1) Find the interval of convergence for the following series.

$$\sum_{n=2}^{\infty} \frac{x^n}{n\ln(n)} \tag{1}$$

Solution: $[-1, 1)$

$$\sum_{n=2}^{\infty} \frac{n^2 x^{3n}}{\ln(n+1)} \tag{2}$$

Solution: $(-1, 1)$.

2) Find the 12th derivative of the function $x^2 e^{2x}$ at $x = 0$.
Solution:$\frac{2^{10}}{10!}$.

3) Find the 6th derivative of $\ln(1+x)$ at x=0 by comparing the Mac-Laurin series with Taylor's expansion of the given function.
Solution: $-5!$.

4) Evaluate the exact value of the following series.

$$\sum_{n=0}^{\infty} \frac{(-1)^{n+1}\pi^{2n}}{4^{2n}2n!} \tag{3}$$

Solution: Consider $\cos(x) = \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n}}{2n!}$. Compare the given series with series expansion of $\cos(x)$. The answer is $\frac{-\sqrt{2}}{2}$.

5) Find the series expansion for the following functions.

$$\frac{1}{4-x^2} \tag{4}$$

Solution: Use the partial fraction method and then use the fact that $\frac{1}{1-x} = \sum_{n=0}^{\infty} x^2$ in order to find a series expansion of the given function.

$$\int \arctan(x^2) \tag{5}$$

Solution: First, evaluate the derivative of the function $\arctan(x^2)$. Then, find a series expansion for the derivative and finally use the fact that the integral of the derivative of a given function is equal to itself.

$$\frac{x^3}{(x-2)^2} \tag{6}$$

Solution: Use the fact that $\frac{d}{dx}(\frac{1}{x-2}) = \frac{-1}{(x-2)^2}$.

6) Evaluate the length of the parametric curve $(e^t \cos(t), e^t \sin(t)$ from $t = 0$ to $t = 1$.
Solution: Evaluate $\frac{dx}{dt}$ and $\frac{dy}{dt}$ and then use the relation $\int \sqrt{(\frac{dx}{dt})^2 + (\frac{dy}{dt})^2} dt$.

7) Find the equation of the tangent and normal line on the parametric curve $c(t) = (e^t + e^{-t}, t^2)$ at the point $(2, 0)$ and also evaluate the concavity of this function at this given point.
Solution: First, find for what value of t $(e^t + e^{-t}, t^2) = (2, 0)$. Then, use relations $\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$ in order to find the equation for tangent and normal line and $\frac{d^2y}{dx^2} = \frac{\frac{d}{dt}(\frac{dy}{dx})}{\frac{dx}{dt}}$ in order to find the concavity.

8) Find the area out side the curve $r_1(\theta) = 1 + \sin(\theta)$ and inside $r_2 = \frac{1}{2}$.
Solution: First, find the interval at which $r_1 = r_2$. Then, use the relation $\frac{1}{2} \int (r_1^2(\theta) - r_2^2) d\theta$
9) Find the equation of given polar functions in Cartesian plane.

$$r = 2\sin(\theta) \qquad \tan(\theta) = 2 \qquad \sec(\theta) = 3r \tag{7}$$

Solution: Use relations $x^2 + y^2 = r^2$ and $x = r\cos(\theta)$ and $y = r\sin(\theta)$ in order to solve this problem.
10) Find the series expansion for the following function.

$$\int \frac{e^{3t} - 1 - 3t}{t^2} dt \tag{8}$$

Solution: $\sum_{n=2}^{\infty} \frac{3^n t^{n-1}}{(n-1)n!} + C$