

No. of Printed Pages : 3

MCS-033

02892

MCA (Revised)**Term-End Examination****June, 2011****MCS-033 : ADVANCED DISCRETE
MATHEMATICS***Time : 2 hours**Maximum Marks : 50*

Note : *Question no. 1 is compulsory. Attempt any three from the rest.*

1. (a) Find the order and degree of the following recurrences relations. 6

Determine whether they are homogeneous or non homogeneous :

(i) $a_n = a_{n-1} + a_{n-2} + \dots + a_0$

(ii) $a_n = na_{n-2} + 2^n$

(b) A graph G is said to be self complementary if it is isomorphic to its complement \bar{G} . 4

Show that for a self complementary $(p - q)$ graph G , either P or $(P - 1)$ is divisible by 4.

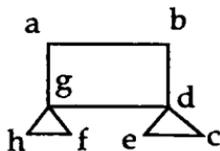
(c) Define minimum vertex degree of G ($\delta(G)$) and maximum vertex degree of G ($\Delta(G)$). 3

- (d) Solve the following recurrence relation : 3
 $4a_r - 5a_{r-1} = 0, r \geq 1, a_0 = 1.$
- (e) Find the generating function for the 2
sequence $0^2, 1^2, 2^2, 3^2, \dots$
- (f) Define bipartite graph. Also give an 2
example of it.
2. (a) Show that if G_1, G_2, \dots, G_n are bipartite, 5

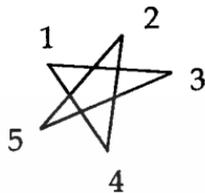
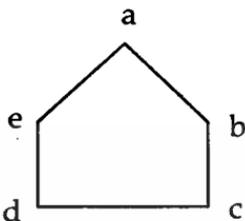
then $\bigcup_{i=1}^n G_i$ is bipartite.

- (b) Solve the recurrence 5
 $a_n = a_{n-1} + 2a_{n-1}, n \geq 2$
with $a_0 = 0, a_1 = 1.$
3. (a) Solve $a_r = a_{r-1} + r \cdot 2^r$, given $a_0 = 1.$ 5
(b) Solve $a_r = 2a_{r-1} + 1$ with $a_1 = 7$, for $r > 1$, by 5
substitution method.

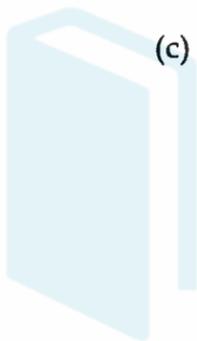
4. (a) Use generating function to solve 3
 $a_n - 9a_{n-1} + 20a_{n-2} = 0, a_0 = -3, a_1 = -10.$
- (b) Solve the recurrence 4
 $a_{r+4} - 4a_{r+3} + 6a_{r+2} - 4a_{r+1} + 4a_r = 0.$
- (c) Find Euler's path in the graph given below : 3



5. (a) Can a simple graph exist with 15 vertices, with each of degree five ? Justify your answer. 3
- (b) Are the following graphs are isomorphic ? If Yes or No Justify. 4



- (c) Show that K_5 is not planar. 3



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No. of Printed Pages : 4

MCS-033

08011

MCA (Revised)

Term-End Examination

December, 2011

MCS-033 : ADVANCED DISCRETE
MATHEMATICS

Time : 2 hours

Maximum Marks : 50

Note : Question no. 1 is compulsory. Attempt any three questions from the rest.

1. (a) Find the order and degree of each of the following recurrence relation. Also find whether they are homogeneous or non-homogeneous ? 4

(i) $a_n = \sqrt{a_{n-1}} + a_{n-2}^2$

(ii) $a_n = a_{n-1} + a_{n-2} + \dots + a_0$

- (b) Find the recurrence relation whose solution is given by $a_n = A \cdot 3^n + B(-4)^n$. 3

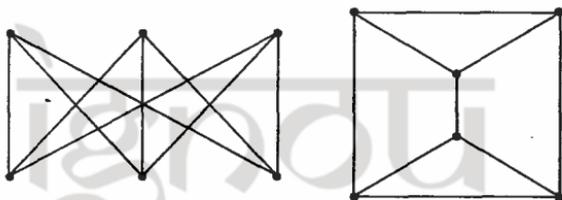
- (c) Solve the recurrence relation given by 3

$$a_n - 5a_{n-1} + 6a_{n-2} = 0$$

where $a_0 = 2$ and $a_1 = 5$.

- (d) Draw the graph $k_{2,5}$ 3
- (e) Show that for a subgraph H of a graph G , $\Delta(H) \leq \Delta(G)$ 4
- (f) If a graph of n vertices is isomorphic to its complement, how many vertices it must have? 3

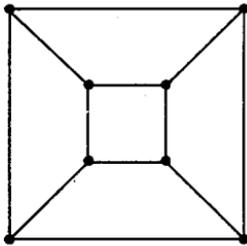
2. (a) Determine whether the graphs are isomorphic. 4



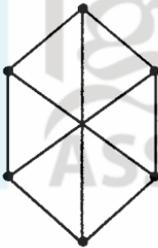
- (b) Show that a graph G without parallel edges or self loop with n vertices and k components can have at most $(n-k)(n+k-1)/2$ edges. 6

3. (a) Check that $a_n = \frac{3}{2}n - 2$ is a solution to the 5
recurrence $a_n = 2a_{n/2} + 2$, where n is a
power of 2 and $a_2 = 1$.
- (b) Solve the recurrence relation $T_n = 2T_{n-1} + 1$ 5
if $n \geq 2$ and $T_1 = 1$, using generating
function.

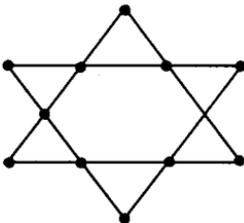
4. (a) Show that the graph in the fig. given below has a Hamiltonian circuit. 4
- has a Hamiltonian circuit.



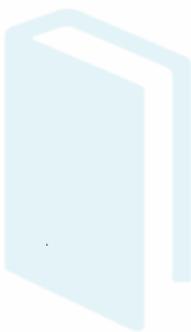
- (b) What is the chromatic number of the following graph? 2



- (c) Whether the following graph contains Euler circuit or not? 4



5. (a) Solve the recurrence relation 4
- $$a_{n+1}^2 = 5a_n^2, \text{ where } a_n > 0 \text{ and } a_0 = 2.$$
- Find a_8
- (b) Show that K_5 is not planar. 3
- (c) How many integer solutions are there to 3
- $$a_1 + a_2 + a_3 + a_4 + a_5 = 28 \text{ with } a_k > k \text{ for each } k, 1 \leq k \leq 5 ?$$



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MCS-033

MCA (Revised)**Term-End Examination**

June, 2012

**MCS-033 : ADVANCED DISCRETE
MATHEMATICS**

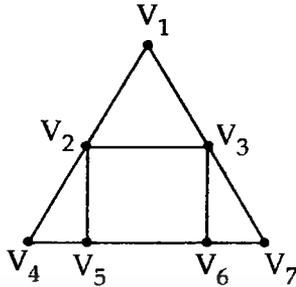
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*Time : 2 hours**Maximum Marks : 50*

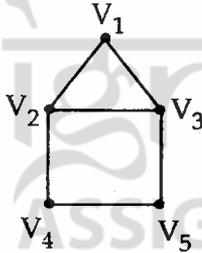
Note : Question no. 1 is compulsory. Attempt any three questions from the rest.

1. (a) Using mathematical induction method, show that $T_n = 2^n - 1$, $n \geq 1$, where T_n denotes the number of minimum number of moves required to transfer n discs from one peg to another under the rules of Tower of Hanoi/Brahma. 4
- (b) Find the generating function of the following function $a_r = \frac{1}{(r+1)!}$; $r=0, 1, 2, \dots$. What are combinatorial identities? Explain with an appropriate example. 4
- (c) Let G be a simple graph with 6 vertices and 11 edges. Check whether the graph G is connected or not. 4

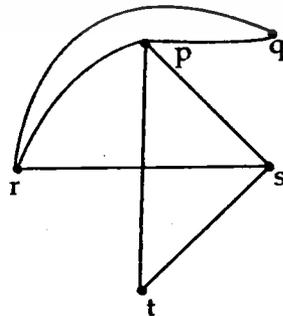
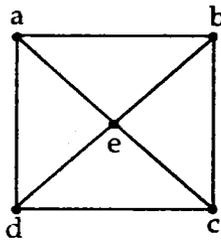
- (d) Find the degree of each vertex in the given graph. 4



- (e) What is the complement of the given graph. 4



2. (a) Determine whether the graphs are isomorphic. 5



(b) A connected planar graph has six vertices each of degree 4. Determine the number of regions into which this planar graph can be splitted ? 5

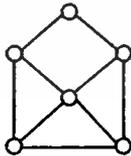
3. (a) Find the order and degree of the following recurrence relation. Also find whether they are homogeneous or non-homogeneous ? 4

(i) $a_n = \sin a_{n-1} + \cos a_{n-2} + \sin a_{n-3} + \dots + e^x$

(ii) $a_n = n a_{n-2} + 2^n$.

