

OPTION - A

Paper : BOT-HG-3016/RC-3016

(Plant Physiology and Metabolism)

1. Answer the following questions as directed :

তলত দিয়া প্ৰশ্নবোৰৰ উত্তৰ দিয়া :

1×7=7

(i) Which one of the following statement is correct when a cell is fully turgid ?

- (a) $DPD = OP$
- (b) $DPD = 0$ (zero)
- (c) $WP = 0$ (zero)
- (d) $OP = 0$ (zero)

সম্পূৰ্ণ স্ফীত এটা কোষৰ ক্ষেত্ৰত নিম্নোক্ত কোনটো উক্তি সঁচা ?

- (a) $DPD = OP$
- (b) $DPD =$ শূন্য
- (c) $WP =$ শূন্য
- (d) $OP =$ শূন্য

(ii) Who first proposed the transpiration pull and cohesive force of water theory for ascent of sap ?

- (a) Dixon and Jolly
- (b) Sir J. C. Bose
- (c) Noggle and Fritz
- (d) Boehm

প্ৰস্বেদন বল আৰু পানীয় সংশক্তি মতবাদ কোনে প্ৰথমে আগবঢ়াইছিল ?

- (a) ডিক্সন আৰু জলী
- (b) চাৰ জে. চি. বসু
- (c) নগোল আৰু ফ্ৰিট্জ
- (d) বহেম

(iii) Which one of the following is not an essential micro elements ?

- (a) Boron
- (b) Iron
- (c) Manganese
- (d) Potassium

নিম্নোক্ত কোনটো মৌল আৱশ্যকীয় অনুমাত্ৰিক মৌল নহয় ?

- (a) ব'ৰন
- (b) আইৰন
- (c) মেংগানিজ
- (d) পটাচিয়াম

(iv) Who first coined the term photoperiodism ?

- (a) Curtis and Clark
- (b) Garner and Allard
- (c) Miller and Skoog
- (d) Salisbury and Ross

কোনে পোন প্ৰথমে 'ফ'ট'পেৰিয়ডিজিম' (দীপ্তিকাল প্ৰতিক্ৰিয়া) শব্দটো প্ৰচলন কৰিছিল?

- (a) কাৰ্টিচ আৰু ক্লাৰ্ক
- (b) গাৰ্নাৰ আৰু এল্লাৰ্ড
- (c) মিল্লাৰ আৰু স্কুগ
- (d) চেলিছবুৰী আৰু ৰছ

(v) Swelling of wooden doors and windows during rainy season is due to _____ phenomenon. (Fill in the blank)

বাৰিষাৰ দিনত কাঠৰ দুৱাৰ নাইবা খিড়িকীৰ প্ৰসাৰণ কাৰ্য্য _____ প্ৰক্ৰিয়াৰ বাবে ঘটে। (খালী ঠাই পূৰণ কৰা)

(vi) Indole-3-acetic acid is belongs to _____ group of plant growth regulators. (Fill in the blank)

ইন্ডল-3-এচিটিক এচিড হৈছে _____ গোটেৰ উদ্ভিদ বৃদ্ধি নিয়ন্ত্ৰক। (খালী ঠাই পূৰণ কৰা)

(vii) In Calvin cycle, how many ATP molecules are required to produce one molecule of glucose. (Answer directly)

এটা গ্লুকজ অণুৰ সৃষ্টি কৰিবলৈ কেলেভিন চক্ৰত কেইটা ATP অণুৰ প্ৰয়োজন। (প্ৰত্যক্ষ উত্তৰ দিয়া)

2. Write short notes on the following: $2 \times 4 = 8$

- (a) Importance of osmosis in plants
- (b) Role of phosphorus in plant growth
- (c) Co-enzymes
- (d) Vernalin

নিম্নোক্ত প্ৰশ্নসমূহৰ চমু টোকা লিখা :

- (a) উদ্ভিদত আসৃতিৰ গুৰুত্ব
- (b) উদ্ভিদৰ বৃদ্ধিত ফছফৰাছৰ ভূমিকা
- (c) সহ-উৎসেচক
- (d) ভানেলিন

3. Answer **any three** of the following questions: $5 \times 3 = 15$

- (a) "Cell is an osmotic system". Justify the comment.
- (b) Write notes on various agents of biological nitrogen fixation.

- (c) Theory of starch \Rightarrow sugar interconversion in stomatal opening and closing.
- (d) Cytochrome pump hypothesis.
- (e) Describe Munch hypothesis of translocation of solutes.

