



# Indian Institute of Technology Kharagpur

AUTUMN Semester 2020  
COMPUTER SCIENCE AND ENGINEERING

## CS 60047 Advanced Graph Theory

Online MCQ Test-02

Date: 21 November 2020

Full Marks: 50

Credit: 20%

Time: 12:00 noon – 1:30 PM

**Instructions:** This is an OPEN-BOOK, OPEN-NOTES, MCQ or TRUE/FALSE-type Test. For each MCQ question, please choose one answer from the given choices. Each *correct answer* will fetch 4 points, *incorrect answer* will contribute 0 point, and *no answer* leads to 1 point. Unless otherwise stated, for each TRUE/FALSE type question, a *correct answer* will fetch 2 points, *incorrect* 0 point, and *no answer* will be given 1 point. You may use calculators if required. Attempt all questions. This question paper has three pages.

**Submission of answers:** Please create a text file including **your name, roll-number**, and your choice of option against each question, and submit it to the CSE Moodle Page by 1:45 PM on 21 November 2020.

1. The graph  $G$  is a tree with 100 vertices. The number of perfect matchings in  $G$  is (choose one):

- A. 0;      B. 1;      C. 0 or 1;      D. arbitrary values depending on the structure of  $G$ ;  
E. none of these

2. Twelve people meet in a party and there are six unlabeled tables each with two seats. The number of ways the guests can sit for dinner is (choose one):

- A. 11;      B. 66;      C.  $2 \times 6!$ ;      D. 10395;      E. none of these

3.  $G$  is a simple connected graph that is drawn on a sphere without any crossover.  $G$  has 20 faces and degree of each vertex in  $G$  is 5. The number of vertices in  $G$  is (choose one):

- A. 8;      B. 10;      C. 12;      D. 14;      E. none of these

4.  $G$  is a simple plane graph with 1000 vertices, 222 faces, and 99 components. The number of components in the dual graph  $G^*$  is (choose one):

- A. 1;      B. 98;      C. 100;      D. 223;      E. none of these

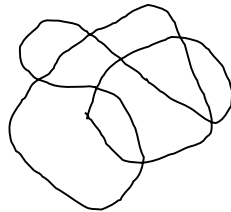
5. Seven football teams A, B, C, D, E, F, G are invited to participate in playing games as per the following schedule:

- A will have to play with B, C, F, G;
- B will have to play with A, C, G;
- C will have to play with A, B, D, E;
- D will have to play with C, E, F, G;
- E will have to play with C, D, F;
- F will have to play with A, D, E, G;
- G will have to play with A, B, D, F.

No team will be playing more than one game each day. The smallest number of days that is required to schedule all the games is (choose one):

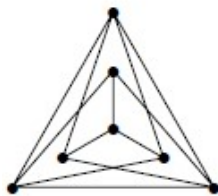
- A. 3;                      B. 4;                      C. 5;                      D. 6;                      E. none of these

6. A random planar map is created by drawing a self-intersecting closed curve on the plane. Assume all intersection points are distinct (i.e., the curve does not pass through a point on the plane more than twice). An example is shown in Figure 1.



**Figure 1:** A planar map

The smallest number of colors necessary to properly color any such randomly drawn planar map is  
A. 2;                      B. 2 or 3;                      C. 2 or 3 or 4.



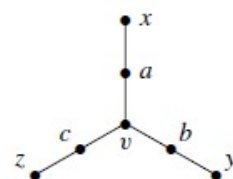
**Figure 2:** Crossing number

7. Consider the graph shown in Figure 2 above. The crossing number of this graph is (choose one):

- A. 0;                      B. 1;                      C. 2;                      D. 3,                      E. none of these

8. Consider the following graph  $G$  as shown in Figure 3:

**Figure 3:** The Graph  $G$



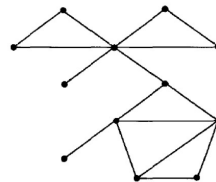
Then  $G$  is a (choose one):

- A. circular-arc graph; B: permutation graph; C. circle graph; D. caterpillar;  
E. None of the above.

State whether each of the following statements (# 9 to #16) is **TRUE** or **FALSE**:

9. A simple connected plane graph  $G$  has 100 vertices and 92 faces, and  $G$  is self-dual.  
10.  $G$  is a simple connected plane graph and two different embeddings of  $G$  are given. Their corresponding duals might have different number of vertices.  
11. We can construct an 11-vertex planar graph such that its complementary graph is also planar.  
12. No triangle-free graph with 51 vertices is 6-chromatic.  
13. The block-cutpoint graph of  $G$  shown in Figure 4 is an interval graph.

**Figure 4:** The graph  $G$



14. The complement of a disconnected graph is connected and the complement of a connected graph is disconnected.  
15. A subgraph of an interval graph is an interval graph.  
16. Every vertex of  $K_5$  is made adjacent to every vertex of  $K_{2,3}$  to form an undirected graph  $G$ . We claim that  $G$  is a permutation graph.  
17. (2 points) In a matrimonial site, three men  $a, b, c$  and three women  $A, B, C$  are looking for possible matches. Their preference lists ordered from highest-to-lowest are as follows:

$a: A, B, C;$      $b: B, A, C;$      $c: A, C, B;$   
 $A: b, a, c;$      $B: c, b, a;$      $C: a, c, b;$

Write whether each of the following statements is TRUE or FALSE:

- (a) The matching  $\{aA, bB, cC\}$  is stable;  
(b) The matching  $\{aC, bA, cB\}$  is unstable.