

	UNIVERSITAS PENDIDIKAN INDONESIA
	SEMESTER LEARNING PLAN (RPS)

COURSE IDENTITY

Course Name	Course Code	Credits	Workload	Course Group	Semester	Prerequisite Course
RADAR REMOTE SENSING	SA514	2	90	Study Programme Core Competency Course (MKKP)	5	Basic Remote Sensing

Prepared by Course Lecturer	Reviewed by Study Programme QA Team	Approved by Head of Study Programme
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COURSE DESCRIPTION AND GRADUATE LEARNING OUTCOMES (CPL)

Course Description	This is an advanced course for students of the Geographic Information Science programme, examining the science and techniques involved in studying one of the latest active remote sensing mapping technologies: Radar imagery. The Radar Remote Sensing course consists of theory and practicum sessions. The methods employed include lectures, Q&A, assignments, practicum, and field visits. Assignments take the form of problem-solving exercises using spatial analysis and case studies conducted in groups.
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Graduate Learning Outcomes (CPL) Assigned to This Course

No.	Graduate Learning Outcomes (CPL) Assigned to This Course
1	To possess a good understanding of the main objectives of active remote sensing.
2	To be capable of understanding the theoretical foundations and methods of active remote sensing systems.
3	To have experience in processing Radar imagery for mapping purposes.
4	To be capable of analysing and interpreting spatial data using geographic science and technology.
5	To be capable of presenting processed data and analysis results as readily comprehensible information.

Course Learning Outcomes (CPMK)

No.	Course Learning Outcomes (CPMK)
1	To be capable of explaining the basic principles of active remote sensing: Radar and its

	systems.
2	To be capable of explaining the basic theory of electromagnetic waves for Radar.
3	To be capable of explaining the concepts and theory of active remote sensing systems.
4	To be capable of explaining the concept of Acquisition Geometry.
5	To be capable of understanding Platform, Radiation, Spectrum, Frequency, Polarimetry, and Interferometry.
6	To be capable of explaining the basic concepts of Radar Interferometry.
7	To be capable of processing Radar imagery data.
8	To be capable of applying several active RS system applications in the field of mapping.

Sub-CPMK

N o.	CPMK Ref.	Sub-CPMK Formulation
1	CPMK - 1	Course regulations (RPS) for Radar Remote Sensing and basic concepts of Radar.
2	CPMK - 2	To understand the functions and theory of Phase, Amplitude, and wavelength.
3	CPMK - 2	Radar Conventions: Microwave spectrum and Band Propagation.
4	CPMK - 3	Radar frequency theory and Radar wave polarisation.
5	CPMK - 3	Sensors and image models of active remote sensing systems.
6	CPMK - 4	Acquisition Geometry, Displacement, and Relief Correction.
7	CPMK - 5	Platform, Radiation, Spectrum, Frequency, Polarimetry, and Interferometry.
8	CPMK - 7	Processing stages: Geocoding, Radiometric Calibration, Segmentation and Classification, and Speckle Filtering.
9	CPMK - 7	To understand SAR data processing.
10	CPMK - 8	Applications of Radar (SAR) image processing: DEM, topographic maps, and deformation.
11	CPMK - 6	Comparison of Radar systems: Real Aperture Radar (RAR) vs Synthetic Aperture Radar (SAR).
12	CPMK - 1	Applications of Radar image processing for DEM, topographic maps, and deformation.

Course Materials

N o.	Course Materials
1	Introduction to Radar remote sensing systems.
2	Basic Radar signals: Phase and Amplitude.
3	Microwave spectrum in Remote Sensing.
4	Wave propagation and frequency band characteristics.
5	Acquisition Geometry, Displacement, and Relief Correction.
6	Active sensor systems, Radar image models, and comparison of SAR and RAR.
7	Sensor platforms, radiation patterns, frequency, and interferometry.

8	Radar image processing: Geocoding, Radiometric Calibration, Segmentation and Classification, and Speckle Filtering.
9	Radar image data processing for DEM and topographic map production.
10	SAR image processing using the InSAR method for deformation studies.
11	Radar image data processing for paddy field mapping.
12	Project: SAR imagery applications in various fields.

Demonstrable Learning Outcomes at the End of the Course	Map products from Radar image processing.
Learning Strategy	Case Method ✓ Team-based Project Other
General Description of Learning Steps	The basic concepts of Radar mapping (active RS system) will be introduced. Discussion will cover the components, equipment, and systems of Radar and their utilisation, particularly for data acquisition, identification, frequency, and polarisation of Radar data. Data collection methods, data types, and mathematical equations in Radar are discussed in lectures, discussions, and classroom presentations. To enhance understanding and gain experience in processing Radar imagery and InSAR, students are also presented with case studies on the utilisation of Radar data and its processing for mapping.
References	1. Robert M. O'Donnell. Radar Fundamentals. Lincoln Lab – MIT USA. 2. Merrill I. Skolnik. 2008. Introduction to Radar Systems. McGraw-Hill International Editions. 3. Radargrammetric Image Processing. 1990. Franz W. Leberl. 4. SAR Guide Book. www.sarmap.ch 5. E-Learning RADAR. SAREdu. https://saredu.dlr.de/ 6. Lectures by Josaphat Tetuko with LAPAN RI. https://www.youtube.com/channel/UC43Z6oscAz_m4KvxLHKa_nQ 7. Introduction to Synthetic Aperture Radar. https://www.youtube.com/watch?v=CVa6nAzGn7Q&feature=emb_logo 8. SAR Processing Stages. https://www.youtube.com/watch?v=ae4t324H1r4