নিম্নোক্ত যিকোনো তিনিটা প্রশ্নৰ উত্তৰ দিয়া :

- (a) “কোষ এক প্ৰকাৰ আসৃতি তন্ত্ৰ”—যথার্থতা প্ৰকাশ কৰা।
- (b) নাইট্ৰজেনৰ জৈৱিক স্থিতিকৰণত ভাগ লোৱা বিভিন্ন অণুজীৱসমূহৰ বিষয়ে চমুকৈ লিখা।
- (c) পত্ৰৰন্ধ্ৰ বন্ধ আৰু খোলা প্ৰক্ৰিয়াত শ্বেতসাৰ \Rightarrow শৰ্কৰা আন্তঃপৰিবৰ্তন সূত্ৰ বৰ্ণনা কৰা।
- (d) চাইটোক্ৰম পাম্প মতবাদ।
- (e) জৈৱদ্ৰব্য পৰিবহণত মুনছৰ মতবাদ বৰ্ণনা কৰা।

4. Answer **any three** of the following questions :
10×3=30

নিম্নোক্ত যিকোনো তিনিটা প্রশ্নৰ উত্তৰ লিখিবা :

- (a) What is enzymes? Describe the modern system of enzyme classification with suitable examples. 2+8=10
উৎসেচক মানে কি বুজা? উৎসেচকসমূহৰ আধুনিক শ্ৰেণী বিভাজন উদাহৰণ সহ ব্যাখ্যা কৰা।
- (b) Write a short note on Kranz anatomy with suitable diagrams. Describe in detail the C₄ cycle of photosynthesis. 4+6=10

ক্ৰেঞ্জ আন্তঃগঠন সম্বন্ধে চিত্ৰ-সহ চমুকৈ এটি টোকা লিখা। সালোকসংশ্লেষণৰ C₄ চক্ৰ বৰ্ণনা কৰা।

- (c) What do you mean by C₃ and C₄ plants? Mention the differences between C₃ and C₄ plants. 5+5=10

C₃ আৰু C₄ উদ্ভিদ বুলিলে কি বুজা। C₃ আৰু C₄ উদ্ভিদৰ মাজত থকা পাৰ্থক্যসমূহ লিপিবদ্ধ কৰা।

- (d) Give an schematic representation of cytoplasmic respiration. Describe how oxidative decarboxylation of pyruvate into Acetyl Co-A. 5+5=10

কোষ প্ৰৰসীয়া শ্বসনক ৰেখাচিত্ৰৰ সহায়ত উপস্থাপন কৰা। সবাত কাৰ্বন বিয়োজনৰ দ্বাৰা পাইৰুভিক এচিডৰ পৰা কেনেকৈ “এচিটাইল ক’ এনজাইম এ” (Acetyl Co-A) প্ৰস্তুত হয় বৰ্ণনা কৰা।

- (e) What is auxin? Discuss the physiological role and functions of auxins in plants. 2+8=10

অক্সিন কি? উদ্ভিদত অক্সিনৰ শৰীৰ বিপাকীয় ভূমিকা আৰু কাৰ্য বহলাই লিখা।

- (f) What do you mean by photoperiodic induction? Describe in detail the mechanisms of photoperiodism. 2+8=10

দীপ্তিকাল উদ্দীপনা মানে কি বুজা? দীপ্তিকাল প্ৰতিক্ৰিয়াৰ প্ৰক্ৰিয়া বিস্তাৰিত ভাবে বৰ্ণনা কৰা।

OPTION - B
Paper : BOT-HG-3026
(Environmental Biotechnology)

1. Answer the following questions : $1 \times 7 = 7$

তলত দিয়া প্রশ্নবোৰৰ উত্তৰ দিয়া :

(a) Name one secondary pollutant.
এটা গৌণ প্রদূষকৰ নাম লিখা।

(b) Name a Ramsar site of the state of Assam.
অসম ৰাজ্যৰ এটা ৰামছাৰ স্থানৰ নাম লিখা।

(c) Name one NGO from Assam that work in the field of environmental conservation and ecology.
পৰিৱেশ সংৰক্ষণ আৰু পৰিৱেশ বিজ্ঞানৰ ক্ষেত্ৰত কাম কৰা অসমৰ এটা বেচৰকাৰী সংস্থাৰ নাম লিখা।

(d) _____ leads to reduction in the dissolved oxygen.
_____ ৰ ফলত দ্ৰৱীভূত অক্সিজেন হ্রাস পায়।

(e) What is the full form of COD ?
COD ৰ সম্পূৰ্ণ ৰূপ কি ?

(f) From which district the Chipko Movement started ?
কোন জিলাৰ পৰা চিপকো আন্দোলন আৰম্ভ হৈছিল ?

(g) Where is the headquarter of United Nations Environment Programme (UNEP) situated ?
ৰাষ্ট্ৰসংঘৰ পৰিৱেশ কাৰ্যসূচীৰ (UNEP) মুখ্য কাৰ্যালয় ক'ত অৱস্থিত ?

2. Write short answers : $2 \times 4 = 8$

অতি চমুকৈ উত্তৰ দিয়া :

(a) What are the various components of acid rain ?
এচিড বৰষুণৰ বিভিন্ন উপাদান কি কি ?

