SEMESTER LEARNING PLAN (RPS)
S1 BUILDING ENGINEERING EDUCATION PROGRAM
DEPARTMENT OF CIVIL ENGINEERING, FACULTY OF ENGINEERING, STATE UNIVERSITY OF PADANG

COURSE NAME	CODE	GRASS MK	SKS		SEM	VERSION
			Theory	Pract		
Heavy Equipment and Mechanical Earthmoving		Study Program Compulsory Courses	**2**			

Responsible Lecturer	**Nidal Zuwida, S.Pd., M.Pd.T**	**TTD Responsible Lecturer** **Nidal Zuwida, S.Pd., M.Pd.T** NIP. 199101172019032014

Information	**Dean of the Faculty of Engineering**	**Head of Civil Engineering Department**	**Chords. S1 Study Program Building Engineering Education**
	Dr. Fahmi Rizal, M.Pd., MT NIP. 195912041985031004	**Faisal Ashar, Ph.D.** NIP. 19750103 200312 1001	**Drs. Revian Body, MSA.** NIP. 19600103 198503 1003

Learning Outcomes of Graduates	**Study Program Graduate Learning Outcomes (CPL)**
	1. Able to apply basic science knowledge (mathematics, natural sciences) and other multidisciplinary disciplines which become the foundation for the field of Building Engineering Vocational Education in carrying out professional work in their respective fields (Knowledge and Understanding). 1.1. Able to show a good understanding and implement basic mathematical concepts to solve various problems in the field of building engineering.

	1.2. Have a high understanding and can implement basic concepts of physics and chemistry (natural sciences) in the field of building engineering. 1.3. Have a high understanding and can implement the basic principles of basic engineering (mechanics, engineering drawings, materials science) in the field of building engineering. 2. Able to think critically and creatively in identifying, formulating, problem solving, evaluating various problems in the field of Building Engineering Vocational Education with the most appropriate and effective scientific methods (Engineering analysis, investigations and assessment). 2.1. Able to identify various technical problems in the field of building engineering 2.2. Able to analyze various technical problems in the field of building engineering 2.3. Able to evaluate various technical problems in the building sector 2.4. Able to communicate Engineering Analysis, Investigation and Assessment materials to students / training. 3. Have a reliable ability in designing, implementing and supervising engineering design works. 3.1. Able to realize work drawings in collaboration with various related parties. 3.2. Able to manage building engineering work by paying attention to environmental, social, health and safety aspects. 3.3. Able to supervise the implementation of building engineering work 3.4. Able to communicate Engineeering Design material to students. 4. Have a reliable ability to design, implement and evaluate the learning process in Building Engineering Vocational Education (Education design). 4.1. Able to design curriculum and learning process in the field of building engineering. 4.2. Able to implement, control, evaluate and improve the quality of the learning process 4.3. Able to develop effective, efficient, and attractive learning media. 5. Having the ability to adapt and innovate to the development of science and technology and implement it into educational goals and professional work by considering possible non-technical risks (Engineering practice). 5.1. Able to innovate and develop technology in the field of building engineering by considering social, economic and environmental aspects. 5.2. Able to analyze environmental conditions in the planning, implementation and supervision of buildings.