LEARNING PLAN

Week	Sub-CPMK	Sub-CPMK Achievement Indicators	Course Materials	Assessment Form (test/no n-test)	Assessment Weight (%)	Synchronous (face-to-face and virtual)	Asynchronous (individual and group assignments)	Duration	Reference No.	Access Time
1	Course regulations (RPS) for Radar Remote Sensing and basic concepts of Radar.	To understand the course overview and applicable regulations.	Introduction to Radar remote sensing systems.	Participatory	5	Face-to-face; Expository with interactive media	Independent material exploration	2×50	1	03-09-2024 11:25
2	To understand the functions and theory of Phase, Amplitude, and wavelength.	To explain the basic principles of active remote sensing: Radar and its systems; functions and theory of Phase, Amplitude, and wavelength.	Basic Radar signals: Phase and Amplitude.	Essay	5	Face-to-face; Expository with interactive media	Independent material exploration	2×50	1	10-09-2024 10:35
3	Radar Conventions: Microwave spectrum and Band Propagation.	To explain the Microwave spectrum and Band Propagation.	Microwave spectrum in Remote Sensing.	Essay	5	Face-to-face; Expository with interactive media	Independent material exploration	2×50	2	17-09-2024 10:20
4	Radar frequency theory and Radar wave polarisation.	To explain Radar frequency theory and Radar wave polarisation.	Wave propagation and frequency band characteristics.	Essay	5	Face-to-face; Expository with interactive media	Independent material exploration	2×50	2	24-09-2024 10:20
5	Acquisition Geometry, Displacement, and Relief Correction.	To understand the fundamentals of radargrammetry: geometry, slope, relief displacement, and SLR.	Acquisition Geometry, Displacement, and Relief Correction.	Essay	5	Face-to-face; Expository with interactive media	Independent material exploration	2×50	2	01-10-2024 10:20
6	Sensors and image models of active remote sensing systems.	To explain sensors, Radar image models, and the comparison of SAR with RAR.	Active sensor systems, Radar image models, and comparison of SAR and RAR.	Essay	5	Face-to-face; Expository with interactive	Independent material exploration	2×50	2	08-10-2024 10:20

						media				
7	Platform, Radiation, Spectrum, Frequency, Polarimetry, and Interferometry.	To explain the platforms used, radiation patterns, spectrum, frequency, and various techniques for obtaining additional information from objects on the Earth's surface.	Sensor platforms, radiation patterns, frequency, and interferometry.	Essay	10	Face-to-face; Expository with interactive media	Independent material exploration	2×50	2	15-10-2024 08:40
8	MID-SEMESTER EXAMINATION (UTS)									10
9	To understand SAR data processing.	To understand SAR data processing.	Radar image processing: Geocoding, Radiometric Calibration, Segmentation and Classification, Speckle Filtering.	Multiple Choice	5	Face-to-face; Expository with interactive media	Independent processing with provided module	2×50	1	29-10-2024 08:20
10	Applications of Radar (SAR) image processing: DEM, topographic maps, and deformation.	To perform Radar image data processing for DEM and topographic map production.	Radar image data processing for DEM and topographic map production.	Essay	5	Face-to-face; Expository with interactive media	Independent material exploration	2×50	1	05-11-2024 08:20
11	To understand SAR data processing.	To apply SAR image processing using the InSAR method for deformation studies.	SAR image processing using the InSAR method for deformation studies.	Performance	5	Face-to-face; Expository with interactive media	Independent material exploration	2×50	4	12-11-2024 08:40
12	Applications of Radar (SAR) image processing: DEM, topographic maps, and deformation.	To apply SAR image processing using the InSAR method for deformation studies.	SAR image processing using the InSAR method for deformation studies.	Performance	5	Face-to-face; Expository with interactive media	Independent processing with provided module	2×50	6	12-11-2024 10:20
13	Applications of Radar image processing for DEM, topographic maps, and deformation.	To perform Radar image data processing for paddy field mapping.	Radar image data processing for paddy field mapping.	Performance	5	Face-to-face; Expository with interactive media	Independent processing with provided module	2×50	6	26-11-2024 10:20
14	To understand SAR data processing.	To apply SAR image processing for various fields.	Project: SAR imagery applications in various fields.	Performance	5	Face-to-face; Expository with	Independent processing with provided module	2×50	5	03-12-2024 10:20

						interactive media				
15	Applications of Radar (SAR) image processing: DEM, topographic maps, and deformation.	To apply SAR image processing for various fields.	Project: SAR imagery applications in various fields.	Performance	5	Face-to-face; Expository with interactive media	Independent processing with provided module	2×50	4	10-12-2024 10:20
16	FINAL SEMESTER EXAMINATION (UAS)									15

