MODULE PORTFOLIO
EVEN SEMESTER ACADEMIC YEAR 2019/2020

MODULE NAME	:	Multivariable Calculus	LECTURER:
MODULE CODE	:	4420104057	
CLASS	:	2018	
SEMESTER	:	4	
DATE	:	6 Juli 2020	Budi Priyo Prawoto, M.Si
COURSE LEARNING OUTCOMES	:	Programme Learning Outcomes (PLO) Knowledge (KNO-1: Demonstrating mathematical knowledge and mathematical insight) CLO-1 : Able to Demonstrate mathematical knowledge related to vector, vector valued function, real valued multivariable vector, differential calculus of multivariable function, integral calculus of multivariable function, and calculus of vector field. Skill (SKI-1: Formulating and solving fundamental mathematical problems) CLO-2 : Able to formulate and solve basic problems of vector, vector valued function, real valued multivariable function, differential calculus of multivariable function, and integral calculus of multivariable function. Skill (SKI-2: Applying the basic principles of mathematics to solve simple* mathematical problems) CLO-3 : Able to use the method of finding solutions in solving related mathematical problems vector, vector valued function, real valued multivariable function, differential calculus of multivariable function, and integral calculus of multivariable function. Skill (SKI-4: Implementing simple mathematical procedures in computer programs) CLO-4 : Able to implement concept and properties of vector, vector valued function, real valued multivariable vector, differential calculus of multivariable function, and integral calculus of multivariable function for making a simple computer problem in order to solve problems. Competences (COM-2: Generating ideas used for completing mathematical tasks and to communicate them either in writing or orally, in accordance with scientific principles)	

		CLO-5 : Generalize the ideas used to complete tasks related to the concept of vector, vector valued function, real valued multivariable vector, differential calculus of multivariable function, and integral calculus of multivariable function and able to communicate verbally or in writing. **Correlation Between PLO and CLO Multivariable Calculus** **Multivariable Calculus** | **KNO-1** | **SKI-1** | **SKI-2** | **SKI-4** | **COM-2** CLO-1 | √ CLO-2 | √ CLO-3 | √ CLO-4 | √ CLO-5 | √
LEARNING STRATEGIES	:	The course is carried out by activating students with the following strategies: Lectures, Discussions, Presentations, and Group Assignments
ASSESSMENT	:	The assessment carried out during the course includes the following three components. 1. Assignment 2. Mid-term exam 3. Final Exam **1. Assignment** ✔ Assignments are given twice in one semester, before Mid-term Exam and after Mid-term Exam ✔ The assignment before the Mid-term Exam is an independent / individual task in the form of a description of the materials that have been discussed before the Mid-term Exam as well as the quizzes after the Mid-term Exam related to the material studied after the Mid-term Exam ✔ The quiz is held in the classroom for 100 minutes ✔ Assessment of assignments is carried out to see the achievements of the PLO and CLO that are in accordance with the characteristics of the Transformational Geometry course.

2. Mid-term exam

- ✔ Mid-term exam is held at the 8th meeting.
- ✔ Mid-term exam is held in class with 100 minutes of implementation time according to the class schedule.
- ✔ Mid-term exam is conducted to see the achievements of the PLO and CLO that correspond to the characteristics of Transformational Geometry courses.

3. Final Exam

- ✔ The final exam is held at the 16th meeting.
- ✔ The final exam is is held in class with 100 minutes of implementation time according to the class schedule.
- ✔ The final exam is conducted to see the achievements of the PLO and CLO which correspond to the characteristics of Transformational Geometry courses.