<table>
<tr><td></td><td>5.3. Implement information technology and computers into the planning, implementation, and supervision processes of buildings.
6. Having social and managerial competence, working together, communicating effectively, having an entrepreneurial character, having an environmental perspective and being aware of the importance of lifelong learning (transferable and soft skills).
6.1. Able to work creatively, innovatively, collaboratively, be careful, responsible, responsive to environmental changes.
6.2. Have curiosity, think critically, are open-minded, and objective.
6.3. Able to communicate effectively and work together in a team work.</td></tr>
<tr><td>Subject Learning Outcomes</td><td>Subject Learning Outcomes (CPMK)
<table><tr><th>CPMK</th><th>CPL</th></tr><tr><td>1. Able to analyze the selection of alternative heavy equipment used at the project work site</td><td>1.1,2.1,2.2,3.2,5.2</td></tr><tr><td>2. Able to plan work methods using heavy equipment efficiently</td><td>1.1,2.1,2.2,3.2,5.2</td></tr><tr><td>3. Able to accelerate project work by using heavy equipment to implement management techniques as a construction project management tool, so that the project achieves its goals and objectives.</td><td>2.1,2.2,3.3, 5.2</td></tr></table></td></tr>
<tr><td>Short course descriptions</td><td>This course provides knowledge about descriptions of the types of PTM tools and their determination of types and quantities, an explanation of the approximate determination of the type and quantity of heavy equipment, as well as an explanation of production and costs. Methods of unloading, loading and transporting excavated and stockpiled earth materials, followed by transportation equipment equipment and operations</td></tr>
<tr><td>References</td><td>Main (RU):
1. Mechanical Soil Transfers, Rochmanhadi, Dep.PU, 1998
2. Mechanical Soil Transfers and Heavy Equipment, Darmansya, UNSRI, 1998
3. Calculation of Work Implementation Costs Using Heavy Equipment, Rochmandi, Dep. PU, 1984
4. Mechanical Soil Transfers, Partanto, ITB, 1996
5. Calculation of Heavy Equipment Production, Dep Pu, 1984
6. Heavy Equipment, PEDC, Bandung, 1984</td></tr>
</table>

	Support (RP)	
	1. Caterpilar Product Lina, PT. Trakindo, Jakarta, 1993 2. Caterpilar Performance Handbook 33, PT. Trankindo, Jakarta, 20	
Learning Media		**Hardware:**
	Office Word and Excel	Computers, LCD projectors and whiteboards and peripherals
Team Teaching	Nidal Zuwida, S.Pd, M.Pd.T	
Assessment	UTS, UAS, Independent & group assignments	
Requirements Subject	Nothing	

LEARNING MATERIALS

Sunday	Competence to be achieved	Study Materials	Learning Methods and Strategies	Assignments / assignments	Assessment Criteria / Indicators	Reference
(1)	**CPMK-1 (PLO-2.1,2.2,3.2)** Understand the concepts and functions of PTM and heavy equipment, PTM field of work, material classification and soil properties	1. Concept and function of PTM and heavy equipment, 2. PTM field of work, 3. Classification of materials and soil properties	Material explanation Question and answer Review related subject matter Discussion	Make a summary and description of the material presented in the resume book	Able to understand concepts and functions of PTM and heavy equipment, PTM field of work, classification of materials and soil properties	
(2)	**CPMK-1 (PLO-2.1,2.2,3.2)** Understand development objectives, work site analysis, work	1. Development goals 2. Workplace analysis, perplan work and production unit costs	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book	Able to Understand development objectives, analysis of workplaces, work	

Sunday	Competence to be achieved	Study Materials	Learning Methods and Strategies	Assignments / assignments	Assessment Criteria / Indicators	Reference
	planning and unit production costs			• Task work on questions	planning and unit production costs	
(3)	**CPMK-1 (PLO-2.1,2.2,3.2)** Understand the concept of machine use, machine ownership considerations, and machine selection systems	1. Heavy equipment usage concept 2. Ownership considerations heavy equipment 3. Machine selection system	Material explanation Question and answer	• Make a summary and description of the material presented in the resume book	Able munderstand the concept of heavy equipment use, machine ownership considerations, and machine selection systems	
(4)	**CPMK 2 (PLO-1.1,2.1,2.2,3.2,5.2)** Understand the grouping of machines according to prime movers and their functions	Grouping of heavy equipment according to the prime mover and its function	Material explanation Question and answer	• Make a summary and description of the material presented in the resume book	Able munderstand the classification of heavy equipment according to the prime mover and their functions	
(5)	**CPMK 2 (PLO-1.1,2.1,2.2,3.2,5.2)** Understand the types and functions of excavators, loaders, cutters, diggers, compactors, spreaders, asphalt processing, concrete processing, breakers, rakes, cranes.	1. Types and functions of excavators, loaders, cutters, diggers, compactors, spreaders, asphalt processing, concrete processing, crusher, dredger, crane	Material explanation Question and answer	• Make a summary and description of the material presented in the resume book	Able munderstand the types and functions of excavators, loaders, cutters, diggers, compactors, spreaders, asphalt processing, concrete processing,	

