

**SEMESTER COURSE OUTLINE  
& LESSON PLANS  
SECOND SEMESTER  
2022/2023**



Agricultural Microbiology Major  
Department of Agricultural Microbiology  
**Biomass Production Technology**  
PNU20193222

Team Teaching:

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**UNIVERSITAS GADJAH MADA  
FACULTY OF AGRICULTURE  
2023**



## Universitas Gadjah Mada

Faculty of Agriculture  
Department of Agricultural Microbiology  
Second Semester of 2022/2023

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

Kode Mata Kuliah <i>Course Code</i>	Nama Mata Kuliah <i>Course Name</i>	Bobot (sks) <i>Credits</i>		Semester <i>Semester</i>	Status Mata Kuliah <i>Course Status</i>	Mata Kuliah Prasyarat <i>Prerequisite Courses</i>
PNU20193222	<i>Teknologi Produksi Biomassa Biomass Production Technology</i>	<i>T: 2</i>	<i>P: 0</i>	<i>Second Semester</i>	<i>Pilihan Elective</i>	<i>Tidak ada None</i>
<b>Deskripsi Singkat Mata Kuliah</b>  <i>Course Overview</i>	<p>Mata kuliah Teknologi Produksi Biomassa merupakan mata kuliah yang ditujukan bagi mahasiswa program studi Mikrobiologi Pertanian, Fakultas Pertanian. Mata kuliah ini membahas mengenai konsep dasar teknologi produksi biomassa serta potensi mikrobia dalam bidang industri. Pada mata kuliah ini juga membahas mengenai teknik fermentasi dan cara pengunduhan biomassa dalam proses produksi berbasis mikrobia.</p> <p><i>Biomass Production Technology is a course intended of students of the Agricultural Microbiology study program, Faculty of Agriculture. This course discusses the fundamentals of biomass production technology and the potential of microorganisms in the industrial sector. Fermentation technique and biomass downstream processes are also discussed in this course.</i></p>					
<b>Capaian Pembelajaran Lulusan Program Studi (CPL)</b>  <i>Program Learning Outcome (PLO)</i>	<b>CPL1</b>  <i>PLO1</i>	Mampu menerangkan konsep teoritis mengenai teknologi produksi tanaman dengan memperhatikan aspek ekonomi dan sosial-humaniora untuk mencapai pertanian yang berkualitas, berkelanjutan, dan menguntungkan ( <i>profitable</i> ) (P1).  <i>Able to explain theoretical concepts regarding plant production technology by giving attention to economic and social-humanitarian aspects to achieve quality, sustainable and profitable agriculture (K1).</i>				
	<b>CPL2</b>  <i>PLO2</i>	Mampu menjelaskan konsep teoritis biologi mikroorganisme serta mengembangkan teknologi berbasis mikroba untuk meningkatkan produksi tanaman dan layanan lingkungan (P2)  <i>Able to explain theoretical concepts of biology microorganism and develop microbial-based technology to increase plant production and environmental services (K2).</i>				
	<b>CPL3</b>  <i>PLO3</i>	Mampu mengidentifikasi, merancang, melaksanakan, serta dapat memecahkan masalah yang timbul dalam pelaksanaan usaha pertanian (KK1).  <i>Able to identify, design, implement, and solve problems that arise in the implementation of agricultural businesses (S1)</i>				

