The database structure is based on a hierarchical principle. It includes two main branches: people and groups. The branch of the group in turn is divided into employees and students, which are also divided by the structural subdivision (Fig.3).

LDAP Account Manager has been selected as the system for managing graphical the LDAP database management system. This system allows you to work with the record tree directly, and through a convenient and flexible interface, which also has the ability to preprogramming and customizing. The system supports various authentication and expansion modules (“Authentication Plugins”, 2017). For ease of operation has been made the localization of the interface into the Ukrainian language.

To log in to the administration system, you must go to the address http://login.kubg.edu.ua/lam (“Centralized authentication using OpenLDAP”, 2017). A general view of the user list is presented at (Fig.4).

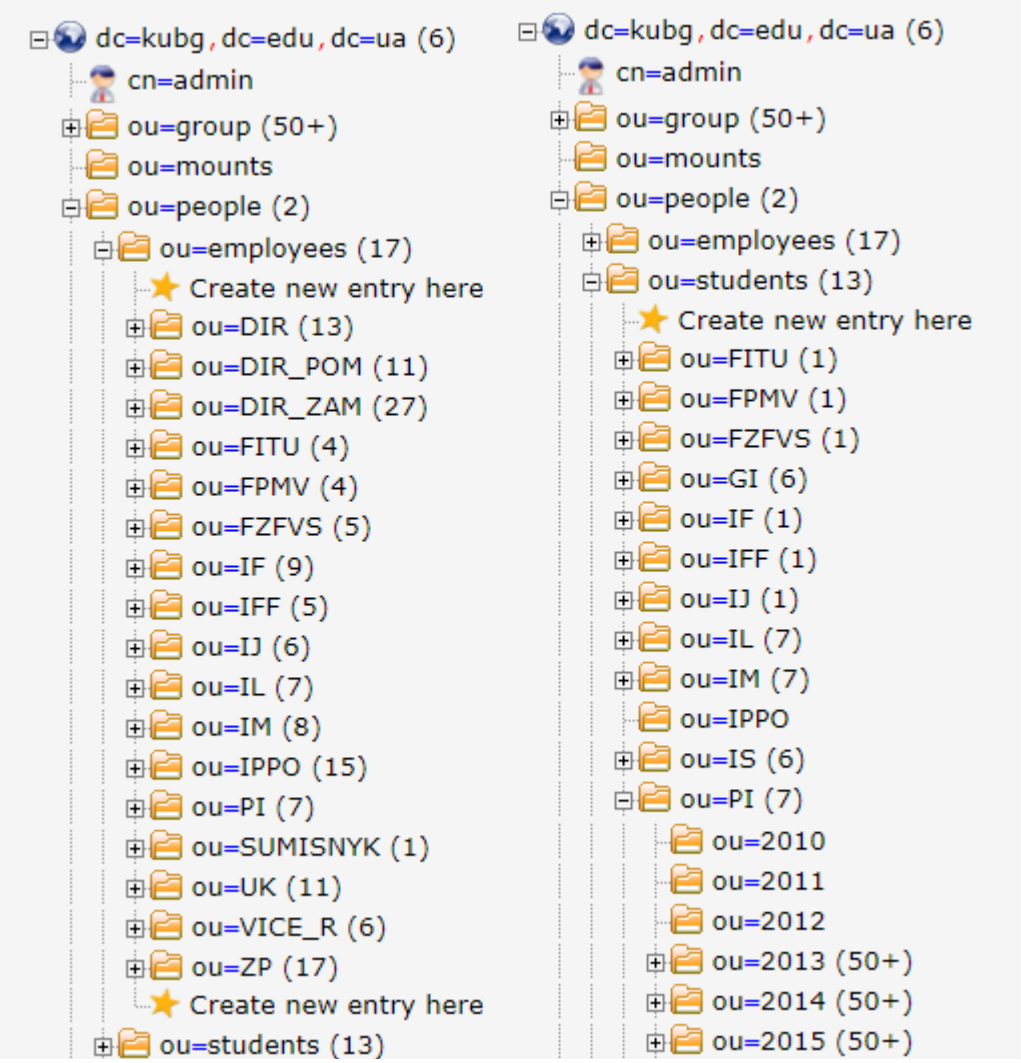

Fig.3. Database structure

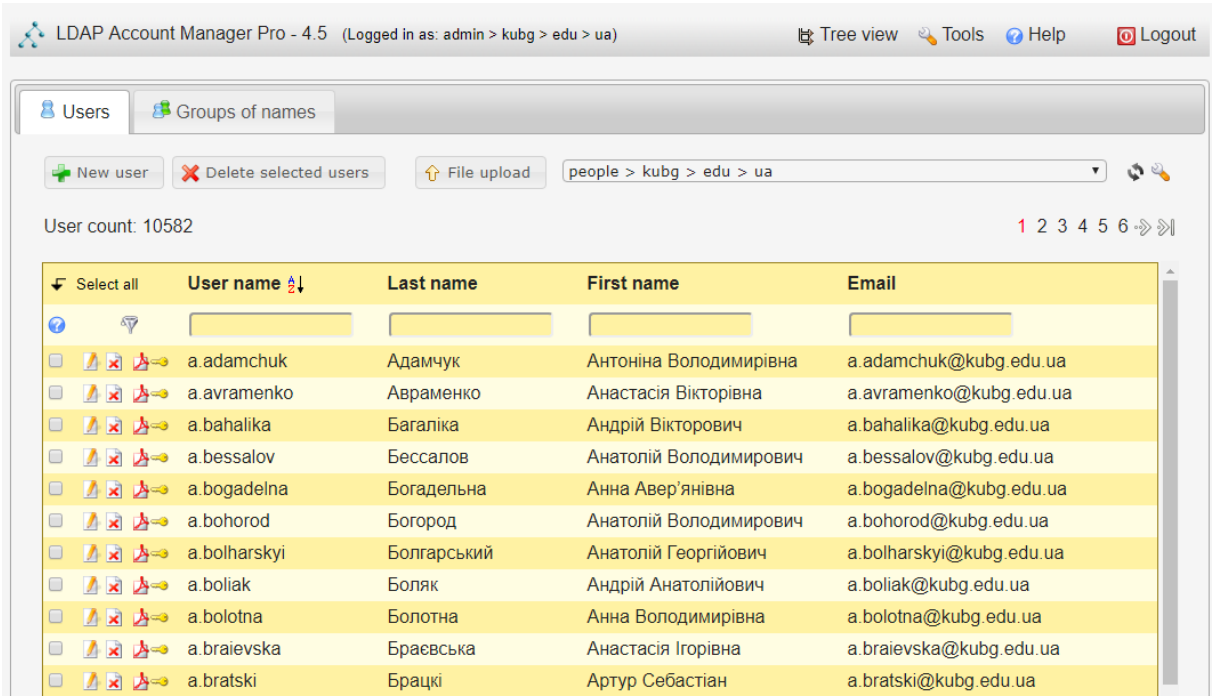

Fig.4. General view of the user list

The module Users with the initOrgPerson schema are connected to work with users. Student groups are connected to the Schema Name Group module groupOfUniqueNames (Fig.5).