Sunday	Competence to be achieved	Study Materials	Learning Methods and Strategies	Assignments / assignments	Assessment Criteria / Indicators	Reference
					breakers, rakes, cranes	
(6)	**CPMK 2 (PLO-1.1,2.1,2.2,3.2,5.2)** Understand the definition power of heavy equipment and can analyze fallow powert such as: existing energy, energy needed and energy used	1. Heavy equipment definition and types of heavy equipment power such as: existing power, energy required,and power that is utilized 2. Analysis heavy equipment power such as: existing power, energy required,and power that is utilized	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Able munderstand and analyze definition power heavy equipment and various kinds of heavy equipment power such as: existing power, energy needed and energy used	
(7)	**CPMK 2 (PLO-1.1,2.1,2.2,3.2,5.2)** Knowing and understanding the factors that affect production	Factors affecting production	Material explanation Question and answer	• Make a summary and description of the material presented in the resume book	Get Mknow and understand the factors that affect production	
(8)	**Mid-Semester Exam**					
(9)	**CPMK 2 (PLO-1.1,2.1,2.2,3.2,5.2)** Understand the calculation of unit costs: cost of ownership, operational costs and	1. Cost unit calculation: 2. Cost of ownership, 3. Operational costs and - Equipment unit costs	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Get Munderstand the calculation of unit costs: cost of ownership, operational costs	

Sunday	Competence to be achieved	Study Materials	Learning Methods and Strategies	Assignments / assignments	Assessment Criteria / Indicators	Reference
	unit costs of equipment				and unit costs of equipment	
(10)	**CPMK 3 (PLO-2.1,2.2,3.3, 5.2)** Understand the definition of heavy equipment production, basic calculation principles, and heavy equipment production calculations such as: bulldozers and excavators	1. Production work of heavy equipment 2. The basic principle of calculation of production 3. Heavy equipment production calculations such as: bulldozers and excavators	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Get Munderstand the definition of heavy equipment production, basic calculation principles, and heavy equipment production calculations such as: bulldozers and excavators	
(11)	**CPMK 3 (PLO-2.1,2.2,3.3, 5.2)** Have an understanding in calculating work production: Loaders, dump trucks and graders	Calculating work production: 1. Loader, 2. Dump truck 3. Graders	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Can understand and calculate work production: Loaders, dump trucks and graders	
(12)	**CPMK 3 (PLO-2.1,2.2,3.3, 5.2)** Have understanding in calculating work production: scraper,	Calculating the production of work: 1. Scraper, 2. Ripper, and 3. - Compactor	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book	Can understand and calculating the production work: scraper,	

Sunday	Competence to be achieved	Study Materials	Learning Methods and Strategies	Assignments / assignments	Assessment Criteria / Indicators	Reference
	ripper, and compactor			• Task work on questions	ripper, and compactor	
(13)	**CPMK 3 (PLO-2.1,2.2,3.3, 5.2)** Have an understanding in calculating work production: compressors, water pumps, concrete mixers and asphal processing	Calculating work production: 1. Compressor, 2. Water pump, 3. Concrete mixer and 4. Asphal processing	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Can understand and calculate work production: compressors, water pumps, concrete mixers and asphal processing	
(14)	**CPMK 3 (PLO-2.1,2.2,3.3, 5.2)** Have an understanding of analyzing equipment operations consisting of: Efficiency factors and equipment combination modeling	Analyzing equipment operation consists of: 1. Efficiency factor 2. Equipment combination modeling	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Can understand and analyzing the operation of the equipment consisting of: Efficiency factors and equipment combination modeling	
(15)	**CPMK 3 (PLO-2.1,2.2,3.3, 5.2)** Students can calculate planned costs: Based on equipment costs and based on equipment production, maintenance and	Calculating the cost plan: 1. Based on cost tool 2. Based on the production of tools 3. Maintenance and maintenance of heavy equipment.	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Dapat calculate cost plan: Based on equipment cost and based on equipment production, maintenance and	

