

# MUHANDISLIK

## & IQTISODIYOT

# №2

ijtimoiy-iqtisodiy, innovatsion texnik,  
fan va ta'limga oid ilmiy-amaliy jurnal

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ТАШКЕНТСКИЙ ФИЛИАЛ



# **muhandislik** **& iqtisodiyot**

ijtimoiy-iqtisodiy, innovatsion texnik,  
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- 05.01.01 – Muhandislik geometriyasi va kompyuter grafikasi. Audio va video texnologiyalari
- 05.01.02 – Tizimli tahlil, boshqaruv va axborotni qayta ishlash
- 05.01.03 – Informatikaning nazariy asoslari
- 05.01.04 – Hisoblash mashinalari, majmualari va kompyuter tarmoqlarining matematik va dasturiy ta'minoti
- 05.01.05 – Axborotlarni himoyalash usullari va tizimlari. Axborot xavfsizligi
- 05.01.06 – Hisoblash texnikasi va boshqaruv tizimlarining elementlari va qurilmalari
- 05.01.07 – Matematik modellashtirish
- 05.01.11 – Raqamli texnologiyalar va sun'iy intellekt
- 05.02.00 – Mashinasozlik va mashinashunoslik
- 05.02.08 – Yer usti majmualari va uchish apparatlari
- 05.03.02 – Metrologiya va metrologiya ta'minoti
- 05.04.01 – Telekommunikatsiya va kompyuter tizimlari, telekommunikatsiya tarmoqlari va qurilmalari. Axborotlarni taqsimlash
- 05.05.03 – Yorug'lik texnikasi. Maxsus yoritish texnologiyasi
- 05.05.05 – Issiqlik texnikasining nazariy asoslari
- 05.05.06 – Qayta tiklanadigan energiya turlari asosidagi energiya qurilmalari
- 05.06.01 – To'qimachilik va yengil sanoat ishlab chiqarishlari materialshunosligi
- 05.08.03 – Temir yo'l transportini ishlatish
- 05.09.01 – Qurilish konstruksiyalari, bino va inshootlar
- 05.09.04 – Suv ta'minoti. Kanalizatsiya. Suv havzalarini muhofazalovchi qurilish tizimlari
- 10.00.06 – Qiyosiy adabiyotshunoslik, chog'ishtirma tilshunoslik va tarjimashunoslik
- 10.00.04 – Yevropa, Amerika va Avstraliya xalqlari tili va adabiyoti
- 08.00.01 – Iqtisodiyot nazariyasi
- 08.00.02 – Makroiqtisodiyot
- 08.00.03 – Sanoat iqtisodiyoti
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- 08.00.05 – Xizmat ko'rsatish tarmoqlari iqtisodiyoti
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- 08.00.07 – Moliya, pul muomalasi va kredit
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- 08.00.11 – Marketing
- 08.00.12 – Mintaqaviy iqtisodiyot
- 08.00.13 – Menejment
- 08.00.14 – Iqtisodiyotda axborot tizimlari va texnologiyalari
- 08.00.15 – Tadbirkorlik va kichik biznes iqtisodiyoti
- 08.00.16 – Raqamli iqtisodiyot va xalqaro raqamli integratsiya
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# MUNDARIJA

