

**END-SEMESTER EXAMINATION, JULY-2022
CALCULUS-II (MTH 2001)**

Programme: B.Tech

Full Marks: 60

Semester: 2nd
Time: 3 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Use the knowledge of three dimensions and vectors to describe the region, lines, planes and surfaces.	L1,L1,L1 L1,L1,L3	1(a),(b),(c) 2(a),(b), (c)	2 × 6
Compute the length of the curve, curvature, tangent normal vector, tangent plane.	L1,L1,L1 L1,L1,L1	3(a),(b), (c) 4(a) ,(b),(c)	2 × 6
Apply the concept of function of several variables to find the limit, derivative, directional derivative, linearization and maxima minima.	L1,L1,L3 L1,L1,L3 L1,L3	5(a),(b), (c) 6(a),b), (c) 7(a),(b)	2 × 8
Apply the concept of double and triple integration to evaluate the integral, to find moment of inertia of lamina and surface area.	L3 L1,L5,L5 L1	7(c) 8(a,(b), (c) 9(a)	2 × 5
Apply the concept of line integral to evaluate it, in conservative vector field and in Green's theorem.	L5,L5 L1	9(b),(c) 10(a)	2 × 3
Apply the concept of curl, divergence in Stokes theorem and the divergence theorem.	L1,L3	10(b),(c)	2 × 2

*Bloom's taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

1. (a) Find the volume of the parallelepiped with adjacent edges PQ, PR, PS , where $P(3,0,1), Q(-1,2,5), R(5,1,-1), S(0,4,2)$. 2
 - (b) Find the center and radius of sphere $x^2 + y^2 + z^2 - 2x - 4y + 8z = 15$. 2
 - (c) Find the angle between the vector $\langle 4, 0, 2 \rangle$ and $\langle 2, -1, 0 \rangle$. 2
2. (a) Find the equation of plane passing through the point $(6, 3, 2)$ and 2

perpendicular to the vector $\langle -2, 1, 5 \rangle$.

- (b) Find whether the planes $x + y + z = 1, x - y + z = 1$ are parallel, perpendicular or neither. If neither, then find the angle between them.

- (c) Find

$$\lim_{t \rightarrow 1} \left\langle \frac{t^2 - t}{t - 1}, \sqrt{t+8}, \frac{\sin \pi t}{\ln t} \right\rangle$$

3. (a) Find a vector function that represents the curve of intersection of the two surfaces, the cone $z = \sqrt{x^2 + y^2}$ and the plane $z = 1 + y$.

- (b) Find the curvature of the curve $\vec{r}(t) = \langle \sqrt{2}t, e^t, e^{-t} \rangle$.

- (c) A gun is fired with angle of elevation 30° . What is the muzzle speed if the maximum height of the shell is 500m?

4. (a) Find the equation of the tangent line of the curve

$$x = 1 + 2\sqrt{t}, y = t^3 - t, z = t^3 + t \text{ at the point } (3, 0, 2).$$

- (b) Find the tangent and normal vector of the vector

$$\vec{r}(t) = \langle \cos t, \sin t, \ln \cos t \rangle \text{ at } (1, 0, 0).$$

- (c) Find the tangential and normal components of acceleration vector for $\vec{r}(t) = \langle t, \cos^2 t, \sin^2 t \rangle$.

5. (a)

$$\text{Find } \lim_{(x,y) \rightarrow (0,0)} \frac{x^2 + \sin^2 y}{2x^2 + y^2} \text{ if it exists, or show that the limit does not exist.}$$

- (b) Find and sketch the domain of the function

$$f(x, y) = \ln(9 - x^2 - 9y^2).$$

- (c)

$$\text{Find } \frac{\partial^3 u}{\partial r^2 \partial \theta} \text{ of the function } u = e^{r\theta} \sin \theta$$