Sunday	Competence to be achieved	Study Materials	Learning Methods and Strategies	Assignments / assignments	Assessment Criteria / Indicators	Reference
	maintenance of heavy equipment.				maintenance of heavy equipment.	
(16)	**Final Semester Evaluation (Evaluation which is intended to determine the final achievement of student learning outcomes)**					

Note :

1. Face-to-face lectures last for 14 meetings
2. Scoring system consists of individual Tasks, UTS and UAS
3. Group discussion: Looking at projects, especially those that use heavy equipment. Students are asked to make a paper about the operation of the heavy equipment

Correlation between CPMK and CPL and Assessment Methods2.1,2.2,3.3, 5.2

	Assessment	Weigh t (%)	CPL-1			CPL-2				CPL-3				CPL-4			CPL-5			CPL-6		
			1	2	3	1	2	3	4	1	2	3	4	1	2	3	1	2	3	1	2	3
CPMK-1	Assignment, Paper, Mid Semester	40	x			x	x	x										x				
CPMK-2	Assignment, Mid Semester, Final Exam	30	x			x	x	x										x				
CPMK-3	Tasks, Final Exam	30		x			x	x										x				
TOTAL		100																				

Assessment Components

Midterm exam	: 30%
Final exams	: 30%
Assignment 1	: 15%
Assignment 2	: 25%
Presence	: (minimum 80%)
Total	: 100%

Rating Level Description

	Excellent	**Good**	**Satisfy**	**Fail**
Description	Be able to describe with right and complete	Be able to describe with right but less complete	Be able to describe but unclear and less complete	Not capable describe
Formulations	Able to formulate correctly and completely	Able to formulate correctly but incomplete	Able to formulate but less clear and incomplete	Not able to formulate
Calculate	Able to calculate correctly and completely	Able to calculate correctly but not complete	Able to count but less clear and incomplete	Not able to count
Analysis	Able to analyze correctly and completely	Able to analyze correctly but incomplete	Able to analyze but less clear and incomplete	Not able to analyze

Scoring system

Score	Quality Value	Quality Score	Designation of Quality	Score	Quality Value	Quality Score	Designation of Quality
85 - 100	A	4.0	With compliments	55 - 59	C	2.0	Enough
80 - 84	A-	3.6	Very very good	50 - 54	C-	1.6	Not enough
75 - 79	B +	3.3	Very well	40 - 49	D	1.0	Less
70 - 74	B	3.0	Good	≤ 39	E	0.0	Failed
65 - 69	B-	2.6	Pretty good	-	T	-	Delayed
60 - 64	C +	2.3	More than enough				

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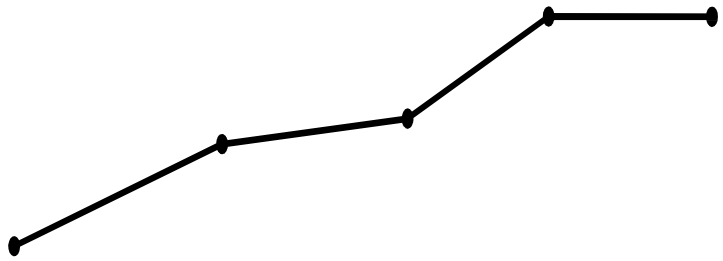
MIDDLE SEMESTER EXAM PROBLEM

Courses : Heavy Equipment and Mechanical Earthmoving
Code / SKS :
Nature of the Exam : Open the book
Lecturer : Nidal Zuwida, S.Pd., M.Pd.T
Time : 60 minutes
Maximum value weight : 30