RIVOJLANGAN MAMLAKATLAR BANKLARIDA RISK-MENEJMENTNING TASHKILYI MODELLARI.....	26
<b>Madaminov Bekzod Allayarovich</b>	
“HUDUDGAZTA‘MINOT” AJ DA AMALGA OSHIRILGAN LOYIHALAR SAMARASI .....	32
<b>Shukurillaev Jahongir Botir o‘g‘li</b>	
HARBIY XIZMATCHI AYOLLARNING MAXSUS KIYIM SIFATIGA QO‘YILADIGAN DASTLABKI TALABLARNI SHAKLLANTIRISH .....	37
<b>Abduraxmanova N.D., Mirtolipova N.X., Nasirullayeva G.S.</b>	
СОВРЕМЕННОЕ СОСТОЯНИЕ ПРОБЛЕМЫ НЕСПЕЦИФИЧЕСКОГО ЯЗВЕННОГО КОЛИТА У ДЕТЕЙ .....	42
<b>Закирова Бахора Исламовна, Каримов Достон Рустам угли</b>	
ОЦЕНКА ВОЗДЕЙСТВИЯ ФИСКАЛЬНЫХ И КРЕДИТНЫХ ИНСТРУМЕНТОВ НА РЫНКИ ВЫСОКОЛИКВИДНОЙ ПРОДУКЦИИ И ЕСТЕСТВЕННЫХ МОНОПОЛИЙ В РЕСПУБЛИКЕ УЗБЕКИСТАН.....	48
<b>Бекзод Умматов</b>	
ТРАНСФОРМАЦИЯ СИСТЕМ БУХГАЛТЕРСКОГО УЧЕТА В УСЛОВИЯХ ЦИФРОВИЗАЦИИ: СРАВНИТЕЛЬНЫЙ ЭКОНОМИКО-СТАТИСТИЧЕСКИЙ АНАЛИЗ ЭФФЕКТИВНОСТИ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА.....	55
<b>Вахидов Азизжон Саиджонович</b>	
SUG‘URTA FAOLIYATIDAGI MOLIVAVIY RISKLAR: BAHOLASH VA MINIMALLASHTIRISH STRATEGIYALARI .....	58
<b>Xalikulova Shirin Utkir qizi</b>	
“ANDIJONDONMAHSULOT” AJ MISOLIDA XARAJATLARNING STRATEGIK BOSHQARUV HISOBİ: AMALIY TAHLIL VA TAKOMILLASHTIRISH TAVSIYALARI .....	62
<b>Xayitboyeva Laylo Oybekovna</b>	
XORIJYIY MAMLAKATLARNING NORASMIY IQTISODIYOT DARAJASINI PASAYTIRISHDAGI TAJRIBASI .....	66
<b>Alimardonov G‘ayratjon Nuraliyevich</b>	
XO‘JALIK YURITUVCHI SUBYEKTLARDA BARQARORLIK HISOBOTLARI AUDITINI SHAKLLANTIRISH .....	72
<b>Xolikov Ravshan Anvar o‘g‘li</b>	
PUL - KREDIT SIYOSATINING TRANSMISSION MEXANIZMINI RIVOJLANTIRISH .....	76
<b>Obidova Zilola Ikromjon qizi</b>	
HOMILADORLIK DAVRIDA AYOLLARDA UCHRAYDIGAN GESTOZLI KATARAL GINGIVITNI KOMPLEKS DAVOLASHNI OPTIMALLASHTIRISH .....	81
<b>Nomurodova Farangiz Lazizovna</b>	
AGRAR KORXONALARDA INNOVATSION TEXNOLOGIYALARNI JORIY ETISHDA INVESTITSIYA MEXANIZMLARINING IQTISODIY SAMARADORLIGI VA RIVOJLANTIRISH YO‘NALISHLARI .....	87
<b>Egamberdiyev Abdujabbor Xusanovich</b>	
YOSHLAR TADBIRKORLIGI VA KICHIK BIZNES IQTISODIYOTINI TA‘MINLASHDA INFRATUZILMALARDAN FOYDALANISH IMKONIYATLARI .....	92
<b>Mirzatov Baxtiyor Toxirovich</b>	
KICHIK BIZNES SUBYEKTLARI FAOLIYATINI BAHOLASH METODOLOGIYASINING MAZMUNI VA TAMOIYILLARI .....	96
<b>Mavrulov Ravshan Nematjonovich</b>	



