D 93938-A

(Pages : 4)

Name.......................................

Reg. No....................................

FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION NOVEMBER 2020

Mathematics

MEC 1C 01—MATHEMATICAL ECONOMICS

(2019 Admissions)

(Multiple Choice Questions for SDE Candidates)

Time : 15 Minutes	Total No. of Questions : 15	Maximum : 15 Marks

INSTRUCTIONS TO THE CANDIDATE

1. This Question Paper carries Multiple Choice Questions from 1 to 15.
2. The candidate should check that the question paper supplied to him/her contains all the 15 questions in serial order.
3. Each question is provided with choices (A), (B), (C) and (D) having one correct answer. Choose the correct answer and enter it in the main answer-book.
4. The MCQ question paper will be supplied after the completion of the descriptive examination.

MEC 1C 01—MATHEMATICAL ECONOMICS

(Multiple Choice Questions for SDE Candidates)

1. Which of the following are NOT true ?

(A) $f(x) = ax^n$ implies $f'(x) = anx^{n-1}$.

(B) $f(x) = 4x^5 - 3x^2$ implies $f'(x) = 20x^{-5} - 6x^{-2}$.

(C) $f(x) = 4x + 3/x^2$ implies $f'(x) = 4 - 6/x^3$.

(D) $f(x) = \ln(x)$ implies $f'(x) = x^{-1}$.

2. Which of the following statements are (in general) true ?

(A) Marginal cost (MC) is minimised where MC = Average Variable Cost (AVC).

(B) Total Cost (ATC) is minimised where MC = ATC.

(C) Average Variable Cost (AVC) is minimised where MC = AVC.

(D) Total revenue is maximised where MC = Marginal Revenue (MR).

3. For the function $Q = AK^aL^b$ which of the following statements are NOT true ?

(A) $dQ/dL = AbK^aL^{b-1}$.

(B) Marginal Product of Labour (MPL) = $AaK^{a-1}L^b$.

(C) Marginal Product of Capital (MPK) = aQ / K.

(D) Marginal rate of substitution of capital for labour (MRS) = $|dK / dL|$.

4. The law which studies the direct relationship between price and quantity supplied of a commodity is :

(A) Law of demand.

(B) Law of variable proportion.

(C) Law of supply.

(D) None of the above.

5. In case of perfectly inelastic supply the supply curve will be :

(A) Rising.

(B) Vertical.

(C) Horizontal.

(D) Falling.

6. At what point does total utility starts diminishing ?

   (A) When marginal utility is positive.

   (B) When it remains constant.

   (C) When marginal utility is increasing.

   (D) When marginal utility is negative.

7. Few sellers is the feature of :

   (A) Monopoly.

   (B) Oligopoly.

   (C) Perfect competition.

   (D) Monopolistic competition.

8. Supply curve of a perfectly competitive firm is :

   (A) Vertical.

   (B) Upward sloping.

   (C) Horizontal.

   (D) Downward sloping.

9. Suppose the supply for product A is perfectly elastic. If the demand for this product increases :

   (A) The equilibrium price and quantity will increase.

   (B) The equilibrium price and quantity will decrease.

   (C) The equilibrium quantity will increase but the price will not change.

   (D) The equilibrium price will increase but the quantity will not change.

10. If the demand for agricultural products is inelastic :

   (A) As the prices decrease, the revenues earned by producers increase.

   (B) As the prices decrease, the revenues earned by producers decrease.

   (C) Rising prices do not lead to differentiation in producers' incomes.

   (D) The percentage decrease in prices is lower than the percentage increase in demand.

11. If the demand curve for product A moves to the right, and the price of product B decreases, it can be concluded that :

   (A) A and B are substitute goods.

   (B) A and B are complementary goods.

   (C) A is an inferior good, and B is a superior good.

   (D) Both goods A and B are inferior.

12. If a price increase of 50% results in an increase in the quantity supplyed of an economic good from 10 to 20 pieces, calculate the co-efficient of price elasticity of supply :

(A) 1/4.
(B) 1/2.
(C) 1.
(D) 2.

13. An economic agent contracts a loan of 15.000 lei, which he will repay in three equal annual installments. What will be the total interest paid, knowing that the annual interest rate is 12% per year ?

(A) 3.600 lei.
(B) 1.800 lei.
(C) 5.400 lei.
(D) 1.500 lei.

14. Which of the following statements is false :

(A) Perfect competition involves many sellers of standardized products.
(B) Monopolistic competition involves many sellers of homogeneous products.
(C) The oligopoly involves several producers of standardized or differentiated products.
(D) Monopoly involves a single product for which there are no close substitutes.

15. If the price of coffee falls by 8% and the demand for Tea declines by 2%. The cross price elasticity of demand for Tea is :

(A) 0.45.
(B) 0.25.
(C) +0.44.
(D) – 0.30.

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FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION NOVEMBER 2020

Mathematics

MEC 1C 01—MATHEMATICAL ECONOMICS

(2019 Admissions)

Time : Two Hours Maximum : 60 Marks

Section A

Answer at least **eight** *questions.*

Each question carries 3 *marks.*

All questions can be attended.

Overall Ceiling 24.

1. Define Law of Demand.
2. What is meant by Cross elasticity of demand ?
3. Define MRSxy.
4. Define AFC.
5. Explain the meaning of Short run costs.
6. What is meant by a Point of inflexion ?
7. What is an Indifference map ?
8. Explain the term Shift in demand curve.
9. Explain the meaning of Budget line.
10. What is meant by Constrained optimization?
11. If $TC = 5Q^2 + 12Q + 14$, find MC.
12. Define the term Consumer equilibrium.

(8 × 3 = 24 marks)

Section B

Answer at least **five** *questions.*

Each question carries 5 *marks.*

All questions can be attended.

Overall Ceiling 25.

