

B.A./B.Sc.(Honours) Examination, 2019
Semester-IV
Mathematics (Honours)
Core Course: BMC-43
(Mechanics-II)

Time: Three Hours

Full Marks: 40

Questions are of value as indicated in the margin.

Notations and symbols have their usual meanings unless otherwise stated.

Answer **any four** questions.

1. a) Show that a system of coplanar forces can be reduced to a single force together with a single couple. 5
b) A system coplanar forces has the total moments H , $2H$ and $3H$ about the points $(0, 0)$, $(0, 1)$ and $(2, 4)$ respectively. Find the magnitude and the equation of the line of action of the resultant. 5
2. a) Define virtual displacement and virtual work for a rigid body acted upon by the force F . Find the virtual work done by the mutual action and reaction between two particles of a rigid body. 2+3
b) Four equal rods, each of length a , are freely jointed and the system hangs from an angular point. If this angular point be connected to the opposite vertex by an elastic string of modulus of elasticity equal to the weight of the rod, and if the configuration be a square in equilibrium, then show that the natural length of the string is $\frac{a\sqrt{2}}{3}$. 5
3. a) If a system of bodies be in equilibrium under the action of gravitational force only, discuss the conditions of its stability and instability. Hence show that if the system has one degree of freedom, the stable and unstable positions of equilibrium occur alternatively. 5
b) A lamina in the form of a cycloid, whose generating circle is of radius a , rests on the top of another cycloid whose generating circle is of radius b , their vortices being in contact and their axes vertical. If b be the height of the centre of gravity of the upper cycloid above its vertex, show that the equilibrium is stable if $h < \frac{4ab}{a+b}$. 5
4. a) Find the conditions of equilibrium of a system of non-coplanar forces acting at different points of a rigid body. 5
b) Six forces, each equal to P , act along the edge of a cube, taken in order, which do not meet a given diagonal. Show that their resultant is a couple of moment $2\sqrt{3}Pa$, where a is the edge of the cube. 5
5. a) Explain what is meant by Poinsot's central axis. Hence define the terms Wrench, Pitch and Screw. 3+2
b) Two forces, act one along the line $y=0, z=0$ and the other along the line $x=0, z=c$. Show that the surface generated by the axis of their equivalent Wrench is $(x^2 + y^2)z = cy^2$. 5
6. a) A particle is projected from the lowest point along the inside of a smooth vertical circle. Discuss the motion when it will describe a complete circle. 5
b) A small bead is projected with any velocity along a smooth circular wire under the action of a force varying inversely as the fifth power of the distance from a centre of force situated on the circumference. Prove that the pressure on the wire is constant. 5