УПРАВЛЕНИЕ ИНФОРМАЦИОННЫМИ КОММУНИКАЦИЯМИ В ПРОЕКТАХ .....	101
<b>Носирова Гулираъно Абдулазиз кизи</b>	
DAVLAT BUDJETI JARAYONIDA MONITORING VA MOLIYAVIY NAZORATNI TAKOMILLASHTIRISH MASALALARI .....	107
<b>Yax'yayeva Dilfuza Bagdatovna</b>	
XIZMAT KO'RSATISH SOHASIDA KICHIK KORXONALAR RAQOBATBARDOSHLIGINI OSHIRISH MEKANIZMLARINI TAKOMILLASHTIRISH .....	111
<b>Axmedov Sanjar Temur o'g'li</b>	
RAQAMLI MOLIYA TEXNOLOGIYALARI EVOLYUTSIYASINING ISTIQBOLLI YO'NALISHLARI VA YUZAGA KELISHI MUMKIN BO'LGAN XATARLAR TAHLILI .....	117
<b>Ko'chimov Jahongir Shuxrat o'g'li</b>	
GAZ VA GAZ KONDENSATINI YIG'ISH VA TAYYORLASH TIZIMLARI UCHUN ZAMONAVIY LOYIHALASH USULLARI TAHLILI .....	123
<b>Abdirazakov Akmal Ibragimovich Namozov Og'abek Maxmud o'g'li</b>	
AGILE PROJECT MANAGEMENT IN THE DIGITAL ERA: STRATEGIES, FRAMEWORKS, AND BEST PRACTICES FOR SUCCESS .....	128
<b>Utkirova Maftuna Murodjon qizi</b>	
O'ZBEKISTON EKSPORTYOR KORXONALARINING YANGI BOZORLARGA CHIQUISHIDA FAOL MARKETING VOSITALARIDAN FOYDALANISH HOLATI VA MUAMMOLARI .....	134
<b>Baqoyev Sunnatillo Burxon o'g'li</b>	
TADBIRKORLIK FAOLIYATIGA RAQAMLI TEXNOLOGIYALARNI JORIY ETISHNING ILMIIY-NAZARIY ASOSLARI .....	139
<b>Salaydinov Shodiyor Nizom o'g'li</b>	
TO'QIMACHILIK SANOATIDA INVESTITSION LOYIHALARNI BOSHQARISH METODOLOGIYASINI TAKOMILLASHTIRISHNING TASHKILIIY-IQTISODIY JIHA TLARI .....	144
<b>Qurbonov Jasurbek Pozilovich</b>	
OPTIMIZATION OF ROADSIDE AUTO CAMPING SITES (REST AREAS) ON HIGHWAYS USING ARTIFICIAL INTELLIGENCE: INFRASTRUCTURE GAPS AND CORRIDOR-BASED EVIDENCE FROM UZBEKISTAN .....	150
<b>Akramov Akbarjon Akmal ugli</b>	
QURILISH KORXONALARIDA INNOVATSION MARKETING YONDASHUVLARINING AHAMIYATI .....	156
<b>Aminov Abbas Mo'minboy o'g'li</b>	
XIZMAT KO'RSATISH SOHASIDA AHOLI ISH BILAN BANDLIGI SAMARADORLIGINI IFODALOVCHI KO'RSATKICHLAR .....	160
<b>Abdusaidov Akmal Abduvaliyevich</b>	
MINTAQADA XUSUSIY TIBBIYOT MUASSASALARIDA MARKETING STRATEGIYASI .....	165
<b>Yakubov Temur G'anibekovich</b>	
AHOLI DEMOGRAFIK JARAYONLARINI IFODALOVCHI STATISTIK KO'RSATKICHLAR TIZIMI .....	169
<b>Siroj Zarina Rustambekovna</b>	
AXBOROT MAHSULOTLARI BIZNESINING YAIM VA BANDLIKKA TA'SIRI: EKONOMETRIK TAHLIL .....	176
<b>Abdullayev Abdulla Fayzulla o'g'li</b>	
RAQAMLI IQTISODIYOT SHAROITIDA SOG'LIQNI SAQLASH TIZIMINI IQTISODIY SAMARADORLIGINI OSHIRISHNING KONSEPTUAL ASOSLARI .....	181
<b>Ziyodullayev Qahramon</b>	
ЭНЕРГОЭФФЕКТИВНОСТЬ: ПОЛЬЗА ДЛЯ ЭКОНОМИКИ И ЭКОЛОГИИ .....	185
<b>Хамдамова Гавхар Абсаматовна</b>	
O'ZBEKISTONDA EKSPORTNI RAG'BATLANTIRISHNING MOLIYAVIY VOSITALARI VA ULARNI TAKOMILLASHTIRISHNING ASOSIY YO'NALISHLARI .....	191
<b>Mamatov Baxodir Quldoshovich</b>	