13. Derive the relation between MR, AR and elasticity of demand.

14. What is ordinal utility of demand ?

15. State the law of equi-marginal utility. If the utility function is $U = f(q_1, q_2)$ and the budget equation is $M = p_1q_1 + p_2q_2$, derive the law of equi-marginal utility.

16. Explain the properties of indifference curves.

17. Explain the conditions for the optimization of the multivariable functions.

18. Assume a four sector economy, where $Y = C + I + G + (X - M)$, $C = C_0 + bY$, $I = I_0 + aY$, $G = G_0$, $Z = Z_0$. Find the equilibrium level of income in terms of general parameters.

19. What is marginal productivity ? Given the production function $Q = AL^aK^b$, show that marginal productivity of labor and capital depends on capital (K) – labor (L) ratio.

(5 × 5 = 25 marks)

Section C

Answer any **one** *question.*

The question carries 11 *marks.*

20. Explain the significance of Lagrange multiplier and optimize the function $3x^2 - 2xy + 6y^2$ subject to the constraint $x + y = 36$ using the Lagrange multiplier.

21. Explain cardinal utility analysis of demand. Derive consumer equilibrium using cardinal utility method.

(1 × 11 = 11 marks)

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FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION NOVEMBER 2020

Mathematics

MTS 1C 01—MATHEMATICS—I

(2019 Admissions)

Time : Two Hours Maximum : 60 Marks

Section A

Answer at least **eight** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 24.

1. A train has position $x = 3t^2 + 2 - \sqrt{t}$ at time t. Find the velocity of the train at $t = 2$.

2. Find $\lim\limits_{x \to 2} \dfrac{-3x}{x^2 - 4x + 4}$.

3. Find the slope of the line tangent to the graph of $f(x) = x^8 + 2x^2 + 1$ at $(1, 4)$.

4. Suppose that $f(t) = \frac{1}{4}t^2 - t + 2$ denotes the position of a bus at time t. Find and plot the speed as a function of time.

5. Find $\dfrac{d^2}{dr^2}\left(8r^2 + 2r + 10\right)$.

6. If $x^2 + y^2 = 3$, compute $\dfrac{dy}{dx}$ when $x = 0$ and $y = \sqrt{3}$.

7. On what interval is $f(x) = x^3 - 2x + 6$ increasing or decreasing ?

Turn over

8. Use the second derivative test to analyze the critical points of the function $f(x) = x^3 - 6x^2 + 10$.

9. Discuss the concavity of $f(x) = 4x^3$ at the points $x = -1$ and $x = 1$.

10. Find $\int_2^6 \left(x^2 + 1\right) dx$.

11. Find the area between the graph of $y = x^2$ and $y = x^3$ for x between 0 and 1.

12. Find the average value of $f(x) = x^2$ on $[0, 2]$.

(8 × 3 = 24 marks)

Section B

Answer at least **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 25.

13. (a) Find $\frac{d}{dx}\left(\frac{\sqrt{x}}{1 + 3x^2}\right)$.

(b) Calculate approximate value for $\sqrt{9.02}$ using linear approximation around $x_0 = 9$.

14. Find the equation of the tangent line to the curve $2x^6 + y^4 = 9xy$ at the point $(1, 2)$.

15. Find the slope of the parametric curve given by $x = \left(1 + t^3\right)^4 + t^2, y = t^5 + t^2 + 2$ at $t = 1$.

16. State mean value theorem. Verify mean value theorem for the function $f(x) = x^2 - x + 1$ on $[-1, 2]$.

17. Find $\lim_{x \to 0}\left(\frac{1}{x \sin x} - \frac{1}{x^2}\right)$.

18. An object on the x-axis has velocity $v = 2t - t^2$ at time t. If it starts out at $x = -1$ at time $t = 0$, where is at time $t = 3$? How far has it traveled ?

19. Find average value of $f(x) = x^2 \sin x^3$ on $[0, \pi]$.

(5 × 5 = 25 marks)

Section C

Answer any **one** *question.*
The question carries 11 *marks.*

20. (a) Using product rule, differentiate $(x^2 + 2x - 1)(x^3 - 4x^2)$. Check your answer by multiplying out first.

(b) Find the dimensions of a rectangular box of minimum cost if the manufacturing costs are 10 cents per square meter on the bottom, 5 cents per square metre on the sides, and 7 cents per square metre on the top. The volume is to be 2 cubic meters and height is to be 1 metre.

21. (a) The curves $y = x^2$ and $x = 1 + \frac{1}{2}y^2$ divide the xy plane into five regions, only one of which is bounded. Sketch and find the area of this bounded region.

(b) The region between the graph of x^2 on $[0, 1]$ is revolved about the x-axis. Sketch the resulting solid and find its volume.

(1 × 11 = 11 marks)

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FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION NOVEMBER 2020

Mathematics

MTS 1B 01—BASIC LOGIC AND NUMBER THEORY

(2019 Admissions)

(Multiple Choice Questions for SDE Candidates)

Time : 15 Minutes	**Total No. of Questions : 20**	**Maximum : 20 Marks**

INSTRUCTIONS TO THE CANDIDATE

1. This Question Paper carries Multiple Choice Questions from 1 to 20.
2. The candidate should check that the question paper supplied to him/her contains all the 20 questions in serial order.
3. Each question is provided with choices (A), (B), (C) and (D) having one correct answer. Choose the correct answer and enter it in the main answer-book.
4. The MCQ question paper will be supplied after the completion of the descriptive examination.

MTS 1B 01—BASIC LOGIC AND NUMBER THEORY

(Multiple Choice Questions for SDE Candidates)

1. Let P : Mathematics is interesting, Q : You should not learn it. Then 'Mathematics is interesting and you should learn it' is best represented by :

(A) $\neg P \vee \neg Q$.

(B) $P \wedge \neg Q$.

