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	: **DSC- Mechanics and Discrete Mathematics**
Semester	: **V**
Duration	: **3 hours**
Maximum Marks	: **75 Marks**

Attempt any four questions. All questions carry equal marks.

1. (a) Define the motion along a curved path. Explain all physical quantities of the below equation:

$$\ddot{r} = \frac{dv}{dt}\,\hat{t} + v\,\omega\,\hat{n}$$

By using Equation (1), prove that

$$\ddot{r} = \frac{dv}{dt}\,\hat{t} + \frac{v^2}{\rho}\,\hat{n}$$

where ρ is the radius of curvature.

For what values of n, the following graphs are bipartite. Justify your answer.

(i) $\mathbf{K_n}$ (ii) $\mathbf{C_n}$ (iii) $\mathbf{W_n}$.

2. A weight of mass m is suspended by a spring and stretched from its natural length by x_0. Show that its motion is simple harmonic motion. (Take k as spring constant).

Draw all possible types of graphs, whether directed or indirected for the given adjacency matrices. If the drawn graph is indirected then find degree of each vertex and in case drawn graph is directed then find in-degree & out-degree of each vertex.

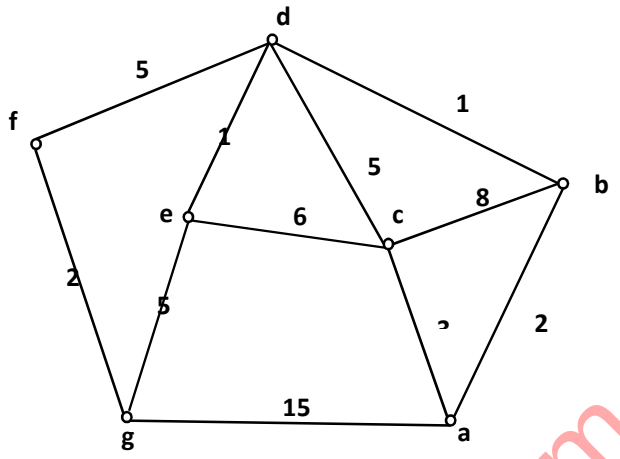
$$\begin{pmatrix} 0 & 2 & 1 & 1 \\ 2 & 0 & 2 & 0 \\ 1 & 2 & 0 & 1 \\ 1 & 0 & 1 & 2 \end{pmatrix}$$

3. Let β be the angle of the inclined plane and α be the angle of projection, then show that range R up a plane:

$$R = \frac{V^2}{g}\,\frac{\sin(2\alpha - \beta) - \sin\beta}{\cos^2\beta}$$

where V is the magnitude of velocity at $t = 0$, g is the gravitational acceleration constant.

Using Dijkstra's algorithm, find the length of shortest path between the vertices a and g in the following graph.



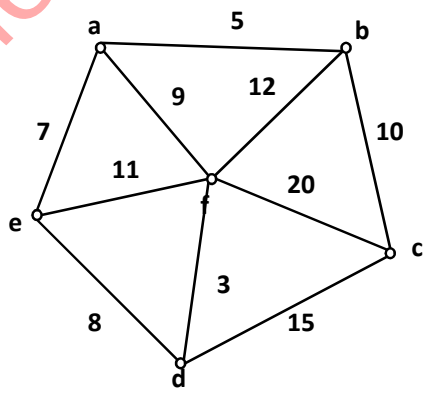
4. Three forces P, Q and R act along the sides BC, CA, AB of triangle ABC, and forces P', Q' and R' act along OA, OB, OC, O is the centre of circumscribing circle. Prove that if the six forces are in equilibrium,

$$P\cos A + Q\cos B + R\cos C = 0,$$

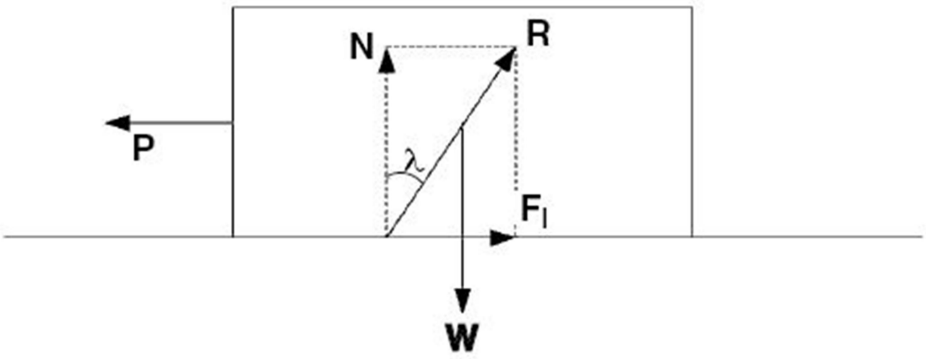
and

$$\frac{PP'}{BC} + \frac{QQ'}{CA} + \frac{RR'}{AB} = 0.$$

Use Kruskal's algorithm to find a spanning tree with minimum weight from the graph given below. Also calculate the total weight of spanning tree.



5. Describe the angle of friction. In the below figure, let the pull P be removed but let the surface on which the block rests be tilted until the block is on the verge of slipping. Find the relation between the angle of tilt of the surface



and the angle of friction.

Either draw a graph with the given specifications or explain why no such graph exists.

(i) Tree with nine vertices and nine edges.

(ii) Tree with six vertices and having total degree 14.

(iii) Tree with five vertices and having total degree 8.

(iv) Tree with six vertices having degrees 1, 1, 1, 1, 3, 3.

6. Describe work done by a particle along the curve path and also explain conservative field of force.

For the graph given below, determine which of the following sequences are paths, simple paths, cycle and simple cycle. Explain

(a) b e_7 b

(b) d e_3 c e_2 b e_5 e e_4 d

(c) a e_6 d e_3 c e_2 b e_5 e.