KO'P QIRRALI VALLARNING SHAKLLANTIRISH METODLARI VA USULLARINI TAHLIL QILISH .....	197
<i>Xasanov Bobirmirzo Maxmudali o'g'li, Valixonov Dostonbek Azim o'g'li, Alibekov Rasulbek Qanotbek o'g'li</i>	
MINTAQA SANOATINING TARKIBIY TRANSFORMATSIYASI VA UNNING IQTISODIY O'SISHGA TA'SIRINI EKONOMETRIK MODELASHTIRISH .....	205
<i>Abdinazarov Xusan Shaymanovich</i>	
RAQAMLI TRANSFORMATSIYA SHAROITIDA SUG'URTA BOZORINING RAQOBATBARDOSHLIGINI OSHIRISH .....	209
<i>Nomozova Qumri Isoyevna</i>	
XALQARO STANDARTLAR TALABLARI ASOSIDA AUDITORLIK TEKSHIRUVINI TASHKIL ETISHNING ILMIY-NAZARIY ASOSLARI .....	216
<i>Akromov Shohrux Shuhrat o'g'li</i>	
QASHQADARYO VILOYATIDA XIZMATLAR SOHASINING RIVOJLANISHNI TARTIBGA SOLISH TIZIMI .....	221
<i>Achilova Firuza Kurbanovna</i>	
BANK MENEJMENTIDA INKLYUZIV MOLIYALASHTIRISHNING NAZARIY ASOSLARI, TAMOYILLARI VA STRATEGIK AHAMIYATI .....	225
<i>Rajabov Oybek Panjievich</i>	
MINTAQADA OLIY TA'LIM TIZIMINING ISHSIZLIK DARAJASIGA TA'SIRINI EKONOMETRIK MODELASHTIRISH .....	229
<i>Rustamov Jasurbek Ravshanbek o'g'li</i>	
MAISHIY XIZMATLAR SOHASIDA INNOVATSION KLASTER MODELINI JORIY ETISHNING USTUVOR YO'NALISHLARI .....	235
<i>Normurodova Zebo Eshmaxmatovna</i>	
RAQAMLI TEXNOLOGIYALAR ASOSIDA INVESTITSIYA FAOLIYATINI BOSHQARISH .....	240
<i>Xatamov Nurbek Ochildiyevich, Sharifi Abdul Fatah</i>	
MOLIYAVIY REJALASHTIRISHNING AMALDAGI MUAMMOLARI VA ULARNI YECHIMI YUZASIDAN TAKLIFLAR .....	245
<i>Pardayev Jamshid Muzaffarovich</i>	
TIJORAT BANKLARI LIKVIDLIK RISKLARINI BAHOLASH METODOLOGIYASINI TAKOMILLASHTIRISH MASALALARI .....	251
<i>Sulaymanov Samandarboy Adhambek o'g'li</i>	
O'ZBEKISTON TIJORAT BANKLARIDA RISKLARNI BOSHQARISH AMALIYOTINI TAKOMILLASHTIRISH .....	257
<i>Karimov Shohrux Boydulla o'g'li</i>	
"O'ZBEKISTON TEMIR YO'LLARI" AKSIYADORLIK JAMIYATINING HISOBOTLARINI XALQARO STANDARTLARGA TRANSFORMATSIYA QILISH .....	262
<i>Astanov Zafar Murodillayevich</i>	
QARAMA-QARSHI AYLANUVCHI IKKI ROTORLI SHAMOL TURBINASINING MATEMATIK MODEL .....	266
<i>Pirmatov Nurali Berdiyevich, Bekishev Allabergen Yergashevich, Saodullayev Abror Saypullayevich, Qurbonov Najmiddin Abduxamidovich</i>	
YASHIL IQTISODIYOT SHAROITIDA KICHIK VA O'RTA BIZNESNI BARQAROR RIVOJLANTIRISHNING INSTITUTIONAL VA INVESTITSION MEXANIZMLARINI TAKOMILLASHTIRISH .....	272
<i>Norboev Sarvar Azodovich</i>	
O'ZBEKISTONDA TRANSPORT SOHASIDA FAOLIYAT YURITAYOTGAN TADBIRKORLIK SUBYEKTLARINING IQTISODIY AHAMIYATI .....	277
<i>Jaloliddinov Anvar Jaloliddin o'g'li</i>	
ANALYSIS OF UZBEKISTAN'S MAIN ECONOMIC INDICATORS AND GDP GROWTH .....	283
<i>B.Beknazarov</i>	