(C) $P \vee Q$.

(D) $P \wedge Q$.

2. The compound statement $A \to (A \to B)$ is false, then the truth values of A, B are respectively.

(A) T, T.

(B) F, T.

(C) T, F.

(D) F, F.

3. The compound propositions p and q are called logically equivalent if ———— is a tautology.

(A) $p \leftrightarrow q$.

(B) $p \to q$.

(C) $\neg(p \vee q)$.

(D) $\neg p \vee \neg q$.

4. Let P (x) denote the statement "$x > 7$". Which of these have truth value true ?

(A) P (0).

(B) P (4).

(C) P (6).

(D) P (9).

5. $p \vee q$ is logically equivalent to :

(A) $\neg q \to \neg p$.

(B) $q \to p$.

(C) $\neg p \to \neg q$.

(D) $\neg p \to q$.

6. The value of 155 mod 9 is :

(A) 0.

(B) 1.

(C) 2.

(D) 3.

7. If a and b are relatively prime then :

(A) $a \mid b$.

(B) $b \mid a$.

(C) $\gcd(a, b) = 1$.

(D) $1\text{ cm.}(a, b) = 1$.

8. Let $\gcd(a, b) = d$, then :

(A) $d = ax + by$, for some x and y.

(B) $a \mid d$.

(C) $b \mid d$.

(D) $d = a + b$.

9. The number '1' is :

(A) Prime number.

(B) Composite number.

(C) Neither Prime nor Composite.

(D) None of the mentioned.

10. Difference of two distinct prime numbers is ?

(A) Odd and prime.

(B) Even and composite.

(C) None of the mentioned.

11. If a, b are integers such that $a > b$ then 1 cm. (a, b) lies in :

(A) $a > 1\text{ cm }(a, b) > b$.

(B) $a > b > 1\text{ cm.}(a, b)$.

(C) $1\text{ cm }(a, b) \geq a > b$.

(D) None of the mentioned.

12. $(1001111)_2$ = ————.

(A) 79.

(B) 89.

(C) 69.

(D) 99.

13. The linear Diophantine equation $ax + by = c$ has a solution if and only if :

(A) $gcd\ (a, c) \mid b$.

(B) $gcd\ (a, b) \mid c$.

(C) $gcd\ (c, b) \mid a$.

(D) $c \mid gcd\ (a, b)$.

14. A composite number n for which $a^n \equiv a \pmod{n}$ is called :

    (A) A pseudoprime.

    (B) A prime.

    (C) A pseudoprime to the base a.

    (D) An absolute pseudoprime.

15. If $p, q_1, q_2, .., q_n$ are all primes and $p \mid q_1 q_2 \cdots q_n$, then :

    (A) $p = q_k$ for some k.

    (B) $p = 2$.

    (C) $q_k = 2$ for some k.

    (D) $p \mid q_k$ for some k.

16. If P_n is the n^{th} prime number, then :

    (A) $P_n = n + 1$.

    (B) $Pn \leq 2^2$.

    (C) $P_n = n! + 1$.

17. If $a \equiv b \bmod n$, then :

    (A) a and b leave the same non-negative remainder when divided by n.

    (B) a and b leave the different non-negative remainder when divided by n.

    (C) a and b need not leave the same non-negative remainder when divided by n.

18. If a is an odd integer, then $a^2 \equiv$ ———— (mod 8) :

    (A) 1.

    (B) 2.

    (C) 3.

    (D) 4.

19. If $a \equiv b \bmod n$ and a is a solution of $P(x) \equiv 0 \bmod n$, then :

    (A) b is also a solution.

    (B) b need not be a solution.

    (C) 0 is a solution.

20. The linear congruence $ax \equiv b \bmod n$ has a solution if and only if :

    (A) $b = 1$.

    (B) $b = 0$.

    (C) $d \mid b$ where $d = gcd\,(a, n)$.

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Name.....................................

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FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION, NOVEMBER 2020

Mathematics

MTS 1B 01—BASIC LOGIC AND NUMBER THEORY

(2020 Admissions)

Time : Two Hours and a Half

Maximum : 80 Marks

Section A

Answer at least **ten** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 30.

1. Find the truth table for the *Disjunction* of two propositions.

2. Define a proposition. Give an example.

3. Define Valid and Invalid Arguments.

4. Show that the proposition P(0) is true where P(n) is the propositional function "If $n > 1$ then $n^2 > n$".

5. Prove that every non-empty set of non-negative integers has a least element.

6. Find the quotient q and the remainder r when :

   (i) 207 is divided by 15.

   (ii) –23 is divided by 5.

7. Prove that 2 and 3 are the only two consecutive integers that are primes.

8. State and prove Handshake Problem.

9. Define the Fibonacci sequence and write the first four Fibonacci Numbers and Lucas numbers.

10. Using the Euclidean algorithm, express (4076, 1024) as a linear combination of 4076 and 1024.

11. Find the number of trailing zeros in 234 !.

12. Find the largest power of 2 that divides 109 ! .

13. Find all solutions of the congruence $9x \equiv 21 \pmod{30}$.

14. If 2p +1 is a prime number, prove that $(p)^2 + (-1)^r$ is divisible by $2p + 1$.

15. Find the remainder obtained when 5^{38} is divided by 11.

(10 × 3 = 30 marks)

Turn over

Section B

Answer at least **five** *questions.*
Each question carries 6 *marks.*
All questions can be attended.
Overall Ceiling 30.

16. Give a proof by contradiction of the theorem "if n^2 is even, then n is even."

17. Write any 5 inference rules.

18. Prove that there is no positive integer between 1 and 2.

19. Obtain an explicit formula corresponding to the recursive relation :

    $h(n) = h(n-1) + (n-1), n \geq 2$.

