LEBANESE AMERICAN UNIVERSITY
DEPARTMENT OF COMPUTER SCIENCE AND MATHEMATICS
MTH 201 - CALCULUS 3
EXAM 1 – FALL 2011

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Duration: 75 minutes

Name: **ID#:**

- **This exam consists of 9 pages and 8 problems.**
- **Answer the questions below on the space provided. You can use the back pages for scratch or for more space for your answers. Please specify.**
- **Make sure you justify all your answers.**

Question Number	**Grade**
1. 10%	
2. 12%	
3. 20%	
4. 12%	
5. 12%	
6. 10%	
7. 12%	
8. 12%	
TOTAL	

Problem 1: (10%) Evaluate the following limits

(a) $\lim_{x\to\infty} \sin^{-1}(\frac{x^2}{1+2x^2})$

(b) $\lim_{x\to\infty} \frac{\tan^{-1}(e^x)}{e^{2x}+x}$

Problem 2: (12%)

(a) Simplify the following expression

$$\ln\left(\cosh 6x - \sinh 6x\right) + \ln\left(\cosh 3x + \sinh 3x\right)$$

(b) Evaluate

$$\int \frac{\sinh\left(\ln x\right)}{x}\,dx$$

Simplify your answer.

Problem 3: (20%) Evaluate the following integrals

(a) $\int \tan^{-1}(4x)\, dx$

(b) $\int \frac{1}{x^2+4x+5}\, dx$

Problem 4: (12%) Evaluate the following improper integrals

(a) $\int_2^4 \frac{1}{x^2-x-2}\,dx$

(b) $\int_{-\infty}^{\infty} \frac{1}{(e^x+e^{-x})}\,dx$

Problem 5: (12%) Determine the convergence or divergence of the following improper integrals. Justify your answers.

(a) $\int_0^\infty \frac{1}{(e^x+1)^2}\,dx$

(b) $\int_1^\infty \frac{\ln x}{e^x}\,dx$

Problem 6: (10%) Show that

$$\int_1^\infty \frac{\sin x + 2}{x^2}\, dx$$

converges, whereas

$$\int_1^\infty \frac{\sin x + 2}{x}\, dx$$

diverges.

Problem 7: (12%)

Find the values of p for which

$$\int_1^\infty \frac{x}{\sqrt{x^p + 1}}\,dx$$

converges.

Justify your answer.

Problem 8: (12%) Determine if the following sequences converge or diverge. Justify your answers.

(a) $a_n = \dfrac{n \sin\left((2n-1)\frac{\pi}{2}\right)}{n+1}$

(b) $a_n = (1 + \dfrac{2}{n})^{n \frac{1}{\sqrt[n]{n^2}}}$