(b) Write two disadvantages of trickling filter.
ট্ৰিক্লিং ফিল্টাৰৰ দুটা অসুবিধা লিখা।

(c) What is air quality index (AQI) ?
বায়ুৰ গুণাগুণ সূচাকাংক (AQI) কি ?

(d) What is environmental ethics ?
পৰিৱেশ নৈতিকতা কি ?

3. Answer **any three** of the following : $5 \times 3 = 15$

নিম্নোক্ত যিকোনো তিনিটাৰ উত্তৰ লিখা :

(a) Give a brief account of indoor air pollution.

ঘৰৰ ভিতৰৰ বায়ু প্ৰদূষণৰ চমু বিৱৰণ দিয়া।

(b) What are the effects of increased carbon footprints ?

কাৰ্বন ফুটপ্ৰিন্ট বৃদ্ধিৰ প্ৰভাৱ কি কি ?

(c) What are the positive and negative impacts of trade on the environment ?

পৰিৱেশৰ ওপৰত বাণিজ্যৰ ইতিবাচক আৰু নেতিবাচক প্ৰভাৱ কি কি ?

(d) Describe the process involved in an oxidation pond.

অক্সিডেচন পুখুৰীত জড়িত প্ৰক্ৰিয়া বৰ্ণনা কৰা।

(e) State the functions of the Central Pollution Control Board.

কেন্দ্ৰীয় প্ৰদূষণ নিয়ন্ত্ৰণ ব'ৰ্ডৰ কাম-কাজসমূহ উল্লেখ কৰা।

4. Answer **any three** of the following : $10 \times 3 = 30$

যিকোনো তিনিটা প্ৰশ্নৰ উত্তৰ লিখা :

(a) What is greenhouse effect ? What are the major greenhouse gases ? State few measures to reduce emission of greenhouse gases.

$3+2+5=10$

সেউজ গৃহ প্ৰভাৱ কি ? প্ৰধান সেউজ গৃহ গেছবোৰ কি কি ? সেউজ গৃহ গেছৰ নিৰ্গমন হ্ৰাস কৰাৰ বাবে কিছুমান ব্যৱস্থা উল্লেখ কৰা।

(b) State few major causes for environment movements in India. Give an account of the Narmada Bachao Andolan. $4+6=10$

ভাৰতত পৰিৱেশ আন্দোলনৰ কিছুমান প্ৰধান কাৰণ উল্লেখ কৰা। নৰ্মদা ৰচাও আন্দোলনৰ বিৱৰণ দিয়া।

(c) Give an account of International NGOs that work in the field of environment.

10

পৰিৱেশৰ ক্ষেত্ৰত কাম কৰা আন্তঃৰাষ্ট্ৰীয় এন জি অ'সমূহৰ বিৱৰণ দিয়া।

(d) What is Kyoto Protocol ? Describe the salient features of the Kyoto Protocol.

$2+8=10$

কিয়ট প্ৰট'কল কি ? কিয়ট প্ৰট'কলৰ উল্লেখযোগ্য বৈশিষ্ট্যসমূহ বৰ্ণনা কৰা।

- (e) What is bioremediation? Give an account of molecular approaches in bioremediation. $2+8=10$

জৈৱ প্ৰতিকাৰ (বায়োৰিমেডিয়েচন) কি? জৈৱ প্ৰতিকাৰত আণৱিক পদ্ধতিৰ বিৱৰণ দিয়া।

- (f) Give an account of the Rio declarations on environment and development. What were the important outcomes of the Rio Earth Summit 1992? $7+3=10$

পৰিৱেশ আৰু উন্নয়নৰ ওপৰত ৰিঅ'ৰ ঘোষণাসমূহৰ বিৱৰণ দিয়া। ১৯৯২ চনৰ ৰিঅ' আৰ্থ ছামিটৰ গুৰুত্বপূৰ্ণ ফলাফল কি আছিল?

Total number of printed pages-4

3 (Sem-3/CBCS) ZOO HC 1

2023

ZOOLOGY

(Honours Core)

Paper : ZOO-HC-3016

(Diversity of Chordata)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : $1 \times 7 = 7$
- (i) Which is not a chordate character?
- (a) Dorsal hollow tubular nerve cord
 - (b) Longitudinal supporting rod-like notochord
 - (c) A series of pharyngeal gill slits
 - (d) Diploblastic

Contd.