SOTISH JARAYONIDA INNOVATSION TEXNOLOGIYALAR VA MARKETING TADQIQOTLARINING INTEGRATSIIYASI .....	288
<b>Abduxalilova Laylo Tohtasinovna</b>	
ПРИМЕНЕНИЕ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В АУДИТЕ ФИНАНСОВОЙ ОТЧЕТНОСТИ: ГЛОБАЛЬНЫЙ И УЗБЕКСКИЙ КОНТЕКСТ .....	294
<b>Мегноров Алмардон Абдирахмонович</b>	
RISK MANAGEMENT STRATEGIES IN UNCERTAIN ECONOMIC ENVIRONMENTS: A GLOBAL COMPARATIVE STUDY .....	302
<b>Nigmatova Malika</b>	
OLIIY TA'LIM MUASSASALARIDA MOLIIYAVIIY BARQARORLIKNI TA'MINLASHNING NAZARIY ASOSLARI.....	307
<b>Hamrayev Maqsudjon Saidaxmadovich</b>	
BARQAROR RIVOJLANISHNI TA'MINLASHDA AHOLI BANDLIGINI OSHIRISH MASALALARI .....	311
<b>Mamajonova Gulbaxor Toxirjon qizi</b>	
АВТОМАТИЗАЦИЯ АУДИТОРСКИХ ПРОЦЕДУР НА ОСНОВЕ ЦИФРОВЫХ ТЕХНОЛОГИЙ И МЕЖДУНАРОДНЫХ СТАНДАРТОВ: ВЛИЯНИЕ НА КАЧЕСТВО АУДИТОРСКИХ ЗАКЛЮЧЕНИЙ .....	316
<b>Киличева Ф.Б.</b>	
MAISHIY TEXNIKA EKSPORTIDA YASHIL IQTISODIY SAMARADORLIKNI BAHOLASHNING NAZARIY-METODOLOGIK ASOSLARI .....	320
<b>Kushmanova Mahbuba</b>	
GAZ TA'MINOTIDA YO'QOTISHLARNI KAMAYTIRISHNING IQTISODIY ASOSLARI .....	324
<b>Xamidov Xayriddin Faxritdinovich</b>	
DAVLAT AKTIVLARINI XUSUSIYLASHTIRISHNING MINTAQA IQTISODIY RIVOJLANISHIGA TA'SIRINI BAHOLASH (QASHQADARYO VILOYATI MISOLIDA).....	329
<b>Sharapov Farrux Shomuratovich</b>	
КРИТЕРИИ ОТБРАКОВКИ ЭКСТРУЗИОННЫХ АЛЮМИНИЕВЫХ ПРОФИЛЕЙ ГРУППЫ ALMGS1 ПО МАКРОСТРУКТУРНЫМ ПРИЗНАКАМ В ПРОИЗВОДСТВЕННЫХ УСЛОВИЯХ .....	333
<b>Ибрахимов Фаррухжон Фарходович</b>	
AKSIYADORLIK JAMIYATLARIDA DEBITORLIK QARZLARI VA FAKTORING OPERATSIYALARI HISOBINI TAKOMILLASHTIRISH .....	336
<b>G'oziyeva Mokhira Rustamovna</b>	
KULTIVATOR YUMSHATKICH PANJALARI O'TMASLANISH DARAJASINING ISH KO'RSATKICHLARIGA TA'SIRI .....	345
<b>Quvondiqov Yoqub Tursunbaevich, Nuraliyev To'liqin Alimardanovich</b>	
SANOAT KORXONALARINI BOSHQARISHDA INNOVATSION STRATEGIYANI RIVOJLANTIRISH BO'YICHA XORIJIY TAJRIBALAR .....	352
<b>To'g'onov Ibroximxo'ja</b>	
TMK KORXONASI SHAROITIDA R6AM5 MARKALI TEZKESAR PO'LATDAN TAYYORLANGAN PARMA UCHUN TERMIK ISHLOV BERISH REJIMI .....	358
<b>Djalalova Sevara Toxtamuratovna</b>	
РОЛЬ ЦИФРОВЫХ ТЕХНОЛОГИЙ В РАЗВИТИИ ИНКЛЮЗИВНОГО ОБРАЗОВАНИЯ .....	362
<b>Шоев Алим Халмуратович</b>	
TRANSFORMATSIYA VA XUSUSIYLASHTIRISH OMILLARINING BANK SAMARADORLIGI KO'RSATKICHLARIGA TA'SIRI .....	367
<b>Umirzoqova Aziza Olim qizi</b>	
SANOAT KORXONALARIDA INNOVATSION BOSHQARUV SAMARADORLIGINI OSHIRISH .....	372
<b>Ismatov Raxmatilla Oltinovich</b>	
RAQAMLI TO'LOV TIZIMLARI TADBIRKORLIK SAMARADORLIGINI OSHIRISH OMILI SIFATIDA.....	376
<b>Yoqubjonov Ibrohim G'olibjon o'g'li</b>	