Assessmen Plan

Multivariable Calculus	**KNO-1**	**SKI-1**	**SKI-2**	**SKI-4**	**COM-2**
CLO-1	Assignment, mid-term test, final test				
CLO-2		Assignment, mid-term test, final test			
CLO-3			Assignment, mid-term test, final test		
CLO-4				Assignment	
CLO-5					Assignment

Weight of Test Ability

Multivariable Calculus	KNO-1	SKI-1	SKI-2	SKI-4	COM-2
Assignment	20%	15%	10%	25&	30%
Mid-term test	40%	30%	30%	-	-
Final test	40%	30%	30%	-	-

The Calculation of PLO's Weight

	T	UTS	UAS	
KNO-1	0.2	0.4	0.4	**1**
SKI-1	0.15	0.3	0.3	**0.75**
SKI-2	0.1	0.3	0.3	**0.7**
SKI-4	0.25	-	-	**0.25**
COM-2	0.3	-	-	**0.3**
	1	**1**	**1**	**3**

LEARNING OUTCOMES :

The Calculation of PLO for each students

NO	NIM	x				
		KNO-1	SKI-1	SKI-2	SKI-4	COM-2
1	16030214038	67.31	67.31	65	95	95
2	17030214057	72.77	72.77	70.5	100	100
3	18030214001	93.77	93.77	93.8	93	93
4	18030214002	79.69	79.69	78	100	100
5	18030214003	78.31	78.31	76.5	100	100
6	18030214007	82	82	80.5	100	100
7	18030214008	79.38	79.38	77.7	100	100
8	18030214009	81.38	81.38	79.8	100	100

NO	NIM	x				
		KNO-1	SKI-1	SKI-2	SKI-4	COM-2
33	18030214069	74.08	74.08	72.3	95	95
34	15030214023	56.92	56.92	56.7	60	60
35	18030214004	66.15	66.15	65	80	80
36	18030214005	80.38	80.38	80	85	85
37	18030214006	68.46	68.46	67.5	80	80
38	18030214010	77.69	77.69	77.5	80	80
39	18030214011	61.54	61.54	60	80	80
40	18030214012	66.92	66.92	65.8	80	80

9	18030214013	83.54	83.54	82.2	100	100
10	18030214014	69.54	69.54	67	100	100
11	18030214015	82.08	82.08	81	95	95
12	18030214022	81.08	81.08	79.5	100	100
13	18030214023	76.77	76.77	74.8	100	100
14	18030214029	76	76	74	100	100
15	18030214030	73.69	73.69	71.5	100	100
16	18030214031	66.62	66.62	63.8	100	100
17	18030214032	82.69	82.69	81.7	95	95
18	18030214037	86.62	86.62	85.5	100	100
19	18030214038	83.08	83.08	81.7	100	100
20	18030214039	78.92	78.92	77.2	100	100
21	18030214044	70.54	70.54	68.5	95	95
22	18030214045	83.08	83.08	81.8	98	98
23	18030214050	61.69	61.69	58.5	100	100
24	18030214051	81.54	81.54	80.2	98	98
25	18030214055	86.85	86.85	86.2	95	95
26	18030214056	79.23	79.23	77.5	100	100
27	18030214057	83.77	83.77	82.8	95	95
28	18030214061	80.31	80.31	78.7	100	100
29	18030214062	60.85	60.85	59	83	83
30	18030214063	86.31	86.31	85.2	100	100
31	18030214067	87.08	87.08	86	100	100
32	18030214068	76.92	76.92	75	100	100

41	18030214016	66.15	66.15	65	80	80
42	18030214017	86.15	86.15	86.7	80	80
43	18030214018	66.15	66.15	65	80	80
44	18030214019	61.54	61.54	60	80	80
45	18030214020	83.46	83.46	83.3	85	85
46	18030214021	61.54	61.54	60	80	80
47	18030214025	83.08	83.08	83.3	80	80
48	18030214026	73.08	73.08	72.5	80	80
49	18030214027	66.15	66.15	65	80	80
50	18030214033	75.38	75.38	75	80	80
51	18030214034	67.69	67.69	66.7	80	80
52	18030214035	76.15	76.15	75.8	80	80
53	18030214036	66.92	66.92	65.8	80	80
54	18030214040	76.15	76.15	75.8	80	80
55	18030214046	69.23	69.23	68.3	80	80
56	18030214047	76.15	76.15	75.8	80	80
57	18030214048	69.23	69.23	68.3	80	80
58	18030214052	66.15	66.15	65	80	80
59	18030214053	78.46	78.46	78.3	80	80
60	18030214054	68.46	68.46	67.5	80	80
61	18030214058	78.46	78.46	80	60	60
62	18030214060	61.54	61.54	60	80	80
63	18030214064	68.46	68.46	67.5	80	80
64	18030214065	76.92	76.92	76.7	80	80
65	18030214066	66.92	66.92	65.8	80	80