- (ii) *Balanoglossus* is commonly known as
- Snake worm
 - Acorn worm
 - Corn worm
 - Hemichordata
- (iii) The Dipleurula concept was first proposed by
- Darwin
 - Bather
 - Garstang
 - None of the above
- (iv) The larva of Lamprey is
- Tornaria
 - Trochophore
 - Ammocoete
 - Ascidia tadpole larva
- (v) The Ostracoderms are grouped into
- Pisces
 - Agnatha
 - Gnathostomata
 - Tetrapoda

- (vi) Which of the following is the connecting link between osteichthyes and Amphibian?
- Peripatus
 - Neopilina
 - Protopterus
 - Ornithorhynchus
- (vii) Snakes are sensitive to
- noises made by birds
 - earth borne vibrations
 - thunder
 - air borne vibrations
2. Answer the following : 2×4=8
- Write short notes on parental care in Amphibia.
 - Describe the mechanism of osmoregulation in marine fish.
 - What is active flight or true flight?
 - State distinctive characters of class Reptilia.
3. Answer **any three** of the following questions : 5×3=15
- Distinguish between Lamprey and Hagfish.
 - Write a brief note on Archaeopteryx with suitable diagram.
 - Write about the anatomical peculiarities of Sphenodon.

- (iv) Distinguish between Megachiroptera and Microchiroptera.
- (v) Write briefly on Wegener's continental drift theory.

4. Answer the following questions : $10 \times 3 = 30$

- (a) Describe the retrogressive metamorphosis in Urochordata with suitable diagrams.

Or

- (b) What do you mean by parental care? Discuss about the various mechanism of parental care in Fishes. $2+8=10$

5. (a) Write about the general characteristics of class Amphibia. Give an outline classification of Amphibia. $5+5=10$

Or

- (b) Birds are 'glorified reptiles'. Justify the statement.

6. (a) Name *two* venomous snake of India. Describe the biting mechanism of snake with suitable diagram. $2+8=10$

Or

- (b) What do you mean by Zoogeography? Give an account of different zoogeographical region with its faunal diversity and distribution. $2+8=10$

Total number of printed pages-11

3 (Sem-3/CBCS) MAT SE 1/2

2023

MATHEMATICS

(Skill Enhancement Course)

Answer the Questions from any one Option.

OPTION-A

Paper : MAT-SE-3014

**(Computer Algebra Systems and Related
Software)**

OPTION-B

Paper : MAT-SE-3024

(Combinatorics and Graphy Theory)

Full Marks : 50

Time : Two hours

***The figures in the margin indicate
full marks for the questions.***

Contd.

OPTION-A

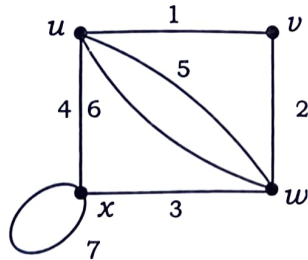
Paper : MAT-SE-3014

(Computer Algebra Systems and Related Software)

1. Answer the following : $1 \times 4 = 4$
- (a) Fill in the blank :
The ; (semicolon) symbol is used to _____ commands.
- (b) Write the Maple command to calculate π .
- (c) Write *three* well known constants in Mathematica.
- (d) 'Take' command can be used to extract submatrices of a given matrix.
(Write True or False)
2. Answer the following questions : $2 \times 3 = 6$
- (a) How to use a computer algebra system as a calculator ?
- (b) Why do all Mathematica command names begin with capital letters ?

- (c) How many of these integers are divisible by 3 or 5 or 7.
- (b) How many of these integers are divisible by 3 or 5 but not by 7 ?
- (a) How many of these integers are divisible by 3 or 5 ?
6. In the set of positive integer from 1 to 250, find :
 $2+4+4=10$
 $1+2+7=10$
only if each vertex has even degree.
that a connected graph is Eulerian if and that one is Euler and the other is not. Show Define Euler graph. Draw two graphs such

- (b) For the following graph, write down the following :



- (i) a walk of length 7 between u and w
- (ii) all the cycles of lengths 1, 2, 3 and 4
- (iii) a path of maximum length
- (iv) a self loop
- (v) a subgraph with 4 vertices and 4 edges.

- (c) Check if the following graphs are Eulerian :

(i) K_8 , the complete graph.

(ii) $K_{8,8}$, the complete bipartite graph.

- (d) Give the combinatorial proof :

Let n and k be positive integers, then

$$\binom{n}{k} = \binom{n-1}{k} + \binom{n-1}{k-1}$$

4. Explain the 'Four Cubes Problem'. 10

Or

Explain with example how graph is used to represent interpersonal relationships in social sciences.

5. Define Hamiltonian cycles and Hamiltonian graph. Discuss about Hamiltonian cycles on a dodecahedron. 2+2+6=10

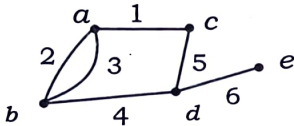
OPTION-B

Paper : MAT-SE-3024

(Combinatorics and Graphy Theory)

1. Answer the following : $1 \times 4 = 4$

(a) State true **or** false :



Edges 2 and 3 are adjacent.

(b) Fill in the blank :

The number of vertices of odd degree in a graph is always _____.