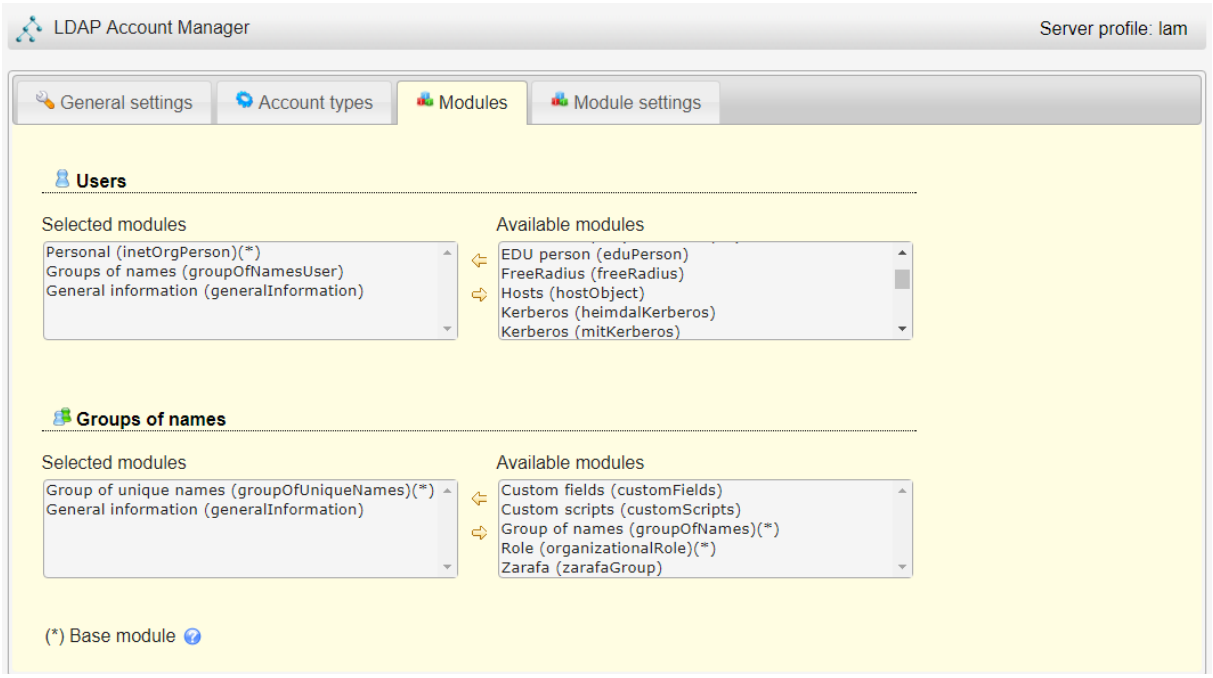

Fig.5. Display of connected modules

To implement a single sign-on page, the idea of which was that for the input to any resource or system of information and educational environment of the university user will be redirected to the single sign-on page to the environment (Fig.1). After successful

authentication, the user selects the necessary resource (Fig.2) and enters without the need for re-entering the credentials (“LDAP Properties for CSVDE and VBScript”, 2017).

To realize this possibility was selected the CAS system (Central Authentication Service) (http://jasig.github.io/cas/4.0.x/index.html). This system is written using java servlets. Therefore, there was a need for Apache Tomcat to use it. The corresponding software has been installed on the server and configured to work with our LDAP database. There were also programmed forms for authentication in corporate colors and template decisions taken at the University:

- entry form;
- the form of a productive entry;
- the form of denial of entry.

In order to synchronize the University's corporate mail and available Google services with the LDAP database, we use the Google Apps Directory Sync program developed by Google (Oleksiuk, 2013). Currently not all features are used, but only synchronization of the structure and all users in Google Apps. As a result creating and editing users is one-time and only in the base LDAP. Next, as a result of synchronization, the corresponding accounts are created in the Google Apps environment.