The predicate of PLO for each student

NO	NIM	x				
		KNO-1	SKI-1	SKI-2	SKI-4	COM-2
1	16030214038	S	S	S	E	E
2	17030214057	G	G	G	E	E
3	18030214001	E	E	E	E	E
4	18030214002	G	G	G	E	E
5	18030214003	G	G	G	E	E
6	18030214007	E	E	E	E	E
7	18030214008	G	G	G	E	E
8	18030214009	E	E	G	E	E
9	18030214013	E	E	E	E	E
10	18030214014	S	S	S	E	E
11	18030214015	E	E	E	E	E
12	18030214022	E	E	G	E	E
13	18030214023	G	G	G	E	E
14	18030214029	G	G	G	E	E
15	18030214030	G	G	G	E	E
16	18030214031	S	S	S	E	E
17	18030214032	E	E	E	E	E
18	18030214037	E	E	E	E	E
19	18030214038	E	E	E	E	E
20	18030214039	G	G	G	E	E
21	18030214044	G	G	S	E	E
22	18030214045	E	E	E	E	E
23	18030214050	S	S	S	E	E
24	18030214051	E	E	E	E	E

NO	NIM	x				
		KNO-1	SKI-1	SKI-2	SKI-4	COM-2
33	18030214069	G	G	G	E	E
34	15030214023	G	G	G	E	E
35	18030214004	S	S	S	S	S
36	18030214005	S	S	S	E	E
37	18030214006	E	E	E	E	E
38	18030214010	S	S	S	E	E
39	18030214011	G	G	G	E	E
40	18030214012	S	S	S	E	E
41	18030214016	S	S	S	E	E
42	18030214017	S	S	S	E	E
43	18030214018	E	E	E	E	E
44	18030214019	S	S	S	E	E
45	18030214020	S	S	S	E	E
46	18030214021	E	E	E	E	E
47	18030214025	S	S	S	E	E
48	18030214026	E	E	E	E	E
49	18030214027	G	G	G	E	E
50	18030214033	S	S	S	E	E
51	18030214034	G	G	G	E	E
52	18030214035	S	S	S	E	E
53	18030214036	G	G	G	E	E
54	18030214040	S	S	S	E	E
55	18030214046	G	G	G	E	E
56	18030214047	S	S	S	E	E

25	18030214055	E	E	E	E	E
26	18030214056	G	G	G	E	E
27	18030214057	E	E	E	E	E
28	18030214061	E	E	G	E	E
29	18030214062	S	S	S	E	E
30	18030214063	E	E	E	E	E
31	18030214067	E	E	E	E	E
32	18030214068	G	G	G	E	E

57	18030214048	G	G	G	E	E
58	18030214052	S	S	S	E	E
59	18030214053	S	S	S	E	E
60	18030214054	G	G	G	E	E
61	18030214058	S	S	S	E	E
62	18030214060	G	G	E	S	S
63	18030214064	S	S	S	E	E
64	18030214065	S	S	S	E	E
65	18030214066	G	G	G	E	E

E = Excellent
G = Good
S = Satisfy
F = Fail

LEARNING OUTCOMES ANALYSIS :