<p><b>Capaian Pembelajaran Mata Kuliah (CPMK)</b></p> <p><i>Course Learning Outcomes (CLO)</i></p>	<p>Setelah menyelesaikan pembelajaran mata kuliah ini, mahasiswa diharapkan mampu:  <i>After completing this course, students are expected to be able:</i></p>			
<p><b>CPMK1</b></p> <p><b>CLO1</b></p>	<p>Mahasiswa mampu menjelaskan mengenai konsep dasar teknologi produksi biomassa, nutrisi dan pertumbuhan mikrobia, serta metabolisme dan bioenergetik [CPL3]</p> <p><i>Students can explain the biomass production technology principles, microbes nutrition and growth, metabolism and bioenergetics [PLO 3] □ S1</i></p>			
<p><b>CPMK2</b></p> <p><b>CLO2</b></p>	<p>Mahasiswa mampu menjelaskan teknik dasar isolasi dan manajemen kultur, potensi mikrobia dalam bidang industri dan proses fermentasi. [CPL 1]</p> <p><i>Students can explain the basic principles of isolation techniques and culture management, microbes for industrial applications, and fermentation processes [PLO 1] □ K1</i></p>			
<p><b>CPMK 3</b></p> <p><b>CLO3</b></p>	<p>Mahasiswa mampu menjelaskan teknik fermentasi substrat cair, fermentasi substrat padat, instrumentasi dan pengendalian, serta <i>scale up/down</i> dalam proses produksi biomassa [CPL 2]</p> <p><i>Students can explain the techniques of liquid state fermentation, solid state fermentation, instrumentation and control, scale up/down in biomass production processes [PLO 2] □ K2</i></p>			
<p><b>Kaitan CPMK dengan Materi dan Bentuk Pembelajaran, serta Alokasi Waktu</b></p> <p><i>Correlation among CLO, the material, learning method and estimated time</i></p>	<p><b>Materi Pembelajaran</b>  <i>Course Materials</i></p>	<p><b>Bentuk Pembelajaran (Luring/Daring)</b>  <i>Course Methos (Offline/Online)</i></p>	<p><b>Alokasi Waktu</b>  <i>Estimated Time</i></p>	
<p><b>CPMK1</b></p> <p><b>CLO1</b></p>	<p>1. Pengantar:            Arti penting, tujuan, dan cakupan kuliah</p> <p><i>1. Introduction: the importance, objectives and scope of the course</i></p>	<p>Kuliah Interaktif</p> <p><i>Interactive lectures</i></p>	<p>2 x 50 menit kuliah sinkron</p> <p><i>2 x 50 minutes of synchronous lectures</i></p>	
<p><b>CPMK1</b></p> <p><b>CLO1</b></p>	<p>2. Nutrisi dan pertumbuhan mikrobia:            Kebutuhan nutrisi, pertumbuhan dan kinetika, faktor-faktor pertumbuhan mikrobia</p> <p><i>2. Microbial nutrition and growth: nutritional requirements, growth and kinetics, microbial growth factors</i></p>	<p>Kuliah Interaktif</p> <p><i>Interactive lectures</i></p>	<p>2 x 50 menit kuliah sinkron</p> <p><i>2 x 50 minutes of synchronous lectures</i></p>	

	<b>CPMK1</b> <b>CLO1</b>	<p>3. Metabolisme dan Bioenergetik: Glikolisis, <i>gluconeogenesis</i>, siklus <i>Krebs</i>, regulasi metabolisme</p> <p>3. <i>Metabolism and Bioenergetics: glycolysis, Krebs cycle, metabolism regulation</i></p>	<p>Kuliah Interaktif dan diskusi</p> <p><i>Interactive lectures and discussion</i></p>	<p>2 x 50 menit kuliah sinkron</p> <p><i>2 x 50 minutes of synchronous lectures</i></p>
	<b>CPMK2</b> <b>CLO2</b>	<p>4. Teknik Dasar: Isolasi, seleksi, manajemen isolat, dan preservasi kultur</p> <p>4. <i>Basic Technique: isolation, selection, isolate management, and culture preservation</i></p>	<p>Kuliah Interaktif</p> <p><i>Interactive lectures</i></p>	<p>2 x 50 menit kuliah sinkron</p> <p><i>2 x 50 minutes of synchronous lectures</i></p>
	<b>CPMK2</b> <b>CLO2</b>	<p>5. Mikrobia Industri: Jenis dan potensi mikrobia dalam industri pertanian (pupuk hayati, pengendalian hayati), lingkungan (bioremediasi limbah), pangan, dan kesehatan, <i>strain improvement</i></p> <p>5. <i>Industrial Microbes: various types of microorganism and their potential applications in agriculture (biofertilier, biocontrol), environment (waste bioremediation), food and health industries, and strain improvement</i></p>	<p>Kuliah Interaktif dan Tugas kelompok</p> <p><i>Interactive lectures and group assignment</i></p>	<p>2 x 50 menit kuliah sinkron</p> <p><i>2 x 50 minutes of synchronous lectures</i></p>
	<b>CPMK2</b> <b>CLO2</b>	<p>6. Fermentasi (perbanyak mikrobia): Definisi dan <i>road-map</i> fermentasi, macam fermentasi/perbanyak (<i>batch, fed-batch, continuous system</i>)</p> <p>6. <i>Fermentation: definition and fermentation road-map, types</i></p>	<p>Kuliah Interaktif</p> <p><i>Interactive lectures</i></p>	<p>2 x 50 menit kuliah sinkron</p> <p><i>2 x 50 minutes of</i></p>