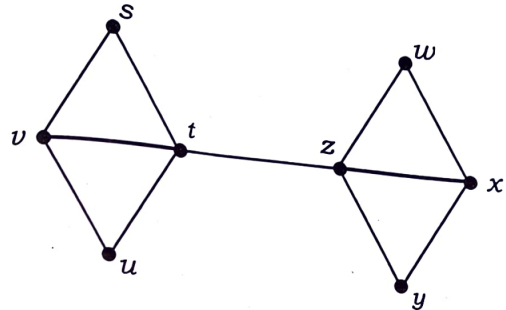
(c) What is a regular graph ?

(d) What is an order relation on a set ?

2. Answer the following :

$2 \times 3 = 6$

(a) Write down all the paths between s and y in the following graph :



(b) Prove that there are no 3-regular graphs with seven vertices.

(c) Prove by bijection that the total number of subsets of a set of order n is 2^n .

3. Answer **any two** parts from the following : $5 \times 2 = 10$

(a) Explain why a tree with n vertices has $n-1$ edges.

4. Answer **any three** questions : $10 \times 3 = 30$

(a) Define a function $f(x) = x^{3x} + \sin x$. Write programs for differentiate and integrate of $f(x)$ in Mathematica, Maple and Maxima.

(b) (i) Write short notes on Mathematica and Maple as a calculator.

(ii) Write a short note on built in functions and user-defined functions in Maxima. Give examples.

(c) Mention the plot commands in Mathematica, Maple and Maxima for the following :

(i) $z = e^{-(x^2+y^2)}$ for $-2 \leq x, y \leq 2$

(ii) Three lines $y = 4x + 1$, $y = -x + 4$
and $y = 9x - 8$ for $0 \leq x \leq 2$

(d) Write a program using Newton's method to find the square root of 81.

(e) Write Mathematica code to solve the non homogeneous system of linear equations $mx = b$

where

$$m = \begin{pmatrix} 1 & 5 & -4 & 1 \\ 3 & 4 & -1 & 2 \\ 3 & 2 & 1 & 5 \\ 0 & -6 & 7 & 1 \end{pmatrix}$$

$$x = \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix}, \quad b = \begin{pmatrix} 1 \\ 2 \\ 3 \\ 4 \end{pmatrix}$$

(f) What is QR-Decomposition? Determine QR-Decomposition in the matrix

$$m = \begin{pmatrix} 1 & 0 & 0 \\ -1 & 2 & 0 \\ 0 & 1 & 3 \end{pmatrix}$$

using commands of a suitable computer system.

(c) What do you mean by span and linear independence ?

3. Answer **any two** : $5 \times 2 = 10$

(a) Write the rules when defining a function in Mathematica.

(b) Write the plot commands in Mathematica, Maple and Maxima for the function $y = \sin x$ for $0 \leq x \leq 2\pi$.

(c) Let $A = (a_{ij})_{3 \times 3}$ be a matrix. Write the commands in Mathematica to extract the diagonal elements from the matrix and obtain the adjoint of A. Hence write the commands to find inverse of A, without using the Mathematica command Inverse [A]:

(d) What is Gaussian elimination ? Using Mathematica command to find the reduced row echelon form of the matrix

$$\begin{pmatrix} 1 & 1 & 4 & 25 \\ 2 & 1 & 0 & 7 \\ -3 & 0 & 1 & -1 \end{pmatrix}$$

Or

Define lex and colex listing of combinations. In the lex and colex listing of all 3-subsets of [7] find : $2+4+4=10$

- (a) The 18th subset in the lex order
- (b) The rank of the subset $\{1,4,7\}$ in the colex order

Total number of printed pages-20

3 (Sem-3/CBCS) MAT HG 1/2/RC

2023

MATHEMATICS

(Honours Generic/Regular)

Answer the Questions from any one Option.

OPTION-A

Paper : MAT-HG-3016 /MAT-RC-3016

(Differential Equation)

OPTION-B

Paper : MAT-HG-3026

(Linear Programming)

Full Marks : 80

Time : Three hours

**The figures in the margin indicate
full marks for the questions.**

Contd.

OPTION-A

Paper : MAT-HG-3016 / MAT-RC-3016

(Differential Equation)

Answer **either** in English **or** in Assamese.

1. Answer the following questions: $1 \times 10 = 10$

তলত দিয়া প্ৰশ্নবোৰৰ উত্তৰ দিয়া :

(a) Define order and degree of an ordinary differential equation.

সাধাৰণ অৱকল সমীকৰণৰ ক্ৰম আৰু ঘাতৰ সংজ্ঞা লিখা।

(b) What do you mean by an ordinary differential equation? Give *one* example.

সাধাৰণ অৱকল সমীকৰণ বুলিলে কি বুজা? এটা উদাহৰণ দিয়া।

(c) Define exact differential equation.

যথার্থ অৱকল সমীকৰণৰ সংজ্ঞা লিখা।

(d) Obtain the differential equation of family of parabolas given by $y^2 = 4ax$.