PLO Assessment Rubric

PLO	Description	Excellent $x \geq 80$	Good $70 \leq x < 80$	Satisfy $55 \leq x < 70$	Fail $x < 55$
KNO-1	Demonstrating mathematical knowledge and mathematical insight.	Able to Demonstrate mathematical knowledge related to vector, vector valued function, real valued multivariable vector, differential calculus of multivariable function, integral	Able to Demonstrate mathematical knowledge related to vector, vector valued function, real valued multivariable vector, differential calculus of multivariable function, integral calculus of multivariable function, and calculus of vector	Able to Demonstrate mathematical knowledge related to vector, vector valued function, real valued multivariable vector, differential calculus of multivariable function, integral calculus of multivariable function,	Able to Demonstrate mathematical knowledge related to vector, vector valued function, real valued multivariable vector, differential calculus of multivariable function, integral calculus of multivariable function,

				calculus of multivariable function, and calculus of vector field **with skor at least 80.**	field **with skor at least 70 and less than 80.**	and calculus of vector field **with skor at least 55 and less than 70.**	and calculus of vector field**with skor less than 55.**
		SKI-1	Formulating and solving fundamental mathematical problems	Able to formulate and solve basic problems of vector, vector valued function, real valued multivariable function, differential calculus of multivariable function, and integral calculus of multivariable function **with skor at least 80.**	Able to formulate and solve basic problems of vector, vector valued function, real valued multivariable function, differential calculus of multivariable function, and integral calculus of multivariable function **with skor at least 70 and less than 80.**	Able to formulate and solve basic problems of vector, vector valued function, real valued multivariable function, differential calculus of multivariable function, and integral calculus of multivariable function**with skor at least 55 and less than 70**	Able to formulate and solve basic problems of vector, vector valued function, real valued multivariable function, differential calculus of multivariable function, and integral calculus of multivariable function **with skor less than 55.**
		SKI-2	Applying the basic principles of mathematics to solve simple* mathematical problems	Able to use the method of finding solutions in solving related mathematical problems vector, vector valued function, real valued multivariable function, differential	Able to use the method of finding solutions in solving related mathematical problems vector, vector valued function, real valued multivariable function, differential calculus of multivariable function, and integral calculus of	Able to use the method of finding solutions in solving related mathematical problems vector, vector valued function, real valued multivariable function, differential calculus of multivariable function, and integral calculus of	Able to use the method of finding solutions in solving related mathematical problems vector, vector valued function, real valued multivariable function, differential calculus of multivariable function, and integral calculus of

				calculus of multivariable function, and integral calculus of multivariable function **with skor at least 80.**	multivariable function **with skor at least 70 and less than 80.**	multivariable function **with skor at least 55 and less than 70**	multivariable function **with skor less than 55.**
		SKI-4	Implementing simple mathematical procedures in computer programs	Able to implement concept and properties of vector, vector valued function, real valued multivariable vector, differential calculus of multivariable function, and integral calculus of multivariable function for making a simple computer problem in order to solve problems **with skor at least 80.**	Able to implement concept and properties of vector, vector valued function, real valued multivariable vector, differential calculus of multivariable function, and integral calculus of multivariable function for making a simple computer problem in order to solve problems **with skor at least 70 and less than 80.**	Able to implement concept and properties of vector, vector valued function, real valued multivariable vector, differential calculus of multivariable function, and integral calculus of multivariable function for making a simple computer problem in order to solve problems **with skor at least 55 and less than 70**	Able to implement concept and properties of vector, vector valued function, real valued multivariable vector, differential calculus of multivariable function, and integral calculus of multivariable function for making a simple computer problem in order to solve problems**with skor less than 55.**
		COM-2	Generating ideas used for completing mathematical tasks and to communicate them either in	Generalize the ideas used to complete tasks related to the concept of vector, vector valued function, real valued multivariable vector,	Generalize the ideas used to complete tasks related to the concept of vector, vector valued function, real valued multivariable vector, differential calculus of multivariable	Generalize the ideas used to complete tasks related to the concept of vector, vector valued function, real valued multivariable vector, differential calculus of	Generalize the ideas used to complete tasks related to the concept of vector, vector valued function, real valued multivariable vector, differential calculus of