		<i>of fermentation (batch, fed-batch, continuous system)</i>		<i>synchronous lectures</i>
<b>CPMK 2</b> <b>CLO2</b>	7. Proses Fermentasi: Persiapan media (formulasi dan sterilisasi media), persiapan inokulum, inokulasi dan produksi (inkubasi), faktor-faktor fermentasi (aerasi, agitasi, suhu, buih, dan sebagainya)		Kuliah interaktif	2 x 50 menit kuliah sinkron
	7. <i>Fermentation Process: media preparation (formulation and sterilization), inoculum preparation, inoculation and production (incubation), factors affecting fermentation (aeration, agitation, temperature, foam, etc)</i>		<i>Interactive lectures</i>	<i>2 x 50 minutes of synchronous lectures</i>
<b>UTS/Hasil Tugas Project/Hasil Analisis Kasus Mid Exam/Project Results/Case Study Results</b>				
<b>CPMK3</b> <b>CLO3</b>	8. Fermentasi Cair: Fungsi dan cakupan, perancangan fermentasi, proses fermentasi dalam <i>shake-flask (pure liquid, biphasic)</i> , bioreaktor (tipe dan prinsip kerjanya)		Kuliah Interaktif	2 x 50 menit kuliah sinkron
	8. <i>Liquid State Fermentation: scope and function, fermentation design, fermentation process in shake-flask (pure liquid, biphasic), bioreactor (type and working principle)</i>		<i>Interactive lectures</i>	<i>2 x 50 minutes of synchronous lectures</i>
<b>CPMK3</b> <b>CLO3</b>	9. Fermentasi substrat padat ( <i>Koji Process</i> ): Fungsi dan cakupan, perancangan fermentasi, proses fermentasi secara koji		Kuliah Interaktif	2 x 50 menit kuliah sinkron
	9. <i>Solid State Fermentation (Koji Process): scope and function, fermentation design, koji fermentation process</i>		<i>Interactive lectures</i>	<i>2 x 50 minutes of synchronous lectures</i>

	<b>CPMK3</b>  <b>CLO3</b>	<p>10. Instrumentasi dan Pengendalian: Biosensor, pengukuran variabel proses (fisik, kimia, biologi), sistem pengendalian (<i>computer-aided control</i>)</p> <p>10. <i>Instrumentation and Control: biosensor, measurement of process variables (physical, chemical, biology), control system (computer-aided control)</i></p>	<p>Kuliah interaktif</p> <p><i>Interactive lectures</i></p>	<p>2 x 50 menit kuliah sinkron</p> <p><i>2 x 50 minutes of synchronous lectures</i></p>
	<b>CPMK3</b>  <b>CLO3</b>	<p>11. <i>Scale-up/down</i>: Parameter scale-up/down (jumlah generasi, medium, agitasi, aerasi), prosedur (pemilihan jumlah fase, karakteristik proses dan strategi), hasil (analisis teknik dan ekonomi), pengadaan pilot plant, laboratorium support</p> <p>11. <i>Scale-up/down: scale-up/down parameters (number of generations, medium, agitation, aeration), procedures (phase selection, process characteristics and strategies), results (technical and economic analysis), acquisition of pilot plant and laboratory support</i></p>	<p>Kuliah Interaktif</p> <p><i>Interactive lectures</i></p>	<p>2 x 50 menit kuliah sinkron</p> <p><i>2 x 50 minutes of synchronous lectures</i></p>
	<b>CPMK3</b>  <b>CLO3</b>	<p>12. Pengunduhan Biomassa: Proses pemanenan (filtrasi, sentrifugasi dan sebagainya), penyimpanan, formulasi, pengujian produk biomassa, dan monitoring</p> <p>12. <i>Biomass Production Downstream: harvesting processes (filtration, centrifugation, etc), storage,</i></p>	<p>Kuliah Interaktif</p> <p><i>Interactive lectures</i></p>	<p>2 x 50 menit kuliah sinkron</p> <p><i>2 x 50 minutes of synchronous lectures</i></p>