$y^2 = 4ax$ অধিবৃত্তৰ পৰিয়ালটোৰ অৱকল সমীকৰণটো গঠন কৰা।

(e) Write the condition of exactness of an ordinary differential equation.

এটা সাধাৰণ অৱকল সমীকৰণৰ যথার্থতাৰ চৰ্ত লিখা।

(f) Find the integrating factor of

$$\frac{dy}{dx} + \frac{y}{x} = \cos x.$$

$\frac{dy}{dx} + \frac{y}{x} = \cos x$, ৰ অনুকলন গুণক নিৰ্ণয় কৰা।

(g) Define orthogonal trajectory of a family of curve.

এটা বক্ৰ পৰিয়ালৰ লাম্বিক প্ৰক্ষেপপথৰ সংজ্ঞা লিখা।

(h) Write the complementary function of $(D^2 + 4)y = x^2$.

$(D^2 + 4)y = x^2$ অৱকল সমীকৰণটোৰ পৰিপূৰক ফলনটো লিখা।

(i) Write the general form of a linear differential equation of n^{th} order.

এটা n মাত্ৰাৰ ৰৈখিক অৱকল সমীকৰণৰ সাধাৰণ ৰূপটো লিখা।

(j) If $y_1 = \sin 2x$ and $y_2 = \cos 2x$, then find the Wronskian of $y_1(x)$ and $y_2(x)$.

যদি $y_1 = \sin 2x$ আৰু $y_2 = \cos 2x$, তেন্তে $y_1(x)$ আৰু $y_2(x)$ ৰ Wronskian নিৰ্ণয় কৰা।

2. Answer the following questions: $2 \times 5 = 10$

তলত দিয়া প্ৰশ্নবোৰৰ উত্তৰ দিয়া :

(a) Determine the particular integral of the differential equation

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} + 1 = \sin 2x.$$

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} + 1 = \sin 2x \text{ অৱকল সমীকৰণটোৰ}$$

বিশেষ অনুকলন নিৰ্ণয় কৰা।

(b) Derive the orthogonal trajectory of $xy = a^2$.

$xy = a^2$, ৰ লাম্বিক প্ৰক্ষেপপথ নিৰ্ণয় কৰা।

(c) Find the integrating factor of the differential equation

$$(x^2y - 2xy^2)dx - (x^3 - 3x^2y)dy = 0$$

$$(x^2y - 2xy^2)dx - (x^3 - 3x^2y)dy = 0$$

অৱকল সমীকৰণটোৰ অনুকলন গুণক নিৰ্ণয় কৰা।

(d) Solve: $\frac{dx}{y^2} = \frac{dy}{x^2} = \frac{dz}{x^2y^2z^2}$

সমাধান কৰা: $\frac{dx}{y^2} = \frac{dy}{x^2} = \frac{dz}{x^2y^2z^2}$

(e) Solve: $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 13y = 0$

সমাধান কৰা: $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 13y = 0$

3. Answer the following: (**any four**) $5 \times 4 = 20$

তলত দিয়া প্ৰশ্নবোৰৰ উত্তৰ দিয়া : (যিকোনো চাৰিটা)

(a) Solve: $x^2 \frac{d^2y}{dx^2} - 3x \frac{dy}{dx} + 4y = 2x^2$

সমাধান কৰা: $x^2 \frac{d^2y}{dx^2} - 3x \frac{dy}{dx} + 4y = 2x^2$

(b) Find the orthogonal trajectories of the series of hypocycloid $x^{2/3} + y^{2/3} = a^{2/3}$.

$x^{2/3} + y^{2/3} = a^{2/3}$, পৰিয়ালটোৰ লাম্বিক প্ৰক্ষেপপথ নিৰ্ণয় কৰা।

(c) Solve the simultaneous linear differential equations $\frac{dx}{dt} = -py$ and

$\frac{dy}{dt} = px$ and show that the point (x, y) lies on a circle.

$\frac{dx}{dt} = -py$ আৰু $\frac{dy}{dt} = px$; অৱকল সমীকৰণটো

সমাধান কৰা আৰু দেখুওৱা যে (x, y) বিন্দুটো এটা বৃত্তত থাকিব।

(d) Solve by reducing to exact differential equation

$$xydx + (2x^2 + 3y^2 - 20)dy = 0$$

$xydx + (2x^2 + 3y^2 - 20)dy = 0$ সমীকৰণক যথার্থ অৱকল সমীকৰণলৈ সমানীত কৰি সমাধান কৰা।

(e) Solve the Bernoulli's equation :

$$x \frac{dy}{dx} + y = y^2 \log x$$

বাৰ্নোলীৰ সমীকৰণটো সমাধান কৰা :

$$x \frac{dy}{dx} + y = y^2 \log x$$

(f) Solve $x^2 \frac{d^2y}{dx^2} - 3x \frac{dy}{dx} + 4y = 0$, given that $y = x^2$ is one of the solution.

$$x^2 \frac{d^2y}{dx^2} - 3x \frac{dy}{dx} + 4y = 0 \text{ অৱকল সমীকৰণটো}$$

সমাধান কৰা, য'ত সমীকৰণটোৰ এটা সমাধান $y = x^2$.