(b) Prove that the generating function for the sequence of Binomial coefficients $\{c(k, 0), c(k, 1), c(k, 2), \dots\}$ is $(1+az)^k$. 6

4. (a) Determine the chromatic number of the following graph. 4



(b) Construct a non-Hamiltonian graph on 5-vertices. 3

(c) Check whether the complete graphs of 4 and 5 vertices are Eulerian. 3

5. (a) Show that, in a connected Eulerian graph, an Eulerian circuit can be traced starting from any vertex. 3
- (b) Solve the recurrence relation given as follows : $a_n - 5a_{n-1} + 6a_{n-2} = 7^n$ 4
- (c) Draw a graph which is both regular and bipartite ? 3



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No. of Printed Pages : 2

MCS-033

10555

MCA (Revised)

Term-End Examination

December, 2012

MCS-033 : ADVANCED DISCRETE
MATHEMATICS

Time : 2 hours

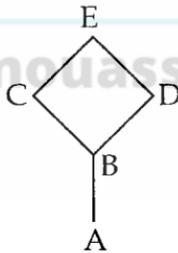
Maximum Marks : 50

Note : Question no. 1 is compulsory. Attempt any three questions from the rest.

1. (a) Find the order and degree of the following recurrence relation. Also state are they homogeneous or non homogeneous ? 6
- (i) $a_n = 3a_{n-1} + n^2$
- (ii) $a_n = a_{n-1} + a_{n-2}$
- (b) Construct a 5-regular graph on 10 vertices. 3
- (c) Show that C_6 is bipartite and K_3 is not bipartite. 3
- (d) What is a spanning tree ? Illustrate with an example and a non-exemplar each. 2
- (e) Solve the recurrence $a_n = a_{n-1} + 2 ; a_0 = 3$ 3
- (f) Find the sequence generated by the following : 3

$$5x^2 (1-x)^{-1}$$

2. (a) Solve $a_r = a_{r-1} + r^2$; $a_0 = 7$ by substitution method. 5
 (b) State and Prove Euler's formula for graph. 5
3. (a) Solve the recurrence relation described as follows : 5
 $a_n = 5 a_{n-1} - 6 a_{n-2}$, for $n \geq 2$, $a_0 = 1$, $a_1 = 0$
 (b) Solve : $a_r - 7a_{r-1} + 10a_{r-2} = 0$, $r \geq 2$ 5
4. (a) Use Substitution method to solve the following : 4
 $t_n = 1$, $n=2$ and $t_n = 2 t_{n-1} + 1$, $n > 2$
 (b) Use generating function to solve 4
 $a_n = 3 a_{n-1} + 2$, $n \geq 1$ with $a_0 = 1$
 (c) Illustrate Cutpoint using an example. 2
5. (a) Determine whether, the following graph has an Euler path or Eulerian Circuit ? 3



- (b) Determine the chromatic number of the complete graph K_n with n vertices. 4
 (c) Show that K_5 is non-planar. 3

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MCS-033

MCA (Revised)

Term-End Examination

June, 2013

MCS-033 : ADVANCED DISCRETE
MATHEMATICS

Time : 2 hours

Maximum Marks : 50

Note : Question no. 1 is compulsory. Attempt any three questions from the rest.

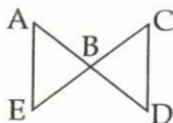
1. (a) Find order and degree of the following recurrence relation. Also, state whether they are homogeneous or non-homogeneous. 6

(i) $a_n = na_{n-2} + 2^n$

(ii) $a_n = a_{n-1} + a_{n-2} + \dots + a_0$

- (b) Is every subgraph of a regular graph regular? Justify. 3

- (c) Draw three spanning tree of the following graph : 3



- (d) What is a connected graph? Explain with an example and a non-examples each. 2

- (e) Solve the recurrence relation : 3

$a_n = 3a_{n-1} + 1; a_0 = 1.$

- (f) Find the sequence generated by the following : 3

$$\frac{1}{1-z} + 5z^3$$

2. (a) Solve $a_r = a_{r-1} + r \cdot 2^r$; $a_0 = 1$ by substitution method. 5

- (b) Show that maximum number of edges in a 5

simple graph with n vertices is $\frac{n(n-1)}{2}$.

3. (a) Solve the recurrence relation given as follows : 5

$$a_n = 8a_{n-1} - 16a_{n-2} \text{ for } n \geq 2, \quad a_0 = 16, \\ a_1 = 80$$

- (b) Solve the recurrence relation given as follows : 5

$$a_{r+4} - 4a_{r+3} + 6a_{r+2} - 4a_{r+1} + 4a_r = 0$$

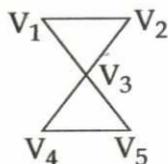
4. (a) Use substitution method to solve $t_n = 1, n = 0$ and $t_n = 2t_{n-1}, n \geq 1$. 4

- (b) Use generating function to solve 4

$$a_{n+2} - 2a_{n+1} + a_n = 2^n; \quad a_0 = 2; \quad a_1 = 1$$

- (c) Define bridge in a graph. Also give an example of it. 2

5. (a) Find that the graph has Eulerian Circuit or not ? 3



- (b) Find chromatic number of bipartite graph K_m, n . 4
- (c) Show that $K_3, 3$ is non-planar. 3



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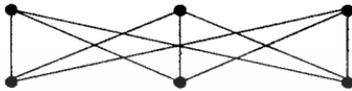
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MCA (Revised)**Term-End Examination****December, 2013****MCS-033 : ADVANCED DISCRETE
MATHEMATICS***Time : 2 hours**Maximum Marks : 50**Note : Question no. 1 is compulsory. Attempt any three questions from the rest.*

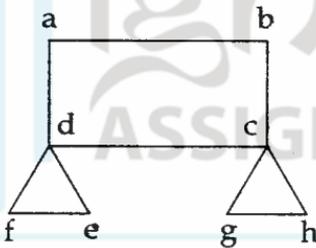
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1. (a) Define : 4
- (i) Graph (ii) Simple Graph
(iii) null graph (iv) connected Graph
- (b) Find the order and degree of the following 6
recurrence relations. Determine whether they
are homogeneous or non homogeneous .
- (i) $a_n = 2a_{n-1} + 3.2^n$
(ii) $a_n = 8a_{n,2} - 16a_{n,4}$
- (c) Solve the following recurrence relation : 3
 $a_n - 5a_{n-1} + 6a_{n-2} = 0$ where $a_0 = 2$,
 $a_1 = 5$.
- (d) Define $\delta(G)$ and $\Delta(G)$ for a graph G 2
- (e) Define walk, path and circuits in a graph. 3
- (f) What is the generating function for the 2
sequence 1, 1, 1, 1, 1, 1 ?

