MEDIAN   Autumn *2018*

Duration : **90** minutes

- You are advised to take knowledge of the entire text before answering any question.
- Answers must respect the used notation and specify in each case the question number.
- Most attention will be given to the clarity of writing, presentation, the diagram and the presence of measurement unit
Results will be put in frames

Exercises are independent
Documentation: A4 double face is authorized (handwritten), Calculator authorized, phone forbidden

Exercise 1:

A Hoist (monte-charge) has to lift a weight of 300kg to a high of 6m during 12s.

1. Calculate the requested work and power.
2. The winch (treuil) on which the cable is wrapped has a diameter of 30cm. Calculate the rotational speed and the torque developed by this winch.
3. This winch is driven by a motor having a speed of n=1500 RPM (revolution per minute). A gearbox is used to reduce the motor speed. The mechanical transmission (gearbox + winch) has an efficiency of 85%.
     Calculate the motor useful power and the developed torque.
4. Calculate the electrical power consumed by the motor if the efficiency of the motor is 90%.

Exercise 2:

A small factory is supplied in single phase under 230 [V] 50 [Hz]. It has connected in parallel:
     20 lamps of 100 [W] each and a motor of 4 [kW] having a cos φ of 0.75

1) When all electrical devices are turned ON, calculate the following:
     a- Active Power, Reactive power, Apparent power,
     b- Current in the line (phase),
     c- The total power factor.
2) EDF proposes the following costs (2018) of subscription to the grid as function of the installed apparent power:

Installed power (kVA)	Yearly subscription fees TTC (Euros)
3	69
6	107
9	125
12	143,5

Depending on your calculations in question 1), what would be the adequate installed power to be subscribed ?
3) In case of a use on 12 hours/day, 5 days/week, 40 weeks/year, calculate the energy bill considering a cost at 15c€/kWh.
4) Calculate the capacity bank to be installed to obtain a phase shift of 0° when all devices are on.
5) Redo question 2) with the new phase shift, how much money could be saved (if any) (we admit in addition, that EDF applies a tax of 50€/year on factories with cos φ < 0.93) ?
6) Suppose a cost of 50 € for the added capacitance of the question 4) Calculate the payback time of this solution ?
7) Beside the direct calculation of the question 5), are there any other advantages to increase the power factor ?