

JK Lakshmipat University Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY
 End-Term Examination, May-June 2023
 B. Tech., Semester II, 2022-23

Roll No.....

ES1103: Calculus and Applied Mechanics

Time: 2 hours

Max. Marks: 30

Instructions to students:

1. Do not write anything other than your roll number on the question paper.
2. Assume suitable data wherever required and mention it clearly.

- | | | |
|-----|---|------------------------------|
| Q.1 | The heat equation is a partial differential equation that describes the distribution of heat in a region at time t , and it is represented as
$\frac{\partial f}{\partial t} = \frac{\partial^2 f}{\partial x^2}$ for any function $f(x, t)$.
Find the relation between the constants α and β such that, $u(x, t) = \sin(\alpha x) \cdot e^{-\beta t}$ satisfies the heat equation. | 3.0
(CO2) |
| Q.2 | Find all the local maxima, local minima, and saddle points of the function,
$f(x, y) = 2x^3 + 2y^3 - 9x^2 + 3y^2 - 12y$. | 3.0
(CO7) |
| Q.3 | What is the largest value that the directional derivative of $f(x, y, z) = xyz$ can have at the point $(1, 1, 1)$? | 3.0
(CO5) |
| Q.4 | Using the concepts of vector calculus, find an equation of the plane tangent to the level surface, $x^2 - y - 5z = 0$ at the point $P_0(2, -1, 1)$. | 3.0
(CO5) |
| Q.5 | Find the divergence and curl of the vector,
$\vec{F} = (3x + 2z^2)\hat{i} + \frac{x^3y^2}{z}\hat{j} - (z - 7x)\hat{k}$. | 3.0
(CO5) |
| Q.6 | (a) Rewrite the integral, $\int_0^3 \int_1^{\sqrt{4-y}} (x + y) dx dy$, after changing the order of integration.
(b) Using double integral, find the area of the region bounded by the lines $y = 1 - x$, $y = 2$, and the curve $y = e^x$. | 2.0
(CO4)
4.0
(CO4) |
| Q.7 | Find the volume of a solid formed by rotating the arc,
$y = \sqrt{4 - x^2}$, $-1 \leq x \leq 1$ about x-axis. | 3.0
(CO4) |
| Q.8 | A rectangular pontoon (a flat-bottomed boat) is 4 m long, 2.5 m wide and 1 m high. The depth of immersion of pontoon is 0.60 m in the sea water. If the centre of gravity is 0.5 m above the bottom of the pontoon, determine the meta-centric height and comment on the nature of stability. Take density of sea water as 1025 kg/m^3 . | 4.0
(CO6) |
| Q.9 | Determine centroid of area shown in the following figure considering its left face and base as the axes of reference. | 2.0
(CO6) |

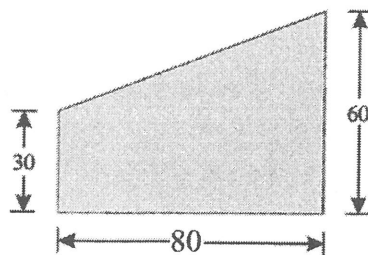


Fig. Problem of centroid