20. Let $(a,b) = d$. Then prove that $(a, a-b) = d$.

21. Explain Jigsaw Puzzle.

22. Find the remainder obtained upon dividing the sum

    1! + 2! + 3! + 4! +....+ 99! + 100! by 12.

23. Let p be a prime and a any integer such that p does not divide a. Then prove that the solution of the linear congruence $ax = b \pmod{p}$ is given by $x = a^{p-2}b \pmod{p}$.

(5 × 6 = 30 marks)

Section C

Answer any **two** *questions.*
Each question carries 10 *marks.*

24. (a) Prove that $\sqrt{2}$ is irrational by giving a proof by contradiction.

    (b) Prove the implication "If n is an integer not divisible by 3, then $n^2 \equiv 1 \pmod{3}$."

25. (a) Prove that a palindrome with an even number of digits is divisible by 11.

    (b) Let a and b be any positive integers, and r the remainder, when a is divided by b. Then prove that $\gcd(a, b) = \gcd(b, r)$.

26. (a) Prove that the gcd of the positive integers a and b is a linear combination of a and b.

    (b) State Duncan's identity. Using recursion, evaluate (18, 30, 60, 75, 132).

27. (a) Prove that no prime of the form $4n + 3$ can be expressed as the sum of two squares.

    (b) Prove that the linear congruence $ax \equiv b \pmod{m}$ is solvable if and only if $d | b$, where $d = (a, m)$ and if $d | b$, then it has d incongruent solutions.

(2 × 10 = 20 marks)

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FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION NOVEMBER 2020

Mathematics

MTS 1B 01—BASIC LOGIC AND NUMBER THEORY

(2019 Admissions)

Time : Two Hours and a Half

Maximum : 80 Marks

Section A

Answer any number of questions.
Each question carries 2 marks.
Maximum 25 marks.

1. Define what is meant by *disjunction* of two statements. Construct the disjunction of the following statements :

   Statement 1) Vinod watches cinemas during holidays .

   Statement 2) Vinod enjoys poetry during holidays.

2. What is meant by the *converse* of an implication ? Give an example.

3. What is the difference between *tautology* and a *contradiction* ?

4. Show that if $c|a$ and $c|b$, then $c|\alpha a + \beta b$ for any integers α, β.

5. Express $(1092)_{10}$ in base 8.

6. Define the GCD of integers a, b. When do we say that they are relatively prime ?

7. Find the canonical decomposition of 1980.

8. Find $(252, 350)$ and hence find $[252, 360]$.

9. If $a \equiv 5 \pmod{25}$ give four possibilities of a.

10. Which of the following is a complete set of residues modulo 8? $\{1, 2, 4, 5, 7, 8, 11, 14\}$ or $\{1, 2, 4, 5, 7, 8, 19, 24\}$ or both ? Why ?

11. Find the inverse of 7 modulo 50.

Turn over

12. Evaluate $\phi(35), \phi(48)$ directly without using formula.

13. State Fermat's Little Theorem. Prove it.

14. Define the function τ. Evaluate $\tau(19)$ and $\tau(23)$.

15. Compute $\phi(666)$ and $\phi(1976)$ using canonical decomposition.

Section B

Answer any number of questions.
Each question carries 5 marks.
Maximum 35 marks.

16. Test the validity of the following argument :

A_1 There are more residents in New Delhi than there are hairs in the head of any resident.

A_2 No resident is totally bald.

Hence At least two residents must have the same number of hairs on their heads.

17. State the Inclusion-Exclusion Principle. Use it to find the number of positive integers ≤ 2076 that are divisible by neither 4 nor 5.

18. Define Fermat numbers. Derive a recurrence formula for the n^{th} Fermat number f_n.

19. Let a and b be any positive integers, and r the remainder, when a is divided by b. Prove that $(a, b) = (b, r)$.

20. Find the general solution to the LDE $12x + 20y = 28$.

21. Prove that no integer of the form $8n + 7$ can be expressed as a sum of three squares.

22. Let p be a prime and a any positive integer. Prove that $a^p \equiv a \pmod{p}$. Does this result hold for some non-prime integer p ? Justify.

23. Prove that if n is an odd pseudoprime, then $N = 2^n - 1$ is also an odd pseudoprime.

Section C

Answer any **two** *questions.*
Each question carries 10 *marks.*
Maximum 20 *marks.*

24. (a) Prove directly that the product of any even integer and any odd integer is even.

    (b) Prove by cases that for any integer $n, n^2 + n$ is an even integer.

    (c) Prove by contradiction that $\sqrt{5}$ is an irrational number.

25. (a) Let p be a prime and $p | a_1 a_2 \ldots\ldots a_n$, where $a_1, a_2, \ldots, a_n$ are positive integers. Prove that $p | a_i$ for some i, where $1 \le i \le n$.

    (b) State and prove the Fundamental Theorem of Arithmetic.

26. Prove that the linear congruence $ax \equiv b \pmod{m}$ is solvable if and only if $d | b$, where $d = (a, m)$. Also, prove that if $d | b$, then it has d incongruent solutions.

27. Prove that the function ϕ is multiplicative. Use it to evaluate $\phi(221)$ and $\phi(6125)$.

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Name..

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FIRST SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION NOVEMBER 2020

Mathematics

ME 1C 01—MATHEMATICAL ECONOMICS

(Multiple Choice Questions for SDE Candidates)

Time : 15 Minutes	Total No. of Questions : 20	Maximum : 20 Marks

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ME 1C 01—MATHEMATICAL ECONOMICS

(Multiple Choice Questions for SDE Candidates)

1. When the elasticity of demand e_p is greater than 1 the demand for good is ?

   (A) Inelastic.
   (B) Unitary elastic.
   (C) Relatively elastic.
   (D) Elastic.

2. When the cross price elasticity e_c is less than 0, the goods are ?

   (A) Substitutes.
   (B) Complementary.
   (C) Independent.
   (D) None of these.