2. (a) Solve the recurrence relation, $a_n = 6a_{n-1} - 11a_{n-2} + 6a_{n-3}$ with the initial conditions $a_0=2, a_1=5$ and $a_2=15$. 5
- (b) Define Bipartite graph. Show that every two chromatic graph is Bipartite. 5

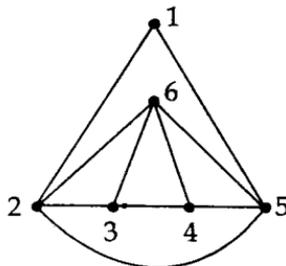
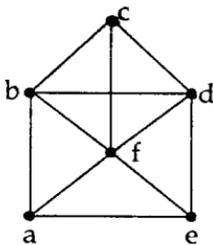
3. (a) Show that the graph given below is not Eulerian. 3



- (b) Solve $a_{n+1} - a_n = n$ with $a_0=1$ using method of generating functions. 5
- (c) Find the chromatic number of the given graph. 2



4. (a) Show that $K_{3,3}$ is non planar. 3
- (b) Are the following graphs isomorphic? If Yes or No justify. 4



- (c) Solve $a_n - 2a_{n-1} = 7n$, 3

5. (a) Solve the recurrence relation $a_n - 3a_{n-1} + 2a_{n-2} = 2^n$ 5
- (b) A connected planar graph has six vertices each of degree 4. Determine the number of regions into which this planar graph can be split. 5
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No. of Printed Pages : 3

MCS-033

07459

MCA (Revised)

Term-End Examination

June, 2014

MCS-033 : ADVANCED DISCRETE
MATHEMATICS

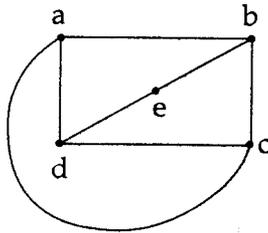
Time : 2 hours

Maximum Marks : 50

Note : Question No. 1 is compulsory. Attempt any three from the rest.

1. (a) Find the order and degree of the following recurrences relations. Determine whether they are homogeneous or non-homogeneous. 6
- (i) $a_n = a_0 a_{n-1} + a_1 a_{n-1} + \dots + a_{n-1} a_0$
- (ii) $a_n^2 + a_{n-1}^2 = -1$
- (b) Define : 4
- (i) Simple graph
- (ii) Finite and infinite graph
- (iii) Isolated vertex
- (iv) Subgraph
- (c) Solve the recurrence relation 3
- $a_{n+1} - 1.5a_n = 0$
- (d) Find the generating function of the following 2
- $a_n = 3^n + 5^n$

- (e) Find the chromatic number of the given graph. 2



- (f) How many edges are there in a graph with 10 vertices each of degree 6? 3

2. (a) Solve the recurrence relation 5

$$a_n - 6a_{n-1} + 8a_{n-2} = 3^n$$

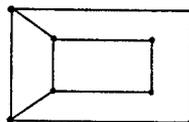
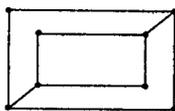
where $a_0 = 3$ and $a_1 = 7$

- (b) Draw a graph (connected) which can be both regular and bipartite? 5

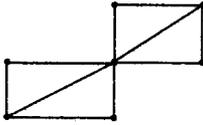
3. (a) Find the solution to the recurrence relation 5

$$a_n = -3a_{n-1} - 3a_{n-2} - a_{n-3} \text{ with } a_0 = 1, a_1 = -2, a_2 = -1$$

- (b) Define Isomorphism of two graphs. Find whether the given graphs are isomorphic or not. 5



4. (a) Find Euler's path in the graph given below : 3



- (b) Show that K_4 is planar graph. 3
- (c) Solve the recurrence relation $a_n + 2a_{n-1} + 2a_{n-2} = 0$ given that $a_0 = 0$, $a_1 = -1$. 4

5. (a) Solve the recurrence relation $a_{n+2} - 5a_{n+1} + 6a_n = 2$, $a_0 = 1$, $a_1 = 2$ using the method of generating function. 5
- (b) State and prove Hand Shaking Theorem. 5

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No. of Printed Pages : 3

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MCA (Revised)
Term-End Examination
December, 2014

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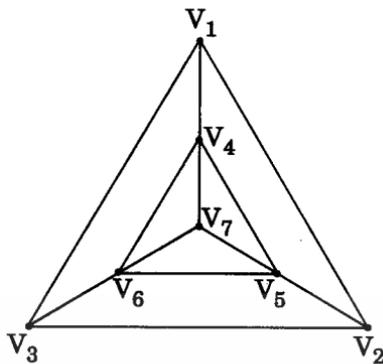
MCS-033 : ADVANCED DISCRETE MATHEMATICS

*Time : 2 hours**Maximum Marks : 50*

Note : Question number 1 is **compulsory**. Attempt any **three** questions from the rest.

1. (a) Differentiate methods of 'inspection' and 'telescoping sums' on relevant attributes. Cite an example application for each. 4
- (b) Explain the Tower of Hanoi problem with an example. 4
- (c) Suppose that the sequence $\{a_n\} n \geq 0$, has the generating function $A(z)$. Then, the generating function $B(z)$ for the sequence $\{b_n\} n \geq 0$, where $b_n = a_n - a_{n-1}$ for $n \geq 1$, and $b_0 = a_0$, is given by $\frac{B(z)}{A(z)} = (1 - z)$. 4
- (d) State and prove Handshaking theorem. 4

- (e) Find the chromatic number of the following graph : 4



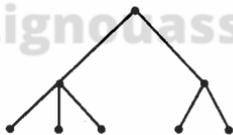
2. (a) Show that K_5 is not planar. 5
 (b) Which of the following graphs are trees, and why? 5



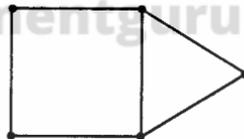
(a)



(b)



(c)



(d)

3. (a) Show that for a sub-graph H of a Graph G , $\Delta H \leq \Delta G$. 5
 (b) Solve the recurrence relation
 $u_n = 2 u_{n-1} + 2^n - 1$ where $n \geq 1$ and
 $u_0 = 0$. 5

4. (a) Evaluate the sum $\sum_{k=1}^n k 3^k C(n, k)$, using generating function technique. 5
- (b) Prove that $a_n = \frac{3n}{2} - 2$ is a solution of the recurrence $a_n = 2a_{(n/2)} + 2$, where n is a power of 2 and $a_2 = 1$. 5
5. (a) Solve the third order recurrence $u_n - 9 u_{n-1} + 26 u_{n-2} - 24 u_{n-3} = 0$, where $n \geq 3$ with the initial conditions $u_0 = 6, u_1 = 17$ and $u_2 = 53$. 5
- (b) Anil takes a loan of r rupees which is to be paid back in t months. If i is the interest rate per month for the loan, what constant payment p must he make at the end of each period? 5

No. of Printed Pages : 3

MCS-033

MCA (Revised)
Term-End Examination

06863

June, 2015

MCS-033 : ADVANCED DISCRETE MATHEMATICS

Time : 2 hours

Maximum Marks : 50

Note : Question number 1 is compulsory. Attempt any three questions from the rest.

1. (a) Explain divide and conquer relations with an example. 4
- (b) Find the order and degree of each of the following recurrences : 4
- (i) $a_n = a_{n-1} + a_{n-2}$
- (ii) $a_n = a_{n-1} + n$
- (iii) $a_n = n a_{n-1} + (-1)^n$
- (iv) $a_n = a_n a_0 + a_{n-1} + \dots + a_0 a_n (n \geq 2)$
- (c) Explain generating functions with suitable examples. 4

- (d) Define Graph and Subgraph. Give an example of a subgraph H of a graph G with $\delta(G) < \delta(H)$ and $\Delta(H) < \Delta(G)$. 4
- (e) Define Tree and Bipartite graph. Is tree a bipartite graph ? Justify your answer. 4
2. (a) What are Hamiltonian graphs ? Construct a non-Hamiltonian graph on 5-vertices. 5
- (b) Show that K_5 is not planar. 5
3. (a) What is the chromatic number of the following :
- (i) A tree with at least two vertices 2
- (ii) An even cycle C_{2n} , $n \geq 2$ 2
- (iii) An odd cycle C_{2n+1} , $n \geq 1$ 2
- (b) State and prove Euler's formula. 4
4. (a) Find the sum of the series given as,
- $$\sum_{k=0}^{\infty} \frac{(k+1)^2}{\lfloor k \rfloor} = \frac{1^2}{\lfloor 0 \rfloor} + \frac{2^2}{\lfloor 1 \rfloor} + \dots + \frac{(n+1)^2}{\lfloor n \rfloor} + \dots,$$
- using exponential generating functions. 5
- (b) How many integer solutions are there to $a_1 + a_2 + a_3 + a_4 + a_5 = 28$, where $a_k > k$ for each k , where $1 \leq k \leq 5$? 5

5. (a) Solve the recurrence $a_n = 4a_{n-2}$, where

(i) $a_0 = 4, a_1 = 6$ 2

(ii) $a_0 = 6, a_2 = 20$ 2

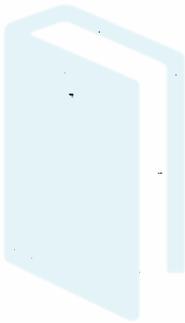
(iii) $a_1 = 6, a_2 = 20$ 2

(b) Using an appropriate substitution, solve the recurrence given by,

$$y_n = \left(\frac{n-1}{n}\right)y_{n-1} + \frac{1}{n}, \quad n \geq 1,$$

where $y_0 = 5$.

