

SEMESTER COURSE PLAN

**MATHEMATICAL GEOPHYSICS I COURSES
(23H06110503)**



TEACHING TEAM

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STUDI PROGRAM OF GEOPHYSICS - S1
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
HASANUDDIN UNIVERSITY
MAKASSAR
2025

**STUDY PROGRAM OF GEOFISIKA - S1
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
HASANUDDIN UNIVERSITY**

Vision

Become a program Reliable studies in the field of geophysics to produce superior graduates and mastering science, technology, arts and culture based on BMI in 2030.

Vision Strategy

Mission

Based on the Vision above, the Geophysics Study Program has a mission:

1. Improving the quality of education to produce graduates who are competitive, able to work independently and in groups in implementing and developing BMI science and technology;
2. Carrying out research to produce reliable and competitive scientific work oriented towards the scientific development of solid geophysics, marine geophysics, geoinformatics and hydro-meteorology;
3. Disseminate the results of applied research, action studies and appropriate technology packages in synergistic and accelerated productive activities to improve the quality of life of the community.

Graduate Profiles

Educators in the Field of Geophysics; meteorologist; geomaths; oceanographer; exploration geophysicist; seismologist ; geophysical entrepreneur.

PLO charged to courses

CPL-5 (P2) - Mastering Geophysical concepts and principles in applying applied mathematics in the field of Geophysics

CPL-11 (KK1) - Able to apply the principles of mathematics and earth science, as well as the principles of Exploration and Mitigation to solve natural resource exploration and disaster mitigation problems (Exploration natural resources and natural disaster mitigation)

Course Learning Outcomes (CLO)

CPMK-1: Able to model complex number analysis and vector calculus in graphic, contour or geometric form (CPL5)

CPMK-2: Able to apply complex analysis methods and vector calculus to geophysical problems (CPL11)

Sub-CLO

Sub CPMK-1: Able to solve concepts and applications of complex numbers and functions as a whole (CPMK-1)

Sub CPMK-2: Able to apply complex differentiation concepts and applications using the Cauchy-Riemann equation (CPMK-1)

Sub CPMK-3: Able to demonstrate the concepts and applications of logarithmic and exponential functions, hyperbolic and trigonometric functions (CPMK-1)

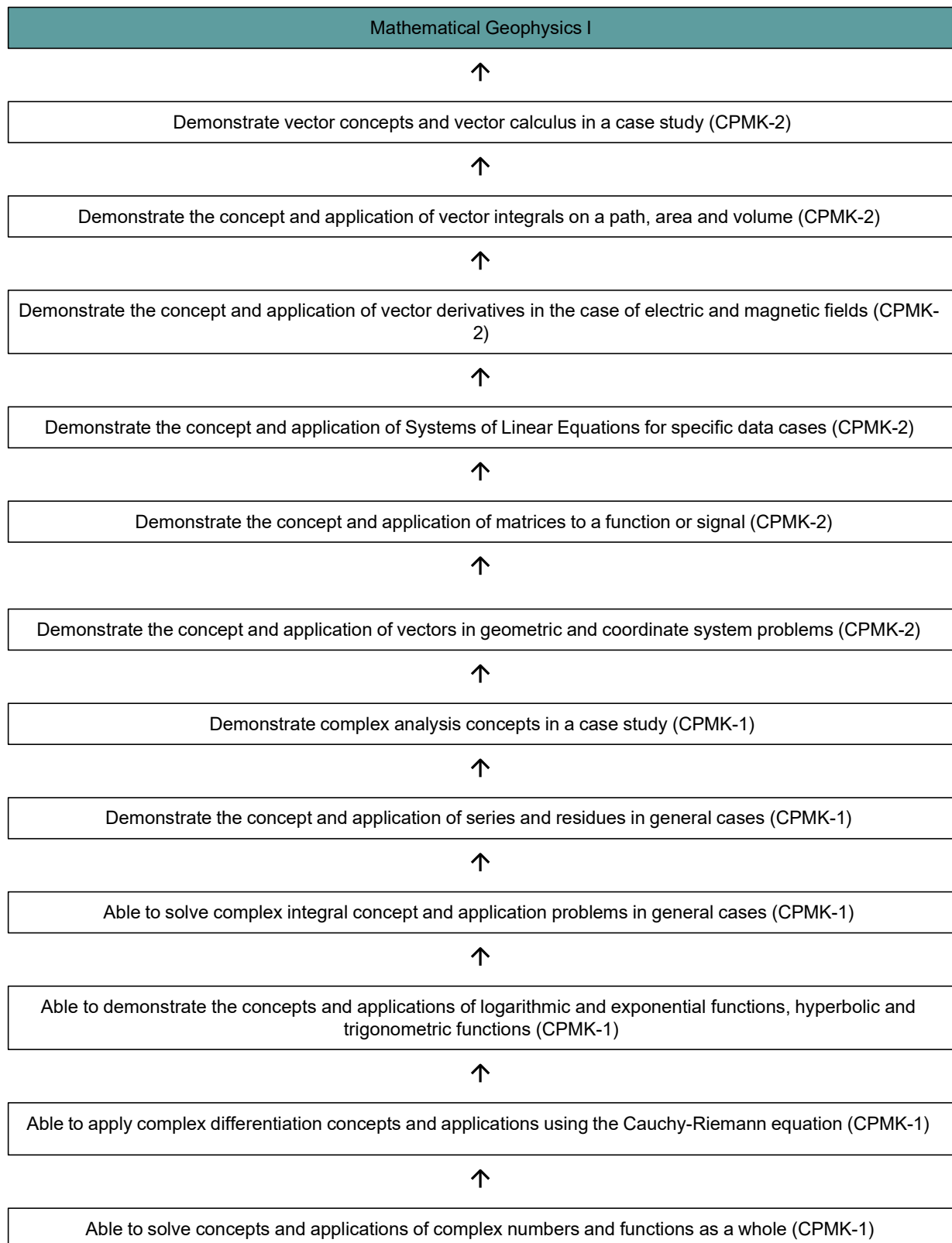
Sub CPMK-4: Able to solve complex integral concept and application problems in general cases (CPMK-1)