3. The point price elasticity of demand e_p is given by :

   (A) $\frac{dP}{dQ}.\frac{P}{Q}$.
   (B) $\frac{dQ}{dP}.\frac{Q}{P}$.
   (C) $\frac{dQ}{dP}.\frac{P}{Q}$.
   (D) $\frac{1}{P}.\frac{dQ}{dP}$.

4. In the case of a perfectly inelastic supply curve, the elasticity of supply η_s is :

   (A) Infinity.
   (B) One.
   (C) Greater than 1.
   (D) Zero.

5. The variables in the demand function which are related to price are :

   (A) Own price of the product.
   (B) Price of compliment.
   (C) Price of substitutes.
   (D) All the above.

6. When the purchases of goods increase with rising levels of income, such goods are called :

   (A) Inferior goods
   (B) Normal goods.
   (C) Giffen goods.
   (D) Laxurious goods.

7. The influence of a change in a product's price on real income is called :

   (A) Substitution effect.
   (B) Income effect.
   (C) Both (A) and (B).
   (D) None.

8. In a demand curve price is measured along the :

(A) Vertical axis.

(B) Horizontal axis.

(C) Both (A) and (B).

(D) None.

9. When the elasticity of supply $\eta_p^s = 0$, the supply curve will be :

(A) Parallel to x axis.

(B) Passing through origin.

(C) Parallel to y axis.

(D) None.

10. For a unitary elastic supply curve, η_p^s is :

(A) Less than 1.

(B) More than 1.

(C) Equal to 1.

(D) Zero.

11. The price elasticity of demand of the demand function Q = 400 – 4P at p = 10 is :

(A) 0.11.

(B) 0.10.

(C) –0.11.

(D) –1.

12. Luxury goods are :

(A) Price inelastic.

(B) Price elastic.

(C) Both (A) and (B).

(D) None.

13. The elasticity of demand η_d in terms of AR and MR is :

(A) $\frac{AR - MR}{AR}$.

(B) $\frac{AR - MR}{MR}$.

(C) $\frac{MR}{AR - MR}$.

(D) $\frac{AR}{AR - MR}$.

14. A distinction between cost of production and expenses of production is made by :

(A) Engel.

(B) Marshall.

(C) Keynes.

(D) None of these.

15. Total variable cost plus total fixed cost gives :

    (A) Total cost.
    (B) Average cost.
    (C) Marginal cost.
    (D) None of these.

16. A firm decide to discontinue production and accept a loss equal to it fixd cost :

    (A) Loss > FC.
    (B) Loss < FC.
    (C) Loss = FC.
    (D) None.

17. Which of the following is correct ?

    (A) Indifference curves slopes downward to the right.
    (B) Indifference curves do not intersect.
    (C) Indifference curves are convex to the origin.
    (D) All the above.

18. An attribute possessed by a commodity to satisfy a human want, to yield satisfaction to consumer is termed as :

    (A) Utility.
    (B) Preference.
    (C) Want.
    (D) None of these.

19. The second order condition for maximising utility is :

    (A) $\frac{du}{dq_1} = 0.$
    (B) $\frac{d^2u}{dq_1^2} > 0.$
    (C) $\frac{d^2u}{d^2q_1} < 0.$
    (D) $\frac{d^2u}{da_1^2} = 0.$

20. An indifference map is a collection of :

    (A) Indifference curves.
    (B) Cost curve.
    (C) Revenue curve.
    (D) None of these.

D 93824

(Pages : 4)

Name.....................................

Reg. No.................................

FIRST SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION NOVEMBER 2020

Mathematics

ME 1C 01—MATHEMATICAL ECONOMICS

Time : Three Hours

Maximum : 80 Marks

Part A

Answer all the **twelve** *questions.*
Each question carries 1 *mark.*

1. The demand curve shows the relationship between :

   (a) Price and quantity.
   (b) Income and quantity.
   (c) Consumption and quantity.
   (d) Consumption and income.

2. The elasticity of demand at different points on the same demand curve is :

   (a) Same.
   (b) Zero.
   (c) Different.
   (d) None.

3. The total of the quantities demanded by all consumers in an economy at each price is called :

   (a) Market demand curve.
   (b) Market supply curve.
   (c) Market equilibrium.
   (d) None of the these.

4. Sum of explicit cost and implicit cost gives :

   (a) Total cost.
   (b) Average cost.
   (c) Marginal cost.
   (d) None of these.

5. The ratio of total cost to the quantity produced is called :

   (a) Average cost.
   (b) Marginal cost.
   (c) Total variable cost.
   (d) None.

6. When marginal cost is greater than average cost, the total cost elasticity will be :

   (a) Greater than 1.
   (b) Less than 1.
   (c) Equal to 1.
   (d) None.

Turn over

7. The concept of indifference curves was developed by :

(a) J.R. Hicks.

(b) R.G.D. Allen.

(c) J.R. Hicks and Allen.

(d) None of these.

8. The equilibrium of a consumer purchasing one commodity is attained when :

(a) $\frac{du}{dQ} < P$.

(b) $\frac{du}{dQ} = P$.

(c) $\frac{du}{dQ} > P$.

(d) $\frac{du}{dQ} = 0$.

9. The point at which the marginal utility first increases, reaches the maximum, then diminishes is called :

(a) Point of inflexion.

(b) Minimum point.

(c) Saturation point.

(d) None of these.

10. Let $10 + 30kk^2$ be a production function, where k represents capital. Then the marginal productivity when $k = 3$ is :

(a) 116.

(b) 16.

(c) 58.

(d) 24.

11. When the average revenue function is AR = 10 – .5q, the marginal revenue is :

(a) $0.5q^2$.

(b) $10 - q$.

(c) $10q0.5$.

(d) 10.