BANK TIZIMIDAGI AKTIVLARINING UNUMDORLIGINI OSHIRISH BO'YICHA STRATEGIK YONDASHUVLAR .....	379
<b>Sadikov Q.M.</b>	
СЦЕНАРНОЕ МОДЕЛИРОВАНИЕ ПОВЫШЕНИЯ ЭНЕРГОЭФФЕКТИВНОСТИ ОТРАСЛЕЙ ЭКОНОМИКИ УЗБЕКИСТАНА В УСЛОВИЯХ НЕОПРЕДЕЛЁННОСТИ И СТРУКТУРНЫХ ПРЕОБРАЗОВАНИЙ .....	383
<b>Муслимова Ф.С., Хашимова Н.А.</b>	
RAQAMLI IQTISODIYOT SHAROITIDA TIBBIY XIZMATLARNI TAQDIM QILISHNING INNOVATSION YONDASHUVLARI .....	390
<b>S.M. Raximova</b>	
YANGI O'ZBEKISTONDA OLIY TA'LIM MUASSASALARI AXBOROT-RESURS MARKAZLARI FAOLIYATINI STRATEGIK BOSHQARISH MODELI .....	395
<b>Qurbanova Muazzam Fazliddinova</b>	
IQTISODIYOTNING TRANSFORMATSIYALASHUVI JARAYONIDA INVESTITSION KREDITLASHNING TAHLILI .....	399
<b>Tuxsanov Eldor Dilmurod o'g'li</b>	
RAQAMLI IQTISODIYOT SHAROITIDA EKSPORTNI RAG'BATLANTIRISH MASALALARI .....	404
<b>Abdug'aniyev Murodjon Shavkat o'g'li</b>	
XO'JALIK YURITUVCHI SUBYEKTLARNING INNOVATSION FAOLIYATINI INVESTITSIYALAR YORDAMIDA QO'LLAB-QUVVATLASH .....	408
<b>Baxriddinov Nodirbek Zamirdinovich</b>	
FRANSUZ TILIDA FE'L SEMANTIKASINING KO'PMA'NOLILIK VA BIRMA'NOLILIK ASPEKTLARI .....	412
<b>Jo'rayeva Malohat Muhammadovna, Bekmetova Munisa Karimbayevna</b>	
QORAQALPOG'ISTON RESPUBLIKASIDA ASOSIY KAPITALGA KIRITILGAN INVESTISIYALARDA CHET-EL INVESTISIYASI VA KREDITLARINI ROLI .....	418
<b>Sultanov Anvar Abdullaevich</b>	
INSON QON TOMIRLARINING TARMOQLANISHINI L-SISTEMALAR ASOSIDA HOSIL QILISH ALGORITMNI ISHLAB CHIQUV .....	423
<b>Boliyeva Dilrabo Nurbek qizi</b>	
YASHIL IQTISODIYOT LOYIHALARINI MOLIYALASHTIRISHDA DAVLAT-XUSUSIY SHERIKLIK (DXSH)NING AHAMIYATI .....	429
<b>Ergashev Axmadjon Maxmudjon o'g'li</b>	
NAMANGAN VILOYATIDA TURIZM SOHASINI RIVOJLANTIRISHNING STRATEGIK YO'NALISHLARI .....	434
<b>Otaylor Usmonaliyev</b>	
TIJORAT BANKLARIDA VALYUTA ARBITRAJI VA UNING MOHIYATI .....	440
<b>Yaxyayev Ziyodilla Lutfullayevich</b>	
TIJORAT BANKLARI TOMONIDAN ALOQA SOHASINI MOLIYALASHTIRISHNING NAZARIY JIHATLARI .....	443
<b>Mirzaraximova Aziza Azimdjanovna</b>	
DON VA UN MAHSULOTLARINI QAYTA ISHLASH KORXONALARIDA MARKETING FAOLIYATINI BOSHQARISH XUSUSIYATLARI .....	450
<b>Boyjigitov Sanjarbek Komiljon o'g'li</b>	
SURXONDARYO VILOYATIDA TUXUM ISHLAB CHIQARISHNING JORIY HOLATI TAHLILI .....	454
<b>Ismoilov Zuhridin Sayitqulovich</b>	
ZAMONAVIY TURAR-JOY ME'MORCHILIGIDA MILLIYLIK VA AN'ANAVIYLIKNING O'RNI VA AHAMIYATI .....	459
<b>Toshniyozov Otabek Hakimovich</b>	
MARKAZIY QIZILQUM FOSFORIT RUDALARIDAN QIMMATBAHO KOMPONENTLARNI KOMPLEKS AJRATISH TEXNOLOGIYASI .....	464
<b>Eshonqulov Uchqun Xudaynazar o'g'li, Ruzibayeva Dildora Akramovna, Xushvaqtova Dilshoda Shavkat qizi</b>	



