SEMESTER COURSE OUTLINE
& LESSON PLANS
SECOND SEMESTER
2022/2023

Agricultural Microbiology Major

Department of Agricultural Microbiology

Soil and Plant Microbiology

PNM20192210

Team Teaching:

Ir. Donny Widianto, Ph.D.

M. Saifur Rohman, S.P., M.Si., M.Eng., Ph.D.

Ir. Ngadiman, M.Si., Ph.D.

UNIVERSITAS GADJAH MADA
FACULTY OF AGRICULTURE
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	Universitas Gadjah Mada Faculty of Agriculture Department of Agricultural Microbiology Second Semester of 2022/2023	**Document Code:**

RENCANA PROGRAM DAN KEGIATAN PEMBELAJARAN SEMESTER (RPKPS)
SEMESTER COURSE OUTLINE & LESSON PLANS

Kode Mata Kuliah *Course Code*	**Nama Mata Kuliah** *Course Name*	**Bobot (sks)** *Credits*		**Semester** *Semester*	**Status Mata Kuliah** *Course Status*	**Mata Kuliah Prasyarat** *Prerequisite Courses*
PNM20192210	*Mikrobiologi Tanah dan Tanaman* *Soil and Plant Microbiology*	*T: 2*	*P: 1*	*Second semester*	*Wajib* *Compulsory*	*Biologi Mikroorganisme* *Biology of Microorganisms*

Deskripsi Singkat Mata Kuliah ***Course Overview***		Mata kuliah Mikrobiologi Tanah dan Tanaman merupakan mata kuliah yang dikhususkan bagi mahasiswa program studi Mikrobiologi Pertanian, Departemen Mikrobiologi Pertanian, Fakultas Pertanian. Mata kuliah ini ini mempelajari tentang keberadaan, peranan dan hubungan timbal balik antara mikrobia yang menempati tubuh tanah dengan kesuburan tanah dan kualitas lingkungan. *Soil and Plant Microbiology is a course designed specifically for students from Agricultural Microbiology study program, Department of Agricultural Microbiology, Faculty of Agriculture. This course studies the existence, role and interactions between microorganism that inhabit soil bodies with soil fertility and environmental quality.*
Capaian Pembelajaran Lulusan Program Studi (CPL) ***Program Learning Outcome (PLO)***	***CPL1*** ***PLO1***	Mampu menjelaskan konsep teoritis biologi mikroorganisme serta mengembangkan teknologi berbasis mikroba untuk meningkatkan produksi tanaman dan layanan lingkungan (P2) *Able to explain theoretical concepts of biology microorganism and develop microbial-based technology to increase plant production and environmental services (K2).*
	CPL2 ***PLO2***	Mampu menguraikan metodologi mutakhir di bidang mikrobiologi untuk mewujudkan pembangunan pertanian yang ramah lingkungan dan berkelanjutan (P3) *Able to describe the latest methodology in the field of microbiology to create environmentally friendly and sustainable agricultural development (K3).*
	CPL3 ***PLO3***	Mampu memilih, memanfaatkan, dan mengelola potensi mikroba dan mikrobioma untuk membangun sistem industri dan pertanian (KK3) *Able to select, utilize and manage the potential of microbes and microbiomes to build industrial and agricultural systems (S3).*
Capaian Pembelajaran	**Setelah menyelesaikan pembelajaran mata kuliah ini, mahasiswa diharapkan mampu:** ***After completing this course, students are expected to be able:***	