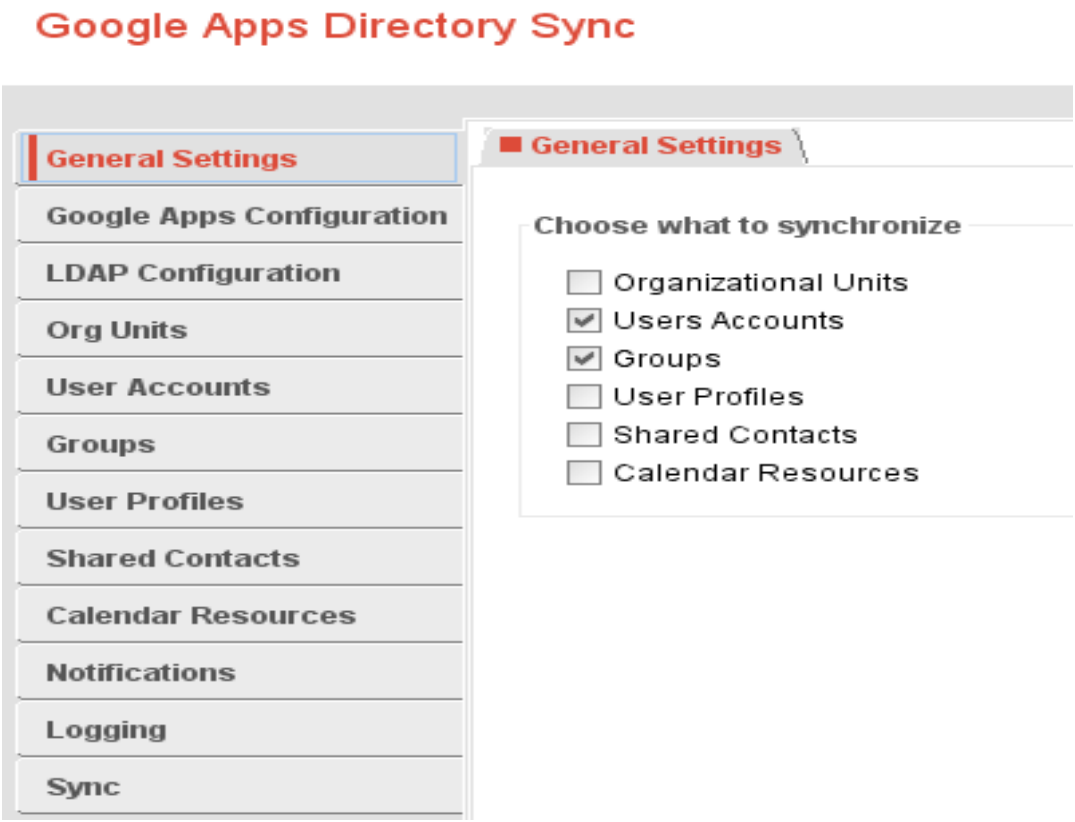

Fig.6. View of Google Apps Directory Sync

The next task is to connect the user application user database to the LDAP:

- e-learning system http://e-learning.kubg.edu.ua;
- Wiki portal of the University http://wiki.kubg.edu.ua;
- scientific conferences and seminars http://conf.kubg.edu.ua;
- e-portfolio http://eportfolio.kubg.edu.ua;
- institutional repository http://elibrary.kubg.edu.ua;

- base of master's works with the verification of plagiarism http://resbase.kubg.edu.ua;
- database of university registries http://rg.kubg.edu.ua and others.

Let us consider some of the connection.

The e-learning system is based on the Moodle platform, which already has an appropriate module for authenticating users through the LDAP database. This module should only be enabled and configured. To do this, you had to go through the link http://e-learning.kubg.edu.ua/admin/auth_config.php?auth=ldap and fill out the specified elements of the form. Fragment shape configuration shown on (Fig.7).

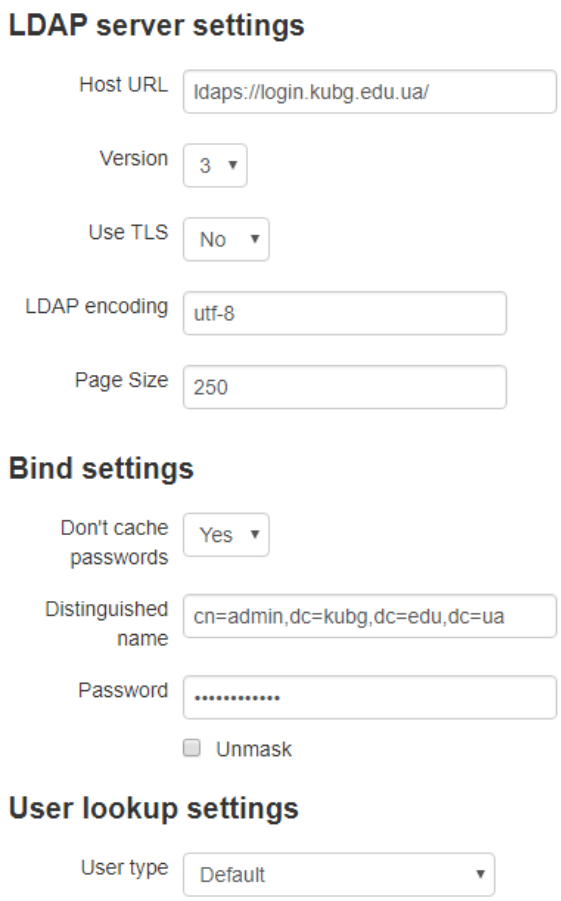

Fig.7. Fragment of the module configuration form

To synchronize groups from LDAP to the cohort, the local module local_ldap was installed in the Moodle system. Using it from the LDAP database to Moodle, the groups are transferred as cohorts and the necessary students are added to them. Thus, even placing students in groups is done only once in the LDAP database, and then only synchronized.