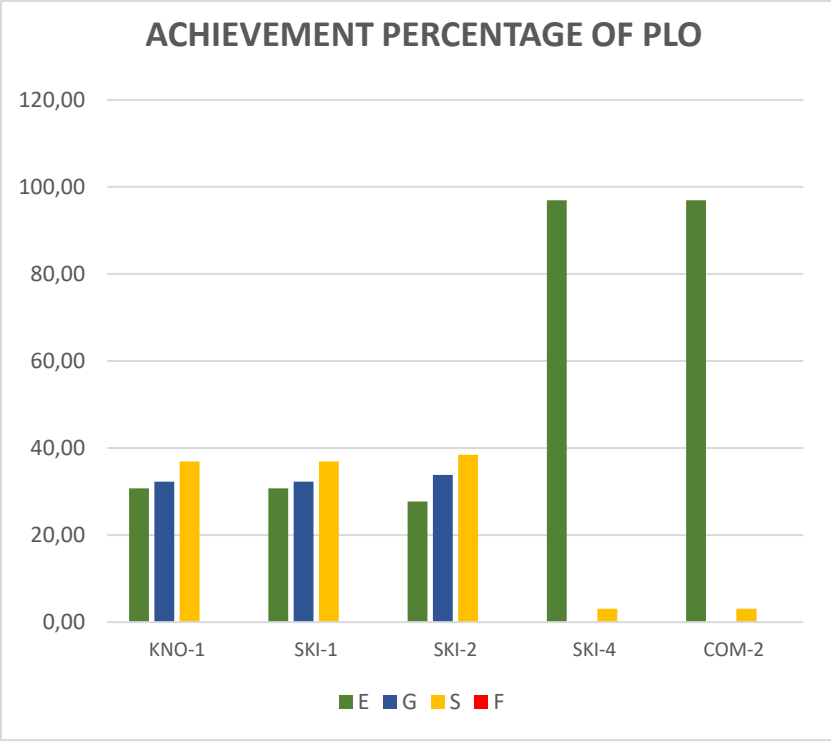
		writing or orally, in accordance with scientific principles	differential calculus of multivariable function, and integral calculus of multivariable function and able to communicate verbally or in writing with skor at least 80.	function, and integral calculus of multivariable function and able to communicate verbally or in writing with skor at least 70 and less than 80.	multivariable function, and integral calculus of multivariable function and able to communicate verbally or in writingwith skor at least 55 and less than 70	multivariable function, and integral calculus of multivariable function and able to communicate verbally or in writing with skor less than 55.

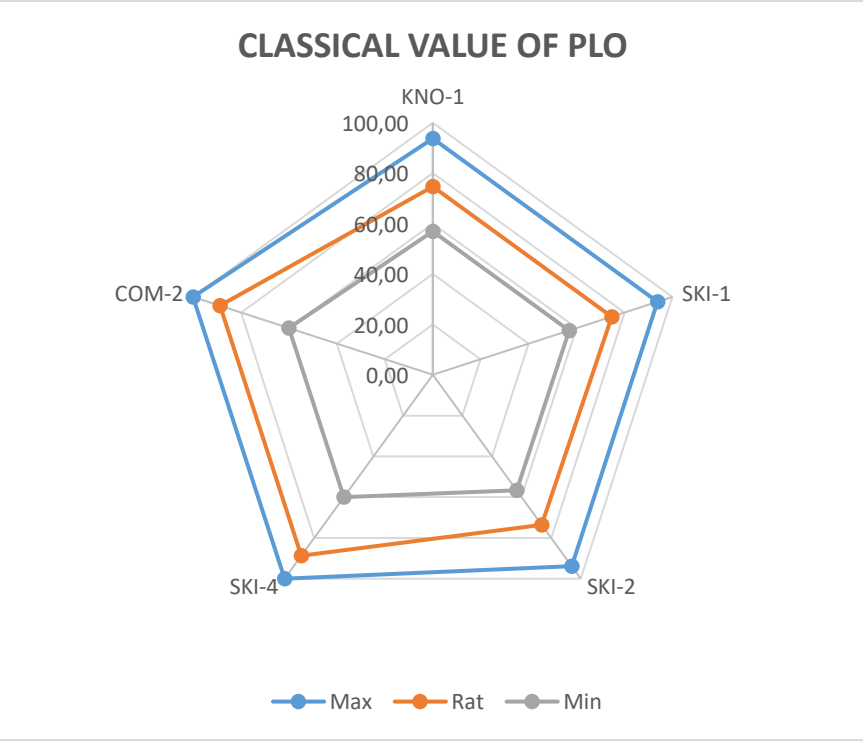
CLASSICAL VALUE OF PLO					
	KNO-1	SKI-1	SKI-2	SKI-4	COM-2
Max	93.77	93.77	93.83	100.00	100.00
Rat	74.69	74.69	73.53	88.72	88.72
Min	56.92	56.92	56.67	60.00	60.00