BANKLARDA CHAKANA KREDITLASH JARAYONLARINI RAQAMLASHTIRISH TARTIBI .....	470
<i>Axmedova Dilrabo Kurbondurdi qizi</i>	
TADBIRKORLIK VA KICHIK BIZNESNI QO‘LLAB-QUVVATLASHNING XALQARO MODELLARI HAMDA ULARNING AMALIY AHAMIYATI .....	476
<i>Nodirbek Shavkatovich Mirzaaxmedov</i>	
DAVLAT FUQAROLIK XIZMATIDA XOTIN-QIZLARNING BOSHQARUV KARYERASI: MOHIYATI, ZARURIYATI VA ILMIY-NAZARIY ASOSLARI .....	483
<i>Abduraxmonova Feruzabonu</i>	
ASOSIY KAPITALGA INVESTITSİYALARNI MOLIYALASHTIRISHNING RIVOJLANAYOTGAN MAMLAKATLAR TAJRIBALARI .....	489
<i>Xoshimov Sobir Murtazayevich</i>	
QURILISH MATERIALLARI ISHLAB CHIQARUVCHI KORXONALARDA MARKETING FAOLIYATINING TASHKILY TUZILMASINI OPTIMALLASHTIRISH .....	495
<i>Uzakova Umida Ruziyevna</i>	
OLIY TA‘LIMNI MOLIYALASHTIRISH SAMARADORLIGI VA PROFESSOR-O‘QITUVCHI–TALABA NISBATI O‘RTASIDAGI IQTISODIY BOG‘LIQLIK.....	502
<i>Dusanov Salim Mamarasulovich</i>	
МЕЖДУНАРОДНЫЙ ОПЫТ ВНЕДРЕНИЯ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В СИСТЕМЫ AML: АНАЛИЗ ПРАКТИК ВЕДУЩИХ БАНКОВ И СТРАН СНГ .....	507
<i>Рашидов Авазбек Рахимович</i>	
BOJXONA TIZIMINI RAQAMLASHTIRISHDAGI MAVJUD MUAMMOLAR TAHLILI .....	516
<i>Radjapova Latofat Sardorovna</i>	
DEFORMATSİYALANUVCHAN STANDART CHIZIQLI QATTIQ (STANDARD LINEAR SOLID MODEL, SLS) MODEL ISHLAB CHIQISH VA SONINI TAHLIL QILISH .....	523
<i>Ahmadov Ilhom Aktam o‘g‘li, Faxriddinova Rayhona Vahobjon qizi, Rustamova Ruxsora Kamtar qizi</i>	
ВЛИЯНИЕ КЕРАМИЧЕСКИХ КОМПОЗИЦИОННЫХ ПОКРЫТИЙ НА ТЕПЛОВУЮ ЭФФЕКТИВНОСТЬ КАМЕННОГО ТЕПЛОАККУМУЛЯТОРА В СОЛНЕЧНО-АССИСТИРОВАННЫХ БИОГАЗОВЫХ УСТАНОВКАХ .....	530
<i>Д.М. Жураханов</i>	
O‘ZBEKISTONDA ISLOMIY MOLIYA TIZIMINI RIVOJLANTIRISHNING KELAJAKDAGI IMKONIYATLARI.....	537
<i>Akbarov Husniddinjon Mo‘ysin o‘g‘li</i>	
MAHALLIY BUDJETLARNI BOSHQARISHDA RAQAMLI TEXNOLOGIYALAR VA OCHIQLIKNI KUCHAYTIRISH .....	544
<i>Xolmirzayev Ulug‘bek Abdulazizovich, Normatov Joxongir Murodillayevich</i>	
DON MAHSULOTLARI TARMOG‘IDA ISHLAB CHIQARISH QUVVATLARIDAN FOYDALANISH SAMARADORLIGINI OSHIRISH MEXANIZMLARINI TAKOMILLASHTIRISH .....	548
<i>Aipova Iroda Ikramovna</i>	
BUXORO VILOYATI SANOATI ISHLAB CHIQARISHINING TARMOQ TARKIBI DINAMIKASI VA UNDAGI O‘ZGARISHLAR TAHLILI .....	554
<i>Toshov Mirzabek Hakimovich</i>	
TEMIR YO‘L TRANSPORTINING RAQOBATBARDOSHLIGINI OSHIRISH MEZONLARI .....	560
<i>Nurxo‘jayeva Xilola Hakimxo‘jayevna</i>	
СОВРЕМЕННЫХ ТЕХНОЛОГИЙ В УПРАВЛЕНИИ УГОЛЬНОЙ ПРОМЫШЛЕННОСТЬЮ НА ОСНОВЕ УСТОЙЧИВОСТИ ЭФФЕКТИВНОСТИ ЧЕЛОВЕЧЕСКОГО КАПИТАЛА .....	568
<i>Teshaboyev To‘lqin Zakirovich, Muradov Botir Xayat</i>	
IQTISODIYOT TARMOQLARIDA SUV ISTE‘MOLINING BOSHQARUVINI RAQAMLI TEXNOLOGIYALAR ASOSIDA TAKOMILLASHTIRISHNING NAZARIY JIHATLARI .....	578
<i>Karimov Anvarjon Muqumjonovich, Turg‘unov Muhammadaziz Baxtiyorjon o‘g‘li</i>	
SUV RESURSLARINI BOSHQARISHDA RAQAMLI TEXNOLOGIYALAR VA MOBIL ILOVALAR ASOSIDA SAMARADORLIKNI OSHIRISH MEXANIZMLARI .....	584
<i>Karimov Anvarjon Muqumjonovich, Uzakov Sirojiddin Djuraboyevich</i>	