6. (a) Determine whether $u = x^2 - y^2$ is a solution of Laplace's equation 2
 $u_{xx} + u_{yy} = 0$
- (b) Find the directional derivative of the function 2
 $f(x,y) = ye^{-x}$ in the direction of $\theta = \frac{2\pi}{3}$ at the point $(0,4)$.
- (c) Use the chain rule to find $\frac{\partial z}{\partial s}$ if 2
 $z = e^r \cos \theta, r = st$ and $\theta = \sqrt{s^2 + t^2}$.
7. (a) Find the maximum rate of change of $f = (x+y)/z$ at $(1,1,-1)$ 2
and the direction in which it occurs.
- (b) Use Lagrange multipliers to find the maximum and minimum values 2
of the function $f(x,y) = x^2 + y^2$ subject to the given constraint
 $xy = 1$.
- (c) Find the local maximum and minimum values and saddle points of 2
the function $f(x,y) = \sin x, \sin y, -\pi < x < \pi, -\pi < y < \pi$.
8. (a) Evaluate the double integral 2
 $\iint x^3 dA, D = \{(x,y) | -1 \leq x \leq e, 0 \leq y \leq \ln x\}$
- (b) Use polar coordinates to find the volume of the solid that lies below 2
the paraboloid $z = 18 - 2x^2 - 2y^2$ and above the xy -plane.
- (c) Evaluate the iterated integral 2

$$\int_0^1 \int_0^1 \int_0^{\sqrt{1-z^2}} \frac{z}{y+1} dx dz dy$$
.
9. (a) Find the volume of the tetrahedron enclosed by the coordinate planes 2
and the plane $2x+y+z=4$.

$\ln(1+x)$
 $\pi \cos \pi x$

- (b) Find spherical coordinates of the point with rectangular coordinates $(\sqrt{3}, -1, 2\sqrt{3})$. 2
- (c) Find the area of the surface, that is a part of plane $3x + 2y + z = 6$ which lies in the first octant. 2
10. (a) Assuming the appropriate partial derivatives exist and are continuous, show that 2

$$\operatorname{div}(\vec{F} \times \vec{G}) = \vec{G} \cdot \operatorname{curl} \vec{F} - \vec{F} \cdot \operatorname{curl} \vec{G}$$

- (b) Use Green's theorem to evaluate the line integral 2
 $\int_C y^3 dx - x^3 dy$ along the positively oriented curve C , a circle
 $x^2 + y^2 = 4$.
- (c) Use the Divergence theorem to calculate the flux of 2
 $\vec{F} = \langle x^3 + y^3, y^3 + z^3, z^3 + x^3 \rangle$, across the surface S , a sphere with center the origin and radius 2.

End of Questions

END SEMESTER EXAMINATION, JULY-2022

University Physics: Electricity & Magnetism (PHY2001)

Programme: B. Tech.

Full Marks: 60

Semester: 2nd

Time: 3 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
PHY/ a,e	L ₁ , L ₂ , L ₃	1	6
PHY/ a,e,g	L ₁ , L ₂ , L ₃	2	6
PHY/ a,e,g	L ₁ , L ₂ , L ₃	3	6
PHY/ a,e	L ₁ , L ₂ , L ₃	4	6
PHY/ a,e	L ₁ , L ₂ , L ₃	5	6
PHY/ a,e,g	L ₁ , L ₂ , L ₃	6	6
PHY/ a,e,g	L ₁ , L ₂ , L ₃	7	6
PHY/ a,e	L ₁ , L ₂ , L ₃	8	6
PHY/ a,e,g	L ₁ , L ₂ , L ₃	9	6
PHY/ a,e,g	L ₁ , L ₂ , L ₃	10	6

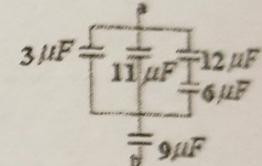
*Bloom's taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

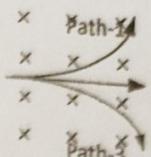
Answer all questions. Each question carries equal mark.