12. Behaviour of the function defined by $y = x^4 - 6x^3 + 4x^2 - 13$ at $x = 4$ is :

(a) Decreasing.

(b) None.

(c) Increasing.

(d) Stationary.

(12 × 1 = 12 marks)

Part B

Answer any **six** *questions in two* **or** *three sentences.*
Each question carries 3 *marks.*

13. What is a Demand Function ?
14. Write any three factors determining supply.
15. What is price elasticity of demand ?
16. Define average revenue and marginal revenue.
17. Define elasticity of total cost.
18. Write a note on Legrange's multiplier.
19. What do you mean by utility ?
20. Find average cost and marginal cost from the total cost function $\text{TR} = 10 + x + 2x^2$.
21. Show that the function $3x^3 + 3x^2 + x - 1$ is monotonic increasing.

(6 × 3 = 18 marks)

Part C

Answer any **six** *questions from the following.*
Each question carries 5 *marks.*

22. Describe various elasticities of demand.
23. What are the determinants of elasticity of demand ?
24. Give the nature and property of a demand function for a normal good.
25. Cost function is given by $\pi = a + bq + cq^2$. Prove that $\frac{d(\text{AC})}{dq} = \frac{\text{MC} - \text{AC}}{q}$.
26. What are the similarities between utility approach and indifference curve approach ?
27. Find the maximum profit : Given the profit function $\pi = -\text{Q}^3 - 6\text{Q}^2 + 1440\text{Q} - 545$.
28. Find the critical points of $z = 3x^2 - xy + 2y^2 - 4x - 7y + 12$.

29. $z = \frac{x+y}{x+2}\Big)$. Find dz.

30. Find all the four second order partial derivatives of $z = 3x^3y^2$.

(6 × 5 = 30 marks)

Part D

Answer any **two** *questions from the following.*
Each question carries 10 *marks.*

31. Write short notes on determinants of price elasticity of demand.

32. (a) Prove that marginal cost (MC) must equal marginal revenue (MR) at the profit-maximizing level of output.

    (b) The total cost function of a firm is given by $TC = 400 - 10q + q^2$. Find the optimum size of output.

33. Explain briefly properties of indifference curves.

34. Given the profit function $\pi = 160x - 3x^2 - 2xy - 2y^2 + 120y - 18$ for a firm producing two goods x and y. Find the maximum profit.

(2 × 10 = 20 marks)

D 93823 (Pages : 3) Name..

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FIRST SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION NOVEMBER 2020

Mathematics

MAT 1C 01—MATHEMATICS

Time : Three Hours Maximum : 80 Marks

Part A (Objective Type Questions)

*Answer **all** questions (1 - 12).*
Each question carries 1 mark.

1. $\lim\limits_{x \to \infty} x \sin\left(\frac{1}{x}\right) = \ldots\ldots$

2. $\lim\limits_{x \to 0} \frac{\sin(2+x) - \sin 2}{x} = \ldots\ldots$

3. Define removable discontinuity.

4. State the condition(s) for local maximum of the function $y = f(x)$.

5. What is (are) the vertical asymptote(s) of the curve $xy^3 - 2xy^2 - 2y^3 - 4 = 0$.

6. State Rolle's theorem.

7 Find $\frac{d}{dx}(\cosh(3x-2))$.

8. State the second derivative test for concavity of a function $y = f(x)$.

9. State the mean value theorem for definite integral.

10. $\sum\limits_{k=1}^{4}\left(k^2 - 3k\right) = \ldots\ldots$

11. Let f be a continuous function on $[a,b]$. Then what is the average value of f on $[a,b]$.

12. Area bounded by the curves $y = f(x), y = g(x)$ and the ordinates $x = a$ and $x = b$ is given by __________.

(12 × 1 = 12 marks)

Part B (Short Answer Type)

Answer any **nine** *questions (13 - 24).*
Each question carries 2 *marks.*

13. If $\sqrt{3-2x} \le f(x) \le \sqrt{3-x}$, find $\lim_{x \to 0} f(x)$.

14. Find $\lim_{x \to 2} \frac{x-3}{x^2-4}$.

15. Find the equation of the tangent line to the curve $y = \sqrt{x}$ at $x = 4$.

16. Find the absolute extrema of $f(x) = x^{2/3}$ on $[-2, 3]$.

17. Find the points of inflection of the function $y = 2 + \cos x, x \ge 0$.

18. Find $\lim_{x \to \infty} \frac{5x^2+8x-3}{3x^2+2}$.

19. Find the horizontal asymptotes of the graph of the function $f(x) = \frac{-8}{x^2-4}$.

20. Find the linearization of $f(x) = x^3 - 2x + 3$ at $x = 2$.

21. Find $\frac{dy}{dx}$ if $y = \int_1^{x^2} \cos t \, dt$.

22. Find $\lim_{x \to 1} \frac{1-x}{\log x}$.

23. Find $\lim_{x \to \infty} x^{1/x}$.

24. Verify Rolle's theorem for the function $f(x) = \tan x$ in $[0, \pi]$.

(9 × 2 = 18 marks)

Part C (Short Essay Type)

Answer any **six** *questions (25 - 33).*
Each question carries 5 *marks.*

25. State and prove the rule for the limit of a sum.

26. Show that if a function *f* has a derivative at $x = c$, then show that *f* is continuous at $x = c$.

27. State and prove Rolle's theorem.

28. Verify mean value theorem for the function $f(x) = x^3 - 3x^2 + 2x$ in $\left[0, \frac{1}{2}\right]$.

29. Find the intervals on which $f(x) = -x^3 + 12x + 5, x \in [-3, 3]$ is increasing and decreasing.

30. Find all the asymptotes of $f(x) = \frac{x^2 - 3}{2x - 4}$.

31. Give an example of a function which is not Riemann integrable. Prove your claim.

32. Find the area between $y = \sec^2 x$ and $y = \sin x$ from 0 to $\pi/4$.

33. Verify the mean value theorem for integrals for the function $f(x) = \frac{x}{\sqrt{x^2 + 16}}$ in [0, 3].

(6 × 5 = 30 marks)

Part D (Essay Questions)

Answer any **two** *questions (34 - 36).*
Each question carries 10 marks.

