

**SEMESTER COURSE OUTLINE
& LESSON PLANS
FIRST SEMESTER
2023/2024**



Agricultural Microbiology Major
Department of Agricultural Microbiology
Soil and Environmental Biotechnology
PNM20193116

Team Teaching:

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**UNIVERSITAS GADJAH MADA
FACULTY OF AGRICULTURE
2023**

	Universitas Gadjah Mada Faculty of Agriculture Department of Agricultural Microbiology First Semester of 2023/2024					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
PNM20193116	Bioteknologi Tanah dan Lingkungan Soil and Environmental Biotechnology	T: 2	P: 0	First Semester (odd semester)	Pilihan Elective	Tidak Ada none
Deskripsi Singkat Mata Kuliah Course Overview	Mata kuliah Bioteknologi Tanah dan Lingkungan merupakan mata kuliah pilihan yang ditujukan bagi mahasiswa program studi Mikrobiologi Pertanian, Fakultas Pertanian. Dalam mata kuliah ini akan dipelajari teknologi pemanfaatan mikroorganisme/organisme dan senyawa-senyawa yang dihasilkan untuk mempertahankan, meningkatkan, dan memperbaiki kualitas tanah dan lingkungan agar dapat mendukung kehidupan yang lebih baik dan lestari. The Soil and Environmental Biotechnology course is an elective course intended for students of the Agricultural Microbiology study program, Faculty of Agriculture. In this course, you will study the technology of using microorganisms/organisms and the compounds they produce to maintain, enhance, and improve the quality of soil and the environment in order to support a better and more sustainable life.					
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	Mampu memilih, memanfaatkan, dan mengelola potensi mikroba dan mikrobioma untuk membangun sistem industri dan pertanian. (KK3)				

	PLO3	<i>Able to select, utilize and manage the potential of microbes and microbiomes to build industrial and agricultural systems. (S3)</i>		
Capaian Pembelajaran Mata Kuliah (CPMK) <i>Course Learning Outcomes (CLO)</i>	Setelah menyelesaikan pembelajaran mata kuliah ini, mahasiswa diharapkan mampu: <i>After completing this course, students are expected to able:</i>			
	CPMK1 CLO1	Mampu mendefinisikan ruang lingkup, sejarah dan perkembangan terkini mengenai berbagai inovasi pada bidang bioteknologi tanah dan lingkungan [CPL 1] <i>Able to define the scope, history and current developments regarding various innovations in the field of soil and environmental biotechnology [PLO 1] K2</i>		
	CPMK2 CLO2	Mampu menjelaskan siklus dan transformasi unsur pada tanah serta hambatan dan pemanfaatannya dalam bidang pertanian [CPL 3] <i>Able to explain the cycles and transformations of elements in soil as well as the obstacles and uses in agriculture [PLO 3] S3</i>		
	CPMK 3 CLO3	Mampu mengidentifikasi dan memberikan contoh mengenai berbagai metode pengendalian hayati dan bioremediasi untuk memperbaiki kualitas tanah dan lingkungan [CPL 2] <i>Able to identify and provide examples of various biological control and bioremediation methods to improve soil and environmental quality [PLO 2] K3</i>		
Kaitan CPMK dengan Materi dan Bentuk Pembelajaran, serta Alokasi Waktu <i>Correlation among CLO, the material, learning method and estimated time</i>		Materi Pembelajaran <i>Course Materials</i>	Bentuk Pembelajaran (Luring/Daring) <i>Course Method (Offline/Online)</i>	Alokasi Waktu <i>Estimated Time</i>
	CPMK1 CLO1	1. <i>Bioteknologi Penambatan Nitrogen I: Biologi dan biokimia penambatan N non-simbiotik, pemanfaatan penambat N non-simbiotik, dan rekayasa genetika penambat N non-simbiotik</i> 1. <i>Nitrogen Fixation Biotechnology I: Biology and biochemistry of non-symbiotic N fixers, utilization of non-symbiotic N fixers, and genetic engineering of non-symbiotic N fixers</i>	Kuliah Interaktif dan diskusi kasus <i>Interactive lectures and discussions</i>	2 x 40 menit kuliah sinkron 20 menit diskusi kasus <i>2 x 40 minutes of synchronous lectures</i> 20 minutes discussion