No.	Question	Weight
1	Describe the function of the tool: a. Excavator b. Bulldozer c. Ripper d. Wheel Loader e. Dump Truck	2.5
2	In making preparations for earth moving work, a number of soil conditions must be taken into account which may affect the volume of soil found in earth moving work. Explain the state of the land in question?	2.5
3	Determine the bulk density of the soil in the original state (BM) and in the solid state (CM), if it is known that the bulk density of the soil at the loose state (LM) is 9xy kg / m3, the% expansion and% shrinkage are 6y% and 4x%, respectively. Also determine the LF of the soil conditions?	5
4	Calculate the speed of a Dump Truck that has a working power of 400 HP, where the Dump Truk has a traction of 15000 kg in 1st gear,	10

	10000 kg in 2nd gear, 6000 kg in 3rd gear, 5000 kg in 4th gear and 3500 kg in 5th gear, if efficiency tool is 0.8x!	
5	A 550 HP off highway Truck is operated to transport gravel material from a project location A to location D for landfilling, as illustrated below:  Tool model : 651 E / 550 HP Capacity : 85 m3 Tool Empty Weight : 50 tons Traction Factor : 0.40 Weight distribution: - Loaded : 63% - Empty : 55% Material Content Weight : 1500 kg / m3 Work Efficiency : 85% Constant number : 375 Average speed: Gear 1 6.98 km / hr Gear 2 8.30 km / hr Gear 3 10.26 km / hr Gear 4 14.53 km / hour Gear 5 20.52 km / hour Gear 6 32.59 km / hr Gear 7 45.89 km / hour Gear 8 72.66 km / hr A - B □ RR = 40kg / ton, GR = 7.0%, Distance = 200 m B - C □ RR = 70 kg / ton, GR = 5.5%, Distance = 400 m	10

	C - D □ RR = 30 kg / ton, GR = 6.0%, Distance = 300 m D - E RR = 50 kg / ton, GR = 0.0% Distance = 600 m Count: 1. The power required for each section from A - E and from E– A! 2. Power available at every gear level! 3. Calculate the usable power of AE! 4. Compare the energy needed with the energy available! 5. Maximum speed for each section!	

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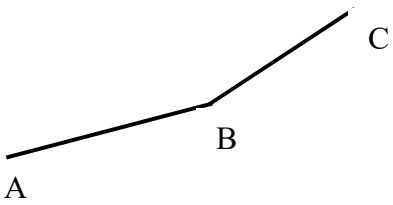
SEMESTER FINAL EXAM PROBLEMS

Courses : Heavy Equipment and Mechanical Earthmoving
Code / SKS :
Nature of the Exam : Open the book
Lecturer : Nidal Zuwida, S.Pd., M.Pd.T
Time : 60 minutes
Maximum value weight : 30

No.	Question	Weight
1	Describe the classification of machines according to prime mover and according to their function	2.5
2	A road surface that will be passed by the dump truck consists of two sections, as shown below:  Section AB RR = 4x kg / ton GR = 2% Section BC RR = 5x kg / ton GR = 2.5% Calculate the power required for the two sections if the total weight of the tool is 90 tons?	5
3	Komatsu bulldozer on road works carried out the eviction with the following data: Blade width = 2.20 m Blade height = 1.20 m Blade factor = 0.80 Distance Eviction = 30 m Speed = a) forward = 3 km / h (50 m / min) Backward = 6 km / hr Change of gear time = 0.20 minutes	7.5

