Sr. No. of Question Paper : **5046** D Your Roll No...............

Unique Paper Code : 235666

Name of the Course : **B.Sc. Physical Sciences/Applied Physical Sciences/ B.Sc. (Mathematical Science)**

Name of the Paper : Mechanics and Discrete Mathematics (MAPT-606)

Semester : VI

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt any **two** parts from each question.

3. **All** questions are compulsory.

4. Marks are indicated.

1. (a) A uniform bar AB, 10 ft long is hinged at B and is supported in a vertical plane by a light string AC which connects A to a point C, 10 ft directly above B. If AB weighs 20 Ib and AC is 15 ft. Find tension in AC and the reaction at B. (Assume that the weight of AB acts through its middle point). (8)

(b) Two weights w_1 and w_2 rest on a rough plane inclined at an angle α to the horizontal and are connected by a string which lies along the line of greatest slope. If μ_1, and μ_2 are their coefficients of friction with the plane and $\mu_1 > \tan \alpha > \mu_2$. Find that if they are both on the point of slipping then

$$\tan \alpha = \frac{\mu_1 w_1 + \mu_2 w_2}{w_1 + w_2}$$ (8)

(c) (i) Find the mass centre of a wire bent into the form of an isosceles right angle triangle. (4)

(ii) Show that in a conservative field of force the work done is equal to the change in potential energy with the sign reversed.   (4)

2. (a) Prove that for a particle moving in a plane and occupying the position P(r, θ) at an Instant t, the radial and transverse components of velocity are $\left(\dot{r}, r\dot{\theta}\right)$ and acceleration are $\left(\ddot{r} - r\dot{\theta}^2, \dfrac{1}{r}\dfrac{d}{dt}\left(r^2\dot{\theta}\right)\right)$.   (8)

(b) Mud is thrown off from the tyre of a wheel (radius a) of a car travelling at a speed v, where $v^2 > ga$. Neglecting the resistance of the air, show that no mud can rise higher than a height $a + \dfrac{v^2}{2g} + \dfrac{ga^2}{2v^2}$ above the ground.   (8)

(c) Show that motion of simple pendulum is simple harmonic motion. Also find its time period.   (8)

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

G
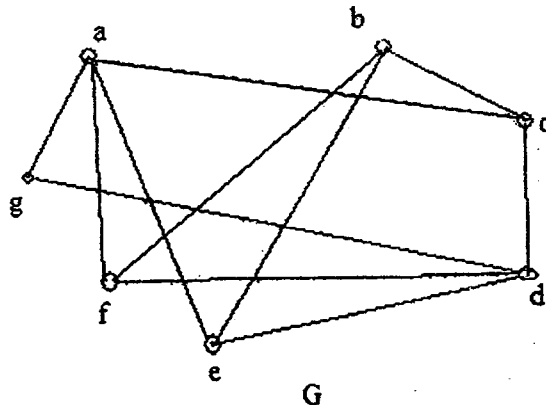
Check out whether the given graph G is bipartite or not.   (7)

(b) Prove that an undirected graph has an even number of vertices of odd degree.   (7)

(c) Let G be a graph with n vertices and e edges. Let M be the maximum degree of the vertices of G and let m be the minimum degree of the vertices of G. Show that (i) $\dfrac{2e}{n} \geq m$ and (ii) $\dfrac{2e}{n} \leq M$.   (7)

4. (a) How many paths of length four are there from a to d in the simple graph G ? Identify all the paths.
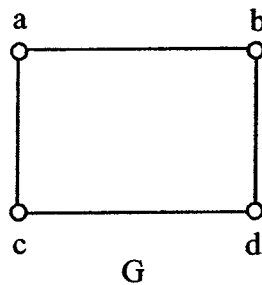
(7)

(b) What is the Konigsberg bridge problem ? Write the graphical representation of this problem. Is it possible to cross all seven bridges in a continuous path without recrossing any bridge ? Justify your answer.   (7)

(c) An undirected graph is a tree if and only if there is a unique simple path between any two of its vertices.   (7)
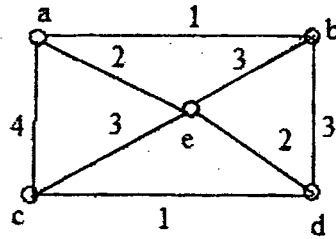
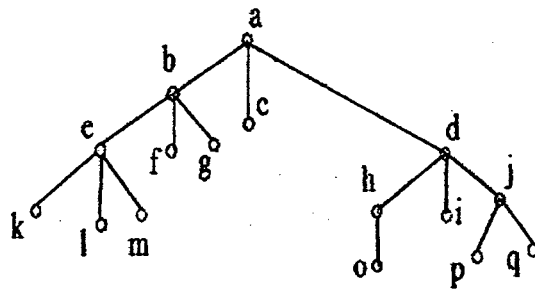5. (a) Use depth-first search to find a spanning tree for the given graph G.
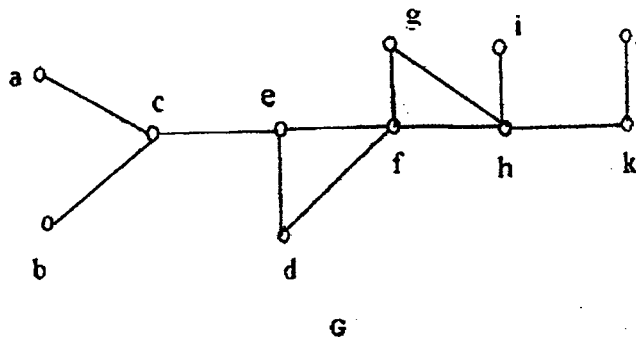
(7½)

(b) Use prim's algorithm to find a minimum spanning tree in the following weighted graph

(7½)

(c) Define inorder, preorder and postorder traversal of a rooted tree. Determine the inorder traversal of the given rooted tree T.

T

(7½)