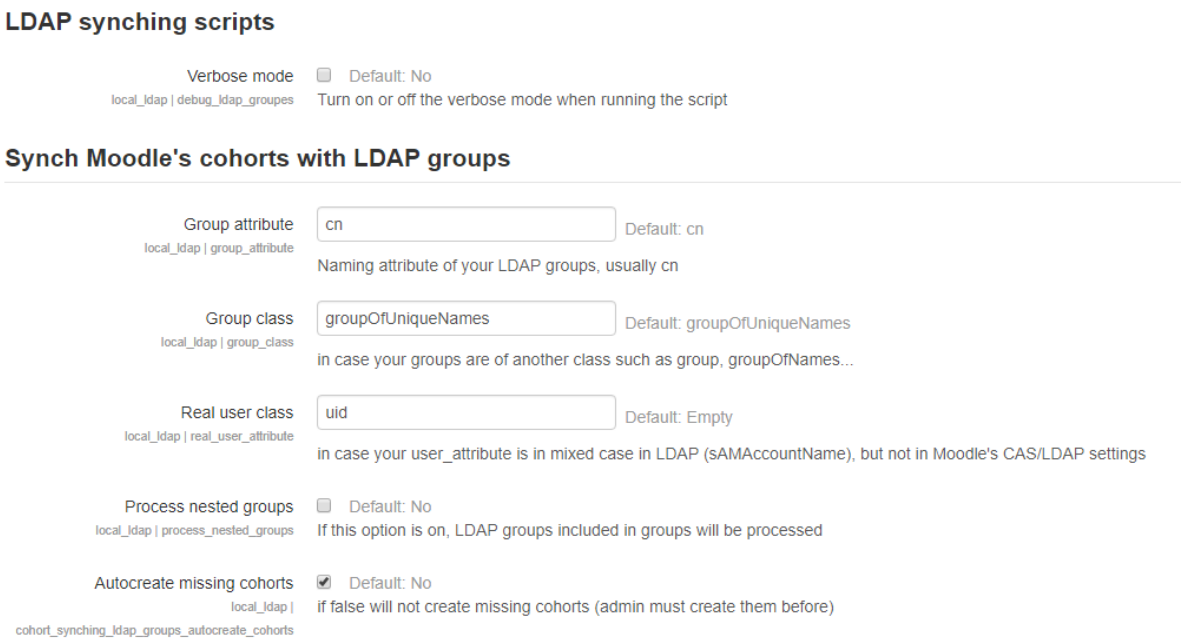

Fig.8. Fetch group sync setting

The Wiki University portal runs on the MediaWiki engine, which also includes the ability to authenticate through the LDAP database. To do this, the LDAP Authentication (LdapAuthentication) module was installed and connected and its settings specified in the LocalSettings.php file. Below is a listing of settings that apply to LDAP authentication.

```
# LDAP authentification
require_once "$IP/extensions/LdapAuthentication/LdapAuthentication.php";
$wgAuth = new LdapAuthenticationPlugin();
$wgLDAPDomainNames = array( 'kubgLDAP');
$wgLDAPServerNames = array( 'kubgLDAP' => 'login.kubg.edu.ua');
$wgLDAPSearchAttributes = array( 'kubgLDAP' => 'uid');
$wgLDAPUserBaseDNs = array('kubgLDAP' => 'ou=people,dc=kubg,dc=edu,dc=ua');
$wgLDAPEncryptionType = array('kubgLDAP' => 'ssl');
$wgLDAPPort = array('kubgLDAP' => 636,);
$wgLDAPProxyAgent =  array('kubgLDAP' => 'cn=admin,dc=kubg,dc=edu,dc=ua');
$wgLDAPProxyAgentPassword = array('kubgLDAP' => '**************');
$wgLDAPPasswordHash = array('kubgLDAP' => 'md5');
$wgLDAPPreferences = array('kubgLDAP' => array( 'email' => 'mail','realname' =>
'cn','nickname' => 'uid','language' => 'preferredlanguage'));
 $wgMinimalPasswordLength = 1;
```

To save previous accounts, local authentication is allowed along with LDAP authentication. But the detected duplicate accounts can be merged into one. These minor technical changes may be made by an administrator or employee with the appropriate rights. Fig. 9 shows the login form with the domain selection - for the login with the LDAP account you must select “login.kubg.edu.ua”.

