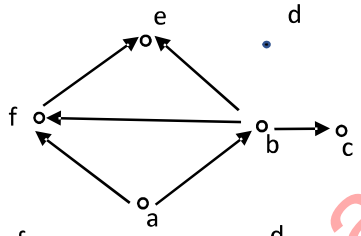
Name of Course	: **CBCS B.Sc. (Math Sci)- II / B.Sc. (Phy Sci)-II / B.Sc. (Life Sci)-II /Applied Sciences-II**
Unique Paper Code	: **42357502**
Name of Paper	: **DSE- Mechanics and Discrete Mathematics**
Semester	: **V**
Duration	: **3 hours**
Maximum Marks	: **75 Marks**

Attempt any four questions. All questions carry equal marks.

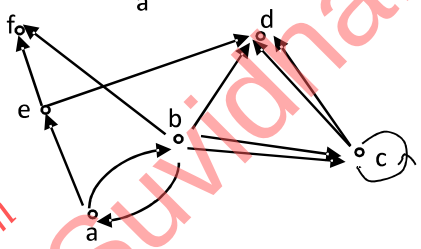
1. Define the radial and transverse components of velocity vector along plane curve. Give the examples and describe how to evaluate the magnitude of the resultant velocity.

Find in-degree and out-degree of each vertex in the following directed graphs as shown in figures:

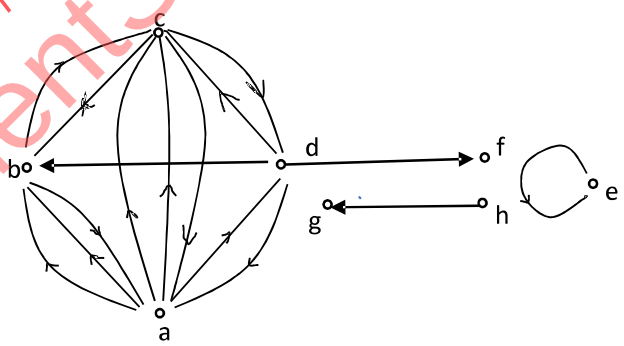
(i)



(ii)



(iii)



2. A particle moves with simple harmonic motion and its motion describe by the equation: $x = a\sin\omega t$, t is time as usual and a and ω are constants. Show that its phase:

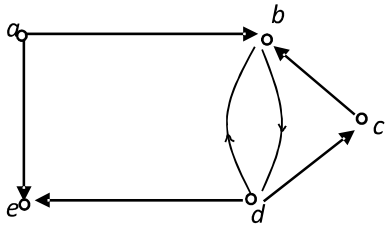
$$\phi = \tan^{-1}\left(\frac{x_0\omega}{v_0}\right)$$

and its amplitude:

$$a = \frac{\sqrt{x_0\omega^2 + v^2}}{\omega}$$

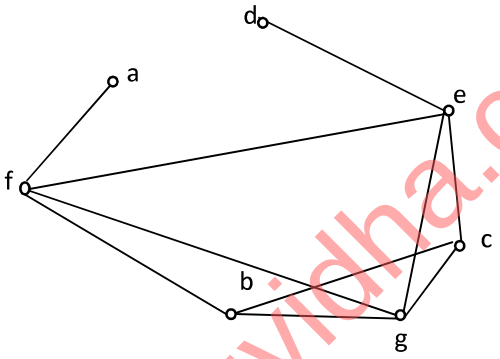
where $x = x_0$ and $\dot{x} = v_0$ when $t = 0$ (Initial conditions).

Find the number of paths of length 2 and 3 between vertex a and d of the following graph:



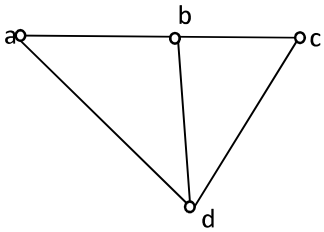
3. State Newton's laws of motion. Prove Newton's second law of motion.

Does the following graph has Hamiltonian path. If yes, find Hamiltonian path ?



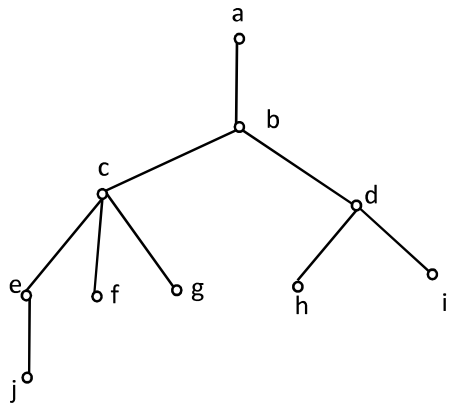
4. Let ABCD is a square of side 2a. Forces 4P, 3P, 2P, 4P Newtons act along the sides AB, CB, CD, AD respectively indicated by the order of letters. Find (i) The magnitude and direction (ii) The line of action of resultant.

How many spanning trees does the following graph have? Draw all of them.



5. A box is placed on inclined plane and has to be pulled upward direction. The angle of inclination is α and θ is the angle of pull, say P, to the horizontal. Find the direction and magnitude for the minimum pull P.

Given the tree with root at 'a' as shown below.



(i) Find the parents of c and h.

(ii) Find the children of d and e.

(iii) Find the descendents of c and e.

(iv) Find the siblings of f and h.

(v) Find the leaves.

(vi) Find the interval vertices.

(vii) Draw the subtree rooted at c.

(viii) What is the height of rooted tree.

6. Show that the centre of gravity of triangle is trisection of the median and also find the condition when centre of gravity coincides with that of three particles of the same weight placed at its corners.

How many vertices and how many edges do the following graphs have:

(i) $\mathbf{K}_n$ (ii) $\mathbf{C}_n$ (iii) $\mathbf{W}_n$ (iv) $\mathbf{K}_{m,n}$.

where m and n are natural numbers.