Mata Kuliah (CPMK) ***Course Learning Outcomes (CLO)***	***CPMK1*** ***CLO1***	Mahasiswa mampu menjelaskan mengenai konsep dasar mikrobiologi tanah serta peranan dan dampaknya pada lingkungan [CPL 1] *Students can explain the fundamental concepts of soil and plant microbiology, as well as their role and impact on the environment* [PLO 1] K2		
	CPMK2 ***CLO2***	Mahasiswa mampu mengidentifikasi keragaman mikrobia pada tanah dan lingkungan serta menguasai metode deteksinya [CPL 2] *Students can identify the soil microbial diversity and master the method of detection [PLO 2]* K3		
	CPMK 3 ***CLO3***	Mahasiswa mampu menjelaskan teknologi yang digunakan dalam pengelolaan pencemaran limbah pada tanah dan lingkungan [CPL 3] *Students can explain about the technologies used for waste management in soil and environment* [PLO 3] S3		
Kaitan CPMK dengan Materi dan Bentuk Pembelajaran, serta Alokasi Waktu ***Correlation among CLO, the material, learning method and estimated time***		**Materi Pembelajaran** ***Course Materials***	**Bentuk Pembelajaran (Luring/Daring)** ***Course Methos (Offline/Online)***	**Alokasi Waktu** ***Estimated Time***
	CPMK1 ***CLO1***	1. Pendahuluan: Pengertian mikrobiologi tanah & Tanaman; Sejarah mikrobiologi tanah & tanaman; Ruang lingkup mikrobiologi Tanah & Tanaman. 1. *Introduction: Definition, History and Scope of Soil and Plant Microbiology*	Kuliah Interaktif dan kuis Praktikum *Interactive lectures and quiz* *Labwork*	2 x 45 menit kuliah sinkron 10 menit kuis 2 x 50 menit praktikum *2 x 45 minutes of synchronous lectures* *10 minutes of quiz* *2 x 50 menit labwork*
	CPMK1 ***CLO1***	2. Tanah sebagai Habitat Mikrobia: Komponen tanah (padat, cair, dan gas), faktor lingkungan yang mempengaruhi kehidupan mikrobia Tanah & Tanaman, Penyebaran	Kuliah Interaktif Praktikum	2 x 50 menit kuliah sinkron

		mikrobia dalam Tanah & Tanaman 2. *Soil as Microbial Habitat: Component of soil (solid, liquid and gas), Environmental factors affecting soil and plant life, microbial distribution in soil and plants*	*Interactive lectures* *Labwork*	*2 x 50 minutes of synchronous lectures* *2 x 50 minutes of labwork*
	CPMK1 ***CLO1***	3. Komponen Mikrobia Tanah: Macam dan pengelompokan mikrobia Tanah & Tanaman, Aktivitas mikrobia Tanah & Tanaman, Peranan mikrobia Tanah & Tanaman, interaksi mikro Tanah & Tanaman 3. *Components of Soil Microbes: types and classification of soil and plant microbes, the activity of soil and plant microbes, the role of soil and plant microbes, and micro-interactions of soil and plant microbes*	Kuliah Interaktif Praktikum *Interactive lectures* *Labwork*	2 x 50 menit kuliah sinkron 2 x 50 menit praktikum *2 x 50 minutes of synchronous lectures* *2 x 50 minutes of labwork*
	CPMK1 ***CLO1***	4. Pengantar Daur Unsur didalam Tanah: Daur unsur dalam tanah, keterkaitan daur, faktor lingkungan yang mempengaruhi daur unsur. 4. *Introduction to Biogeochemical Cycles in Soil: biogeochemical cycles in soil, cycle linkages, and environmental factors affecting the biogeochemical cycles.*	Kuliah Interaktif Praktikum *Interactive lectures* *Labwork*	2 x 50 menit kuliah sinkron 2 x 50 menit praktikum *2 x 50 minutes of synchronous lectures*

				2 x 50 minutes of labwork
	CPMK1 ***CLO1***	5. Dinamika Bahan Organik: Bahan organik dan sifat-sifatnya, siklus karbon, perombakan bahan organik, teknologi pengomposan. 5. *Organic Material Dynamics: organic matter and its properties, organic matter decomposition and composting technology*	Kuliah Interaktif dan kuis Praktikum *Interactive lectures and quiz* *Labwork*	2 x 45 menit kuliah sinkron 10 menit kuis 2 x 50 menit praktikum *2 x 45 minutes of synchronous lectures* *10 minutes of quiz* *2 x 50 menit labwork*
	CPMK2 ***CLO2***	6. Daur Unsur Fosfor: Keberadaan unsur P dalam tanah, daur P di alam, mikrobia pelarut fosfat, mikoriza, faktor-faktor lingkungan yang mempengaruhi ketersediaan P. 6. *The Phosphorus Cycle: the presence of P in soil, P cycle in nature, phosphate solubilizing microbes, mycorrhiza, environmental factors affecting the availability of P.*	Kuliah Interaktif Praktikum *Interactive lectures* *Labwork*	2 x 50 menit kuliah sinkron 2 x 50 menit praktikum *2 x 50 minutes of synchronous lectures* *2 x 50 minutes of labwork*