Sub CPMK-5: Demonstrate the concept and application of series and residues in general cases (CPMK-1)

Sub CPMK-6: Demonstrate complex analysis concepts in a case study (CPMK-1)

- Sub CPMK-7: Demonstrate the concept and application of vectors in geometric and coordinate system problems (CPMK-2)
- Sub CPMK-8: Demonstrate the concept and application of matrices to a function or signal (CPMK-2)
- Sub CPMK-9: Demonstrate the concept and application of Systems of Linear Equations for specific data cases (CPMK-2)
- Sub CPMK-10: Demonstrate the concept and application of vector derivatives in the case of electric and magnetic fields (CPMK-2)
- Sub CPMK-11: Demonstrate the concept and application of vector integrals on a path, area and volume (CPMK-2)
- Sub CPMK-12: Demonstrate vector concepts and vector calculus in a case study (CPMK-2)

Learning Analytics





HASANUDDIN UNIVERSITY
FAKULTY OF MATHEMATICS AND NATURAL SCIENCES
STUDY PROGRAM OF GEOPHYSICS - S1
SEMESTER LEARNING PLAN

Course	Code	Course Group	Credits	SEMESTER		Compilation Date		
Mathematical Geophysics I	23H06110503		3	2		1 Juli 2025		
AUTHORITY		SLP Developer Lecturer		Coordinator		Head of Study Program		
		Dr. Muhammad Alimuddin, Eng., Dr. Muhammad Taufiq Rafi		Dr. Muhammad Alimuddin, Eng.		Dr. Muhammad Alimuddin, Eng.		
Learning Outcomes Course	SLOs that are imposed on the course							
	SLO-5:	Menguasai konsep Geofisika dan prinsip dalam mengaplikasikan matematika terapan dalam bidang Geofisika						
	SLO-11:	Mampu menerapkan prinsip-prinsip matematika dan sains kebumian, serta prinsip Eksplorasi dan Mitigasi untuk menyelesaikan masalah eksplorasi SDA dan mitigasi bencana (Exploration natural resource and natural disaster mitigation)						
	SLO ⇒ Course Learning Outcomes							
	After completing this course, it is expected:							
	SLO-5	CLO-1: Able to model complex number analysis and vector calculus in graphic, contour or geometric form						
	SLO-11	CLO-2: Able to apply complex analysis methods and vector calculus to geophysical problems						
	CLO ⇒ Sub-CLO							
	CLO-1	Sub-CLO-1:Able to solve concepts and applications of complex numbers and functions as a whole						
		Sub-CLO-2:Able to apply complex differentiation concepts and applications using the Cauchy-Riemann equation						
		Sub-CLO-3:Able to demonstrate the concepts and applications of logarithmic and exponential functions, hyperbolic and trigonometric functions						
		Sub-CLO-4:Able to solve complex integral concept and application problems in general cases						
		Sub-CLO-5:Demonstrate the concept and application of series and residues in general cases						
		Sub-CLO-6:Demonstrate complex analysis concepts in a case study						
	CLO-2	Sub-CLO-7:Demonstrate the concept and application of vectors in geometric and coordinate system problems						
		Sub-CLO-8:Demonstrate the concept and application of matrices to a function or signal						
		Sub-CLO-9:Demonstrate the concept and application of Systems of Linear Equations for specific data cases						
		Sub-CLO-10:Demonstrate the concept and application of vector derivatives in the case of electric and magnetic fields						
		Sub-CLO-11:Demonstrate the concept and application of vector integrals on a path, area and volume						
		Sub-CLO-12:Demonstrate vector concepts and vector calculus in a case study						
	Correlation between SLOs/CLOs to Sub-CLOs							