34. A dynamite blast blows a heavy rock straight up with a velocity of 160 ft/sec. It reaches a height of $s = 160t - 16t^2$ft after t seconds.

    a) How high does the rock go ?

    b) What is the velocity and speed of the rock when it is at 256 ft above the ground on the way up? on the way down ?

    c) What is the acceleration of the rock at any time t during its flight ?

35. Sketch the graph of the function $y = x^4 - 4x^3 + 10$, by inspecting increasing, decreasing, concavity, points of inflection, local extrema etc.

36. a) A curved wedge is cut from a cylinder of radius 3 by two planes. One plane is perpendicular to the axis of the cylinder. The second plane crosses the first plane at 45° angle at the center of the cylinder. Find the volume of the wedge by slicing method.

    b) Find the area of the region bounded by the curves $y = x^2$ and $y = x^4 - 4x^2 + 4$.

(2 × 10 = 20 marks)

D 93789-A **(Pages : 4)** **Name..................................**

Reg. No...............................

FIRST SEMESTER B.A./B.Sc. DEGREE EXAMINATION
NOVEMBER 2020

(CUCBCSS)

Mathematics

MAT 1B 01—FOUNDATIONS OF MATHEMATICS

(Multiple Choice Questions for SDE Candidates)

Time : 15 Minutes	**Total No. of Questions : 20**	**Maximum : 20 Marks**

INSTRUCTIONS TO THE CANDIDATE

1. This Question Paper carries Multiple Choice Questions from 1 to 20.
2. The candidate should check that the question paper supplied to him/her contains all the 20 questions in serial order.
3. Each question is provided with choices (A), (B), (C) and (D) having one correct answer. Choose the correct answer and enter it in the main answer-book.
4. The MCQ question paper will be supplied after the completion of the descriptive examination.

MAT 1B 01—FOUNDATIONS OF MATHEMATICS

(Multiple Choice Questions for SDE Candidates)

1. If A and B are two disjoint sets, then $A \oplus B =$ ————.

(A) A. (B) $A \cap B$.

(C) $A \cup B$. (D) B.

2. If A = {1, 3, 5} and B {1, 2, 3}, then $A \oplus B =$ ————.

(A) {5}. (B) {2}.

(C) {2, 5}. (D) {1, 2, 3, 5}.

3. Who is considered to be the father of set theory ?

(A) Bertand Russel. (B) George Cantor.

(C) Srinivasa Ramanujan. (D) George Boole.

4. A and B are subsets of a universal set having 12 elements. If A has 7 elements, B has 9 elements and $A \cap B$ has 9 elements, then what is the number of elements in $A \cup B$?

(A) 11. (B) 16.

(C) 22. (D) 10.

5. For any two sets A and B, A – B defined by :

(A) $\{x : x \in A \text{ and } x \in B\}$. (B) $\{x : x \in A \text{ and } x \notin B\}$.

(C) $\{x : x \notin A \text{ and } x \in B\}$. (D) $\{x : x \in A \text{ or } x \in B\}$.

6. If $|A| = 24$, $|B| = 69$ and $|A \cup B| = 81$, then $|A \cap B| =$ ————.

(A) 12. (B) 10.

(C) 14. (D) 15.

7. If A = {1, 2, 3, 4}, then the number of non-empty subsets of A is :

(A) 16. (B) 15.

(C) 32. (D) 3.

8. For any three sets A, B, C, $(A \cup (B \cap C)$ = ————.

(A) $(A \cup B) \cap (A \cup C)$.
(B) $(A \cup B) \cup (A \cup C)$.
(C) $(A \cap B) \cap (A \cap C)$.
(D) None of these.

9. If a set A has 3 elements and B has 6 elements, then the minimum number of elements in $A \cup B$ is :

(A) 6.
(B) 3.
(C) 9.
(D) None of these.

10. For any three sets A, B, C, A × (B – C) = ————.

(A) $(A \times B) \cup (A \times C)$.
(B) $(A \times B) \cap (A \times C)$.
(C) $(A \times B) - (A \times C)$.
(D) $(A \times C) - (A \times B)$.

11. For any two sets A and B, a relation from A to B is a subset of ————.

(A) A.
(B) B.
(C) A × B.
(D) B × A.

12. If R is a relation from a non-empty set A to a non-empty set B, then :

(A) $R = A \cap B$.
(B) $R = A \cup B$.
(C) $R = A \times B$.
(D) $R \subseteq A \times B$.

13. If A is a finite set containing 'n' distinct elements, then the number of relations on A is :

(A) 2^n.
(B) n^2.
(C) 2^{n^2}.
(D) $2n$.

14. Let R = {(1, 3), (4, 2), (2, 4), (2, 3), (3,1)} be a relation on A = {1, 2, 3,4}, then R is :

(A) Not symmetric.
(B) Transitive.
(C) A function.
(D) Reflexive.

15. If A = {a, b} and B = {1, 2, 3}, then the number of functions from A to B is :

(A) 2^3.
(B) 3^2.
(C) 2 × 3.
(D) 2 + 3.

16. If $f(x) = 2x + 3$ and $g(x) = x^2 + 7$, then the values of 'x' for which $g(f(x)) = 8$ are :

(A) 1, 2.

(B) –1, 2.

(C) –1, –2.

(D) 1, –2.

17. Let A be a set containing 'n' distinct elements. How many bijections from A to A can be defined ?

(A) n^2.

(B) $n!$.

(C) n.

(D) $2n$.