	CPMK2 ***CLO2***	7. Daur Unsur Nitrogen I: Daur nitrogen, mineralisasi N, imobilisasi N, nitrifikasi, denitrifikasi, faktor- faktor yang mempengaruhi nitrifikasi dan denitrifikasi, dampak nitrifikasi dan denitrifikasi terhadap lingkungan. 7. *The Nitrogen Cycle I: nitrogen cycle, N mineralization, N immobilization, nitrification, denitrification, factors affecting nitrification and denitrification, effects of nitrification and denitrification on the environment.*	Kuliah Interaktif Praktikum *Interactive lectures* *Labwork*	2 x 50 menit kuliah sinkron 2 x 50 menit praktikum *2 x 50 minutes of synchronous lectures* *2 x 50 minutes of labwork*
	UTS/Hasil Tugas Project/Hasil Analisis Kasus ***Mid Exam/Project Results/Case Study Results***			
	CPMK2 ***CLO2***	8. Daur Unsur Nitrogen II: Penambatan nitrogen secara simbiotik dan non simbiotik, mikrobia penambat nitrogen, faktor-faktor lingkungan yang mempengaruhi penambatan nitrogen. 8. *The Nitrogen Cycle II: symbiotic and non-symbiotic nitrogen fixation, nitrogen-fixing microbes, environmental factors affecting nitrogen fixation*	Kuliah Interaktif *Interactive lectures*	2 x 50 menit kuliah sinkron *2 x 50 minutes of synchronous lectures*
	CPMK2 ***CLO2***	9. Daur Unsur Belerang: Keberadaan senyawa S dalam tanah, daur S oleh mikrobia tanah, faktor-faktor lingkungan yang mempengaruhi daur S.	Kuliah Interaktif *Interactive lectures*	2 x 50 menit kuliah sinkron

		9. *The Sulfur Cycle: the presence of S compound in soil, S cycle by soil microbes, environmental factors affecting S cycle*		*2 x 50 minutes of synchronous lectures*
	CPMK2 ***CLO2***	10. Alih Rupa Unsur-unsur Logam (dan daur unsur mikro): Keberadaan sampel unsur logam (unsur mikro) dalam tanah, alih rupa unsur-unsur logam oleh mikrobia tanah, faktor-faktor lingkungan yang mempengaruhi alih rupa untur-unsur logam dalam tanah. 10. *Alteration of Metal Elements (Micro-Element Cycle): the presence of metal elements in soil, alteration of metal elements by microbes, environmental factors affecting metal elements alteration in soil*	Kuliah Interaktif *Interactive lectures*	2 x 50 menit kuliah sinkron *2 x 50 minutes of synchronous lectures*
	CPMK3 ***CLO3***	11. Pemanfaatan Mikrobia Tanah: Sebagai pupuk hayati, sebagai agen pengendali hayat, sebagai agen biodegradasi dan bioremediasi, sebagai penghasil biomassa dan bioenergi, mikrobia dalam perubahan global. 11. *Utilization of Soil Microbes: as a biofertilizer, biocontrol agent, biodegradation and bioremediation agent, producer of biomass and bioenergy, and microbes as a factor in climate change*	Kuliah Interaktif *Interactive lectures*	2 x 50 menit kuliah sinkron *2 x 50 minutes of synchronous lectures*
	CPMK3 ***CLO3***	12. Metode untuk Mempelajari Mikrobia Tanah: Teknik pengambilan cuplikan, metode	Kuliah Interaktif	2 x 50 menit kuliah sinkron

		untuk unculturable mikrobia, metode untuk *culturable* mikrobia. 12. *Methods for Studying Soil Microbes: sampling techniques, methods for culturable and unculturable microbes*	*Interactive lectures*	*2 x 50 minutes of synchronous lectures*
	CPMK3 ***CLO3***	13. Seminar Mahasiswa *13. Seminar*	Diskusi Kelompok *Group Discussion*	2 x 50 menit Presentasi mahasiswa terkait topik-topik pada mikrobiologi tanah dan tanaman *2 x 50 minutes of presentation*
	UAS/ Hasil Tugas Project/Hasil Analisis Kasus ***Final Exam/Project Results/Case Study Results***			
Metode Pembelajaran ***Learning Method***	**SCL: Pembelajaran berbasis *Case based* dan *Project based*** ***SCL (Student Center Learning): Case based and Project based learning***			
Pengalaman Belajar Mahasiswa ***Student Learning Experience***	**Saat Sinkron : Melakukan diskusi terkait dengan topik kuliah serta kaitan dan potensi penerapannya dalam bidang mikrobiologi pertanian atau pertanian secara umum** **Saat Asinkron:** **1. Mendapatkan informasi mengenai identifikasi mikroorganisme tanah dan tanaman** **2. Mendapatkan keterampilan dalam penggunaan alat laboratorium yang dibutuhkan dalam kegiatan analisis mikrobiologi tanah dan tanaman** **3. Memperoleh pengalaman dalam kerja sama tim melalui tugas kelompok** **4. Mendapatkan teknik mengenai cara mempresentasikan data melalui tugas presentasi** ***Synchronous lectures: conducting discussions related to lecture topics and their relationships and potential applications in the field of agricultural microbiology or agriculture in general*** ***Asynchronous lectures:*** ***1. Obtain information regarding the identification of soil and plant microbes*** ***2. Acquire laboratory equipment skills required for soil and plant microbes analysis***		

