Mechanics-1
(BHM504/MC502)
Semester-V

M.M. 70.

Note:- 1. Attempt any 4 questions out of total 9 questions.

      2. Each question carries 17.5 marks.

1. **a)** Two forces of magnitude P+Q and P-Q make an angle 2α with one another, and their resultant makes an angle θ with the bisector of the angle between them. Show that $P \tan \theta = Q \tan \alpha$.

   b) The resultant of two forces P and Q acting at a pint is R. If Q be doubled, R is doubled and if Q is reversed, R is again doubled. Show that $P : Q : R :: \sqrt{2} : \sqrt{3} : \sqrt{2}$.

2. A light string of length l is fastened to two points A and B at the same level at distance 'a' apart. A string of weight W can be slide on the string and horizontal force P is applied to it such that it is in equilibrium vertically below B. Show that

   $P = \dfrac{aW}{l}$ and tension of the string is $\dfrac{W(l^2 - a^2)}{2l^2}$.

3. State and prove Varignon's Theorem.

4. ABCDEF is a regular hexagon. Find the resultant of forces equal to 7, 18, 5, 9, and 19 kg. wt. acting respectively along AB, CA, AD, AE, AF.

5. Forces P, Q , R acting along IA, IB, IC, where I is the in-centre of triangle ABC are in equilibrium. Show that $P : Q : R :: \cos \dfrac{A}{2} : \cos \dfrac{B}{2} : \cos \dfrac{C}{2}$

6. **a)** A weight can be just supported on a rough plane by a force P acting along the plane or by a force Q acting horizontally. Show that the weight is $\dfrac{PQ}{\left[Q^2 \sec^2 \lambda - P^2\right]^{\frac{1}{2}}}$,

   λ being the angle of friction.

   b) A uniform quadrilateral ABCD is such that the diagonal AC bisects it and BD divides it in two parts in the ration 2 : 1 . Show that its C.G. divides AC in the ration of 5 : 4.

7. **a)** State and prove $\lambda - \mu$ Theorem. Also discuss about various cases in the theorem.

   b) Point D, E and F are taken on the sides BC, CA and AB respectively of triangle

   ABC, such that $\dfrac{BD}{DC} = \dfrac{CE}{EA} = \dfrac{AF}{FB} = \dfrac{\mu}{\lambda}$

   Prove that forces acting at a point and represented in magnitude and directions by AD, BE and CF are in equilibrium.

8. Forces of magnitude P, 2P, 3P, 4P act along the sides AB, BC, CD and DA respectively of a square ABCD. Determine the pint E on the side BC about which the algebraic sum of moments of the forces is zero. Also find the magnitude and the direction of the resultant force.

9. **a)** State Lami's and converse of Lami's Theorem.

   b) Write down Newton's laws of motions.

   c) Write down the parallelogram law of forces and using this law drive expression for magnitude of resultant of two concurrent forces.

   d) Write down equilibrium conditions for coplanar non-concurrent forces.

   e) What is Friction? Also discuss about classification of Friction.

   f) What is couple? Show that algebraic sum of the moments of the forces forming a couple about any point in their plane is constant.