1. (a) Derive the electric field intensity at an axial point due to a uniformly charged ring and hence find \vec{E} at the center of the ring. 2
 (b) Find the ratio of electrostatic force and gravitational force of attraction between an electron and proton pair where mass of electron $m_e = 9.1 \times 10^{-31} \text{ kg}$ and mass of proton $m_p = 1.67 \times 10^{-27} \text{ kg}$.

$$(G = 6.67 \times 10^{-11} \frac{N \cdot m^2}{kg^2})$$
 (c) A solid metal sphere with radius 0.45m carries a net charge of $0.25nc$. 2
 Find the magnitude of the electric field (i) at a point 0.1m outside the surface of the sphere (ii) at a point 0.1m below the surface inside the sphere.
2. (a) Using gauss law derive electric field due to a uniformly charged distributed infinite linear conductor of linear charge density λ and hence show graphically how E varies with distance from the charged conductor. 2

- (b) If \vec{E} at a certain point is zero, does the electric potential at that point have to be zero? Justify it through an example. 2
- (c) A charge of $3.5nc$ is uniformly distributed over the surface of a metal sphere with a radius of 24cm. If the potential is zero at a point at infinity, find the value of the potential at the following distances from the center of the center of the sphere: (i) 48 cm and (ii) 12 cm. 2
3. (a) Derive an expression for the electric potential energy stored in a charged capacitor. 2
- (b) The plates of a parallel plate capacitor in vacuum are 5 mm apart and $2m^2$ in area. A 10 KV potential difference is applied across the capacitor. Compute (i) Charge on each plate (ii) Magnitudes of the electric field between the plates. 2
- (c) Find the equivalent capacitance across a and b , if the potential difference across a and b is 9V, find the charge across the $9\mu F$ capacitor. 2
4. (a) Rank the magnitude of the current from the highest to lowest value in the following circuits. (i) 1.4Ω connected to 1.5 V battery with internal resistance $r = 0.10\Omega$ (ii) 1.8Ω connected to 4V battery having terminal voltage of 3.6V but with an unknown internal resistance. (iii) An unknown resistor connected to a 12V battery that has an internal resistance of 0.2 and terminal voltage of 11V. 2
- (b) A battery of 24 V is connected to external resistance. If the terminal voltage of 24 V battery is 21.2V. Find (i) internal resistance (ii) external resistance. 2
- (c) You want to connect a $4\mu F$ capacitor and an $8\mu F$ capacitor. With which type of connection will the $4\mu F$ capacitor have a greater potential difference across it than the $8\mu F$ capacitor? 2
5. (a) Design how a 1 mA, 20Ω ammeter can be used as an ammeter of 0-50mA range? 2
- (b) A $1.5\mu F$ capacitor is charging through a 12Ω resistor using a 10V battery. At what time the capacitor will acquire $\frac{1}{4}$ of its maximum charge? 2



- (c) A positive charge is injected with a horizontal velocity at \vec{v} into a magnetic field which is normal and inward to the plane of the paper. Find the direction of force on charge particle and mention the path along which charged particle tends to move (i) Path 1 (ii) Path-2 (iii) Path-3.
- 
6. (a) Discuss the motion of a charged particle in a uniform perpendicular magnetic field of ' B '. Derive the expression of radius (R) and frequency (f) of motion of charged particle where m , v , q are mass, velocity and magnitude of charge respectively.
- (b) An electron experiences a magnetic force of $4.6 \times 10^{-15} N$ moving at an angle 60° with respect to a magnetic field of $3.5 \times 10^{-3} T$. Find the speed of the electron.
- (c) Derive briefly magnetic field due to straight current carrying conductor and discuss how magnetic field varies with distance from an infinite straight conductor carrying current and show it graphically.
7. (a) Two long parallel wire separated by 2.5 cm. Repulsive force per unit length exerted by one on other is $4 \times 10^{-5} N/m$. Current in one wire is 0.6A. (i) Find current in 2nd wire (ii) Direction of two current.
- (b) Derive magnetic field at a centre of a circular coil carrying current if current through the coil is 10A having radius 10cm and no of turns 1000, find magnetic field at its centre.
- (c) A single loop of wire with an area of $0.09 m^2$ is in a uniform magnetic field that has an initial value of $3.80 T$, is perpendicular to the plane of the loop and is decreasing at a constant rate of $0.190 T/s$. (i) What emf is induced in this loop. (ii) If the loop has a resistance of 0.6Ω find the current induced in the loop.
8. (a) Derive an expression for instantaneous current during the growth of current in an R-L circuit
- (b) A 35V battery, a 50Ω resistor and 1.25 mH inductor with negligible resistance are all connected in series with open switch. Switch suddenly closed find how long after closing the switch will current through inductor reach $\frac{1}{2}$ of its maximum value?
- (c) Graphically represent the growth and decay of current in R-L circuit.