4



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01594

No. of Printed Pages : 3

MCS-033

MCA (Revised)
Term-End Examination
December, 2015

MCS-033 : ADVANCED DISCRETE MATHEMATICS

Time : 2 hours

Maximum Marks : 50

Note : Question no. 1 is compulsory. Attempt any three questions from the rest.

1. (a) Define regular graph. Find the number of edges of a 4-regular graph with 6 vertices. 3
- (b) Find the order of the following recurrences and state whether they are homogeneous or non-homogeneous : 4
- (i) $x_{n+1} + 2x_n - 15x_{n-1} = 0$
- (ii) $3x_{n+1} - 7x_n + 4x_{n-1} = 3 + 2n$
- (c) Solve the recurrence relation $x_{n+1} - 8x_n + 15x_{n-1} = 0$, where $x_0 = 5$ and $x_1 = 21$. 4
- (d) Find the generating function for the sequence 0, 1, -2, 3, -4. 3

- (e) Determine whether the sequence $\{a_n\}$ is a solution of the recurrence relation

$$a_n = a_{n-1} + 2a_{n-2} + 2n - 9, \text{ if } a_n = -n + 2. \quad 3$$

- (f) Is a Hamiltonian graph Eulerian? Is a Eulerian graph Hamiltonian? Show with the help of a suitable example. 3

2. (a) Solve $a_{n+1} = 5a_n$ for $n \geq 0$, $a_0 = 2$ by Substitution method. 5

- (b) Solve the recurrence

$$a_n - 7a_{n-1} + 10a_{n-2} = 0, n \geq 2$$

by Characteristic root method. 5

3. (a) Solve the recurrence by using iterative approach: 4

$$a_n = a_{n-1} + 2n + 3, a_0 = 4.$$

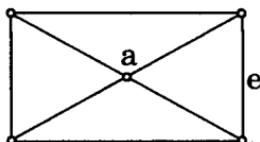
- (b) Find the sequence $\{a_n\}$ having the generating function G given by

$$G(x) = \frac{3}{1-x} + \frac{1}{1-2x}. \quad 4$$

- (c) Define isomorphic graph. Give an example of the same. 2

4. (a) State Euler's formula for the graph. 3

- (b) For the following graph G ,



- draw subgraphs 3
- (i) $G - e$
- (ii) $G - a$
- (c) Is a subgraph of a planar graph, planar ?
Justify your answer. 4
5. (a) Solve $a_n = 4(a_{n-1} - a_{n-2})$ with initial
condition $a_0 = 1, a_1 = 1$. 4
- (b) For which value of m and n is $K_{m,n}$
a tree ? 3
- (c) Show that C_6 is a bipartite graph. 3

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No. of Printed Pages : 3

MCS-033**MCA (Revised)****Term-End Examination****June, 2016**

07186

MCS-033 : ADVANCED DISCRETE MATHEMATICS*Time : 2 hours**Maximum Marks : 50*

Note : Question no. 1 is compulsory. Attempt any three questions from the rest.

1. (a) Is a tree a bipartite graph ? Justify. 3
- (b) Are the following recurrence relations homogeneous or non-homogeneous ? Give the order of each. 4
- (i) $x_{n+1} + 10x_n + 22x_{n-1} = 4$
- (ii) $a_n = a_{n-1} + a_{n-2} + \dots + a_0$
- (c) Solve the recurrence relation $4a_n - 5a_{n-1} = 0$ for $n \geq 1, a_0 = 1$. 4
- (d) Find the generating function for the sequence 1, 1, 1, 0, 1, 1, 3

(e) Let $a_n = 2^n + 5(3^n)$ for $n = 0, 1, 2, \dots$

Show that $a_n = 5a_{n-1} - 6a_{n-2}$ for all integers n with $n \geq 2$. 3

(f) Find the sum $\sum_{k=1}^n k 3^k C(n, k)$ by using generating function. 3

2. (a) Solve $a_n = a_{n-1} + n, a_0 = 2$ by Substitution method. 5

(b) Solve the recurrence relation $a_n - 9a_{n-1} + 26a_{n-2} - 24a_{n-3} = 0, n \geq 3$ by characteristic root method. 5

3. (a) Solve the recurrence relation $a_n = 3a_{n-1} + 1, a_0 = 1$ by using iterative method. 4

(b) Draw K_4 graph. Show that it is planar and 4-colorable. 4

(c) What do you mean by isomorphic graphs? 2

4. (a) State Handshaking Theorem. 3

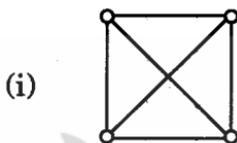
(b) A non-directed graph G has 8 edges. Find the number of vertices, if the degree of each vertex in G is 2. 3

(c) Construct a non-Hamiltonian graph on 5 - vertices. 4

5. (a) Find the number of vertices and number of edges in complete bipartite graph $K_{m, n}$. 3

(b) Solve the recurrence $a_n - 4a_{n-1} = 0$ by Generating function. 4

(c) State whether the following graphs are planar or not : 3



No. of Printed Pages : 3

MCS-033

MCA (Revised)
Term-End Examination

07545

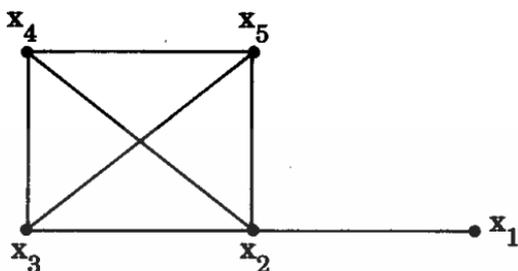
December, 2016

MCS-033 : ADVANCED DISCRETE MATHEMATICS*Time : 2 hours**Maximum Marks : 50*

Note : Question no. 1 is compulsory. Attempt any three questions from the rest.

1. (a) Using induction, show that
 $T_n = 2^n - 1$, where $n \geq 1$,
 where $T_n = 2T_{n-1} + 1$. 5
- (b) Prove that the complement of \bar{G} is G . 5
- (c) Draw at least 3 non-isomorphic graphs on 4 vertices. 5
- (d) Prove that $a_n = \frac{3n}{2} - 2$ is a solution to the recurrence $a_n = 2a_{n/2} + 2$, where n is a power of 2 and $a_2 = 1$. 5

2. (a) Find the number of bijections on a set of n elements, where $n \geq 1$. 5
- (b) Consider the graph on 5 vertices and 7 edges given in the figure. Find x_1 to x_5 walks of length 8 and length 4 respectively. 5

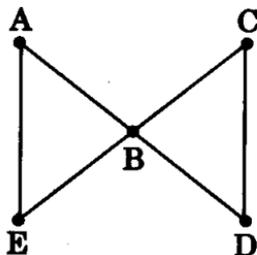


3. (a) If G is a graph with n vertices and k components, then prove that G can have at least $n - k$ edges and at most $\left\{ \frac{(n - k)(n - k + 1)}{2} \right\}$ edges. 5

- (b) Solve the third order recurrence $U_n - 9U_{n-1} + 26U_{n-2} - 24U_{n-3} = 0$, where $n \geq 3$, with the initial conditions $U_0 = 6$, $U_1 = 17$ and $U_2 = 53$. 5

4. (a) Solve the recurrence $d_k = k d_{k-1} + (-1)^k$ if $k \geq 2$ with $d_1 = 0$. 5
- (b) Find $\lambda(G)$, where G is the Petersen graph. 5

5. (a) Draw three spanning trees of the following graph : 3



- (b) What is the difference between an Eulerian graph and an Eulerian circuit ? 2
- (c) Construct a graph with chromatic number 5. 3
- (d) Solve the recurrence relation $a_n = a_{n/2} + 1$ for $n = 2^k$, where $k \geq 1$, $a_1 = 0$. 2

No. of Printed Pages : 3

MCS-033(S)**MCA (Revised)****Term-End Examination****December, 2016**

00337

**MCS-033(S) : ADVANCED DISCRETE
MATHEMATICS***Time : 2 hours**Maximum Marks : 50*

Note : Question no. 1 is compulsory. Attempt any three questions from the rest.