<table>
<tr><td></td><td>Work efficiency = 0.75 good
What was the productivity per hour of the bulldozer?</td><td></td></tr>
<tr><td>4</td><td>In road construction, the Hitachi Ex-100 brand loader is used for loading crushed stone material, with the following data:
Bucket volume (q1) = 1.5 m3
Bucket factor (K1) = 0.6
Efficiency (E) = 70%
Conversion factor 1.65
Time cycle: Transport distance (D) = 30 meters
Forward speed = 125 m / min
Reverse speed = 150 m / min
Fixed time (Z) = 0.5 minutes
What is the loader productivity per hour?</td><td>7.5</td></tr>
<tr><td>5</td><td>Empty scraper weight = 12 tons, load weight = 6 m3 x 1,300 t / m3 = 7.8 tons. RR: rubber tire = 60 kg / ton, crawler / track = 30 kg / ton. The scraper is towed by a crawler tractor weighing 15 tons, and hauling distance = 600 meters. How long does it take for the scraper to operate?
<table>
<tr><th>Gear (Gear)</th><th>Speed (km / h)</th><th>DPB (kg)</th></tr>
<tr><td>1</td><td>2.36</td><td>9000</td></tr>
<tr><td>2</td><td>3.8</td><td>5340</td></tr>
<tr><td>3</td><td>4.51</td><td>4050</td></tr>
<tr><td>4</td><td>6.45</td><td>2540</td></tr>
<tr><td>5</td><td>10.0</td><td>1530</td></tr>
</table>
</td><td>7.5</td></tr>
</table>

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Assignment

Courses : Heavy Equipment and Mechanical Earthmoving
Code / SKS :
Nature of the Exam : Group discussion
Lecturer : Nidal Zuwida, S.Pd., M.Pd.T
Time : 30 minutes
Maximum value weight : 40

Group	Question	Max value
CPMK-1	Field studies Looking at projects, especially those that use heavy equipment. Students are asked to make a paper about the operation of the heavy equipment Paper 1. Hazard Identification 2. Risk Assessment 3. Risk Reduction or Control Performance	 10% 30%

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Assignment

Courses : Heavy Equipment and Mechanical Earthmoving
Code / SKS :
Nature of the Exam : Open book
Lecturer : Nidal Zuwida, S.Pd., M.Pd.T
Time : 30 minutes
Maximum value weight : 10%

Group		Question	Max value
CPMK-1	1	a. What the heavy equipment said b. Explain the purpose of using heavy equipment from a technical, economic and humanist point of view	
	2	a. What is the heavy equipment ownership system that you know b. Explain the advantages and disadvantages one by one	
	3	Describe the classification of machines based on their main movers and their functions	
CPMK-2	1	A Wheel Tractor Scraper with an empty weight of 40 tons, a load capacity of 30 m3 and carries sandy soil with a volume of 2000 kg / m3. This tool operates on a project with haul road conditions having Rolling Resistance (RR = 4%), as well as the slope of the GR = 3% road, the road is in a muddy condition with a penetration of 3 cm. How much power is needed by the tool to move	
	2	A heavy equipment that has an empty weight = 35 tons and is able to carry a load of 25 tons on the road with a rolling resistance of 40 kg / ton and with an incline of 5% and 7%, what is the total resistance of the above conditions.	
	3	2. A 769c / 450 Hp Dump-Truck with a total weight (GVW) of 60 tonnes, operating on haul roads that have a traction factor of 0.40 (clay road full of ruts). Based on the specifications, the weight distribution of the driving wheels is 66.7%. How much traction can be used?	

CPMK-3	1	Describe the work cycle of the Excavator and Wheel Loader machine and of the cycle This work determines the group of work cycles that are included in fixed time and non-fixed time!	
	2	Explain why the efficiency factor needs to be considered in the calculation production work heavy equipment!	
	3	Calculate the labor efficiency factor requiring a break 40 minutes for 4 hours of work!	
	4	Calculate the Bulldozer work production which has the following data: Tool model: D 7G / 7A Blade Height: 0.970 m Blade Width: 4.27 m Displacement speed: 6.6 km / hour Return speed: 12.2 km / h Fixed time: 0.1 minutes Cast / return distance: 85 m Correction factor: Operators: 0.75 Weather (rainy): 0.80 Work efficiency: 0.67	
		Calculate Dump Truck Work Production, if the data are known as Dump Trucks as follows : Tool model: 785 B Body capacity: 57 m3 Waste time: 2 minutes Transport speed: 20 km / hour Return speed: 25 km / h Transport / return distance: 5 km Fixed time: 4.5 minutes Wheel Loader production work: 380 m3 / hour Content factor: 0.9 Work efficiency factor: 50 minutes / hour	