourself with grouping -Presentation after week (Assignment 6) **VDO:Limit Theorems**	-Evaluation of students' group work -Evaluation of the presentation

Week	Objectives/Topics/Details	Hours	Learning Activities	Assessments
7	• Apply the suitable pedagogy in teaching mathematical content in Math Analysis in learning management at the fundamental education.	4	**ONSIDE** -Learning management in 10 minutes (per Groups) use contents Week 1-6 (Project 1)	-Evaluation of students' group work
8	Contents in week 1 - 6	3	Midterm Examination (25%)	-Knowledge test -Workload Assessment (Home work 1)
9	• Able to prove continuity by definition and unifrom continuity. 1. **Continuity** -Pointwise cont./Cont. -Intermediate Value Theorem 2. **Uniform Continuity**	4	**ON DEMAND (3)** -Learning yourself with grouping -Presentation after week (Assignment 7) **Wesite:Continuity**	-Evaluation of students' group work -Evaluation of the presentation
10	• Able to prove derivatives by definition and apply MVT. 1. **Derivative** -Definitions and Rules 2. **Mean Value Theorem** -MVT/L'hospital's rule 3. **Monotone functions**	4	**ONLINE** -Lecture by media commentary -Group discussion (Assignment 8) **VDO:MVT**	-Evaluation of students' group work -Evaluation of the interactive lecture
11	• Able to prove Reimann integral by definition. 1. **Riemann Integral** -Partitions -Riemann Integral	4	**ONSIDE** - Quiz 3 -Lecture by media commentary -Group discussion (Assignment 9) **Website:Riemann Intergral**	-Evaluation of students' group work -Evaluation of the interactive lecture -Knowledge test
12	• Able to find Riemann sum and apply the Fundamental of Calculus. 1. **Riemann sum** 2. **Fundamental Theorem of Calculus**	4	**ON DEMAND (4)** -Learning yourself with grouping -Presentation after week (Assignment 10) **Website:1st Fund. of Cal.**	-Evaluation of students' group work -Evaluation of the presentation
13	• Able to find integral by integration by part and determine convergence of series. 1. **Integration by part** 2. **Infinite series** -Partial sums -Geometric series	4	**ONSIDE** - Quiz 4 -Lecture by media commentary -Group discussion (Assignment 11) **Website:By part**	-Evaluation of students' group work -Evaluation of the interactive lecture -Knowledge test

Week	Objectives/Topics/Details	Hours	Learning Activities	Assessments
14	• Able to determine convergent series by test of series. 1. **Test of series** -Integral test -Comparison/Limit Comparison -Root and Ratio tests	4	**ONSIDE** -Lecture by media commentary -Group discussion (Assignment 12) **VDO:Integral Test**	-Evaluation of students' group work -Evaluation of the interactive lecture
15	• Able to prove continuity by definition and unifrom continuity. 1. **Absolute convergence series** -Absolute/Condition 2. **Alternating series** -Dirichilet's Test/AST	4	**ON DEMAND (5)** -Learning yourself with grouping -Presentation after week (Assignment 13) **VDO:AST**	-Evaluation of students' group work -Evaluation of the presentation
16	• Apply the suitable pedagogy in teaching mathematical content in Math Analysis in learning management at the fundamental education.	4	**ONSIDE** -Learning management in 10 minutes (per Groups) use contents Week 9-15 (Project 2)	-Evaluation of students' group work
17	Contents in week 9 - 15	3	Final Examination (25%)	-Knowledge test -Workload Assessment (Home work 2)

2. Learning Assessment Plan

Learning Outcome	Assessment Activities	Week	Proportion for Assessment (%)
1. Ethics and Morals **1.1 (1)**	Evaluation of the interactive lecture 1. Interactive lecture 2. Workload Assessment Home work 1 Home work 2	 All weeks 8 17	 5% 2.5% 2.5%
2. Knowlwdge **2.1 (2)**	Knowledge Tests 1. Quiz 1-4 2. Midterm Exam. 3. Final Exam.	 3,5,10,12 8 17	 10% 25% 25%
3. Cognitive Skills **3.1 (2)**	Evaluation of student's group work 1. Project 1-2 2. Assignment	 7, 16 All weeks	 20% 10%

Section 6 Learning and teaching resources

1. **Textbooks and Main Documents**

   William R. Wade. (2004). **An introduction Analysis**. New York: Pearson Education. Inc.

2. **Important Documents for Extra Study**

   Thanatyod Jampawai. (2022). **Mathematical Analysis**. Division of Mathematics

   Faculty of Educaton, Suan Sunandha Rajabhat University

3. **Suggestion Information (Printing Materials/Website/CD/Others)**

   Youtube Chanel : Wichran L Chanel

   Website : https://courses-archive.maths.ox.ac.uk

Section 7 Course Evaluation and Revising

1. **Strategies for Course Evaluation by Students**

   (1) Students evaluate the effectiveness of the course according to the content objectives regularly.

   (2) Students evaluate the appropriateness of teaching and learning activities, learning content and the learner nature.

   (3) Students evaluate the lecturer's learning management of the course.

2. **Strategies for Course Evaluation by Lecturers**

   (1) The students' marks

   (2) Interview of the students individually

3. **Teaching Improvement Workshop for teaching and learning improvement**

   None

4. **Feedback for Achievement Standards**

   (1) Revise the course in terms of academic principles by examining the reports and the tasks.

   (2) Revise the course activity accomplishment by examining the score result from participation, responsibility, discipline, and determination in conducting the projects.

   (3) Revise the course from the students' marks.

5. **Methodology and Planning for Course Review and Improvement**
   Have the meetings among the Math major committee regularly in order to analyze the information from the teaching evaluation, the appropriateness of the activity arrangement, comments from the previous meetings and after the teaching, and students' marks of learning achievement. After that, take all information into consideration for planning the improvement plan of the course.

Curriculum Mapping as shown in the Programmed Specification TQF2
MAC3309 Mathematical Analysis

Learning Standards		Graduate Attributes
1. Ethics and Morals	1	●
	2	○
	3	○
	4	○
2. Knowlwdge	1	○
	2	●
	3	○
	4	○
	5	○
3. Cognitive Skill	1	○
	2	●
	3	○
4. Interpersonal Skills and Responsibilities	1	○
	2	○
	3	○
5. Numeral Skills, Communication and Information Technology Skills	1	○
	2	○
	3	○
6. Learning Management Skills	1	○
	2	○
	3	○
	4	○
	5	○