9. (a) An oscillating voltage of fixed amplitude is applied across a circuit element. If the frequency of this voltage is increased, will the amplitude of the current through the element (i) increase (ii) decrease or (iii) remains the same if it is (i) resistor and (ii) an inductor 2
- (b) A series L-C-R circuit comprises of a $L=60\text{mH}$, $C=0.50\mu\text{F}$, $R=300\Omega$ are connected to an ac source of voltage $V=50$ volt and $\omega=10000$ rad/s. Find (i) impedance of the circuit and (ii) expression of current. 2
- (c) A 200Ω resistor is connected in series with a $5\mu\text{F}$ capacitor, the voltage across the resistor is $v_R = 1.2 \cos 2500t$ volt. (i) Write the expression for the circuit current and (ii) Impedance of circuit. 2
- 10 (a) (i) Is it possible to have a purely electric wave propagate through empty space that is a wave made up of an electric field but no magnetic field (ii) What about a purely magnetic wave with a magnetic field but no electric field? 2
- (b) For an electromagnetic wave propagating through free space, calculate the frequency of a wave, with a wave length of (i) 300A (ii) 30m . 2
- (c) Write down the Maxwell's four equations related between electric and magnetic field. 2

End of Questions

**END SEMESTER EXAMINATION, JULY-2022
DATA STRUCTURE AND ALGORITHMS (CSE 2001)**

Programme: B.Tech

Full Marks: 60

Semester: 2nd

Time: 3 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Able to state and explain basic programming syntax, semantics, and building blocks.	L1	1(c), 4(a)	4
Able to develop java programs using the programming constructs like conditional statements, looping, arrays, methods and classes.	L2	2(b,c), 3(a,b,c), 4(b,c), 5(a,b,c)	20
Able to analyze, debug and test the programs and correctly predict their outputs.	L4	2(a), 1(a), 7(a), 8(c), 9(a)	12
Able to differentiate the behaviors of different data structures and their memory representation.	L3	8(b), 9(b,c)	6
Able to choose the appropriate data structures that efficiently model the problem of interest.	L5	6(a,b,c), 7(b,c), 8(a), 10(b)	14
Able to apply advanced programming techniques for developing solutions of different programs.	L3,L4	10(a,c)	4

*Bloom's taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

1. (a) Find the output or error of the following code snippet. Justify your answer. Eliminate typographical error. 2

```
int x=5, y=4;
System.out.println(++x^y-- | (x=y&1100));
```

- (b) Find the output or error of the following code snippet. Justify 2 your answer. Eliminate typographical error.
- ```
interface foo
{
 foo() { }
}
public class test
{
 public static void main(String[] args)
 {
 System.out.println("foo");
 }
}
```
- (c) Consider the statement P and Q below and find which is 2 TRUE/FALSE with justification.
- P : Every class containing abstract methods must be declared abstract.
- Q : Abstract class defines only the structure of the class not its implementation.
2. (a) What is the time complexity of the insertion operation in a 2 linear queue? Justify your answer.
- (b) Write a java method to count positive, negative and zero in an 2 integer array. The method prototype is given below.
- ```
public static void count_PNZ(int a[])
```
- (c) Create a class Point with instance variables x, y to represent 2 co-ordinates of point having instance method *setPoint()* and *display_points()*.
3. (a) From Question no. 2(c), write a Java method to find distance 2 between two points. The prototype of the *findDistance* method is given below:
- ```
public static void findDistance(Point, Point)
```
- (b) Create an interface *Department* containing *getdeptname()* and *getdeptHead()*. Create another class *Hostel* containing instance member *hostel\_name* and *room\_no* containing method *get\_hostel\_name()* and *get\_room\_no()*.
- (c) Create a class *Student* which is inherited from *Department* and *Hostel* containing instance members *student\_name* and *regd\_no* and instance method *setdata()* and *display()*. Print the student details, department and hostel details of a student.
4. (a) Differentiate between Stack and Queue with examples. 2
- (b) Create a class Employee & enter salary, name of the employee. 2 If salary is less than equal to zero, create an exception *salaryException* & throw it using Java