<p><i>Learning Media and Course Method Percentage</i></p>						
<p><b>Metode Penilaian dan Keselarasan dengan CPMK</b></p> <p><i>Methods of assessment in accordance with course learning outcome</i></p>	<p><b>Basis Evaluasi</b> <i>Evaluation Basis</i></p>	<p><b>Komponen Evaluasi</b> <i>Evaluation Components</i></p>	<p><b>Bobot</b> <i>Percentages</i></p>	<p><b>CPMK 1</b> <i>CLO1</i></p>	<p><b>CPMK 2</b> <i>CLO2</i></p>	<p><b>CPMK 3</b> <i>CLO3</i></p>
	<p>A. <b>Aktivitas Partisipatif</b><sup>*)</sup> <i>Participatory Activity</i></p>	<p><b>Diskusi</b> <i>Discussion</i></p>	<p>20%</p>	<p>v</p>		
	<p>B. <b>Hasil Project/Hasil Studi Kasus/ Hasil PBL</b><sup>*)</sup> <i>Project results/case study results</i></p>	<p><b>Tugas Kelompok</b> <i>Group Assignments</i></p>	<p>30%</p>		<p>v</p>	
	<p>C. <b>Kognitif</b> <i>Cognitive</i></p>	<p><b>UTS</b> <i>Mid Exam</i></p>	<p>25%</p>		<p>v</p>	
		<p><b>UAS</b> <i>Final Exam</i></p>	<p>25%</p>			<p>v</p>
		<p><b>Total</b> <i>Total</i></p>	<p><b>100%</b></p>			
	<p><sup>*)</sup> Sesuai IKU 7, <b>jumlah persentase</b> aktivitas partisipatif (A) dan hasil project/studi kasus/hasil PBL (B) adalah minimal 50%.  <sup>*)</sup> <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></p>					
<p><b>Daftar Referensi</b></p> <p><i>References</i></p>	<p><b>Utama:</b> <i>Main references:</i></p> <ol style="list-style-type: none"> <li>1. M.T. Madigan, J.M. Martinko, J. Parker. 2000. Brock Biology of Microorganisms. Prentice Hall Int. Inc.</li> <li>2. R.M. Atlas, A.E. Brown, K.W. Dobra, L. Miller. 1984. Experimental Microbiology: Fundamentals and Applications. MacMillan Publ. Co. New York.</li> <li>3. A.L. Domain and N.A. Solomon. 1986. Manual of Industrial Microbiology and Biotechnology. Am. Soc. Microbiol. Washington.</li> <li>4. W. Crueger and A. Crueger. 1990. A Textbook of Industrial Microbiology. Second Ed. Sinauer Assoc. Inc. Sunderland</li> <li>5. Koubaa, M., F. J. Barba, and S. Roohinejad. 2021. Fermentation Processes: Emerging and Conventional Technologies. Wiley, United Kingdom.</li> </ol>					
<p><b>Nama Dosen Pengampu</b></p> <p><i>Team Teaching</i></p>	<ol style="list-style-type: none"> <li>1. Ir. Ngadiman, M.Si., Ph.D.</li> <li>2. Prof. Ir. Triwibowo Yuwono, Ph.D.</li> <li>3. Ahmad Suparmin, S.P., M.AgrSc., Ph.D.</li> </ol>					

<b>Otorisasi</b> <i>Authorization</i>	<b>Tanggal Penyusunan</b> <i>Date of Authorization</i>	<b>Koordinator Mata Kuliah</b> <i>Course Coordinator</i>	<b>Koordinator Bidang Keahlian (Jika Ada)</b> <i>Expertise Coordinator (if any)</i>	<b>Ketua Program Studi</b> <i>Head of the Study Program</i>
	<i>January 25, 2023</i>	<i>Ir. Ngadiman, M.Si., Ph.D.</i>		<i>Ir. Ngadiman, M.Si., Ph.D.</i>