	CPMK1 CLO1	2. <i>Bioteknologi Penambatan Nitrogen II:</i> Biologi dan biokimia penambatan N simbiotik, pemanfaatan penambat N simbiotik, dan rekayasa genetika penambat N simbiotik 2. <i>Nitrogen Fixation II Biotechnology:</i> <i>Symbiotic N-fixer biology and biochemistry, utilization of symbiotic N-fixer, and genetic engineering of symbiotic N-fixer</i>	Kuliah Interaktif dan diskusi kasus <i>Interactive lectures and discussions</i>	2 x 40 menit kuliah sinkron 20 menit diskusi kasus <i>2 x 40 minutes of synchronous lectures</i> <i>20 minutes discussion</i>
	CPMK2 CLO2	3. Bioteknologi Transformasi N: Pengendalian dan pemanfaatan nitrifikasi, denitrifikasi, dan anammox untuk kesuburan tanah dan pengolahan limbah 3. <i>N Transformation Biotechnology: Control and utilization of nitrification, denitrification, and anammox for soil fertility and waste treatment</i>	Kuliah Interaktif dan diskusi kasus <i>Interactive lectures and discussions</i>	2 x 40 menit kuliah sinkron 20 menit diskusi kasus <i>2 x 40 minutes of synchronous lectures</i> <i>20 minutes discussion</i>
	CPMK2 CLO2	4. Bioteknologi Pelarutan Fosfat I: Ciri khusus jenis mikoriza dan distribusinya, serapan dan transfer hara tanah, fungsi mikoriza, dan produksi serta strategi pemanfaatan mikoriza 4. <i>Phosphate Dissolving Biotechnology I:</i> <i>Specific characteristics of mycorrhizal species and their distribution, absorption and transfer of soil nutrients, mycorrhizal functions, and mycorrhizal production and utilization strategies</i>	Kuliah Interaktif dan diskusi kasus <i>Interactive lectures and discussions</i>	2 x 40 menit kuliah sinkron 20 menit diskusi kasus <i>2 x 40 minutes of synchronous lectures</i> <i>20 minutes discussion</i>

	CPMK2 CLO2	5. Bioteknologi Pelarutan Fosfat II: Biologi dan biokimia bakteri/jamur (non-mikoriza) pelarut fosfat, produksi inokulum bakteri/jamur pelarut fosfat, serta formulasi inokulum bakteri/jamur pelarut fosfat dan strategi pemanfaatannya 5. <i>Phosphate Dissolution Biotechnology II: Biology and biochemistry of phosphate-dissolving bacteria/fungi (non-mycorrhiza), production of phosphate-solvent bacterial/fungal inoculums, and formulation of phosphate-solvent bacterial/fungal inoculums and strategies for their utilization</i>	Kuliah interaktif, Diskusi kasus, dan tugas individu <i>Interactive lectures, Discussions, and individual assignment</i>	2 x 40 menit kuliah sinkron 20 menit diskusi kasus Tugas individu berupa pengumpulan makalah mengenai mikroorganisme pelarut fosfat <i>2 x 40 minutes of synchronous lectures</i> <i>20 minutes discussion</i> <i>Submittal of individual assignment</i>
	CPMK3 CLO3	6. Seminar Mahasiswa I 6. <i>Students Seminar I</i>	Tugas Kelompok <i>Group Assignment</i>	2 x 50 menit presentasi tugas kelompok mengenai pemanfaatan mikroorganisme sebagai pelarut N dan P dalam bidang pertanian <i>2 x 50 minutes of student presentation</i>
	UTS/Hasil Tugas Project/Hasil Analisis Kasus Mid Exam/Project Assignment Results/Case Analysis Results			
	CPMK1 CLO1	7. Bioteknologi Pengendalian Hayati:	Kuliah Interaktif dan diskusi kasus	2 x 40 menit kuliah sinkron

		Konsep dasar dan tujuan pengendalian hayati dan keseimbangan antara tanah-tanaman-mikrobia 7. <i>Biotechnology of Biological Control: Basic concepts and objectives of biological control and soil-plant-microbe balance</i>	<i>Interactive lectures and discussions</i>	20 menit diskusi kasus <i>2 x 40 minutes of synchronous lectures</i> <i>20 minutes discussion</i>
	CPMK3 CLO3	8. Bioteknologi <i>Plant Growth Promoting Bacteria</i> (PGPB): Mekanisme PGPB, substansi pemacu dan pendukung pertumbuhan tanaman, pembuatan inokulum PGPB, dan rekayasa genetika PGPB 8. <i>Biotechnology of Plant Growth Promoting Bacteria (PGPB): Mechanism of PGPB, substances that promote and support plant growth, manufacture of PGPB inoculums, and genetic engineering of PGPB</i>	Kuliah Interaktif dan diskusi kasus <i>Interactive lectures and discussions</i>	2 x 40 menit kuliah sinkron 20 menit diskusi kasus <i>2 x 40 minutes of synchronous lectures</i> <i>20 minutes discussion</i>
	CPMK3 CLO3	9. Bioteknologi Dekomposisi Bahan Organik: Biota pendekomposisi bahan organik dan aktivitasnya, bahan limbah untuk pembuatan kompos, teknologi dan sistem pengomposan, kualitas kompos, pemanfaatan biogas hasil dekomposisi bahan organik 9. <i>Biotechnology of Organic Matter Decomposition: Biota decomposes organic matter and its activities, waste materials for composting, composting technology and systems, quality of compost, utilization of biogas resulting from the</i>	Kuliah Interaktif dan diskusi kasus <i>Interactive lectures and discussions</i>	2 x 40 menit kuliah sinkron 20 menit diskusi kasus <i>2 x 40 minutes of synchronous lectures</i> <i>20 minutes discussion</i>