	ACHIEVEMENT NUMBER OF PLO				
	KNO-1	SKI-1	SKI-2	SKI-4	COM-2
E	20.00	20.00	18.00	63.00	63.00
G	21.00	21.00	22.00	0.00	0.00
S	24.00	24.00	25.00	2.00	2.00
F	0.00	0.00	0.00	0.00	0.00
	65	65	65	65	65

	ACHIEVEMENT PERCENTAGE OF PLO (%)				
	KNO-1	SKI-1	SKI-2	SKI-4	COM-2
E	30.77	30.77	27.69	96.92	96.92
G	32.31	32.31	33.85	0.00	0.00
S	36.92	36.92	38.46	3.08	3.08

F	0.00	0.00	0.00	0.00	0.00
	100.00	100.00	100.00	100.00	100.00





STUDENT'S LEARNING	:	On average, students who program the Multivariable Calculus course have mastered the material provided. Of the 105 students who took this course, more than 60% had met the excellent and good criteria for each PLO. Meanwhile, there are no students who fail to achieve every PLO in this course.

PERFORMANCE ANALYSIS		
RECOMMENDATION FOR FUTURE LEARNING	:	Overall, PLO's achievements in this course have been very good. However, in order to maintain and also improve PLO achievements, several things are recommended: 1. Motivating students to be able to communicate well with all members of the class where the student repeats the course so that the student does not lose information related to the lecture 2. Increase practice questions in the next lecture, through assignments.
RECOMMEDATION FOR INSTITUTION	:	-

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DOCUMENT OF ODD SEMESTER MIDTERM EXAMINATION
ACADEMIC YEAR 2021/2022

Course / Code	:	Multivariable Calculus
Lecturer	:	Rudianto Artiono, M.Si
Program/ Class	:	S1/2020E
Date and Time	:	Tuesday, October 14, 2021
Duration	:	100 Minutes
Type	:	Closed

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1. Write your answers on a sheet of paper with **identification** on each sheet.
2. Avoid using a pencil in writing answers.
3. Photograph/scan your answer sheet so that your answers can be read properly.
4. Sort the answers from the smallest question number and upload your answers in one file (pdf) with the file name: **NIM_NAMA**.
5. Work independently **without any resources but yourself**

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1. Please determine whether these statements are correct or wrong. Give an argument for your answer.
   a. The zero vector is always perpendicular and parallel to any vector space.
   b. For vectors **u** and **v**, if **u** • **v** = 0 and **u** • **w** = 0, then **v** is parallel to **w**.

