Module Handbook of Biomass Production Technology

Module designation	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.
Semester(s) in which the module is taught	Fourth/Sixth Semester
Person responsible for the module	Ir. Ngadiman, M.Si., Ph.D.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	*Elective Course*
Teaching methods	Lecture are conducted in the class with 30-40 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment. Details: 1. Lectures 2. Assignment (Individual and Group) 3. Discussion 4. Midterm 5. Final Exam
Workload (incl. contact hours, self-study hours)	- Lectures = 2 SKS x 50 minutes x 16 meetings = 1.600 minutes = 26,67 hours = 26,67 hours/30hours = 0,89 ECTS - Assignment = 2 SKS x 60 minutes x 16 meetings = 1.920 minutes = 32 hours = 32 hours/30hours = 1,07 ECTS - Self Study = 2 SKS x 60 minutes x 16 meetings = 1.920 minutes = 32 hours = 32 hours/30hours = 1,07 ECTS Total Workload = 3,03 ECTS
Credit points	*2/0 Credit Points*
Required and recommended prerequisites for joining the module	*None*

Module objectives/intended learning outcomes	*Program Learning Outcomes (PLO):* *PLO1: 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.* *PLO2: Able to explain theoretical concepts of biology microorganism and develop microbial-based technology to increase plant production and environmental services.* *PLO3: Able to identify, design, implement, and solve problems that arise in the implementation of agricultural businesses.* *Course Learning Outcomes (CLO):* *CLO1: Students can explain the biomass production technology principles, microbes nutrition and growth, metabolism and bioenergetics.* *CLO2: Students can explain the basic principles of isolation techniques and culture management, microbes for industrial applications, and fermentation processes.* *CLO3: Students can explain the techniques of liquid state fermentation, solid state fermentation, instrumentation and control, scale up/down in biomass production processes.*

Content	1. *Introduction: the importance, objectives and scope of the course (1 meeting)* 2. *Microbial nutrition and growth: nutritional requirements, growth and kinetics, microbial growth factors (1 meeting)* 3. *Metabolism and Bioenergetics: glycolysis, Krebs cycle, metabolism regulation (1 meeting)* 4. *Basic Technique: isolation, selection, isolate management, and culture preservation (1 meeting)* 5. *Industrial Microbes: various types of microorganism and their potential applications in agriculture (biofertilizer, biocontrol), environment (waste bioremediation), food and health industries, and strain improvement (1 meetings)* 6. *Fermentation: definition and fermentation road-map, types of fermentation (batch, fed-batch, continuous system) (1 meeting)* 7. *Fermentation Process: media preparation (formulation and sterilization), inoculum preparation, inoculation and procuction (incubation), factors affecting fermentation (aeration, agitation, temperature, foam, etc) (1 meeting)* 8. *Liquid State Fermentation: scope and function, fermentation design, fermentation process in shake-flask (pure liquid, biphasic), bioreactor (type and working principle) (1 meeting)* 9. *Solid State Fermentation (Koji Process): scope and function, fermentation design, koji fermentation process (1 meeting)* 10. *Instrumentation and Control: biosensor, measurement of process variables (physical, chemical, biology), control system (computer-aided control) (1 meeting)* 11. *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 (1 meeting)* 12. *Biomass Production Downstream: harvesting processes (filtration, centrifugation, etc), storage, formulation, biomass products testing and monitoring (1 meeting)* 13. *Students Seminar (1 meeting)* 14. *Materials Review (1 meeting)*
Examination forms	*High Order Thinking Skills Examination*
Study and examination requirements	*To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.*

Reading list	*Main References:* 1. *M.T. Madigan, J.M. Martinko, J. Parker. 2000. Brock Biology of Microorganisms. Prentice Hall Int. Inc.* 2. *R.M. Atlas, A.E. Brown, K.W. Dobra, L. Miller. 1984. Experimental Microbiology: Fundamentals and Applications. MacMillan Publ. Co. New York.* 3. *A.L. Domain and N.A. Solomon. 1986. Manual of Industrial Microbiology and Biotechnology. Am. Soc. Microbiol. Washington.* 4. *S. Aiba. 1973. Biochemical Engineering. Second ed. Univ. Tokyo Press. Tokyo* 5. *W. Crueger and A. Crueger. 1990. A Textbook of Industrial Microbiology. Second Ed. Sinauer Assoc. Inc. Sunderland* 6. *A.G. Moat and J.W. Fister. 1988. Microbial Physiology. Second Ed. John Wiley and Sons. New York* 7. *M. Moo-Young (Ed.). 1985. Comprehensive Biotechnology. Vol I-IV. Pergamon Press. New York.*