18. If $f(x) = \dfrac{1}{\sqrt{2x-4}}$, then its domain is :

(A) $\mathbb{R} - \{2\}$.

(B) $\mathbb{R}$.

(C) $(2, \infty)$.

(D) $[2, \infty]$.

19. Which of the following is a Polynomial function ?

(A) $\dfrac{x^2 - 1}{x}, x \neq 0$.

(B) $x^3 + 3x^2 - 4x + \sqrt{2}x^{-2}, x \neq 0$.

(C) $\dfrac{3x^3 + 7x - 1}{3}$.

(D) $2x^2 + \sqrt{x} + 1$.

20. If for a function $f(x), f(x+y) = f(x) + f(y)$ for all real number 'x' and 'y'. then $f(0)$ = ————.

(A) 1.

(B) –1.

(C) 2.

(D) 0.

D 93789 (Pages : 4) Name..

Reg. No.....................................

FIRST SEMESTER B.A./B.Sc. DEGREE EXAMINATION NOVEMBER 2020

(CUCBCSS)

Mathematics

MAT 1B 01—FOUNDATIONS OF MATHEMATICS

Time : Three Hours Maximum : 80 Marks

Section A

Answer all the **twelve** *questions.*
Each question carries 1 mark.

1. Fill in the blanks : When A and B are any two sets, A ⊕ B = ——————.
2. Fill in the blanks : If A and B are any two finite sets, $n(A \setminus B) = n(A) -$ ——————.
3. Define a transitive relation on a set.
4. The diagonal elements of the matrix representing a reflexive relation will be ——————.
5. Find the domain of the function $f(x) = \frac{1}{\sqrt{1-x^2}}$. ——————.
6. Number of one-one functions from a set A of m elements to a set B of n elements when $n > m$ is ——————.
7. Find $\lim_{n \to \infty} \frac{\sin n}{n}$.
8. Give an example of a denumerable set.
9. Define a bijection from the set of even integers to the set of odd integers.
10. Solve for x and y if $(x + 2y, x - 2y) = (8, 2)$.
11. How many rows appear in a truth table for the compound proposition : $p \to \neg p$.

Turn over

12. Find the complement of the set of all solutions of the quadratic equation $x^2 - 2x + 1 = 0$ with respect to the set of real numbers.

(12 × 1 = 12 marks)

Section B

Answer any **nine** *out of twelve questions.*
Each question carries 2 marks.

13. Construct a relation R on $A = \{1, 2, 3\}$ such that R is symmetric and anti-symmetric but not reflexive.

14. Find the matrix of the relation R from $A = \{1, 2, 3, 4\}$ to $B = \{x, y, z\}$ given by $R = \{(1, y), (1, z), (3, y), (4, x), (4, z)\}$.

15. Evaluate the limit of $f(x) = \dfrac{|x| + x}{x - |x|}$ as x tends to -1.

16. Find the function obtained by shifting the graph of $f(x) = |x - 1|$ right by 2 units.

17. Test whether the function $\mathbb{R} \to \mathbb{R}$ defined by $f(x) = x^2$ is injective or not.

18. Find all real values of x at which $f(x) = \tan x$ is discontinuous.

19. Show that the relation "is a divisor of" is not a partial order on the set of integers.

20. Find the number of functions which are one-one from $A = \{1, 2, 3\}$ to the set $B = \{a, b, c, d\}$.

21. Find f^{-1} when $f(x) = 2x - 3$.

22. Write down the power set of $A = \{x, y, z\}$.

23. Show that limit of a constant function is that constant through out the domain of that function using the formal definition of the limit.

24. Use a quantified statement to express the verbal statement " Every student in your class has taken a course in calculus."

(9 × 2 = 18 marks)

Section C

Answer any **six** *out of nine questions.*

Each question carries 5 *marks.*

25. Find $g \circ f$ and $f \circ g$, if $f(x) = x^2$ and $g(x) = x + 3$.

26. Show that $\neg \forall x \left(P(x) \to Q(x)\right)$ and $\exists x \left(P(x) \wedge \neg Q(x)\right)$ are logically equivalent.

27. Show that $\mathbb{Q}$, the set of rational numbers is countable.

28. Discuss the continuity of the function $\sin\left(\frac{1}{x}\right)$ at the origin.

29. If $\mathcal{A} = \{\{1, 2, 3\}, \{2, 3, 4\}, \{2, 3, 5\}\}$, find $\bigcup_{A \in \mathcal{A}} A$ and $\bigcap_{A \in \mathcal{A}} A$.

30. Draw the graph of the function obtained by shifting the graph of $f(x) = x^2 - 1$ up by one unit.

31. Let $f : A \to B$ and $g : B \to C$ be functions. If $g \circ f$ is onto, show that g is onto.

32. Show that $\neg(p \vee q)$ and $\neg p \wedge \neg q$ are logically equivalent.

(6 × 5 = 30 marks)

Section D

Answer any **two** *out of ihree questions.*

Each question carries 10 *marks.*

34. (a) Find $\lim_{x \to 4} \frac{\sqrt{x} - 2}{x - 4}$.

(b) Prove that subset of a countable set is countable.

35. (a) Find the continuous extension of the function $h(x) = \frac{x^2 - 4}{x - 2}, x \neq 2$.

(b) Find $\lim_{x \to 0+} \frac{x - \sin mx}{mx}$ when $m \neq 0$.

36. (a) What is the truth value of $\forall x \left(x^2 \geq x\right)$ if the domain consists of all real numbers ? What is the truth value of this statement if the domain consists of all integers ?

(b) Test whether the function

$$f(x) = \begin{cases} \dfrac{e^{1/x} - 1}{e^{1/x} + 1}, & \text{if } x \neq 0 \\ 0, & \text{otherwise} \end{cases}$$

is continuous or not.

(2 × 10 = 20 marks)