   (Score 20)

2. Find the unit tangent vector ($\boldsymbol{T}$), unit normal vector ($\boldsymbol{N}$), and curvature ($\boldsymbol{\kappa}$) of the following curve $r(t) = (t - \sin t)\boldsymbol{i} + (t - \cos t)\boldsymbol{j} + e - t\,\boldsymbol{k}$ at $t = 0$

   (Score 20)

3. Find the value

$$\lim_{(x,y)\to(0,0)} \frac{xy^3}{x^2+y^4}$$

   if exist.

   (Score 20)

4. Define the partial derivative from $\frac{\partial z}{\partial u}$ and $\frac{\partial z}{\partial v}$ on $u = 1$ and $v = -2$ if known $z = \ln q$ and $q = \sqrt{v+3}\tan^{-1} u$

   (Score 20)

5. Find the directional derivative of $f(x, y, z) = x^3y - x^2z^2$ at the point $(-2, 1, 3)$ in the vector direction $i - 2j + 2k$.

   (Score 20)

----------Good Luck----------

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RISET, DAN TEKNOLOGI
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BLUE PRINT OF ODD SEMESTER MIDTERM EXAMINATION

Examination Subjects : Multivariable Calculus

Lectures : Team

Program : Mathematics

No.	Indicator	Test	Key of the answer	Cognitive Domain	Score
1.	Solve problems related to vectors in planes and spaces (CLO-3)	Please determine whether these statements are correct or wrong. Give an argument for your answer. a. The zero vector is always perpendicular and parallel to any vector space. b. For vectors **u** and **v**, if **u** • **v** = 0 and **u** • **w** = 0, then **v** is parallel to **w**.	• Find the definition of zero vector • Find the definition of perpendicular between two vectors • Find the definition of parallel between two vectors • Find the definition of dot product • Find the meaning of **u** • **v** = 0 • Find the meaning of **u** • **w** = 0 • Determine whether **v** is parallel to **w**	C4	20
2.	Calculating vector functions, arc length, curvature (CLO-6)	Find the unit tangent vector ($\boldsymbol{T}$), unit normal vector ($\boldsymbol{N}$), and curvature ($\boldsymbol{\kappa}$) of the following curve $r(t) = (t-\sin t)\boldsymbol{i} + (t-\cos t)\boldsymbol{j} + e - t\,\boldsymbol{k}$ at $t = 0$	• Find the definition of the unit tangent vector ($\boldsymbol{T}$) • Find the definition of the unit normal vector ($\boldsymbol{N}$) • Find the definition of the curvature ($\boldsymbol{\kappa}$)	C4	20
3.	Formulate the concept of limit and continuity of function with two	Find the value $\lim_{(x,y)\to(0,0)} \frac{xy^3}{x^2+y^4}$ if exist.	• Find the definition of existence limit • Find the the value of limit	C5	20

	variables and their properties (CLO-2)				
4	Using the chain rule to determine the partial derivative (CLO-3)	Define the partial derivative from $\frac{\partial z}{\partial u}$ and $\frac{\partial z}{\partial v}$ on $u = 1$ and $v = -2$ if known $z = \ln q$ and $q = \sqrt{v+3}\tan^{-1} u$	• Find the value of $\frac{\partial z}{\partial u}$ from given function • Substitute $u = 1$ • Find the value $\frac{\partial z}{\partial v}$ from given function • Substitute $v = -2$	C4	20
5	Explaining the concept of directional derivative (CLO-2)	Find the directional derivative of $f(x, y, z) = x^3y - x^2z^2$ at the point $(-2, 1, 3)$ in the vector direction $i - 2j + 2k$	• Find the definition of derivative • Substitute the point $(-2, 1, 3)$ • Find the direction	C4	20

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DOCUMENT OF ODD SEMESTER FINAL EXAMINATION
ACADEMIC YEAR OF 2021/2022

Course/Code	: Multivariable Calculus
Lecturer	: Team
Program/Class	: S1/2020
Date and Time	: Thursday, December 16, 2021
Duration	: 100 minutes
Type	: Closed

1. Write answer you on sheet paper accompanied **identity** on each sheet.
2. Avoid use pencil in write answer.
3. Photo /scan sheet answer you like that so that answer you could read with good.
4. Sort answer from number about smallest and upload answers you in one file (pdf) with filename: **NIM_NAMA**.
5. Work on by independent **without any resources but yourself**.