1. (a) Find the order and degree of the following recurrence relation. Also determine whether they are homogeneous or non-homogeneous. 6

(i) $a_n = ca_{n/m} + 5$

(ii) $a_n = 3a_{n-1} + n^2$

(iii) $a_n = c_1 a_{n-1} + c_2 a_{n-2} + \dots + c_{n-k} a_{n-k}$

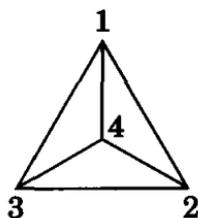
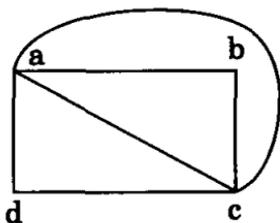
- (b) Solve the following recurrence relation using the characteristic equation : 6

$$t_n = 6t_{n-1} - 9t_{n-2} \text{ for } n > 1$$

$$t_0 = 0$$

$$t_1 = 1$$

- (c) Determine whether the following graphs are isomorphic. If yes, justify your answer. 4



- (d) What is an undirected graph? Prove that an undirected graph has even number vertices of odd degree. 4

2. (a) Define n -regular graph. Show for which value of n the following graphs are regular: 5

(i) K_n

(ii) Q_n

- (b) What is a generating function? Find the generating function for the following sequence: 3

$$1, 1, 1, 1, 1$$

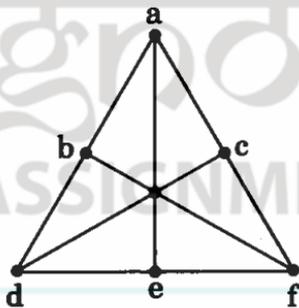
- (c) How many edges does a complete graph of 5 vertices have? 2

3. (a) Derive and explain a recursive relation expression for binary search algorithm. 5

- (b) Define a graph and a subgraph. Show that for a subgraph H of a graph G

$$\Delta(H) \leq \Delta(G). \quad 5$$

4. (a) Define a bipartite graph. For which value of n is Q_n bipartite? 3
- (b) State and prove Euler's formula for a planar graph. 4
- (c) Show that a connected bipartite graph has a chromatic number of 2. 3
5. (a) State and prove Ore's theorem for a graph to be a Hamiltonian graph. 6
- (b) What is a planar graph? Determine whether the given graph is a planar. If so, redraw it such that no edges cross each other. 4



No. of Printed Pages : 3

MCS-033

MCA (Revised)
Term-End Examination
June, 2017

07192

MCS-033 : ADVANCED DISCRETE MATHEMATICS

Time : 2 hours

Maximum Marks : 50

Note : Question no. 1 is compulsory. Attempt any three questions from the rest.

1. (a) Find the order and degree of the following recurrence relation. Also determine whether they are homogeneous or non-homogeneous. 6

(i) $a_n = a_{n-1} + a_{n-2} + \dots + a_0$

(ii) $a_n = na_{n-1} + (-1)^n$

(iii) $a_n = a_{n-1} + a_{n-2}$

- (b) Solve the following recursion relation using characteristic equation : 6

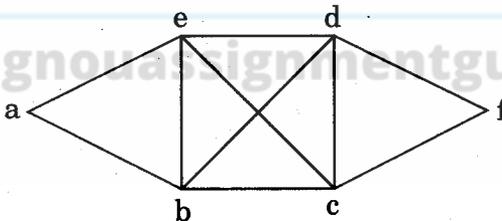
$$t_n = 4t_{n-1} - 3t_{n-2} \text{ for } n > 1$$

$$t_0 = 0$$

$$t_1 = 1$$

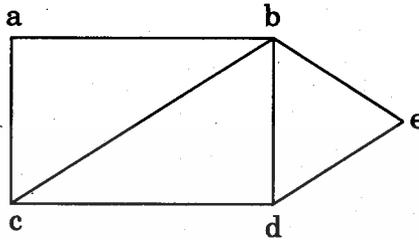
- (c) State and prove the handshaking theorem. 5
- (d) Define the following symbols : 3
- (i) $\delta(G)$
- (ii) $\langle S \rangle G$
- (iii) W_n

2. (a) What is meant by complement of a graph ?
Find the complement of the C_5 graph
(i.e. \bar{C}_5). 3
- (b) What is a complete graph ? 2
- (c) Find the generating function for the
sequence
 $0^2, 1^2, 2^2, 3^2, \dots$ 3
- (d) Determine the chromatic number of the
following graph : 2

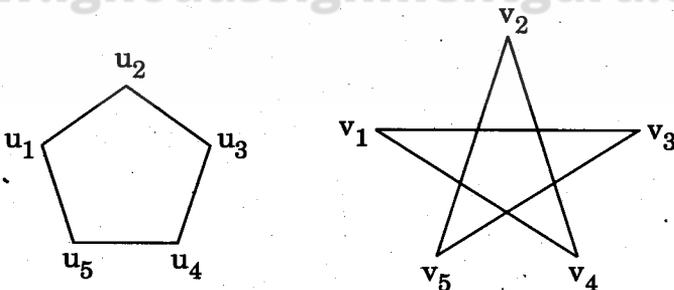


3. (a) Solve the recurrence relation
 $a_n = a_{n-1} + 2, n \geq 2.$ 6
- (b) Prove that the degree of every vertex in a
connected Euler graph is even. 4

4. (a) Derive and explain the recursion relation drawn from the analysis of Merge Sort algorithm. 6
- (b) Determine whether the following graph has a Hamiltonian circuit and a Hamiltonian path. Explain your answer. 4



5. (a) Show and explain that if G_1, G_2, \dots, G_N are bipartite graphs, then $\bigcup_{i=1}^n G_i$ is bipartite. 5
- (b) Show that K_4 is a planar graph. 2
- (c) Define isomorphism. Determine whether the following pair of graphs are isomorphic: 3



No. of Printed Pages : 2

MCS-033

MCA (Revised)

Term-End Examination

00270

December, 2017

MCS-033 : ADVANCED DISCRETE MATHEMATICS

Time : 2 hours

Maximum Marks : 50

Note : Question no. 1 is **compulsory**. Attempt any **three** questions from the rest.

1. (a) Using induction, verify that

$$\sqrt{5} f_n = \left(\frac{1 + \sqrt{5}}{2} \right)^n - \left(\frac{1 - \sqrt{5}}{2} \right)^n, n \geq 1$$

where $f_n = f_{n-1} + f_{n-2}$ and $f_0 = 0$ and $f_1 = 1$. 5

- (b) Determine the number of subsets of a set of n elements, where $n \geq 0$. 5

- (c) Find the sum of the series

$$\sum_{k=0}^{\infty} \frac{(k+1)^2}{k} = \frac{1^2}{0} + \frac{2^2}{1} + \dots + \frac{(n+1)^2}{n} + \dots$$

using exponential generating functions. 5

- (d) Take three vertices x, y, z and draw all possible $(3, 2)$ graphs on these vertices. 5
2. (a) Find the number of integer solutions of the linear equation
- $$a_1 + a_2 + \dots + a_k = n,$$
- using generating function techniques, when $a_i \geq 0$. 5
- (b) State and prove the handshaking theorem. 5
3. (a) Solve the recurrence relation $a_{n+1}^2 = 5a_n^2$ where $a_n > 0$ and $a_0 = 2$. 5
- (b) Construct a 5 regular graph on 10 vertices. 5
4. (a) Solve the linear recurrence
- $$a_n - a_{n-1} = f_{n+2} \cdot f_{n-1} \quad n \geq 1$$
- where $a_0 = 2$ and f_i denotes the i^{th} Fibonacci number. 5
- (b) Show that for a subgraph H of a graph G , $\Delta(H) \leq \Delta(G)$. 5
5. (a) Find all the graphs that have edge chromatic number 1. 5
- (b) Show that C_6 is bipartite and K_3 is not bipartite. 5

No. of Printed Pages : 4

MCS-033

MCA (Revised)

Term-End Examination

June, 2018

01035

MCS-033 : ADVANCED DISCRETE MATHEMATICS

Time : 2 hours

Maximum Marks : 50

Note : *Question no. 1 is compulsory. Attempt any three questions from the rest.*