SLOs that are charged on the Course	CPMK	SUB CPMK	Form of Assessment*		Weight	Value	Student Score
			Formative	Sumative			
				Project/Case Study			
SLO-5	CLO-1	SUB-CLO-1	Participation	2	2		
SLO-5	CLO-1	SUB-CLO-2	Participation and Quizzes	8	8		
SLO-5	CLO-1	SUB-CLO-3	Participation	2	2		
SLO-5	CLO-1	SUB-CLO-4	Participation	2	2		
SLO-5	CLO-1	SUB-CLO-5	Participation	2	2		
SLO-5	CLO-1	SUB-CLO-6	Presentations and Reports	28	28		
SLO-11	CLO-2	SUB-CLO-7	Participation	2	2		
SLO-11	CLO-2	SUB-CLO-8	Participation and Written Test	14	14		
SLO-11	CLO-2	SUB-CLO-9	Participation	2	2		
SLO-11	CLO-2	SUB-CLO-10	Participation and Quizzes	8	8		

SLOs that are charged on the Course		CPMK	SUB CPMK	Form of Assessment [*]		Weight	Value	Student Score
				Formative	Sumative			
					Project/Case Study			
SLO-11		CLO-2	SUB-CLO-11	Participation	2	2		
SLO-11		CLO-2	SUB-CLO-12	Participation and Reports	28	28		
					100	100		
Course Description		The Mathematical Geophysics I course discusses the concept and application of complex numbers and vector calculus in geophysical cases with a load of 3 credits. This course is the core of all geophysical methods and models which are represented in the form of maps, graphs, cross sections or contours. Presented for second semester students in the Geophysics Undergraduate Study Program. The person in charge of the course is the manager of the Mathematical Geophysics I course. Learning methods are Small Group Discussion and Case-Based Study						
Learning Materials/Subjects		1. Analysis complex 2. Series and residue 3. Vector and Matrix 4. Equation system linear 5. Vector Calculus						
Reference		Main References						
		Yang, W.Y., Choi, Y.K., Kim, J., Kim, M.C., Kim, H.J., and Im, T. 2018. Engineering Mathematics with Matlab. Chapman and Hall/CRC.						
		Additional References						
		Kreyszig, E., Stroud, K., and Stephenson, G. 2008. Advanced engineering mathematics. Integration, 9(4). Strang, G. 2016. Introduction to linear algebra Fifth Edition. Wellesley, MA: Wellesley-Cambridge Press.						
Teaching Team		Dr. Muhammad Alimuddin, Eng., Dr. Muhammad Taufiq Rafi						
Course requirement								
Week	Sub CPMK (End-of-stage learning ability)	Penilaian (Assesment)		Learning Forms and Methods [time estimate]				
		Indicator	Techniques & Criteria	Offline				
1	2	3	4	5				
1	Able to solve concepts and applications of complex numbers and functions as a whole (CPMK-1)	Formative: Skilled in algebraic operations of complex numbers and presenting them in geometric forms, powers and roots Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (2) dinilai dengan rubrik 1 Assessment Technique: Non Test	Studying: Case Study (Case Study) 1 x 3 x 50" Other Forms: Self-Directed Learning - Reading Complex Analysis Material at Sikola on Week 1 Learning Flow - Practice doing the exercises in Complex Analysis 1 x 3 x 60"				