		<i>decomposition of organic matter</i>		
	CPMK1 CLO1	10. Bioteknologi Penurunan Emisi Gas Rumah Kaca: Gas rumah kaca dan dampaknya terhadap perubahan iklim global, faktor yang mempengaruhi perubahan iklim global, dan peranan bioteknologi dalam penurunan emisi gas rumah kaca 10. <i>Greenhouse Gas Emission Reduction Biotechnology: Greenhouse gases and their impact on global climate change, factors affecting global climate change, and the role of biotechnology in reducing greenhouse gas emissions</i>	Kuliah Interaktif dan diskusi kasus <i>Interactive lectures and discussions</i>	2 x 40 menit kuliah sinkron 20 menit diskusi kasus <i>2 x 40 minutes of synchronous lectures</i> <i>20 minutes discussion</i>
	CPMK2 CLO2	11. Bioremediasi Senyawa Xenobiotik: Macam senyawa xenobiotik, jalur degradasi, proses kometabolisme, serta bioteknologi dalam remediasi senyawa xenobiotik 11. <i>Bioremediation of Xenobiotic Compounds: Types of xenobiotic compounds, degradation pathways, metabolism processes, and biotechnology in remediation of xenobiotic compounds</i>	Kuliah Interaktif dan diskusi kasus <i>Interactive lectures and discussions</i>	2 x 40 menit kuliah sinkron 20 menit diskusi kasus <i>2 x 40 minutes of synchronous lectures</i> <i>20 minutes discussion</i>
	CPMK3 CLO3	12. Bioremediasi Logam Berat: Definisi logam berat, ketersediaan logam berat, toksisitas dan resistensi logam berat terhadap mikrobia, serta bioteknologi remediasi 12. <i>Bioremediation of Heavy Metals: Definition of heavy metals, availability of heavy</i>	Kuliah interaktif, Diskusi kasus, dan tugas individu <i>Interactive lectures, Discussions, and individual assignment</i>	2 x 40 menit kuliah sinkron 20 menit diskusi kasus Tugas individu berupa pengumpulan makalah

		<i>metals, toxicity and resistance of heavy metals to microbes, and remediation biotechnology</i>		mengenai mikroorganisme pelarut fosfat <i>2 x 40 minutes of synchronous lectures</i> <i>20 minutes discussion</i> <i>Submittal of individual assignment</i>
	UAS/ Hasil Tugas Project/Hasil Analisis Kasus Final Exam/Project Assignment Results/Case Analysis Results			
Metode Pembelajaran <i>Learning methods</i>	SCL: Case based and Project Based Learning <i>SCL (Student Centered Learning) : Case based and Project Based Learning</i>			
Pengalaman Belajar Mahasiswa <i>Student Learning Experience</i>	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 pemanfaatan mikroorganisme dalam proses biodegradasi dan bioremediasi lingkungan pada berbagai bidang di luar kelas 2. Memperoleh pengalaman dalam kerja sama tim melalui tugas kelompok 3. Mendapatkan teknik mengenai cara mempresentasikan data melalui tugas presentasi <i>Synchronized: Conducting discussions related to lecture topics and their relation and potential application in the field of agricultural microbiology or agriculture in general</i> <i>Asynchronous:</i> 1. <i>Get information about the use of microorganisms in environmental biodegradation and bioremediation processes in various fields outside the classroom</i> 2. <i>Gain experience in teamwork through group assignments</i> 3. <i>Get techniques on how to present data through presentation assignments</i>			
Akses Media Pembelajaran/ LMS dan Persentase Luring & Daring	https://elok.ugm.ac.id Luring 100% (<i>Offline 100%</i>)			

