

Monofya University
Faculty of Engineering
Department of Basic Eng. Sciences
Second Semester Exam 2020
Date of Exam: 10/08/2020



Field: Eng. Mechanics
Code: BES 714
Subject: Selected topics in Eng M/cs.
Time allowed: 3 hrs.
Total marks: 100 marks

Answer all the following questions

[100 marks]

1.1 Determine the straight line passing through points (2,3,4) and (3,4,6).

Determine the point of intersection of this line and the plane $2x+y+z-6=0$.

check your results.

1.2 Determine the equation of a plane passing through the point (1,1,1) and the

straight line L: $x+y-1=0$, $z+4=0$, check your results.

[15 marks]

2.1 Determine the space circle generated from the intersection of the plane $x+y+z=3$ with the sphere $x^2+y^2+z^2=3$. Specify a point belongs to this circle and points do not.

2.2 Describe and plot the surface $9x^2+9y^2-4z^2=0$ where $0 < |z| \leq 1$

[15 marks]

3. A circular disc of radius R is rolling without sliding on an inclined smooth plane of an angle of inclination θ with a constant angular velocity ω about an axis normal to the plane (z axis) and passes through its center of mass c (x_c, y_c).

If p is the point of contact between the disc and the plane.

i. Define the absolute coordinates, the type of constraint, the selecting generalized coordinates and the number of degrees of freedom.

ii. Determine Lagranges' equations of motion.

iii. Use d'Alemberts' method to check your result.

[20 marks]

4. Describe the spherical pendulum, and then derive Lagrange's equation of motion. Reduce this equation to formulate the equations of motion of the conic pendulum and the simple pendulum. Using Hamiltons' equation, verify the

equation of motion of the simple pendulum.

[20 marks]

5. A mass of an incompressible liquid is rotating as a rigid body inside a cylindrical container with a uniform angular velocity ω about a fixed vertical axis oz . Determine the followings:

- the pressure distribution of the liquid.
- the equation of the upper surface of the liquid.
- the relationship between the maximum height and the minimum height of the liquid surface at steady state.
- the external forces. **[15 marks]**

6. A propeller shaft is subjected to a combined torsion and an axial thrust is designed to resist shear stress $\tau_{xy} = -45\sqrt{3}$ MPa and normal stress $\sigma_x = -90$ MPa.

- Determine the principal angles.
- Determine the corresponding principal stresses and check your results.
- Show them on a sketch of properly oriented element.
- Determine the maximum shear stresses and the associated shear angles.
- Determine the average normal stress.
- Show these stresses on a sketch of properly oriented element. **[15 marks]**

This exam contributes to achieving Program Academic Standards according to NARS

Question Number	Q1, Q2	Q3, Q4	Q3, Q4, Q5, Q6
	Knowledge & Understanding Skills	Intellectual Skills	Professional Skills

With my best wishes
Dr. Bilal Maher