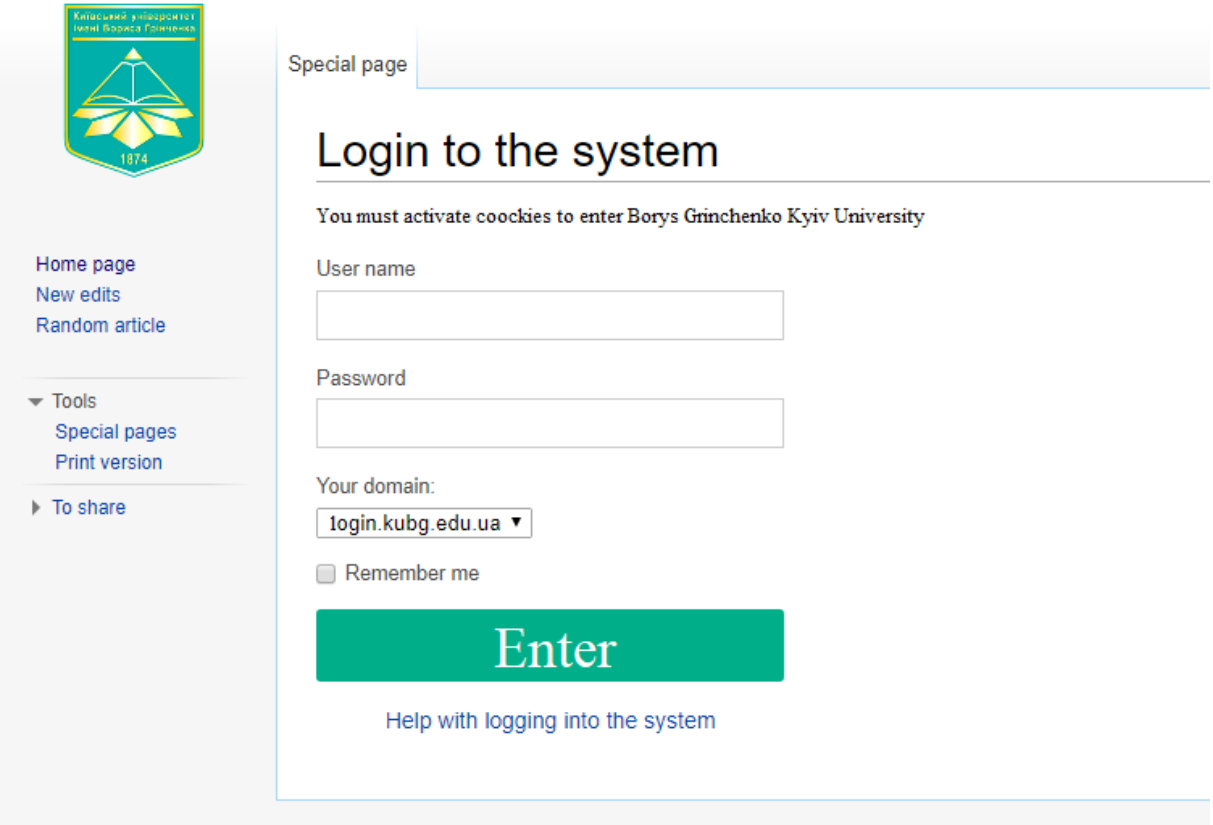

Fig.8. University entrance page to the Wiki

The system of scientific conferences and seminars is based on the open conference system engine, which also includes a module for LDAP authentication (Halatenko, 2017). But the specificity of this module is that the user must fill in the registration form in any case, indicating in it the same data that it has in the LDAP database. This approach is not very user-friendly. Therefore, reprogramming of the LDAP authentication module was implemented. All changes affected only one file.

LDAP authentication is set alongside (without exception) standard registration and authentication in the system itself. Figure 9 shows the LDAP authentication configuration form.

As a result, users who have an account in the LDAP database log in using their login and password. External users are able to register in the system as before.