4. Answer the following: **(any four)** $10 \times 4 = 40$

তলত দিয়া প্ৰশ্নবোৰৰ উত্তৰ দিয়া : (যিকোনো চাৰিটা)

(a) Solve by the method of variation of

$$\text{parameter : } \frac{d^2y}{dx^2} - y = \frac{2}{1+e^x}$$

প্ৰাচল বিচৰণ পদ্ধতিৰে সমাধান কৰা :

$$\frac{d^2y}{dx^2} - y = \frac{2}{1+e^x}$$

(b) Solve : $\frac{d^4 y}{dx^4} - y = x \sin x$

সমাধান কৰা : $\frac{d^4 y}{dx^4} - y = x \sin x$

(c) Solve : $\frac{dx}{dt} + \frac{dy}{dt} + 2x + y = 0$

$$\frac{dy}{dt} + 5x + 3y = 0$$

সমাধান কৰা : $\frac{dx}{dt} + \frac{dy}{dt} + 2x + y = 0$

$$\frac{dy}{dt} + 5x + 3y = 0$$

(d) Solve the exact differential equation :

$$x^2 \frac{d^2 y}{dx^2} + 3x \frac{dy}{dx} + y = \frac{1}{(1-x)^2}$$

যথার্থ অৱকল সমীকৰণটো সমাধান কৰা :

$$x^2 \frac{d^2 y}{dx^2} + 3x \frac{dy}{dx} + y = \frac{1}{(1-x)^2}$$

(e) Solve by reducing to normal form

$$\frac{d^2 y}{dx^2} - 4x \frac{dy}{dx} + (4x^2 - 1)y = -3e^{x^2} \sin 2x$$

নৰ্মাল ৰূপলৈ সমানীত কৰি সমাধান কৰা :

$$\frac{d^2 y}{dx^2} - 4x \frac{dy}{dx} + (4x^2 - 1)y = -3e^{x^2} \sin 2x$$

(f) Show that the term $\frac{1}{x(x^2 - y^2)}$ is an

integrating factor of the differential equation $(x^2 + y^2) dx - 2xy dy = 0$ and hence solve it.

দেখুওৱা যে $(x^2 + y^2) dx - 2xy dy = 0$

সমীকৰণৰ এটা অনুকলন গুণক $\frac{1}{x(x^2 - y^2)}$ আৰু

সমাধান কৰা।

(g) Solve the equation, $4y = x^2 + p^2$, where

$$p \equiv \frac{dy}{dx}$$

সমাধান কৰা: $4y = x^2 + p^2$, যত $p \equiv \frac{dy}{dx}$

(h) Discuss the method of solving a Bernoulli's equation of the form

$$\frac{dy}{dx} + Py = Qy^n; \text{ where } P \text{ and } Q \text{ are}$$

constants as function of x .

এটা $\frac{dy}{dx} + Py = Qy^n$ ৰূপৰ বাৰ্নৌলীৰ সমীকৰণ

সমাধান কৰাৰ পদ্ধতি আলোচনা কৰা, য'ত P আৰু Q হৈছে x ৰ ফলন।

OPTION-B

Paper : MAT-HG-3026

(Linear Programming)

1. Answer the following questions : (Choose the correct answer) 1×10=10
- (a) A basic feasible solution whose variables are
- (i) degenerate
 - (ii) non-degenerate
 - (iii) non-negative
 - (iv) None of the above
- (b) The inequality constraints of an LPP can be converted into equation by introducing
- (i) negative variables
 - (ii) non-degenerate B.F.
 - (iii) slack and surplus variables
 - (iv) None of the above

(c) A solution of an LPP, which optimize the objective function is called

- (i) basic solution
- (ii) basic feasible solution
- (iii) optimal solution
- (iv) None of the above

(d) Given a system of m simultaneous linear equations in n unknowns ($m < n$) the number of basic variables will be

- (i) m
- (ii) n
- (iii) $n - m$
- (iv) $n + m$

(e) A simplex in n -dimension is a convex polyhedron having

- (i) $n - 1$ vertices
- (ii) n vertices
- (iii) $n + 1$ vertices
- (iv) None of the above

(f) At any iteration of the usual simplex method, if there is at least one basic variable in the basis at zero level and all $z_j - c_j \geq 0$ the current solution is

- (i) infeasible
- (ii) unbounded
- (iii) non-degenerate
- (iv) degenerate

(z_j, c_j having usual meaning)

(g) Let $X = \{x_1, x_2\} \subset \mathbb{R}^2$. Then the convex hull $C(X)$ of X is