- (c) Design a package that contains two classes *Employee* & *Test*. The *Employee* class has data members as *ename*, *eid* and instance methods *input()* & *output()*. Similarly the *Test* class has data members as *salary*, *bonus* and instance methods *input()*, *output()*, *Employee* is extended by *Test*. Another package carry interface *Sports* with 2 attributes *score1*, *score2*. Find grand total salary & score in another class. 2
5. (a) Write a java method using Generics to count the occurrence of an element in an array of any type. The signature of count method is given below. 2
- ```
public static int count(T[] array, T item)
```
- (b) Write a recursive java method that takes a character string *S* and output its reverse. For example, the reverse of 'pots&pans' would be 'snap&stop'. 2
- (c) Write a java method to search an item in single linked list. If item found print "Search is Successful" otherwise print "Search is Unsuccessful". The prototype for search method is given below: 2
- ```
public static void search(Node start, int item)
```
6. (a) Write a java method to insert a node at the end of double linked list. 2
- (b)
- 
- Write the java statements to count number of nodes present in the above given linked list.
- (c) Write a java method to delete a node from the beginning of a single Linked list. 2
7. (a) In an array implementation of linear queue what is value of FRONT and REAR after the following operations. (Maximum size of queue is MAX=5). insert(1), insert(10), insert(22), insert(89), insert(66), insert(7), delete(), delete(), insert(55). Show the steps. 2
- (b) Write a java method to DELETE an element from the queue. The prototype of DELETE operation is given below. 2
- ```
public static void DELETE (int QUEUE [], int FRONT, int REAR)
```
- (c) Evaluate the given postfix expression. Also find its corresponding Infix expression. 2
- Postfix Expression: 6 3 2 4 + - **
8. (a) Convert the given Infix expression to Postfix expression using Stack. 2
- P + T * Z + (A * B + C) ^ L*

- (b) Write a java method to PUSH an element into the stack. The prototype of PUSH operation is given below.

public static void PUSH (int stack[], int top, int item)

- (c) A Circular queue of size 5764 with FRONT value 4587 and REAR value 1265. Find the total number of elements present in the circular queue?

- 9 (a) In a circular queue of size 10, value of FRONT is 9 and REAR is 0, what will be the value of FRONT and REAR after deleting two elements. Show through picture.

- (b) From the given figure in question no. 10(c) check whether it is a Binary search tree (BST) or not. If not then keep the root node 14 as fix and re-arrange the nodes in such a way that it will be a BST.

(c)

P	H	I	U		T	M	D				L	Z	
0	1	2	3	4	5	6	7	8	9	10	11	12	13

Find the linked list representation from the above array representation of a Binary Tree.

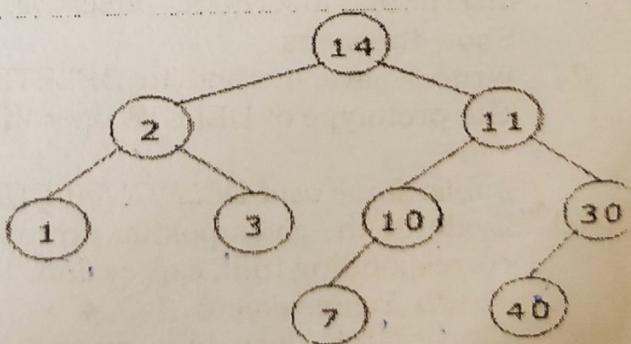
- 10 (a) Suppose a Binary tree is constructed with n number of nodes, such that each node has exactly zero or two children. What will be the maximum height of the Binary tree? Validate your answer with examples.