Learning Media and Course Method Percentage						
Metode Penilaian dan Keselarasan dengan CPMK Assessment Plan and Relations with the CLOs	Basis Evaluasi <i>Evaluation Basis</i>	Komponen Evaluasi <i>Evaluation Components</i>	Bobot <i>Percentages</i>	CPMK 1 <i>CLO1</i>	CPMK 2 <i>CLO2</i>	CPMK 3 <i>CLO3</i>
	A. Aktivitas Partisipatif^{*)} <i>Participatory Activity</i>	Tugas Individu <i>Individual Assignment</i>	20%		v	
	B. Hasil Project/Hasil Studi Kasus/ Hasil PBL^{*)} <i>Project Results/Case Study Results</i>	Tugas Kelompok (Presentasi) <i>Group Assignments (Presentation)</i>	30%			v
	A. Kognitif <i>Cognitive</i>	UTS <i>Mid Exam</i>	25%		v	
		UAS <i>Final Exam</i>	25%			v
		Total	100%			
	^{*)} Sesuai IKU 7, jumlah persentase aktivitas partisipatif (A) dan hasil project/studi kasus/hasil PBL (B) adalah minimal 50%. ^{*)} <i>In accordance with IKU 7, the total percentage of participatory activities (A) and project results/case studies/PBL results (B) is at least 50%.</i>					
Daftar Referensi References	Utama (Main References): 1. Pradeep Kumar, Jayanta Kumar Patra, Pranjal Chandra. 2019. Advances in microbial biotechnology : current trends and future prospects. Apple Academic Press, Inc 2. Rita Kundu and Rajiv Narula. 2019. Advances in Plant and Microbial Biotechnology. Springer Nature Singapore Pte Ltd. 3. Farshad Darvishi Harzevili and Hongzhang Chen. 2015. Microbial Biotechnology : Progress & Trends. CRC press. 4. Lala Behari Sukla, Nilotpala Pradhan, Sandeep Panda, and Barada Kanta Mishra. 2015. Environmental Microbial Biotechnology. Springer International Publishing Switzerland 5. Charles Vincent, Mark S. Goettel, and George Lazarovits. 2007. Biological Control : A Global Perspective. CABI Publishing. 6. Gareth, M. Evans, Judith C. Furlong. 2003. Environmental Biotechnology : Theory and Practices. John Wiley & Sons. 7. Alexander N. Glazer and Hiroshi Nikaido. 2007. Microbial Biotechnology. Cambridge University Press. 8. Harbhajan Singh. 2006. Mycoremediation : Fungal Bioremediation. John Wiley & Sons, Inc. 9. John E. Smith. 2004. Biotechnology. Cambridge University Press. 10. Ross E. McKinney. 2004. Environmental Pollution Control Microbiology. Marcel Dekker, Inc. 11. Eldor A. Paul. 2007. Soil Microbiology, Ecology, and Biochemistry. Academic Press.					

	12. Iqbal Ahmad, et. Al. 2008. Plant-Bacteria Interactions : Strategies and Techniques to Promote Plant Growth. WILEY-VCH Verlag GmbH & Co. KgaA. 13. Samuel S. Gnanamanickam. 2006. Plant-Associated Bacteria. Springer. 14. K. G. Mukerji, et. al. 2006. Microbial Activity in the Rhizosphere. Springer. 15. Sally E. Smith and David Read. 2008. Mycorrhizal Symbiosis. Elsevier. Tambahan (<i>Additional References</i>): Referensi jurnal ilmiah mengenai pemanfaatan mikroorganisme dalam proses biodegradasi dan bioremediasi tanah Nirwati, H., E. Damayanti, E. N. Sholikhah, M. Mutofa, and J. Widada. 2022. Soil-derived <i>Streptomyces</i> sp. GMR22 producing antibiofilm activity against <i>Candida albicans</i>: bioassay, untargeted LC-HRMS, and gene cluster analysis. Heliyon 8:1-8. Islamiati, E. D. J. Widada, T. D. Wahyuningsih, and D. Widiyanto. 2022. Volatile organic compounds of <i>Streptomyces</i> sp. GMR22 inhibit growth of two plant pathogenic fungi. Agriculture and Natural Resources 56:899-908. <i>Scientific journal references regarding the use of microorganisms in soil biodegradation and bioremediation processes</i>			
Nama Dosen Pengampu <i>(Team Teaching)</i>	1. Ir. Donny Widiyanto, Ph.D. 2. Prof. Irfan D. Prijambada, Ph.D. 3. Ir. Jaka Widada, M.P., Ph.D.			
Otorisasi <i>Authorization</i>	Tanggal Penyusunan <i>Date of Authorization</i>	Koordinator Mata Kuliah <i>Course Coordinator</i>	Koordinator Bidang Keahlian (Jika Ada) <i>Expertise Coordinator (if any)</i>	Ketua Program Studi <i>Head of the Study Program</i>
	August 19 th , 2023	Ir. Donny Widiyanto, Ph.D.	Signature and Name	Ir. Ngadiman, M.Si., Ph.D.