

Full Name (Please Print): _____

ACU Student Identification Number: _____

Department: Circle one: BME/MEG or CSE or MBG

Mat 102/112
Mathematics II / Calculus II

Instructor: Elcim Elgun Kırımlı

Date: Friday, June 7, 2024

Section: BME/MEG and CSE and MBG

Time: 11.00 to 12.30

Term: Spring 2024

Duration of exam: 90 minutes

Number of exam pages: 8

Exam type: closed book

Additional Material Allowed: 1 page of handwritten cheat sheet is allowed

Please solve questions in the space provided below its statement.

Show all your work to get full credit!

Instructions

1. Write your name and ID number at the top of this page. Identify yourself on *every* page.
2. This exam consists of 6 questions and there are 65 points available. The exam will be graded out of 60 points.
3. This exam contains 8 pages including the cover page. Check that you have them all.
4. Show all the work required to obtain your answers. You may use the last 2 pages for extra space.
5. No exceptions will be given to Discipline Regulation violations.

FOR EXAMINERS' USE ONLY	
Question	Mark
1	/ 8
2	/8
3	/ 15
4	/ 16
5	/ 8
6	/ 10
Total	/60

1) Determine whether the following statements are True or False. No explanation is required.

[2] (a) If a nonempty subset of $\mathbb{R}$ has an upper bound, it has a least upper bound.

[2] (b) Every nonempty subset of $\mathbb{N}$ contains a minimum element.

[2] (c) The sequence $\{\cos(\pi n)\}_{n \in \mathbb{N}}$ converges.

[2] (d) The series $\sum_{n=2}^{\infty} \frac{1}{(n-1)(n+1)}$ is a telescoping series.

2) Briefly answer the following questions. No explanation is required.

[2] (a) A list of numbers is called _____

[2] (b) Limit of partial sums of $\{a_n\}_{n=1}^{\infty}$ is called _____

[2] (c) Give four different examples of indeterminate forms (e.g.: $\frac{0}{0}$): _____

[2] (d) L'Hopital's Rule states that we can evaluate the limit of the indeterminate form as $\lim_{x \rightarrow c} \frac{f(x)}{g(x)} =$ _____

3) Evaluate the following limits:

[3] (a) $\lim_{n \rightarrow \infty} (-1)^n \cdot \frac{n+2}{n^2}$

[4] (b) $\int_0^e \frac{\ln^2(x)}{x} dx$

[4] (c) $\lim_{x \rightarrow 0} \frac{\sin(x)}{x}$

[4] (d) $\lim_{x \rightarrow 0} \left(1 + \frac{3}{x}\right)^x$

- 4) For the given series, determine whether it is absolutely convergent, conditionally convergent, or divergent. Show your work to get full credit.

[4] (a) $\sum_{n=1}^{\infty} n^{-\frac{4}{3}}$

[4] (b) $\sum_{n=2}^{\infty} \left(\frac{3}{8}\right)^{3n}$

[4] (c) $\sum_{n=1}^{\infty} \frac{n^3}{n^3+1}$

[4] 4.d) $\sum_{n=1}^{\infty} \frac{(-1)^n}{n^{\frac{2}{3}}}$

[8] 5) Find the radius and interval of convergence for the series $\sum_{n=1}^{\infty} \frac{2^n}{n!} (4x + 1)^n$

[4] 6) (a) Determine Taylor series expansion for $f(u) = e^u$ centered at $u = 0$.

[3] (b) Use part (a) to determine a series expansion for $g(x) = e^{2x^3}$.

[3] (c) Use part (b) to get a series expansion for $h(x) = 6x^2e^{2x^3}$.

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1) Determine whether the following statements are True or False. No explanation is required.

[2] (a) Every nonempty bounded subset of $\mathbb{R}$ has a maximum and a minimum.

[2] (b) If S is a finite set, then S has a maximum element.

[2] (c) The equations $a_1 = \sqrt{2}$ and $a_{n+1} = \sqrt{2 + a_n}$ ($n \geq 2$) defines a sequence.

[2] (d) The series $\sum_{n=2}^{\infty} \frac{1}{n(n+1)}$ is a telescoping series.

2) Briefly answer the following questions. No explanation is required.

[2] (a) A list of numbers is called _____

[2] (b) Limit of partial sums of $\{a_n\}_{n=1}^{\infty}$ is called _____

[2] (c) Give four different examples of indeterminate forms (e.g.: $\frac{0}{0}$): _____

[2] (d) L'Hopital's Rule states that we can evaluate the limit of the indeterminate form as $\lim_{x \rightarrow c} \frac{f(x)}{g(x)} =$ _____

3) Evaluate the following limits:

[4] (a) $\int_0^1 \frac{1}{x\sqrt{\ln(x)}} dx$

[3] (b) $\lim_{x \rightarrow 0} \frac{\sin(x)}{x}$

[4] (c) $\int_1^{\infty} \frac{x}{1+x^2} dx$

[4] (d) $\lim_{x \rightarrow 0^+} \frac{\ln(x+1)}{\sin(x)}$

- 4) For the given series, determine whether it is absolutely convergent, conditionally convergent, or divergent. Show your work to get full credit.