1. (a) Write the recurrence relation of Tower of Hanoi problem and explain the formulation. 4
-
- (b) A person invested ₹ 10,000 @ 12% interest compounded annually. How much will he get at the end of 15 years ? (Solve using recurrence relation only) 4
- (c) Explain generating function. What type of problems can be solved using generating function for recurrence relation ? 4

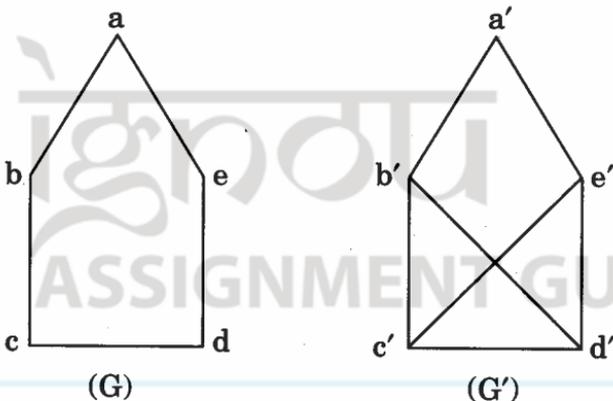
(d) Is there a simple graph corresponding to the following degree sequence : 4

(i) (1, 1, 2, 3)

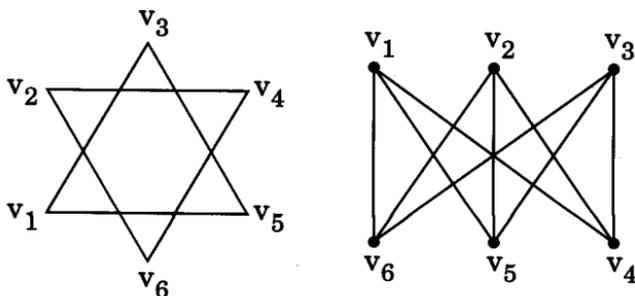
(ii) (2, 2, 4, 6)

(e) For what value of n is the graph of K_n Eulerian ? 4

2. (a) Find whether the following pair of graphs are isomorphic or not. 5



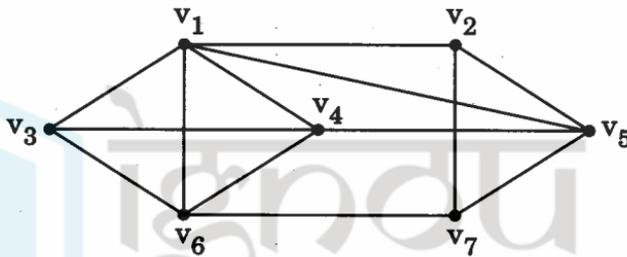
(b) The following graph contains no Euler circuit. Give reasons. 5



3. (a) If G is a connected simple graph with $(h \geq 3)$ vertices and e edges then 5

$$e \leq 3n - 6$$

- (b) Consider the graph G . Use suitable graph colouring algorithm to colour G and find $\chi(G)$. 5



4. (a) Solve

$$a_{n+2} - 5a_{n+1} + 6a_n = 2$$

with initial condition $a_0 = 1, a_1 = -1$. 5

- (b) Determine the generating function of the following sequence : 5

$$a_r = \begin{cases} 2^r & \text{if } r \text{ is even} \\ -2^r & \text{if } r \text{ is odd} \end{cases}$$

5. (a) Determine the number of integer solutions to linear equation 5

$$x_1 + x_2 = 3 \text{ with } 0 \leq x_1 \leq 1 \text{ and } 0 \leq x_2 \leq 2.$$

- (b) Show that $a_n = -2^{n+1}$ is the solution of the non-homogeneous linear recurrence relation 5

$$a_n = 3a_{n-1} + 2^n$$



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No. of Printed Pages : 4

MCS-033

MCA (Revised)
Term-End Examination
December, 2018

01723 (S)

MCS-033 : ADVANCED DISCRETE MATHEMATICS

Time : 2 hours

Maximum Marks : 50

Note : Question no. 1 is **compulsory**. Attempt any **three** questions from the rest.

1. (a) Find the generating function of the following : 3

2, 4, 8, 16, 32, ...

(b) Prove that the number of vertices of odd degree in a graph is always even. 3

(c) Find the order and degree of the following recurrence relation. Also state whether they are homogeneous or non-homogeneous. 6

(i) $a_n = a_{n-1}^2 + a_{n-2} a_{n-3} a_{n-4}$

(ii) $d_n = n d_{n-1} + (-1)^n$

(d) Define :

(i) Walk

(ii) Path

(iii) Circuit

in an undirected graph.

3

(e) Solve the recurrence relation

$$a_r = a_{r-1} + 2a_{r-2} \text{ with } a_0 = 2 \text{ and } a_1 = 10. \quad 3$$

(f) Is every subgraph of a regular graph regular? Justify.

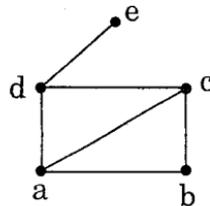
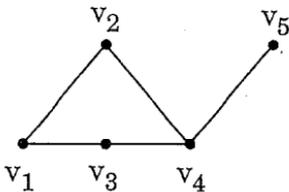
2

2. (a) Find the solution of the recurrence relation

$$a_n = 3a_{n-1} + 2n \quad 5$$

(b) Determine whether the graphs are isomorphic

5



3. (a) Solve the recurrence relation

$$T_n = 2T_{n-1} + 1 \text{ if } n \geq 2 \text{ and } T_1 = 1$$

using generating function.

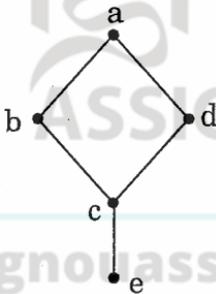
5

- (b) If an undirected graph has exactly two vertices of odd degree there must be a path joining these two vertices.

5

4. (a) Find the chromatic number of the given graph.

2



- (b) Solve the recurrence relation by substitution method

4

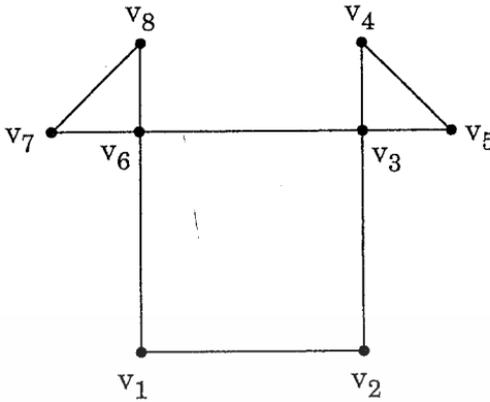
$$a_n = a_{n-1} + n \cdot 2^n;$$

$$a_0 = 1$$

- (c) What is connected graph? Explain with example.

4

5. (a) Find Eulerian path in the given graph. 3



- (b) Solve : 3

$$a_n - 2a_{n-1} = 7^n$$

- (c) Given a connected planar graph with $p = 4$,
 $q = 6$, calculate the number of regions r . 4

04852

No. of Printed Page : 4

MCS-033

MCA (REVISED)

Term-End Examination, 2019

MCS-033 : ADVANCED DISCRETE MATHEMATICS

Time : 2 Hours]

[Maximum Marks : 50

Note : Question number 1 is **compulsory**. Attempt any three questions from the rest.