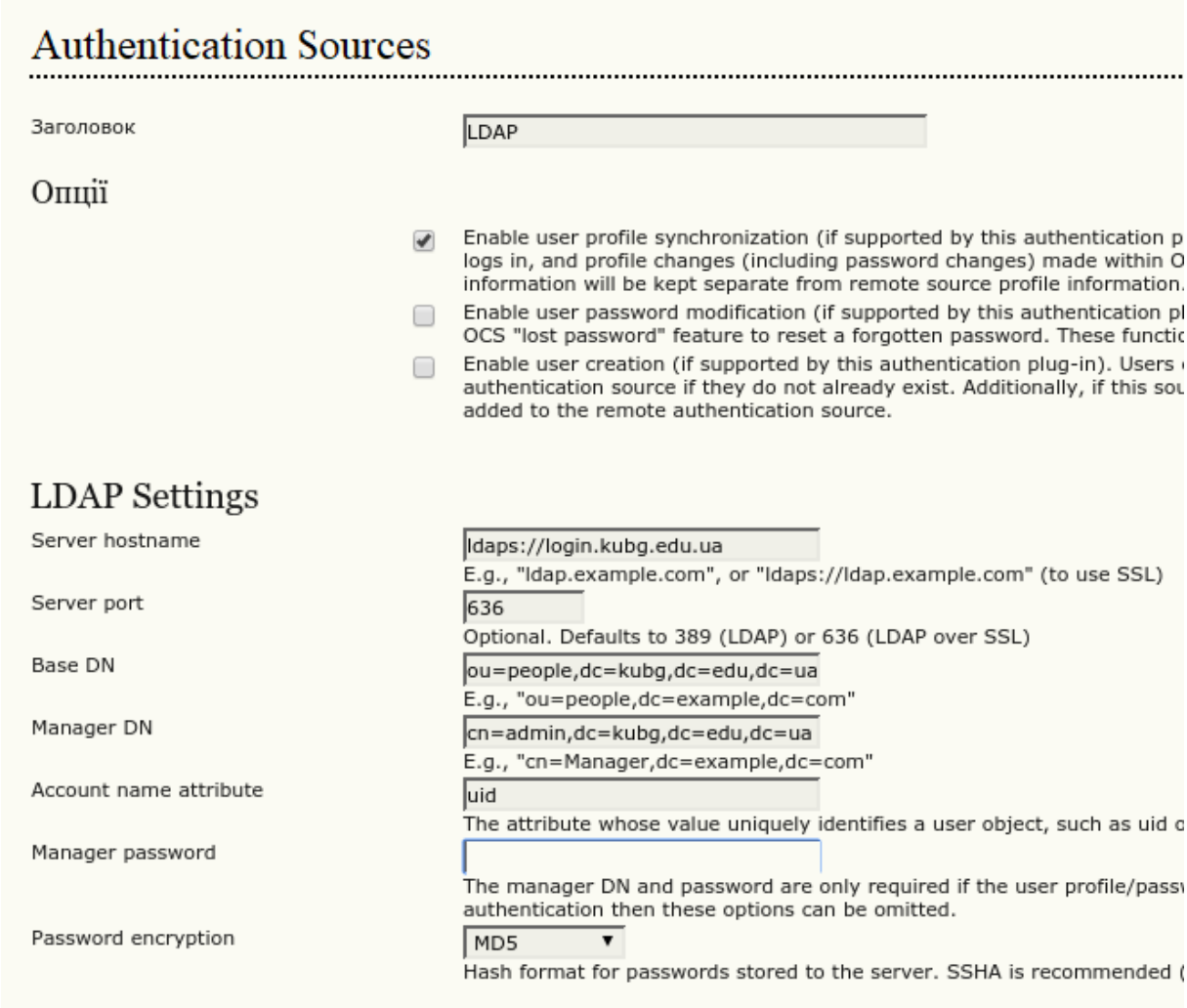

Fig.9. LDAP Authentication Configuration Form

In general, the integration of educational electronic resources into a single information and educational environment is very important for the university, since:

- the single entry point for all resources and systems is used;
- authentication of all university users and configuration management is provided;
- there is coordination of functions and data exchange between components of the e-environment;
- a single approach to data storage and high speed access to them is carried out;
- enhanced protection of information from unauthorized access.

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