

## Task 9: Ferroresonance Phenomena Measurement

(Laboratory F1-116)

In the circuit with a nonlinear inductance observe and record transition to the ferroresonance state. Perform the following measurements:

- Record current and induced voltage waveforms during the transition to the ferroresonance state for capacity  $C = 4 \mu\text{F}$ .
- From measured data plot the dependency of magnetic flux on current  $\Phi = f(i)$ .
- Measure dependencies of  $V_2 = f(V_1)$  during the transition to the ferroresonance state for two capacitances  $C = 4$  and  $40 \mu\text{F}$  for both increasing and decreasing voltage  $V_1$ .

$V_1$  is voltage on the output of the control transformer;

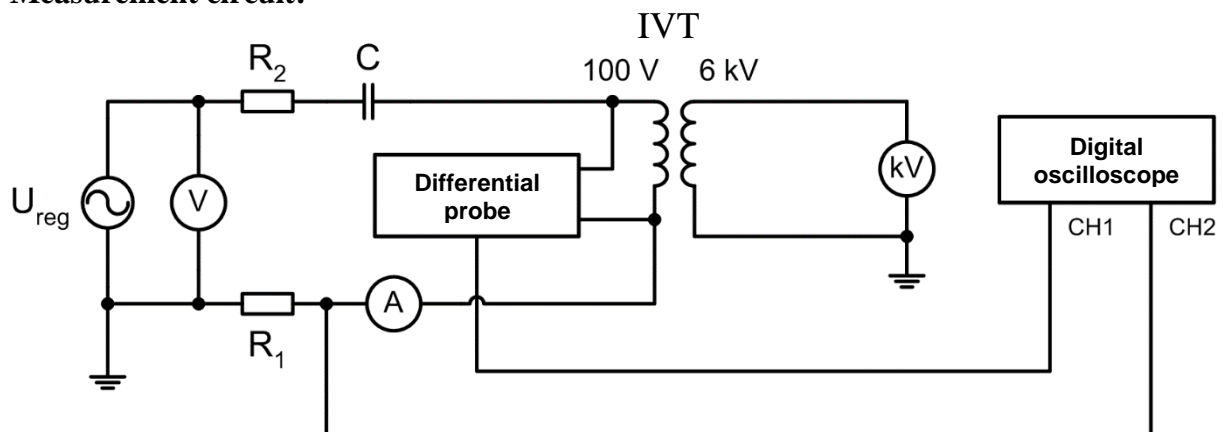
$V_2$  is high voltage on the 6 kV side of instrument voltage transformer (IVT).

Dependencies should be measured for three values of resistivity  $R_2$  (for  $C = 4 \mu\text{F}$ : 100, 50 and  $5 \Omega$ ; for  $C = 40 \mu\text{F}$ : 100, 70 and  $35 \Omega$ ).

### Used equipment:

$U_{\text{reg}}$	control transformer 0 - 250 V
IVT	instrument voltage transformer 6 kV/100 V
A	ammeter up to 20 A
V	voltmeter up to 260 V
kV	electrostatic kilo-voltmeter up to 30 kV
$R_1, R_2$	sensing and load resistors
C	capacitor 4 or $40 \mu\text{F}$
	Digital oscilloscope
	Differential probe

### Measurement circuit:



**Evaluation of the measurement:**

Ad b)

The recorded time dependency of induced voltage  $u_i(t)$  has to be processed by numerical integration (e.g. in software Matlab, Mathematica, Excel, ...).

The time dependency of magnetic flux  $\varphi(t)$  on instrument voltage transformer (IVT) is calculated by numerical integration of  $u_i(t)$ . The final plot of  $\varphi = f(i)$  can be then created.

Ad c)

The dependency  $V_2=f(V_1)$  has a different shape in the case when the voltage is decreasing and in the case when the voltage is increasing (hysteresis dependency – i.e. the state of a system depends on previous state). From this reason it is important to keep the same direction of voltage control during both phases of measurement. In the first phase the voltage is increased up to maximum value  $1.5 U_{1n}$  (on 100 V side of instrument voltage transformer) and in the second phase the voltage is decreased back to zero value. More measured points should be recorded in the area where the system goes to the ferroresonance state.