STUDENT STUDY TIME (WORKLOAD)

Category	Activity	Synchronou s	Asynchrono us	Total (min/hrs)
Learning	Lectures/Tutorials	14×90 min = 1,260 min	-	1,260 min (21.0 hrs)
	Project-based Learning	-	8×90 min = 720 min	960 min (16.0 hrs)
	Discussion (case-based)	8×60 min = 480 min	-	720 min (12.0 hrs)
SUBTOTAL				2,940 min (49.0 hrs)
Assessment	Participation during learning	16×60 min = 960 min	-	960 min (16.0 hrs)
	Project work	-	8×90 min = 720 min	720 min (12.0 hrs)
	Assignments	-	8×60 min = 480 min	480 min (8.0 hrs)
	Quizzes	4×30 min = 120 min	-	120 min (2.0 hrs)
	Formative			90 min (1.5 hrs)
	Summative			90 min (1.5 hrs)
SUBTOTAL				2,460 min (41.0 hrs)
TOTAL WORKLOAD				5,400 min (90 hrs)
Credits				2
Conformity with Credit Hours	CONFORMS			

CPMK ASSESSMENT CRITERIA

N o .	CPMK	CP L Tax on om y	Weig ht	Achievement Criteria
1	To be capable of explaining the basic principles of active remote sensing: Radar and its systems.	2	10	75% of all students obtain a minimum score of 65 (on a scale of 100).
2	To be capable of explaining the basic theory of electromagnetic waves for Radar.	2	10	75% of all students obtain a minimum score of 65 (on a scale of 100).
3	To be capable of explaining the concepts and theory of active remote sensing systems.	2	10	75% of all students obtain a minimum score of 65 (on a scale of 100).
4	To be capable of explaining the concept	2	5	75% of all students obtain a

	of Acquisition Geometry.			minimum score of 65 (on a scale of 100).
5	To be capable of understanding Platform, Radiation, Spectrum, Frequency, Polarimetry, and Interferometry.	3	20	75% of all students obtain a minimum score of 65 (on a scale of 100).
6	To be capable of explaining the basic concepts of Radar Interferometry.	2	0	75% of all students obtain a minimum score of 65 (on a scale of 100).
7	To be capable of processing Radar imagery data.	2	15	75% of all students obtain a minimum score of 65 (on a scale of 100).
8	To be capable of applying several active RS system applications in the field of mapping.	3	30	75% of all students obtain a minimum score of 65 (on a scale of 100).

COLLABORATIVE ASSIGNMENT PLAN

Course Name	Course Code	Credits	Workload	Course Group	Semester	Prerequisite Course
RADAR REMOTE SENSING	SA514	2	90	Study Programme Core Competency Course (MKKP)	5	Basic Remote Sensing

Assignment Title	Radar Image Data Processing for DEM Production
Learning Method	Team-based Project
Duration (minutes)	
Assessment Weight	55
Sub-CPMK	Sub-CPMK not yet selected.
Assignment Description	Processing Radar image data for DEM production.
Assignment Steps	Module available at the following link: https://drive.google.com/drive/folders/1nYjQXsGH02IYe5eGX1iFcQzygItT591B
Final Output	- Digital Elevation Model (DEM): Raster DEM in GeoTIFF (.tif) format with surface elevation data; specified spatial resolution (e.g., 10 m or as per interferogram results); having undergone correction processes (e.g., phase unwrapping, terrain correction). - Practicum Report: Comprising: objectives and background; data and software used (e.g., SNAP, GMTSAR, or LiCSBAS); data processing steps (Sentinel-1 SLC download, co-registration, interferogram generation, phase filtering, phase unwrapping, DEM generation); interpretation of DEM results and comparison with a reference (e.g., SRTM/ASTER); DEM quality evaluation (RMSE, noise, artefacts). - Images and Visualisations: DEM map in JPEG/PNG format or displayed in QGIS/ArcGIS; 3D terrain visualisation (optional, e.g., using Blender or ArcScene); DEM overlay with topographic map or orthophoto.
Indicators, Criteria, and Assessment Weight	Assessment of the Sentinel-1 Radar Image Data Processing practicum for DEM production is based on several proportionally weighted

	indicators: accuracy in data collection and processing (20%), quality of the produced DEM (25%), completeness and neatness of visualisations and maps (10%), systematic quality of the practicum report (20%), analytical and interpretive capability (15%), timeliness of submission (5%), and creativity or additional initiative such as 3D visualisation or advanced DEM analysis (5%).
Implementation Schedule	Activity: Radar Image Data Processing — 2×50 minutes.
Other Notes	If the practicum is conducted in groups, the output may also include a task allocation log, activity log, and group discussion records. Practicum Reflection (if requested): challenges encountered during Radar data processing; comparison between Radar-derived DEM and optically derived DEM; benefits of Radar-derived DEM for geospatial studies (e.g., geomorphology, disaster mitigation).

REFERENCES

1. E-Learning RADAR. SAREdu. <https://saredu.dlr.de/>