F-42/2110

MECHANICS-I-504

SEMESTER-V

TIME ALLOWED 3 Hrs M.M 70

NOTE: The candidates are required to attempt two questions each from Section A & B Section C will be compulsory

**Section A**

1. The resultant of two forces acting at an angle $\theta$ is R. When they act at angle $\frac{\pi}{2}-\theta$, their resultant is $\frac{R}{2}$ and their resultant is $\frac{R}{3}$ when they act at angle $\frac{\pi}{2}+\theta$. Then prove that $\theta=\tan^{-1}\left(\frac{5}{59}\right)$.

2. Two forces $P$ and $Q$ acting at a point have a resultant $R$. If $P$ is doubled, $R$ is doubled and if $Q$ is doubled and reversed in direction, even then $R$ is doubled. Show that $P:Q:R::\sqrt{6}:\sqrt{2}:\sqrt{5}$

3. Each side of a regular hexagon ABCDEF is 2 metres along the sides AB, CB, DC, DE, EF and FA act forces respectively equal to 2, 4, 6, 7, 10 and 12 kg. wt. Find the algebraic sum of the moments of the forces about A.

4. Equal forces $P$, $P$, $P$ act at a point parallel to the sides $BC, CA, AB$ of $\Delta ABC$. Prove that their resultant is given by $P\sqrt{3-2\cos A-2\cos B-2\cos C}$.

2X10=20

**Section B**

5. If forces $P,Q,R$ and $S$ acting along the sides $AB,CB,CD$ and $AD$ respectively of a quadrilateral $ABCD$ are in equilibrium. Show that $\frac{P}{AB}:\frac{Q}{CB}::\frac{S}{AD}:\frac{R}{CD}$.

6. A light string of length $l$ is fastened to two points $A$ and $B$ at the same level at distance '$a$' apart. A ring of weight $W$ can slide on the string and horizontal force $P$ is applied to it such that it is in equilibrium vertically below $B$. Show that $P=\frac{aW}{l}$ and tension in the string is $\frac{W(l^2+a^2)}{2l^2}$.

7. If the force which acting parallel to the rough plane of inclination $\alpha$ to the horizon is just sufficient to draw a weight up be $n$ times the force which will just be on the point of sliding down. If $\mu$ be the coefficient of friction, then show that $\tan\alpha=\mu\frac{n+1}{n-1}$.

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

2X10=20

## Section C

9. Write in short:
   a) State Varignon's theorem.
   b) State Lami's theorem.
   c) State $\lambda - \mu$ theorem.
   d) Two equal forces act on a particle, find the angle between them when the square of their resultant is equal to three times their product.
   e) State generalized theorem of resolved parts.
   f) A couple of moment – 60 units acts in the plane of the paper. Find the arm of the couple if each force is of magnitude 10 units.
   g) The resolved part of a force 32 kg.wt., in a direction is half of it. Find its inclination with the force and also find the other resolved part.
   h) A 120 kg force is resolved into components along AB and AC making angle $45^\circ$ and $\alpha$ respectively. If the component along AC is of magnitude 120kg., determine the angle $\alpha$ and the component along AB.
   i) State laws of limiting friction.
   j) Find Centre of gravity of uniform rod.

$10 \times 3 = 30$