[4] (a) $\sum_{n=1}^{\infty} \frac{1}{\sqrt[4]{n}}$

[4] (b) $\sum_{n=1}^{\infty} \left(\frac{-2}{3}\right)^n$

[4] (c) $\sum_{n=1}^{\infty} \frac{n}{1+n}$

[4] 4.d) $\sum_{n=1}^{\infty} \frac{(-1)^n}{2n+1}$

[8] 5) Find the radius and interval of convergence for the series $\sum_{n=1}^{\infty} \frac{2^n}{(n+1)!} (x+1)^n$

[4] 6) (a) Determine Taylor series expansion for $f(u) = e^u$ centered at $u = 0$.

[3] (b) Use part (a) to determine a series expansion for $g(x) = e^{2x^3}$.

[3] (c) Use part (b) to get a series expansion for $h(x) = 6x^2e^{2x^3}$.

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1) Determine whether the following statements are True or False. No explanation is required.

[2] (a) If a nonempty subset of $\mathbb{R}$ has a greatest lower bound, then it is bounded.

[2] (b) If $m = glb(S)$ and $m' < m$, then m' is a lower bound.

[2] (c) The sequence $\{5 + \frac{1}{n}\}_{n \in \mathbb{N}}$ converges.

[2] (d) The series $\sum_{n=2}^{\infty} \frac{1}{n(n+2)}$ is a telescoping series.

2) Briefly answer the following questions. No explanation is required.

[2] (a) A list of numbers is called _____

[2] (b) Limit of partial sums of $\{a_n\}_{n=1}^{\infty}$ is called _____

[2] (c) Give four different examples of indeterminate forms (e.g.: $\frac{0}{0}$): _____

[2] (d) L'Hopital's Rule states that we can evaluate the limit of the indeterminate form as $\lim_{x \rightarrow c} \frac{f(x)}{g(x)} =$ _____

3) Evaluate the following limits:

[4] (a) $\int_1^{\infty} \frac{1}{4x+1} dx$

[4] (b) $\int_0^e \frac{\ln(x)}{x} dx$

[3] (c) $\lim_{n \rightarrow \infty} \frac{4n^3+3n}{n^3-6}$

[4] (d) $\lim_{x \rightarrow 0} \frac{\arctan(x)}{x}$

- 4) For the given series, determine whether it is absolutely convergent, conditionally convergent, or divergent. Show your work to get full credit.

[4] (a) $\sum_{n=1}^{\infty} n^{\frac{1}{4}}$

[4] (b) $\sum_{n=0}^{\infty} \left(\frac{1}{4}\right)^n$

[4] (c) $\sum_{n=0}^{\infty} \frac{n^2}{n^2+1}$

[4] 4.d) $\sum_{n=1}^{\infty} \frac{(-1)^n}{\sqrt{n}}$

[8] 5) Find the radius and interval of convergence for the series $\sum_{n=0}^{\infty} n(n-1) \left(\frac{x}{3}\right)^n$

[4] 6) (a) Determine Taylor series expansion for $f(u) = e^u$ centered at $u = 0$.

[3] (b) Use part (a) to determine a series expansion for $g(x) = e^{2x^3}$.

[3] (c) Use part (b) to get a series expansion for $h(x) = 6x^2e^{2x^3}$.

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1) Determine whether the following statements are True or False. No explanation is required.

[2] (a) If m is an upper bound for a set S and $n < m$, then n is not an upper bound for S .

[2] (b) The set $(0, 1)$ has a maximum element.

[2] (c) The sequence $\{\frac{n^3}{4n^2-n^3}\}_{n \in \mathbb{N}}$ converges to -1 .

[2] (d) The series $\sum_{n=2}^{\infty} \frac{1}{n(n-1)}$ is a telescoping series.

2) Briefly answer the following questions. No explanation is required.

[2] (a) A list of numbers is called _____

[2] (b) Limit of partial sums of $\{a_n\}_{n=1}^{\infty}$ is called _____

[2] (c) Give four different examples of indeterminate forms (e.g.: $\frac{0}{0}$): _____

[2] (d) L'Hopital's Rule states that we can evaluate the limit of the indeterminate form as $\lim_{x \rightarrow c} \frac{f(x)}{g(x)} =$ _____

3) Evaluate the following limits:

[4] (a) $\int_0^1 \frac{1}{\sqrt{x}(1+\sqrt{x})^2} dx$

[4] (b) $\lim_{x \rightarrow 0^+} x^{2x}$

[3] (c) $\lim_{x \rightarrow 0} \frac{\sin x}{x}$

[4] (d) $\lim_{n \rightarrow \infty} \frac{\ln(n)}{n}$

- 4) For the given series, determine whether it is absolutely convergent, conditionally convergent, or divergent. Show your work to get full credit.

[4] (a) $\sum_{n=1}^{\infty} \frac{1}{n^3}$

[4] (b) $\sum_{n=0}^{\infty} \frac{n}{\ln n}$

[4] (c) $\sum_{n=1}^{\infty} 2^{-3n}$

[4] 4.d) $\sum_{n=1}^{\infty} \frac{(-1)^n}{n^{\frac{3}{4}}}$

[8] 5) Find the radius and interval of convergence for the series $\sum_{n=1}^{\infty} \frac{n}{3^n} (x-2)^n$

[4] 6) (a) Determine Taylor series expansion for $f(u) = e^u$ centered at $u = 0$.

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