Example Prompts for Engineering Problems

## Downloads

* [Download as Word Document (DOCX)](/downloads/teaching/engineering-prompts.docx)

# Example Prompts for Engineering Problems

This resource provides a collection of effective prompts for using AI tools (like ChatGPT, Claude, or Gemini) to solve various engineering problems. These examples demonstrate how to structure prompts to get the most useful and accurate outputs for engineering applications.

## Structural Analysis Prompts

### Beam Analysis

I need to analyze a simply supported beam with the following parameters:
- Length: 6 meters
- Cross-section: I-beam, 300mm height, 150mm width
- Material: Steel (E = 200 GPa)
- Load: Uniformly distributed load of 20 kN/m across the entire span

Please:
1. Calculate the maximum deflection
2. Find the maximum bending moment
3. Determine the maximum normal stress
4. Check if the beam is adequately sized for this load (with a safety factor of 2)
5. Explain your calculation process

### Truss Analysis

I need to analyze a 2D truss structure with the following configuration:
- 4 nodes: A(0,0), B(3m,0), C(6m,0), D(3m,3m)
- Members: AB, BC, AD, BD, CD
- Supports: Pin at A, roller at C
- External load: 10kN downward at node D

Please:
1. Draw a clear diagram of the truss (you can use ASCII or describe it)
2. Calculate the reaction forces at supports
3. Use the method of joints to determine the force in each member
4. Identify which members are in tension vs. compression
5. Calculate the required cross-sectional area if the allowable stress is 120 MPa

## Fluid Mechanics Prompts

### Pipe Flow Analysis

I need to analyze flow through a piping system with these specifications:
- Pipe material: Commercial steel (ε = 0.045 mm)
- Pipe diameter: 100 mm
- Pipe length: 50 meters with 3 standard 90° elbows
- Fluid: Water at 20°C
- Flow rate: 0.02 m³/s

Please:
1. Calculate the Reynolds number and determine if flow is laminar or turbulent
2. Find the friction factor using the Moody diagram or appropriate equation
3. Calculate the major head loss due to friction
4. Estimate the minor losses due to the elbows
5. Determine the required pumping power if the pump efficiency is 75%

### Open Channel Design

I need to design a trapezoidal open channel to carry water with these requirements:
- Design discharge: 3 m³/s
- Available width at top: maximum 5 meters
- Channel material: Concrete (Manning's n = 0.013)
- Longitudinal slope: 0.001 m/m
- Side slopes: 2H:1V

Please:
1. Calculate the optimal dimensions (bottom width and depth)
2. Verify that the flow velocity is within acceptable range (0.6-3 m/s)
3. Check the Froude number and determine flow regime
4. Suggest any modifications if design criteria aren't met
5. Calculate the minimum freeboard required

## Thermodynamics Prompts

### Heat Exchanger Analysis

I need to analyze a counter-flow shell and tube heat exchanger with these parameters:
- Hot fluid: Oil (cp = 2.1 kJ/kg·K) entering at 120°C, mass flow rate 2 kg/s
- Cold fluid: Water entering at 20°C, exiting at 60°C, mass flow rate 1.5 kg/s
- Overall heat transfer coefficient: 800 W/m²·K

Please:
1. Calculate the heat transfer rate
2. Determine the exit temperature of the oil
3. Calculate the required heat exchanger area
4. Find the log mean temperature difference (LMTD)
5. Suggest improvements to increase efficiency

### Refrigeration Cycle Analysis

I need to analyze a vapor-compression refrigeration cycle using R-134a with these conditions:
- Evaporator temperature: -10°C
- Condenser temperature: 40°C
- Compressor isentropic efficiency: 80%
- Cooling capacity: 5 kW
- No subcooling or superheating

Please:
1. Draw a p-h diagram for the cycle (describe key points)
2. Calculate the coefficient of performance (COP)
3. Determine the compressor power input
4. Calculate the mass flow rate of refrigerant
5. Suggest how to improve the COP of this system

## Control Systems Prompts

### PID Controller Tuning

I need to tune a PID controller for a temperature control system with these characteristics:
- Process model: First-order plus dead time
- Time constant: 50 seconds
- Dead time: 10 seconds
- Process gain: 2°C/% controller output
- Controlled variable: Temperature (range 20-100°C)
- Manipulated variable: Heater power (0-100%)

Please:
1. Suggest appropriate PID tuning parameters using Ziegler-Nichols or another method
2. Estimate the closed-loop response time
3. Discuss potential issues with derivative action
4. Suggest anti-windup measures
5. Explain how to implement and test this controller safely

## Best Practices for Writing Engineering Prompts

### 1. Be Specific with Units and Parameters

Always include: - Explicit units for all quantities - Relevant material properties - Boundary conditions - Required precision/accuracy

### 2. Structure Your Request

* Break complex problems into numbered steps
* Ask for explanations alongside calculations
* Request validation checks when appropriate

### 3. Request Process Explanation

* Ask AI to explain its reasoning
* Request alternative approaches when appropriate
* Ask for limitations or assumptions being made

### 4. Verify Results

* Always check AI calculations against your own understanding
* Consider using multiple AI tools to cross-verify
* Validate against known solutions or benchmarks

*These prompts were developed in collaboration with Claude-3.7 Sonnet.*