1. (a) Find the generating function of : [3]

0, 1, -2, 4, -8,

(b) The sum of degrees of all vertices in a graph G is equal to twice the number of edges in G. Prove this statement. [3]

(c) Find the order and degree of the following recurrence relation. Also state are they homogeneous or non-homogeneous : [6]

(i) $a_n = a_n a_0 + a_{n-1} a_1 + \dots + a_0 a_n (n \geq 2)$

(ii) $a_n = \sqrt{a_{n-1}} + a_{n-2}^2$

(d) Define : [3]

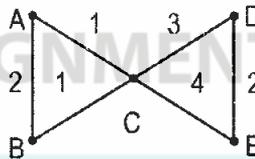
(i) Complete Graph

(ii) Regular Graph

(iii) Bipartite Graph

(e) Solve the recurrence relation $a_n = a_{n-1} + a_{n-2}$
with $a_0 = 0, a_1 = 1$. [3]

(f) Draw the minimum spanning trees of the following
graph : [2]

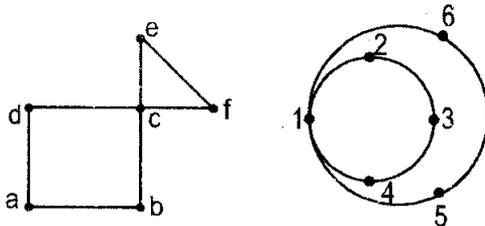


2. (a) Solve the recurrence relation [5]

$$a_n - 5a_{n-1} + 6a_{n-2} = 7^n$$

(b) Determine whether the graphs are isomorphic :

[5]

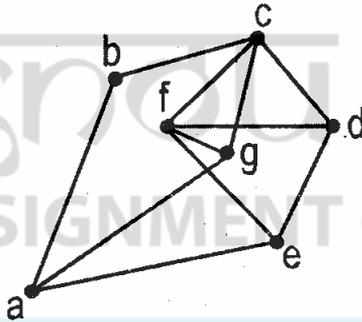


3. (a) Solve the recurrence relation : [5]

$$a_n - 3a_{n-1} - 4a_{n-2} = 4^n$$

- (b) Show that C_6 is bipartite and K_3 is not bipartite. [5]

4. (a) Find the chromatic number of the given graph : [2]

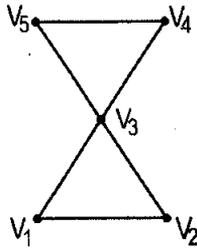


- (b) Solve the recurrence relation : [4]

$$a_n - 5a_{n-1} + 6a_{n-2} = 0 \text{ with } a_0 = 2, a_1 = 5$$

- (c) What is spanning tree ? Give example. [4]

5. (a) Find Euler's path in the graph given below : [3]



(b) Solve : [4]

$$a_n = 6a_{n-1} - 11a_{n-2} + 6a_{n-3}$$

$$\text{with } a_0 = 2, a_1 = 5, a_2 = 15$$

(c) What is the difference between an Hamiltonian circuit and Eulerian circuit ? [3]

05584

No. of Printed Pages : 5

MCS-033

MCA (Revised)

Term-End Examination, 2019

MCS-033 : ADVANCED DISCRETE MATHEMATICS

Time : 2 Hours]

[Maximum Marks : 50

Note : Question No. 1 is compulsory. Attempt any three questions from the rest.

1. (a) Find linear/non-linear, homogenous/non-homogenous, constant coefficients/not constants, degree of the following recurrence relations : [3]

(i) $a_n = (1.05)a_{n-1}$

(ii) $a_n = a_{n-1} + a_{n-2} + a_{n-3} + 2^{n-3}$

(iii) $a_n = na_{n-1} + n^2a_{n-2} + a_{n-1}, a_{n-2}$

- (b) Solve the following recurrence relation : [5]

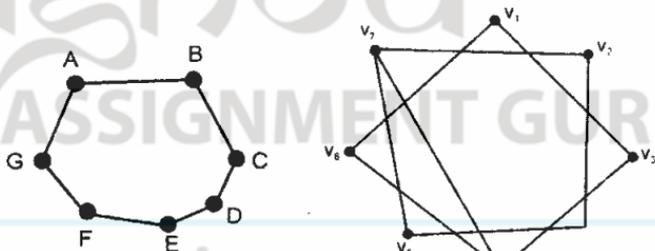
$$t_n - 3t_{n-1} - 4t_{n-2} = 0 \text{ for } n > 1$$

$$t_0 = 0$$

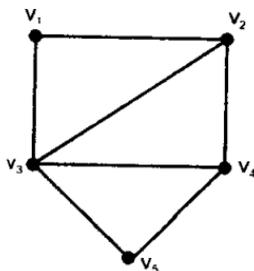
$$t_1 = 1$$

- (c) Find the generating function for the following sequence 1, 1, 1, 1, 1, 1, 0, 0, 0. [3]

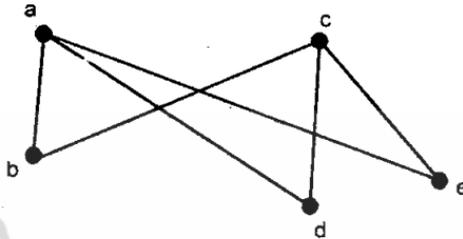
- (d) Determine and explain whether the given pair of graphs is isomorphic or not : [3]



- (e) For the following graph, determine whether Ore's theorem can be used to show that the graph has a Hamiltonian circuit : [3]



- (f) What is planar graph ? Explain whether the following Graph is planar or not : [3]

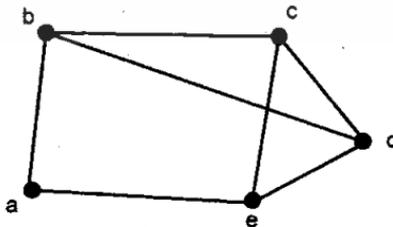


2. (a) Solve the following recurrence relation : [5]

$$t_n - 5t_{n-1} + 7t_{n-2} - 3t_{n-3} = 0 \text{ for } n > 2$$

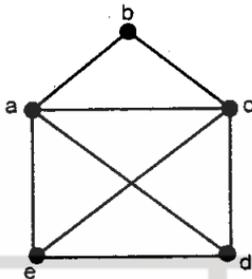
with $t_0 = 1, t_1 = 2$ and $t_2 = 3$

- (b) Determine whether the given graph has an Euler circuit : [3]



- (c) What is chromatic number ? Find the chromatic number of the complete bipartite graph $K_{2,3}$. [2]

3. (a) Explain whether the following graph is a Hamiltonian graph or not : [2]



- (b) Define r-regular graph. Construct a 4-regular graph with 12 vertices. [3]

- (c) Find the generating function for the following sequence : [5]

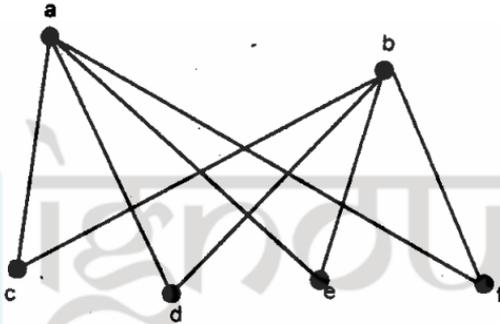
0, 1, -2, 3, -4, 5, -6,

4. (a) Solve the recurrence relation $a_n = a_{n-1} + n$ $a_0 = 3$ using the substitution method. [5]

- (b) Find the chromatic number of the complete graph with five vertices (i.e. K_5). [2]

- (c) What is edge coloring? Color the edges of graph K_3 . [3]

5. (a) Give an example of a subgraph H of a graph G with $\delta(G) < \delta(H)$ and $\Delta H < \Delta(G)$. [3]
- (b) Draw the complement of the following graph : [2]



- (c) Solve the following recurrence relation : [5]

$$a_{n+2} = 3a_{n+1}, a_0 = 4$$

----- x -----

MCA (Revised)**Term-End Examination****MCS-033 : ADVANCED DISCRETE MATHEMATICS****Time : 2 Hours]****[Maximum : Marks : 50**

Note: Attempt any three questions from the rest. Question No. 1 is compulsory.

1. (a) A person climbs a staircase by climbing either (i) two steps in a single stride or (ii) only one step in a single stride. Find the recurrence relation of No. of ways of climbing n stairs. 4

- (b) Find the order and degree of the following recurrence relation:

(i) $a_n = 5a_{n-1} + n^3$

(ii) $a_n = 5a_{n-1} a_{n-2}$

Also determine whether the Recurrence Relation is linear homogeneous with constant coefficient or not. 6

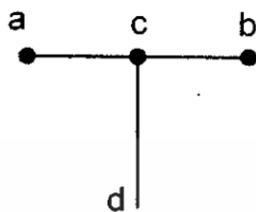
- (c) Find the generating function of the following sequence: 2

$$bn = n + 1$$

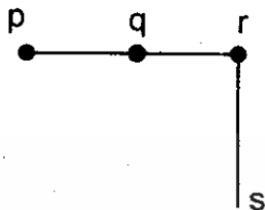


(d) A graph consists of four vertices each of degree three and an isolated vertices. Find the No. of edges. 4

(e) Examine whether the following graph shown in the fig. are iso-morphic or not? 4



(A)