1. If $u = f(x,y,z)$ differentiable in area $D \subseteq R^3, x = r^2 - s^2, y = s^2 - t^2$ and $z = t^2 - r^2$. Prove that the first partial derivative of the function u satisfies $(rsu_t + stu_r + tru_s)\,(r,s,t) = 0$ (Score 15)
2. Find the maximum value for function $f(x,y,z) = x^2 + y^2 + z^2$on the yield curve of the intersection between the plane $x - y = 1$ and $y^2 - z^2 = 1$.

   (Score 15)
3. Let R be the bounded area by $x - 2y = 0, x - 2y = 4, 3x - y = 1, 3x - y = 8$, find the value

$$\iint_R \frac{x-2y}{3x-y}\,dA$$

   (Score 20)
4. Drawing the space among surface $z = \sqrt{9 - x^2 - y^2}$ and $z = \sqrt{1 - x^2 - y^2}$ above the-xy plane, then calculate the volume using triple integral.

   (Score 30)
5. Determine the line integral from function $f(x,y) = \sqrt{y}/x$ along the curve $\boldsymbol{r}(t) = t^3\boldsymbol{i} + t^4\boldsymbol{j}$ and $1/2 \le t \le 1$ (Score 20)

---------- Good Luck ----------

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BLUE PRINT OF ODD SEMESTER FINAL EXAMINATION

Examination Subjects : Multivariable Calculus

Lectures : Team

Program : Mathematics

No.	Indicator	Test	Key of the answer	Cognitive Domain	Score
1.	Using the chain rule to determine the partial derivative (CLO-3)	If $u = f(x,y,z)$ differentiable in area $D \subseteq R^3, x = r^2 - s^2, y = s^2 - t^2$ and $z = t^2 - r^2$. Prove that the first partial derivative of the function u satisfies $(rsu_t + stu_r + tru_s)\,(r,s,t) = 0$	• Find the derivative of u_t, u_r and u_s • Find $rsu_t\,(r,s,t)$ • Find $stu_r\,(r,s,t)$ • Find $tru_s\,(r,s,t)$ • Add $rsu_t + stu_r + tru_s)\,(r,s,t)$	C3	20
2.	Solve problems related to extreme values of functions with two variables (CLO-3)	Find the maximum value for function $f(x,y,z) = x^2 + y^2 + z^2$on the yield curve of the intersection between the plane $x - y = 1$ and $y^2 - z^2 = 1$	• Use Lagrange Multiplier with two constraint • Find the first scalar • Find the second scalar • Find the extreme value	C4	20
3.	Solving the double integral using the transformation method (CLO-5)	Let R be the bounded area by $x - 2y = 0, x - 2y = 4, 3x - y = 1, 3x - y = 8$, find the value $\iint_R \frac{x-2y}{3x-y} dA$	• Find the boundary of area R • Find the Jacobian • Evaluate the double integral	C4	20
4	Solve triple integrals with several methods Define triple integrals (CLO-3)	Drawing the space among surface $z = \sqrt{9 - x^2 - y^2}$ and $z = \sqrt{1 - x^2 - y^2}$ above the-	• Drawing the graph • Find the boundary • Evaluate the volume using triple integral	C4	20

		xy plane, then calculate the volume using triple integral.			
5	Solve mathematical problems related to line integrals	Determine the line integral from function $f(x,y) = \sqrt{y}/x$ along the curve $\boldsymbol{r}(t) = t^3\boldsymbol{i} + t^4\boldsymbol{j}$ and $1/2 \leq t \leq 1$	• Find a smooth parametrization • Find the boundary • Evaluate the line integral	C3	20