(b) Pre-order: Z, M, S, K, A, B, P, C

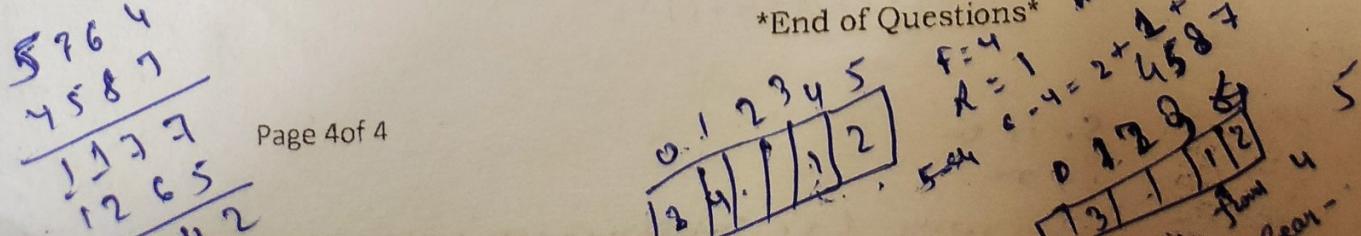
In-order: M, K, S, B, A, Z, C, P

From the above given traversal find the Post-order traversal of the Binary tree.

- (c) Find Post-order and In-order of the below given tree.



End of Questions



END SEMESTER EXAMINATION, JULY-2022
INTRODUCTORY GRAPH THEORY (CSE 1004)

Programme:B.Tech(CSE & CSIT)
Full Marks: 60

Semester:2nd
Time: 3 Hours

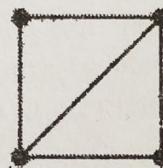
Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Able to understand the fundamental concepts of graphs and apply them to study graph isomorphisms, Eulerian graphs, graphic sequences and digraphs.	L2,L3, L3,L2, L3,L3	1(a),1(b), 1(c),2(a), 2(b),2(c)	2,2, 2,2, 2,2
Able to understand the concepts of trees, spanning trees and study its various concepts and apply the Kruskal's algorithm to find the minimum spanning tree and Dijkstra's algorithm to find the shortest path of connected weighted graphs	L3,L3, L3	3(a),3(b), 3(c)	2,2, 2
Able to understand matchings and factorization of graphs and its various applications.	L3,L3, L3	4(a),4(b), 4(c)	2,2, 2
Able to understand and analyze coloring of graphs, it's enumerative aspects and its applications.	L3,L3, L3,L3, L3,L3	5(a),5(b), 5(c),6(a), 6(b),6(c)	2,2, 2,2, 2,2
Able to understand and analyze planar graphs and its various applications.	L3,L3, L3,L3, L3,L3	7(a),7(b), 7(c),8(a), 8(b),8(c)	2,2, 2,2, 2,2
Able to understand the concepts of line graphs, edge-coloring and the various aspects of Hamiltonian cycles.	L3,L3, L3,L2, L3,L3	9(a),9(b), 9(c),10(a), 10(b),10(c)	2,2, 2,2, 2,2

*Bloom's taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

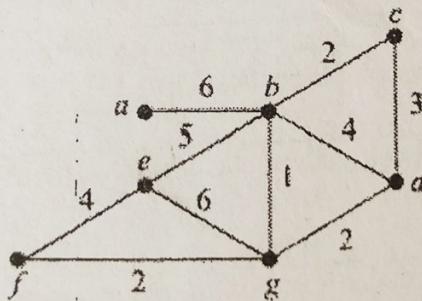
Answer all questions. Each question carries equal mark.