2	Able to apply complex differentiation concepts and applications using the Cauchy-Riemann equation (CPMK-1)	Formative: • Skilled in applying the Cauchy-Riemann criteria analyzing a complex function • Skilled in applying these criteria in potential function cases and stream functions Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Quiz dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (2) dinilai dengan rubrik 1 Project/Case Study (6) dinilai dengan rubrik 1 Assessment Technique: Test and Non-Test	Studying: Case Study (Case Study) 1 x 3 x 50" Other Forms: Self-Directed Learning • Reading Cauchy-Riemann Material Equation in Sikola in Week 2 Learning Flow • Practice doing the exercises in Complex Analysis 1 x 3 x 60"
3	Able to demonstrate the concepts and applications of logarithmic and exponential functions, hyperbolic and trigonometric functions (CPMK-1)	Formative: Skilled in analyzing complex functions in logarithmic, exponential, hyperbolic and trigonometric forms Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (2) dinilai dengan rubrik 1 Assessment Technique: Non Test	Studying: Case Study (Case Study) 1 x 3 x 50" Other Forms: Self-Directed Learning • Reading Exponential and Logarithmic Material Functions and Trigonometric and Hyperbolic Functions at Sikola in Week 3 Learning Flow • Practice doing the exercises in Exponential and Logarithmic Functions and Trigonometric and Hyperbolic Functions 1 x 3 x 60"

4	Able to solve complex integral concept and application problems in general cases (CPMK-1)	Formative: Skilled in using line integrals and contour integrals in complex integrals Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (2) dinilai dengan rubrik 1 Assessment Technique: Non Test	Studying: Case Study (Case Study) 1 x 3 x 50" Other Forms: Self-Directed Learning - Reading complex integrals in Sikola on Alur Week 4 Learning - Practice doing the exercises in integral complex 1 x 3 x 60" Other Forms: Case Study (Case Study) Work in groups on the case study given regarding complex integrals 1 x 3 x 60"
5	Demonstrate the concept and application of series and residues in general cases (CPMK-1)	Formative: Skilled in applications of power and Laurent series and residual integrals for vector fields Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (2) dinilai dengan rubrik 1 Assessment Technique: Non Test	Studying: Case Study (Case Study) 1 x 3 x 50" Other Forms: Self-Directed Learning - Reading Series and Residues in Sikola in Week 5 Learning Flow - Practice doing the exercises in the Series and Residue 1 x 3 x 60"
6-7	Demonstrate complex analysis concepts in a case study (CPMK-1)	Formative: Skilled in applying all concepts in complex analysis of geophysical problems Sumative: -	Formative Criteria: Presentation dinilai dengan rubrik 3 Report dinilai dengan rubrik 2 Sumative Criteria: Project/Case Study (14) dinilai dengan rubrik 2 Assessment Technique: Test	Seminar: Group discussion (Small Group Discussion) 2 x 3 x 100" Other Forms: Self-Directed Learning Revise input on presentations and reports 2 x 3 x 60"

7	Demonstrate complex analysis concepts in a case study (CPMK-1)	Formative: - Sumative: -	Formative Criteria: Sumative Criteria: Project/Case Study (14) dinilai dengan rubrik 1 Assessment Technique: Non Test	
8	Demonstrate the concept and application of vectors in geometric and coordinate system problems (CPMK-2)	Formative: Skilled in vector applications for dot product, cross product and coordinate transformations (Cartesian, cylindrical and spherical) for magnetic/electric fields Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (2) dinilai dengan rubrik 1 Assessment Technique: Non Test	Studying: Case Study (Case Study) 1 x 3 x 50" Other Forms: Self-Directed Learning - Reading Vectors in Sikola on Flow Week 8 Learning - Practice doing the exercises in Vectors 1 x 3 x 60" Other Forms: Other methods - Work in groups on the case study given regarding Vectors 1 x 3 x 60"
9	Demonstrate the concept and application of matrices to a function or signal (CPMK-2)	Formative: Skilled in solving matrix operations, special matrices and matrix inversion methods for non-symmetric elements Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Written Test dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (2) dinilai dengan rubrik 1 Project/Case Study (12) dinilai dengan rubrik 1 Assessment Technique: Test and Non-Test	Studying: Case Study (Case Study) 1 x 3 x 50" Other Forms: Self-Directed Learning - Reading Matrices at Sikola on Week 9 Learning Flow - Practice doing the exercises in Matrices 1 x 3 x 60" Other Forms: Case Study (Case Study) Work in groups on case studies given regarding Matrices 1 x 3 x 60"