- (i) $\{\lambda x_1 + (1 - \lambda) x_2 : \lambda \geq 1\}$
- (ii) $\{\lambda x_1 + (1 - \lambda) x_2 : \lambda \leq 0\}$
- (iii) $\{\lambda x_1 + (1 - \lambda) x_2 : 0 < \lambda < 1\}$
- (iv) None of the above

(h) For given linear programming problem, if z is an objective function

- (i) $\text{Max } z = - \text{Min } z$
- (ii) $\text{Max } z = \text{Min } (-z)$
- (iii) $\text{Max } (-z) = \text{Max } z$
- (iv) None of above

(i) The set $\{(x_1, x_2) : x_1^2 + x_2^2 \leq 1\}$ is a

(i) open set

(ii) closed set

(iii) neither open nor closed

(iv) open and closed both

(j) In linear programming problem

(i) objective function, constraints and variables are all linear

(ii) only objective function to be linear

(iii) only constraints are to be linear

(iv) only variables are to be linear

2. Answer the following: $2 \times 5 = 10$

(a) A hyperplane is given by the equation

$3x_1 + 2x_2 + 4x_3 + 7x_4 = 8$, find in which half space do the point $(-6, 1, 7, 2)$ lie.

(b) Prove that $x_1 = 2, x_2 = -1$ and $x_3 = 0$ is a solution but not a basic solution to the system of equations

$$3x_1 - 2x_2 + x_3 = 8$$

$$9x_1 - 6x_2 + 4x_3 = 24$$

(c) Write the dual of the following primal problem:

$$\text{Minimize } Z = 3x_1 + 5x_2$$

$$\text{subject to } 3x_1 + 5x_2 = 12$$

$$4x_1 + 2x_2 = 10$$

with $x_1, x_2 \geq 0$

(d) In a two-person Zero-sum game, the pay-off matrix is given by

		B		
		I	II	III
A	I	6	8	6
	II	4	12	2

Find its saddle points.

(e) Show that the linear function

$Z = C X, X \in \mathbb{R}^n, C \in \mathbb{R}$ is a convex function.

3. Answer **any four** of the following : $5 \times 4 = 20$

(a) Solve graphically the following LPP :

$$\text{Max. } Z = 5x_1 + 7x_2$$

$$\text{subject to } x_1 + x_2 \leq 4$$

$$3x_1 + 8x_2 \leq 24$$

$$10x_1 + 7x_2 \leq 35$$

$$x_1, x_2 \geq 0$$

(b) Find all basic feasible solutions of the system of equations

$$x_1 + 2x_2 + 3x_3 + 4x_4 = 7$$

$$2x_1 + x_2 + x_3 + 2x_4 = 3$$

(c) Prove that the set of all convex combinations of a finite number of points $x_1, x_2, x_3, \dots, x_n$ is a convex set.

(d) Prove that the dual of a dual is a Primal problem itself.

(e) Solve the following transportation problem using North-West corner method whose cost matrix is given below :

Source	D_1	D_2	D_3	D_4	Supply
S_1	7	10	14	8	30
S_2	7	11	12	6	40
S_3	5	8	15	9	30
Demand	20	20	25	35	

(f) The pay-off matrix of a game is given below. Find the solution of the game to A and B.

		B				
		I	II	III	IV	V
A	I	-2	0	0	5	3
	II	3	2	1	2	2
	III	-4	-3	0	-2	6
	IV	5	3	-4	2	-6

4. Answer **any four** questions : $10 \times 4 = 40$

(a) Old hens can be bought for Rs. 2 each but young ones cost Rs. 5 each. The old hens lay 3 eggs per week and the young ones 5 eggs per week, each being worth 30 paise. A hen costs Re. 1 per week to feed. If I have only Rs. 80 to spend for hens, how many of each kind shall I buy to give a profit of more than Rs. 6 per week, assuming that I can not house more than 20 hens? Formulate the LPP and solve by graphical method.

(b) Prove that if either the primal or the dual problem of an LPP has a finite optimal solution, then the other problem also has a finite optimal solution. Furthermore, the optimal values of the objective function in both the problems are the same, i.e.

$$\text{Max } Z_x = \text{Max } Z_w$$

(c) Solve the following assignment problem :
Projects

	A	B	C	D
I	12	10	10	8
II	14	Not suitable	15	11
III	6	10	16	4
IV	8	10	9	7

(d) Use simplex method to solve the LPP

$$\text{Max } Z = 4x + 10y$$

subject to the constraints

$$2x + y \leq 50$$

$$2x + 5y \leq 100$$

$$2x + 3y \leq 90$$

$$x, y \geq 0$$

(e) Use the two-phase simplex method to solve $\text{Max } Z = 5x_1 - 4x_2 + 3x_3$

subject to the constraints

$$2x_1 + x_2 - 6x_3 = 20$$

$$6x_1 + 5x_2 + 10x_3 \leq 76$$

$$8x_1 - 3x_2 + 6x_3 \leq 50$$

$$x_1, x_2, x_3 \geq 0$$