Please show your calculations for each question.

1. Find an equation of the tangent to \( y = (2 + x)e^{-x} \) at (0, 2). [5 marks]

2. The volume of a cube is increasing at a rate of 10cm³/min. How fast is the surface area increasing when the length of an edge is 30cm? [5 marks]

3. Evaluate the integral \( \int_{0}^{2} y^2 \sqrt{1 + y^3} \, dy \). [5 marks]

4. Evaluate the integral \( \int_{0}^{\pi/8} \sec 2\theta \tan 2\theta \, d\theta \). [5 marks]

5. Evaluate the integral \( \int \frac{x^2 + 8x - 3}{x^3 + 3x^2} \, dx \). [15 marks]

6. Evaluate the integral \( \int \frac{x^2}{(4 - x^2)^{3/2}} \, dx \). [15 marks]

7. Find the volume of the solid obtained by rotating the region bounded by \( x = 0 \) and \( x = 9 - y^2 \) about \( x = -1 \). [15 marks]

8. Find an equation of the curve that passes through the point (1,1) and whose slope at (x,y) is \( y^2 / x^3 \). [10 marks]

9. Find the radius of convergence and interval of convergence for the series \( \sum_{n=1}^{\infty} (-1)^n \frac{x^n}{n^2 5^n} \). [10 marks]

10. Find equations of the tangent plane and the normal line to the surface \( z = e^x \cos y \) at (0,0,1). [15 marks]
1. The following is one way of constructing a flip-flop. (10%) 

![Flip-flop diagram]

(a) Why is it ideal to store a bit of data using a flip-flop? 
(b) If we want to set the output to be 1, how should input 1 and input 2 be set?

2. Convert the following base ten integers to their equivalent two’s complement representations in 5 bits. (12%) 
(a) -1,  (b) 3,  (c) -7.

3. Inside the CPU, what are the contents of (a) the program counter and (b) the instruction register? (12%) 
(c) What are the fetch, decode, and execute steps of the machine cycle?

4. When a computer is turned on, booting is conducted. What is the aim of the booting process? Usually, what kind of memory is used to store the bootstrap program? (8%)

5. What are (a) a domain name server and (b) a gateway in the Internet? (8%)

6. What are cache memory, main memory, and virtual memory? Where are they inside a PC? (10%)

7. **procedure** Prog1 (n) 
   if (n>1) 
   then 
   (Apply the procedure Prog1 to n/2 (integer division), and then print out the value (n mod 2).) 
   else 
   (Print out the value n.)
end if

(a) What does the procedure Prog1 print for a positive integer n?
(b) If n=9, what is the result from Prog1?
(c) How to modify this procedure Prog1 into a new procedure Prog2 that returns 1 if n is of odd parity or 0 if n is of even parity? (20%)

8. Use C or Java to write a subroutine of argument n that prints a diamond shape, for example, n=5: (10%)
   *
   ***
   *****
   ***
   *

9. The number of derangements, \(d_n\), is 
\[
\begin{bmatrix} \frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} + \cdots + (-1)^n \frac{1}{n!} \end{bmatrix}
\]. Use C or Java to write a subroutine of argument n that computes \(d_n\). (10%)