1. (10 pts - 5 pts each) Which of the following sequences converge and which diverge? Find the limit of each convergent sequence.

   a) $a_n = \left\{ \dfrac{n!}{(2n)!} \right\}^2$

   b) $a_n = \left\{ \sin \dfrac{1}{n} \right\}$

2. (15 pts - 5 pts each) Which of the following series converges and which diverges. Find the sum of each converging series if possible:

   a) $\displaystyle\sum_{n=5}^{\infty} \frac{1}{(2+\pi)^{2n}}$

   b) $\displaystyle\sum_{n=1}^{\infty} (-1)^n \frac{n^2}{1+n\sqrt{n}}$

   c) $\displaystyle\sum_{n=4}^{\infty} \frac{n^{100}\, 2^n}{\sqrt{n!}}$

3. (10 pts) Check whether the series converges absolutely, converges conditionally or diverges?

$$\sum_{n=1}^{\infty} \frac{\left[\sin \dfrac{(2n+1)}{2}\pi\right]}{\ln(\ln n)}$$

4. (10 pts) Find the series' radius and interval of convergence and identify the values of x for which the series converges absolutely and conditionally.

$$\sum_{n=0}^{\infty} \frac{(x-2)^{2n}}{\sqrt{n+1}}$$

5. (10 pts) Use the power series (Maclaurin Series) to evaluate the limit.

$$\lim_{x\to 0} \frac{\left(e^x - 1 - x\right)^2}{x^2 - \ln\left(1+x^2\right)}$$

6. (10 pts) How many terms are needed to approximate the sum of the series $\sum_{x=1}^{\infty} \tan^{-1} x$ with an error of magnitude no greater than 10^{-4}? Give reasons for your answers, and estimate the sum of the series.
7. (5 pts) Find L (0.5) with an error of magnitude less than 10^{-3}, knowing that

$$L(x) = \int_0^x \frac{e^t - 1}{t}\,dt$$

8. (10 pts) Find the Fourier series of the function on the given interval:

$$f(t) = \begin{cases} 0 & -1 \le t \le 0 \\ t & 0 \le t < 1 \end{cases}$$

9. (10pts-5 pts each)
   a) Change the following equation from polar coordinates to Cartesian coordinates: $r = 1 - 2\sin\theta$

   b) Change the following equation from Cartesian coordinates to polar coordinates: $x + y^2 = 2y + 3$
10. (10pts-5pts each)

   a) Graph : $r = \sin 3\theta$.
   b) Graph : $r = 2\cos\theta$.