10	Demonstrate the concept and application of Systems of Linear Equations for specific data cases (CPMK-2)	Formative: Skilled in solving systems of linear equations for singular, underdetermined, overdetermined and Gauss(ian) elimination cases Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (2) dinilai dengan rubrik 1 Assessment Technique: Non Test	Studying: Case Study (Case Study) 1 x 3 x 50" Other Forms: Self-Directed Learning - Reading Systems of Linear Algebraic Equations in Sikola in Week 10 Learning Flow - Practice doing the exercises in the System of Linear Algebraic Equations 1 x 3 x 60" Other Forms: Case Study (Case Study) Work in groups on case studies given regarding Systems of Linear Algebraic Equations 1 x 3 x 60"
11-12	Demonstrate the concept and application of vector derivatives in the case of electric and magnetic fields (CPMK-2)	Formative: Skilled in the application of gradient, divergence and curl vectors to the solution of electric and magnetic field equations Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Quiz dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (2) dinilai dengan rubrik 1 Project/Case Study (6) dinilai dengan rubrik 1 Assessment Technique: Test and Non-Test	Studying: Case Study (Case Study) 2 x 3 x 50" Other Forms: Self-Directed Learning - Reading Vector Calculus (Derivatives, Vector Functions, Velocity and Acceleration, Divergence and Curl) at Sikola in the 11th to 12th Week Learning Flow - Practice doing the exercises in Vector Calculus (Derivatives, Vector Functions, Velocity and Acceleration, Divergence and Curl) 2 x 3 x 60" Other Forms: Case Study (Case Study) Work in groups on case studies related to Vector Calculus (Derivatives, Vector Functions, Velocity and Acceleration, Divergence and Curl) 2 x 3 x 60"
13-14	Demonstrate the concept and application of vector integrals on a path, area and volume (CPMK-2)	Formative: Skilled in the application of Line Integrals, Double Integrals, Green's Theorem, Surface Integrals, Stoke's Theorem, Triple Integrals, Divergence Theorem for space and time fields in certain cases (example: Heat Equation) Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (2) dinilai dengan rubrik 1 Assessment Technique: Non Test	Studying: Case Study (Case Study) 2 x 3 x 50" Other Forms: Self-Directed Learning - Reading Vector Calculus (Line Integrals and Path Independence, Double Integrals, Green's Theorem, Surface Integrals, Stoke's Theorem, Triple Integrals and Divergence Theorem) at Sikola in Flow - Practice doing the exercises in Vector Calculus (Line Integrals and Path Independence, Double Integrals, Green's Theorem, Surface Integrals, Stoke's Theorem, Triple Integrals and Divergence 2 x 3 x 60"

15-16	Demonstrate vector concepts and vector calculus in a case study (CPMK-2)	Formative: Skilled in applying all vector concepts and vector calculus to geophysical problems Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 3 Report dinilai dengan rubrik 2 Sumative Criteria: Project/Case Study (14) dinilai dengan rubrik 2 Assessment Technique: Test	Seminar: Group discussion (Small Group Discussion) 2 x 3 x 100" Other Forms: Self-Directed Learning Revise input on presentations and reports 2 x 3 x 60"
16	Demonstrate vector concepts and vector calculus in a case study (CPMK-2)	Formative: - Sumative: -	Formative Criteria: Sumative Criteria: Project/Case Study (14) dinilai dengan rubrik 1 Assessment Technique: Non Test	

Matrix of SLO, CLO, and Assessment Method

SLO / CLO	CLO-1	CLO-2
CPL-5 (P2)	Project/Case Study (Weight 2%) Project/Case Study (Weight 8%) Project/Case Study (Weight 2%) Project/Case Study (Weight 2%) Project/Case Study (Weight 2%) Project/Case Study (Weight 28%)	
CPL-11 (KK1)		Project/Case Study (Weight 2%) Project/Case Study (Weight 14%) Project/Case Study (Weight 2%) Project/Case Study (Weight 8%) Project/Case Study (Weight 2%) Project/Case Study (Weight 28%)

