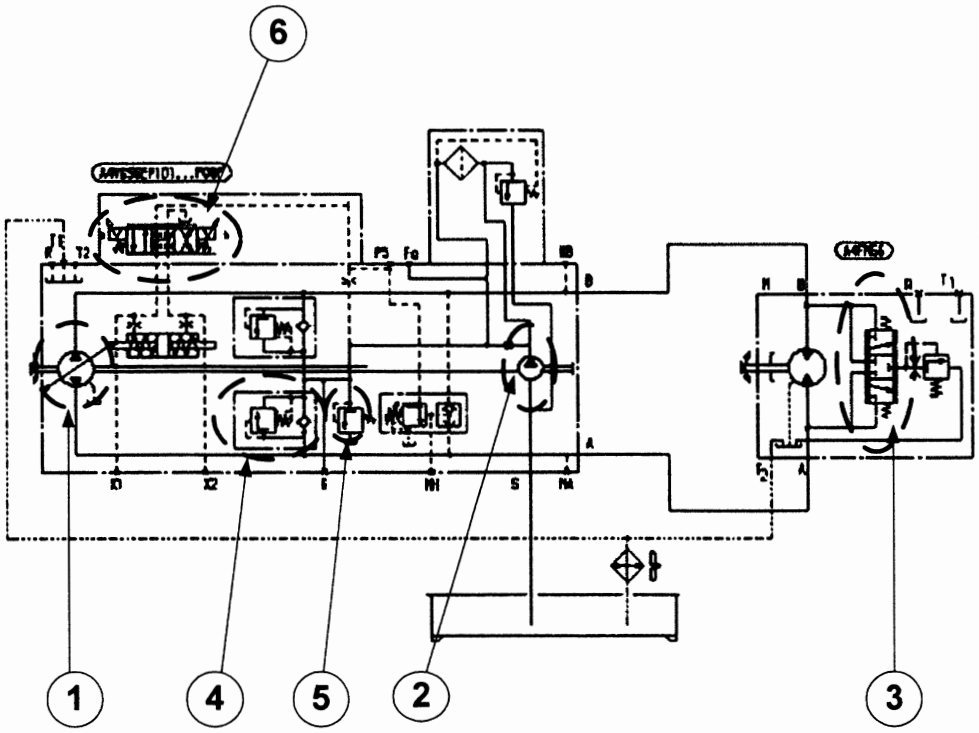
TUT
Faculty of Automation, Mechanical and Material Sciences

IHA-2307 Mobile Machines
Exam 17.12.2010 / Kalevi Huhtala
All the five exercises give equally 6 points. Total amount of points are 30.

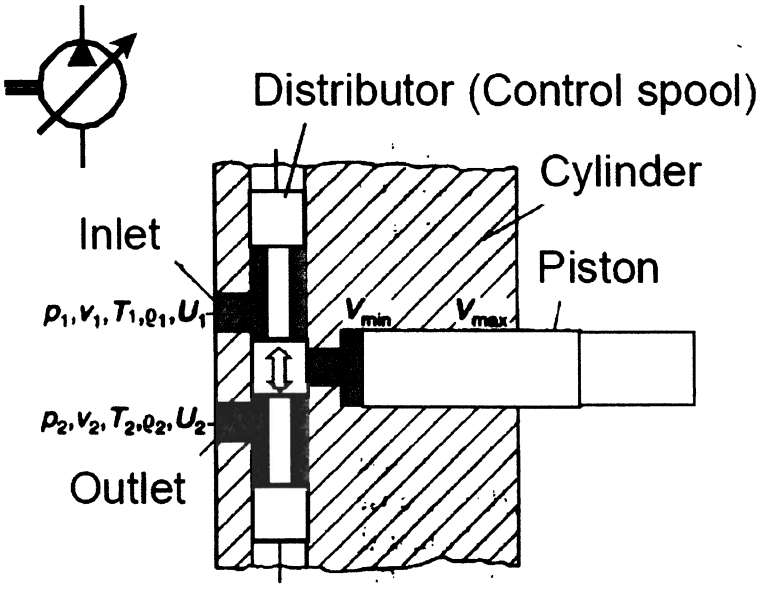
1. There are six (6) statements below. You have to answer whether they are right or wrong.
    a) In constant flow hydraulic systems the hydraulic pump is fixed capacity type ?
    b) Directional valves at mobile applications have normally spools with zero overlap region ?
    c) The damping of the hydraulic system is only dependent on friction ?
    d) The radial piston pumps are more commonly used in hydrostatic transmission systems than the axial piston pumps ?
    e) The basic open loop hydraulic systems are constant flow, constant pressure and load-sensing systems ?
    f) The turbulent flow is linearly dependent on the pressure across the valve?

2. Variable displacement hydraulic pump and motor are connected with pipes and valves which cause a 10% pressure loss of the supply pressure of the hydraulic pump. The hydraulic motor is loaded with constant torque, T_m = 28 Nm. Maximum displacement of the pump and the motor is $V_{pmax} = V_{mmax}$ = 50 cm^3/ r. The rotational speed of the pump is n_p = 1000 r/min. The rotational speed control of the hydraulic motor has been carried out as follows. First the displacement of the hydraulic motor is in its maximum value, and the displacement of the hydraulic pump is at its minimum value. Then the displacement of the hydraulic pump is increased to the maximum value. From this point the rotational speed of the motor can be increased only by decreasing its displacement. In this case the motor and pump are assumed ideal. Calculate:
    a) What is the displacement of the hydraulic motor at 2500 rpm?
    b) What is the set point of the pressure relief valve when the rotational speed of the motor is limited to 5000 rpm? The constant load in this case is 28 Nm
    c) What is the set point of the pressure relief valve when the displacement of the pump is set to 50% and the rotational speed of the hydraulic motor is 5000 rpm? The constant load in this case is 11.5 Nm

3. There is below the hydraulic diagram of the hydrostatic power transmission (a closed loop hydraulic system). Name the numbered components of the hydraulic system and explain their operation in the system briefly.



4. Explain working principle (with pressure and volume diagram) of displacement unit (figure next page). First ideal case which means that compressibility and friction is neglected. How the diagram changes if the compressibility and viscous friction is taken into account?



5. Calculate cylinder velocity, power loss and effective power of the following hydraulic circuit. When the system has a constant flow pump (maximum flow of 20 l/min), system pressure after pump is 200 bar (pressure relief valve set pressure is 200 bar), the variable orifice is in the piston side of the cylinder, piston ~~rod side~~ area is 20 cm2, pressure after variable orifice is 50 bar (pressure effecting by the load) and the flow through orifice is 5 l/min?