1. (a) Define a k -regular graph and give an example of a 3-regular graph. 2
- (b) Draw all simple nonisomorphic graphs of order 3. 2

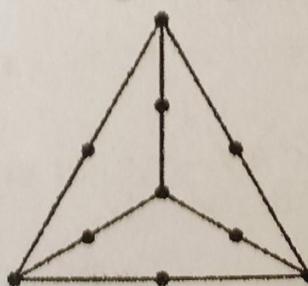
- (c) Prove that every graph has an even number of vertices of odd degree. 2
2. (a) Define an Eulerian graph and give an example. 2
- (b) Prove or disprove: If u and v are the only vertices of odd degree in a graph G , then G contains a u, v -path. 2
- (c) Determine, whether the following is a graphic sequence. If, yes construct the graph. 2
- $d: 5, 5, 4, 4, 2, 2, 1, 1$
- (1)
3. (a) Prove that if G is a simple graph, then $\text{diam } G \geq 3 \Rightarrow \text{diam } \bar{G} \leq 3$. 2
- (b) Determine the number of spanning trees of the given graph by using Matrix Tree computation. 2



- (c) Find the minimum spanning tree of the given graph by using Kruskal's algorithm. 2



4. (a) How many perfect matchings does the graph K_4 have? 2
Draw all the perfect matchings of K_4 .
- (b) Determine whether the given graph has a 1-factor or not. 2



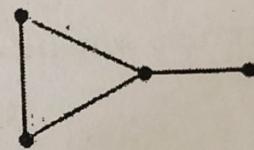
- (c) Prove that if G is a bipartite graph with no isolated vertices, then $\alpha(G) = \beta'(G)$. 2
5. (a) Compute the chromatic number, the clique number and the independence number of the graph given below. 2



- (b) Exhibit a graph G with a vertex v so that $\chi(G - v) < \chi(G)$ and $\chi(\bar{G} - v) < \chi(\bar{G})$. 2
- (c) Prove or disprove: For every graph G , 2

$$\chi(G) \leq n(G) - \alpha(G) + 1.$$

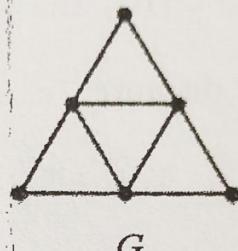
6. (a) Draw $P_4 \vee K_3$ and compute $\chi(P_4 \vee K_3)$. 2
- (b) Compute the chromatic polynomial of the given graph. 2



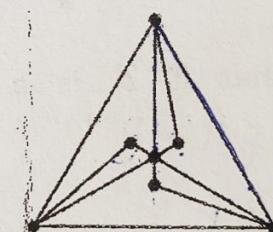
- (c) Prove that if T is a tree with n vertices, then $\chi(T; k) = k(k-1)^{n-1}$. 2

7. (a) Show that $K_{3,3}$ is nonplanar. 2
- (b) If $l(F_i)$ denotes the length of face F_i in a plane graph G , then show that $2e(G) = \sum l(F_i)$. 2
- (c) Prove or disprove: Every subgraph of a nonplanar graph is nonplanar. 2

8. (a) Prove that if G is a plane graph and every face of G has even length, then the dual graph G^* of G is Eulerian. 2
- (b) Prove that every simple planar graph has a vertex of degree atmost 5. 2
- (c) If G is a simple planar graph with atleast 3 vertices then prove that $e(G) \leq 3n(G) - 6$. 2
9. (a) For the given graph G , draw the line graph $L(G)$. 2



- (b) Define edge-chromatic number $\chi'(G)$ of a graph G and determine $\chi'(K_4)$. 2
- (c) Determine whether the given graph is Hamiltonian or not. 2



- 10 (a) Define a 1-factorable graph and give an example of a graph that is 1-factorable. 2
- (b) Prove that if a graph G has a Hamiltonian cycle, then for each nonempty set $S \subseteq V(G)$, the graph $G - S$ has atmost $|S|$ components. 2
- (c) For $n > 1$, prove that $K_{n,n}$ has $\frac{(n-1)!n!}{2}$ Hamiltonian cycles. 2