Evaluation Type and Assessment Weight

Type	Assessment Weight
Project/Case Study	100
Total	100

Assessment and Evaluation of Student Achievement of CLOs

SLOs that are charged on the Course	CLO	SUB CLO	Form of Assessment*		Weight	Value	Student Score
			Formative	Sumative			
				Project/Case Study			
SLO-5	CLO-1	SUB-CLO-1	Participation	2	2		
SLO-5	CLO-1	SUB-CLO-2	Participation and Quizzes	8	8		
SLO-5	CLO-1	SUB-CLO-3	Participation	2	2		
SLO-5	CLO-1	SUB-CLO-4	Participation	2	2		
SLO-5	CLO-1	SUB-CLO-5	Participation	2	2		
SLO-5	CLO-1	SUB-CLO-6	Presentations and Reports	28	28		
SLO-11	CLO-2	SUB-CLO-7	Participation	2	2		
SLO-11	CLO-2	SUB-CLO-8	Participation and Written Test	14	14		
SLO-11	CLO-2	SUB-CLO-9	Participation	2	2		
SLO-11	CLO-2	SUB-CLO-10	Participation and Quizzes	8	8		
SLO-11	CLO-2	SUB-CLO-11	Participation	2	2		
SLO-11	CLO-2	SUB-CLO-12	Participation and Reports	28	28		
				100	100		

Lampiran Rubrik 1 | Rubrik Holistik

Tabel 6. 1 Rubrik Holistik		
Grade Capaian	Skor	Uraian
Sangat Baik	≥ 85	Memperlihatkan pemahaman yang lengkap tentang permasalahan. Semua metode dan persyaratan tentang tugas terdapat dalam jawaban
Baik	71 - 84	Memperlihatkan cukup pemahaman tentang permasalahan. Semua persyaratan tentang tugas terdapat dalam jawaban
Cukup Baik	61 - 70	Memperlihatkan hanya sebagian pemahaman tentang permasalahan. Kebanyakan persyaratan tentang tugas terdapat dalam jawaban
Kurang	51 - 60	Memperlihatkan sedikit pemahaman tentang permasalahan. Banyak persyaratan tugas yang tidak ada
Sangat kurang	< 51	Memperlihatkan tidak ada pemahaman tentang permasalahan

Lampiran Rubrik 2 | Rubrik analitik makalah (kelompok atau individu)

Kriteria/Dimensi	Penilaian mahasiswa					Nilai masing masing kriteria
	Sangat baik	Baik	Cukup	Kurang	Sangat kurang	
	Skor ≥ 85	Skor 71 - 84	Skor 61 - 70	Skor 51 - 60	Skor 41 - 50	
Sistematika Laporan – SL	laporan dibuat sesuai sistematisa penulisan yang dijelaskan di detail tugas	laporan dibuat dengan benar tetapi kurang jelas	laporan dibuat cukup benar dan kurang jelas	laporan dibuat kurang benar dan kurang jelas	laporan dibuat dengan sistematisa yang tidak sesuai yang diminta	10 %
Kelengkapan Laporan - KL	laporan dibuat secara lengkap sesuai petunjuk pembuatan laporan	laporan dibuat tanpa referensi dalam laporan	laporan dibuat tanpa referensi dalam laporan dan kesimpulan	laporan dibuat tanpa referensi dalam laporan, kesimpulan dan daftar pustaka	laporan dibuat tanpa referensi dalam laporan, kesimpulan, daftar pustaka dan lampiran yang diperlukan	20 %
Kejelasan dan keruntutan penulisan –JR	laporan jelas, dapat dipahami, ditulis secara runtut	laporan jelas, tetapi penulisan kurang runtut	laporan cukup jelas, cukup sesuai dengan keruntutan penulisan, tapi ada beberapa ketidak teraturan	laporan kurang jelas, kurang sesuai dengan keruntutan penulisan	laporan tidak jelas, tidak sesuai dengan keruntutan penulisan	20 %
Validitas Referensi – VR	Mencantumkan referensi yang valid di setiap paragraf, rumus, tabel dan gambar	Mencantumkan referensi yang valid tapi di beberapa paragraf, rumus, tabel dan gambar	Ada beberapa referensi yang kurang valid, walau lengkap tercantum di semua paragraf, rumus, tabel dan gambar	Lebih banyak referensi yang kurang valid, kurang tercantum di paragraf, rumus, tabel dan gambar	Tidak menggunakan referensi yang valid dan dominan tidak dicantumkan di setiap paragraf tabel, rumus dan gambar	20%
Kebenaran konsep ide yang dipaparkan – KI	konsep/ide yang dipaparkan tepat, benar, dan sesuai dengan teori	konsep/ide yang dipaparkan sesuai dengan teori tetapi kurang jelas	konsep/ide yang dipaparkan cukup	konsep/ide yang dipaparkan kurang tepat	konsep/ide yang dipaparkan tidak tepat	30 %