Session: **Name:** **Student ID:**

MA 1201 Semester B 2010/21

Assignment 1 — Due at 11:59 pm, 18/2/2021 (Thursday) online on Canvas

Instructions:

- Please show your work. Unsupported answers will receive **NO** credits.
- Make sure you write down the correct lecture session (A/B/C/D/E/F/G/H) you have registered for, together with your full name and student ID on the front page of your answer script. Scan your solution into a single pdf file and upload it to Canvas.
- **NO** late homework will be accepted.

Recall that the vector equation for a line L passing through a point $P_0(x_0, y_0, z_0)$ parallel to a vector $\vec{v} = \langle v_1, v_2, v_3 \rangle$ is

$$\vec{r}(t) = \vec{r}_0 + t\vec{v}, \qquad -\infty < t < \infty,$$

where $\vec{r}$ is the position vector of a point $P(x, y, z)$ on L and $\vec{r}_0$ is the position vector of $P_0(x_0, y_0, z_0)$. In component form, the vector equation is equivalent to three scalar equations:

$$\begin{cases} x = x_0 + tv_1 \\ y = y_0 + tv_2 \\ z = z_0 + tv_3 \end{cases}.$$

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1. (10 points) Find the volume of the tetrahedron with adjacent vortices $A = (1, 2, 0)$, $B = (-1, 3, 4)$, $C = (-1, -2, -3)$ and $D = (0, -1, 3)$.

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2. (10 points) Find the equation of the plane passing points $A = (3, 1, 1)$ and $B = (1, 0, -1)$, and parallel with the line

$$\begin{cases} x = -t \\ y = 1 \\ z = 2t + 2. \end{cases}$$

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3. (15 points) Find the distance from the line

$$\begin{cases} x = t \\ y = -t + 1 \\ z = 2t + 1 \end{cases}$$

to the line, which is the intersection between plane $x + y - z = 1$ and plane $2x + z = 3$. (Hint: One can find the equation of the intersection line by solving the two equations of the planes together with the substitution $x = t$.)

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4. (30 points) Evaluate the following indefinite integrals.

(a) (15 points) $\displaystyle\int \frac{2x-1}{x^2-2x+2}\,dx.$

(b) (15 points) $\displaystyle\int \frac{4x}{\sqrt{2x+4}}\,dx.$

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5. (25 points) Evaluate the following definite integrals.

(a) (10 points) $\displaystyle\int_0^{\pi} \cos(|x-\frac{\pi}{2}|+\frac{\pi}{2})\,dx.$

(b) (15 points) $\displaystyle\int_{-\pi/3}^{\pi/3} (|x|+\sin x)^2\,dx.$ (Hint: Expand the square, split the integral into three pieces, and exploit the even/odd symmetry properties of the integrand. In particular, no integration by parts is needed.)

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6. (10 points) Compute the derivative $\displaystyle\frac{d}{dx}\left(\int_{x^2}^{3x} \frac{y^3}{\sqrt{2y+1}}\,dy\right).$

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