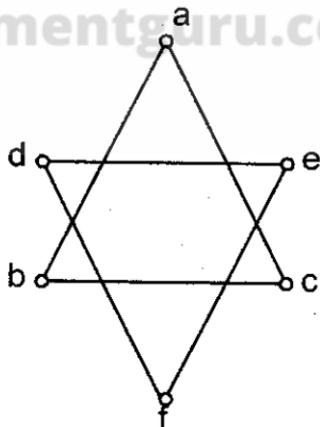
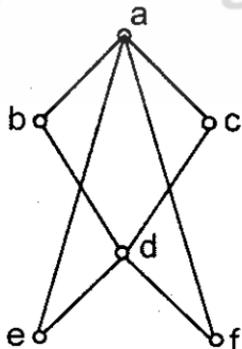


(B)

2. (a) If G is connected planar graph has n vertices, e edges and r regions, then prove that: 5

$$n - e + r = 2$$

(b) Show that the graph given in the figure are planar or not: 5



3. (a) Prove that the complete graph K_n is strongly regular for any n . 5

(b) Find the chromatic number of the following graph with justification: 5

(i) a complete graph (K_5)

(ii) a bipartite graph ($K_{3,4}$)

4. Solve the following recurrence relation:

(a) $a_n - 7a_{n-1} + 10a_{n-2} = n \cdot 4^n$ 5

(b) Using generating function solve the following recurrence relation:

$$a_n - a_{n-1} - 6a_{n-2} = 0$$

given $a_0 = 2$ $a_1 = 1$ 5

5. (a) Find the number of integer solution to $a_1 + a_2 + a_3 = n$ where $-1 \leq a_1 \leq 1$, $1 \leq a_2 \leq 3$ and $a_3 \geq 3$. 5

(b) Solve the following recurrence relation using substitution method: 5

$$a_n = 6a_{n-1} - 8a_{n-2}; a_0 = 1 \text{ and } a_1 = 0$$

—x—

No. of Printed Pages : 6

MCS-033

**MASTER IN COMPUTER
APPLICATION (MCA)**

Term-End Examination

December, 2020

**MCS-033 : ADVANCED DISCRETE
MATHEMATICS**

Time : 2 Hours

Maximum Marks : 50

Note : (i) *Question No. 1 is compulsory.*

(ii) *Answer any **three** questions from the
rest.*

1. (a) Solve the following recurrence relation : 5

$$t_n - 5t_{n-1} + 6t_{n-2} = 0;$$

for $n > 1$ such that $t_0 = 0, t_1 = 1$.

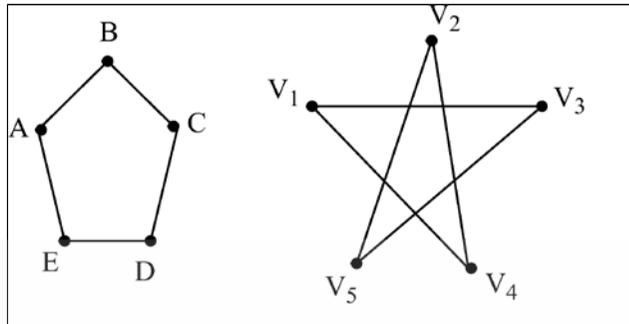
(b) Find the generating function for the
following sequence : 3

1, 3, 3, 1, 0, 0, 0, 0

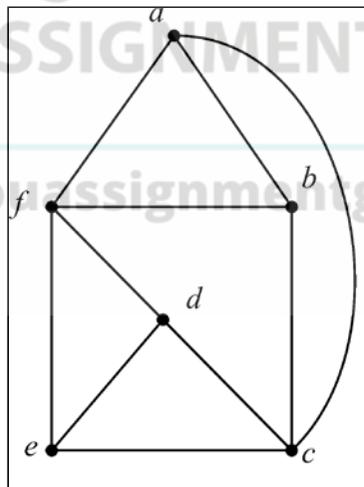
[2]

MCS-033

- (c) Determine and explain whether the given pair of graphs is isomorphic. 3



- (d) Determine whether the given graph has a Euler circuit : 3

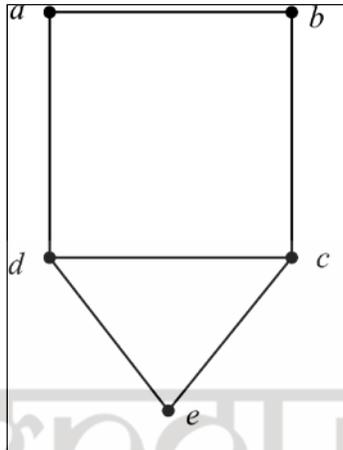


- (e) For the following graph, determine whether Dirac's theorem can be used to

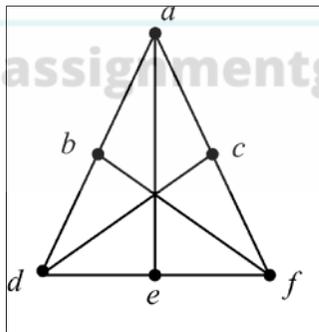
[3]

MCS-033

show that the graph has a Hamiltonian circuit or not ? 3



- (f) Determine whether the given graph is planar. If so, draw it so that not two edges cross each other. 3



2. (a) Solve the following recurrence relation : 5

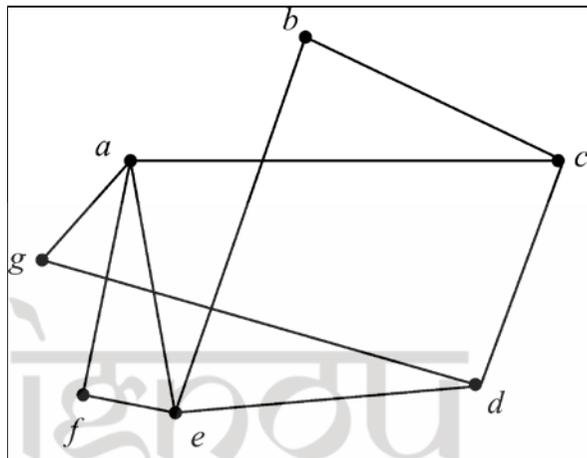
$$t_n - 7t_{n-1} + 15t_{n-2} - 9t_{n-3} = 0$$

for $n > 2$; with $t_0 = 0$, $t_1 = 1$ and $t_2 = 2$.

P. T. O.

(b) Is the following graph bipartite ? Explain :

3



(c) Find the chromatic number of K_4 . 2

3. (a) Solve the following recurrence using

substitution method : 5

$$t_n = 2t_{n-1} + 1;$$

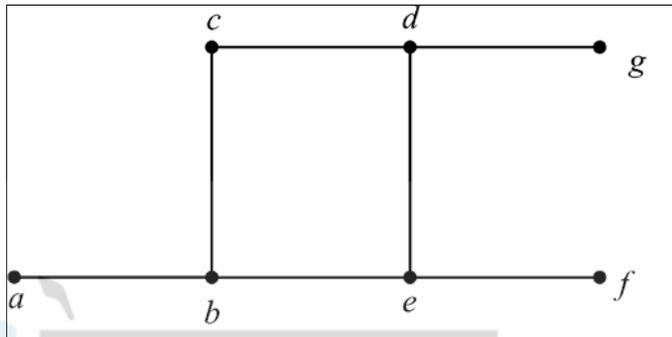
for $n > 1$ with $t_1 = 1$.

(b) Prove that a connected graph G with two or more vertices is edge traceable if and only if it has exactly two vertices of odd degree. 5

[5]

MCS-033

4. (a) Determine whether the following graph has a Hamiltonian circuit or Hamiltonian path. 2



- (b) Consider the following two degree sequence of any graph. Determine, for which sequence graph is possible, if not explain why? 2

(i) (3, 2, 2, 2, 1)

(ii) (3, 2, 2, 2, 1, 1)

- (c) Find the generating function for finite sequence : 3

2, 2, 2, 2, 2, 2

- (d) Draw a 5-regular graph on 10 vertices. 3

5. (a) Show that if G_1, G_2, \dots, G_n are bipartite,

then $\bigcup_{i=1}^n G_i$ is also bipartite. 5

P. T. O.

- (b) Find linear/non-linear, homogeneous/non-homogeneous, constant coefficients/non-coefficients and degree of the following recurrence relation : 3

(i) $a_n = a_{n-1} + 2^{n-1}$

(ii) $a_n = na_{n-1} + n^2a_{n-2} + a_{n-1}a_{n-3}$

(iii) $a_n = a_{n-1} + a_{n-2} + \dots + a_0$

- (c) By using Euler's formula, determine whether the following graph is planar or not ? 2