	3. Gain teamwork experiences through group assignments ***4. Obtain techniques on how to present data through presentation assignments.***
Akses Media Pembelajaran / LMS dan Persentase Luring & Daring ***Learning Media and Course Method Percentage***	https://elok.ugm.ac.id Luring 100% *(Offline 100%)*

Metode Penilaian dan Keselarasan dengan CPMK ***Methods of assessment in accordance with course learning outcome***	**Basis Evaluasi** ***Evaluation Basis***	**Komponen Evaluasi** ***Evaluation Components***	**Bobot** ***Percentages***	**CPMK 1** ***CLO1***	**CPMK 2** ***CLO2***	**CPMK 3** ***CLO3***
	A. Aktivitas Partisipatif[*)] ***Participatory Activity***	**Kuiz** ***Quiz***	10%	V		
		Diskusi Kelompok ***Group Discussion***	10%			v
	B. Hasil *Project*/Hasil Studi Kasus/ Hasil PBL[*)] ***Project results/case study results***	**Praktikum** ***Labwork***	30%		V	
	C. Kognitif ***Cognitive***	**UTS** ***Mid Exam***	25%		V	
		UAS ***Final Exam***	25%			V
		Total ***Total***	**100%**			
	[*)] Sesuai IKU 7, **jumlah persentase** aktivitas partisipatif (A) dan hasil project/studi kasus/hasil PBL (B) adalah minimal 50%. **) In accordance with IKU 7, the total percentage of participatory activities (A) and project results/case studies/PBL results (B) is at least 50%.*					

<table>
<tr><td>Daftar Referensi

References</td><td colspan="4">Utama (Main references) :
1. Van Elsas, J.D., Trevors, J.T., Rosado, A.S.,and Nanipieri, P. 2019. Modern Soil Microbiology. 3rd Edition. Taylor & Francis, Boca Raton.
2. Eldor A. Paul. 2014. Soil Microbiology, Ecology, and Biochemistry. 4th Edition. Academic Press.
3. Dixon, G.R. and Tilston, E.L. 2010. Soil Microbiology and Sustainable Crop Production. Springer Dordrecht Heidelberg London New York
4. Varma, A., Abbot, L., Werner, D., and Hamp, R. 2008. Plant Surface Microbiology. Springer-Verlag Berlin Heidelberg New York
5. Tate, R. L. 2021. Soil Microbiology 3rd Edition. Willey-Blackwell, United States of America.
6. Dubey, S. K. and S. K. Verma. 2021. Plant, Soil and Microbes in Tropical Ecosystems. Springer Nature Singapore, Singapore.
7. Yadav, A. N. 2021. Soil Microbiomes for Sustainable Agriculture: Functional Annotation. Springer Nature Switzerland, Switzerland.

Tambahan:
1. Referensi jurnal ilmiah mengenai mikrobiologi tanah dan tanaman
2. Buku Panduan Praktikum Mikrobiologi Tanah dan Tanaman

Additional references:
1. Scientific journals related to soil and plant microbiology
2. Laboratory Classes in Soil and Plant Microbiology Handbook</td></tr>
<tr><td>Nama Dosen Pengampu
Team Teaching</td><td colspan="4">1. Ir. Donny Widianto, Ph.D.
2. M. Saifur Rohman, S.P., M.Si., M.Eng., Ph.D.
3. Ir. Ngadiman, M.Si., Ph.D.</td></tr>
<tr><td rowspan="2">Otorisasi

Authorization</td><td>Tanggal Penyusunan

Date of Authorization</td><td>Koordinator Mata Kuliah

Course Coordinator</td><td>Koordinator Bidang Keahlian (Jika Ada)

Expertise Coordinator (if any)</td><td>Ketua Program Studi

Head of the Study Program</td></tr>
<tr><td>January 21st, 2023</td><td>Ir. Donny Widianto, Ph.D.</td><td>Signature and name</td><td>Ir. Ngadiman, M.Si., Ph.D.</td></tr>
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