Mahindra University Hyderabad
École Centrale School of Engineering
End-Term (Fractal)

Program: B. Tech. Branch: CSE and CM Year: II Semester: III
Subject: Principles of Economics (HS-2102)

Date: 14/10/2023 **Start Time: 10 AM**
Time Duration: 120 minutes **Max. Marks: 50**

Instructions:
1) Regular calculator is allowed inside the exam hall
2) Use pen/pencil and ruler for diagrams
3) You are required to comply with the directions given by the head invigilator at the examination venue

Section-A

Answer *ANY FIVE* of the following (5*4=20 Marks)

1. Mention the characteristics that adhere to the following types of goods.

   a). Public good
   b). Private good
   c). Club good
   d). Common resources

2. What are the distinctive features of monopolistic competition? Provide a realistic example of a monopolistically competitive firm.

3. Elucidate on negative production and negative consumption externality? Give one suitable example for each.

4. Guess whether the following will be included in National Income or not. Briefly pinpoint why?

   a). Old age pension.
   b). Food purchased by a foreign tourist at a hotel in New Delhi.
   c). Milk purchased by a shop to make milk cake

5. Define price discrimination in monopoly. What is perfect price discrimination?

6. Identify the type of unemployment. Define the type of unemployment which you could identify in both of the specific cases.

a). Many workers were laid off at the time of the global pandemic (Covid-19).

b). Akshay, a skilled worker drops his current job in search of a job which can suit more of his aptitude and skill.

Section-B

Answer ***ANY THREE*** of the following (3*10=30 Marks)

7. Discuss the reasons as to why the Aggregate-Demand curve slopes downward? Also elaborate on the factors that shifts the *AD* curve?

8. I. Elucidate on how the central banking system should induce liquidity (in case of deflation) via these mechanisms (5 marks)

a. Repo rate b. Open market operation

II.

	2014 (base year)		2015		2016	
	P	***Q***	***P***	***Q***	***P***	***Q***
Good A	$30	900	$31	1000	$36	1050
Good B	$100	192	$102	200	$100	205

a. Compute the nominal GDP for the year 2015? (1 mark)
b. Compute the real GDP for the year 2016? (2 marks)
c. Compute the GDP deflator for the year 2016? (2 marks)

9. Briefly discuss the features of the perfectly competitive market. Discuss in detail the profit determination of a perfectly competitive firm in the short-run and long-run.

10. Define sustainable development. Elucidate any ten (10) sustainable development goals (SDGs).

Mahindra University Hyderabad
École Centrale School of Engineering
End-Semester Regular Examination (2022 - Batch), Dec 2023
Program: B. Tech. Branch: CM Year: 2nd Semester: Fall
Subject: Real Analysis (MA2104)

Date: 20/12/2023 **Start Time: 10:00 AM**
Time Duration: 3 Hours **Max. Marks: 100**

Instructions:

1. Each question carries 20 marks.
2. All questions are compulsory.
3. Please start each answer on a separate page and number the responses.
4. Justification is essential wherever asked.

Q 1: 20 marks

(a) Find infimum and supremum of the following sets in $\mathbb{R}$. [6 Marks]
(i) $\{-2, -\frac{3}{2}, -\frac{4}{3}, -\frac{5}{4}, \cdots, -\frac{n+1}{n}, \cdots\}$, (ii) $\{1 - \frac{(-1)^n}{n} \mid n \in \mathbb{N}\}$, (iii) $\{x \in \mathbb{R} \mid x+2 \geq x^2\}$.

(b) Define "at most countable" and "uncountable" sets. Show that the set of all integers is countable. [6 Marks]

(c) Define a metric on a nonempty set X. For $x \in \mathbb{R}$ and $y \in \mathbb{R}$, define

$$d_1(x, y) = \frac{|x-y|}{1+|x-y|},$$
$$d_2(x, y) = |x^2 - y^2|,$$
$$d_3(x, y) = |x - 2y|,$$

for each of these, determine with justification whether it is a metric or not. [8 marks]

Q 2: 20 marks

(a) Define an open cover and compact subset in a metric space. Let $\mathbb{R}$ be the usual metric space and $Y = (0,1)$ be the subspace of $\mathbb{R}$. Consider the class of open intervals $\mathcal{F} = \{(\frac{1}{3},1), (\frac{1}{4},\frac{1}{2})\}, (\frac{1}{5},\frac{1}{3}), (\frac{1}{6},\frac{1}{4}), \ldots\} = \{(\frac{1}{n+2},\frac{1}{n})\}_{n\geq 1}$. Then show that $\mathcal{F}$ is an open cover of Y and contains no finite subcover. [10 marks]

(b) Explain the concepts of (i) Sequential continuity, (ii) Uniform continuity and (iii) Lipschitz continuity. Further, prove or justify by an example that every uniform continuous function need not be Lipschitz continuous. [10 marks]

Q 3: 20 marks

(a) Define a monotonic sequence. Show that the sequence $\{s_n\}$, where

$$s_n = \frac{1}{n+1} + \frac{1}{n+2} + \cdots + \frac{1}{n+n}, \ \forall\, n \in \mathbb{N}$$

is convergent. [6 marks]

(b) Let $s_n = n\sin^2(n\pi/2)$. Find the set of subsequential limits, the limit superior, and the limit inferior of (s_n). [4 marks]

(c) Define a contractive sequence. Consider the sequence of Fibonacci fractions

$$x_n = \frac{f_n}{f_{n+1}} \text{ for } n \in \mathbb{N} \text{ where } f_1 = f_2 = 1 \text{ and } f_{n+1} = f_n + f_{n-1}\ \forall\, n > 2.$$

Show that (i) $x_{n+1} = \frac{1}{1+x_n}$, (ii) The sequence (x_n) is contractive and converges to $\frac{-1+\sqrt{5}}{2}$. [10 marks]

Q 4: 20 marks

(a) Let $f : I \to \mathbb{R}$ be a bounded function on $I = [a,b]$, and let $P = \{a = x_0, x_1, x_2, \ldots, x_n = b\}$ be a partition of I. Define the following terms:

(i) Upper sum $U(f,P)$,

(ii) Lower sum $L(f,P)$,

(iii) Upper integral $U(f)$,

(iv) Lower integral $L(f)$.

Also, explain when a function is Riemann integrable. [10 marks]

(b) Let g be defined on $[0,3]$ as follows:

$$g(x) = \begin{cases} 2, & 0 \le x \le 1 \\ 3, & 1 < x \le 3. \end{cases}$$

For $\epsilon > 0$, we define the partition $P_\epsilon = \{0, 1, 1+\epsilon, 3\}$. Calculate $U(f, P_\epsilon)$, $L(f, P_\epsilon)$, $U(f)$, and $L(f)$.

[10 marks]

Q 5: **20 marks**

(a) Explain the difference between point-wise and uniform convergence of a sequence of functions.

[5 marks]

(b) Consider the function $h_n(x) = \frac{x^2+nx}{n}$, where $x \in \mathbb{R}$ and $n \in \mathbb{N}$, and let $h(x) = x$ for $x \in \mathbb{R}$.

(i) Show that $h_n(x)$ converges point-wise to $h(x)$ for $x \in \mathbb{R}$.

(ii) Determine whether $h_n(x)$ converges uniformly to $h(x)$ or not.

(iii) Comment on the uniform convergence of $h_n(x)$ when x is restricted to the interval $[0, 8]$.

[15 marks]