SUN'IY INTELLEKT VA IQTISODIYOTNING O'ZARO ALOQADORLIGI .....	591
<b>Sobirov Abdurasul Abdugafarovich</b>	
IDENTIFICATION OF WEAVING STRUCTURES IN PILE FABRICS .....	596
<b>Bahrom Baturovich Dautov, Bakhtiyor Yormakhmatovich Abduganiyev, Erkin Shamsiddinovich Rayxonov, Nazar Kilichov Bafoevich</b>	



# IDENTIFICATION OF WEAVING STRUCTURES IN PILE FABRICS

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**Abstract.** This article provides detailed information about the identification of pile fabric weaving processes, their characteristics, production technologies, and research methods. Pile fabrics are analyzed as one of the most complex types of textiles and are classified based on the arrangement of warp and weft threads. The equipment used in the research and the sequential steps of the testing process are described. The practical importance of pile fabric identification and the methodology of laboratory tests are also explored.

**Keywords:** pile fabrics, textile weaving, identification methodology, warp-weft threads, laboratory research, artificial fur, velvet, plush, velour, textile technology.

**Annotatsiya.** Ushbu maqolada tukli matolarning to'qilish identifikatsiyasi, ularning xususiyatlari, ishlab chiqarish texnologiyasi va tadqiqot metodlari haqida batafsil ma'lumot beriladi. Tukli matolar gazlamalar guruhining murakkab turlaridan biri sifatida o'rganilib, arqoq va tanda iplarning joylashuviga ko'ra ajratiladi. Tadqiqotda qo'llanilgan uskunalar va sinov jarayonining ketma-ketligi tavsiflangan. Tukli matolar identifikatsiyasining amaliyotdagi ahamiyati va laboratoriya sinovlarining metodologiyasi o'rganilgan.

**Kalit so'zlar:** tukli matolar, gazlama to'qilishi, identifikatsiya metodikasi, arqoq-tanda iplar, laboratoriya tadqiqoti, sun'iy mo'yna, barxat, plyush, velvet, tekstil texnologiyasi.

**Аннотация.** В данной статье подробно рассматривается идентификация тканых текстильных материалов с ворсом, их характеристики, технологии производства и методы исследования. Ворсовые ткани изучаются как одна из сложных групп текстильных материалов, различаемых по расположению нитей основы и утка. Описывается оборудование, используемое в исследовании, и последовательность проведения испытаний. Изучается практическая значимость идентификации ворсовых тканей и методология лабораторных испытаний.

**Ключевые слова:** ворсовые ткани, текстильное ткачество, методика идентификации, нити основы-утка, лабораторные исследования, искусственный мех, бархат, плюш, велюр, текстильные технологии.



## INTRODUCTION

Nowadays, the range of fabrics is extremely diverse and continues to expand due to advancements in modern science and technology. This process is driven by changing fashion trends and the human desire for aesthetic expression [1]. The expansion and diversity of fabric assortments require systematic study and categorization into specific groups. Examples include cotton fabrics, linen fabrics, pile fabrics, woolen fabrics, silk fabrics, blended fabrics made of chemical fibers, special and technical fabrics, and more. This study provides information about pile materials, their types, and unique characteristics [2].

## REVIEW OF LITERATURE ON THE SUBJECT

Pile fabrics are materials entirely or partially covered with pile. Depending on the type of fabric, the pile may be located across the entire surface or only in specific areas [3].

The pile length in such fabrics ranges from millimeters (or even smaller) to several centimeters. Modern types of pile fabrics include artificial fur, velvet, plush, velour, and others. Their price depends on the raw materials, application, production technology, and fabric type [4].

The manufacturing technology of pile fabrics determines their structure. Any type of raw material can be used: natural, artificial, synthetic, or mixed. According to state standards, fabrics can be made of cotton, silk, viscose, polyester, wool, and others [5].

The most common pile fabrics are traditional velvet (barxat), plush, velvet, and artificial fur. Traditional velvet (barkhat)– characterized by densely packed, almost vertically aligned pile about 2–3 mm long on the surface [6].

Plush – a heavy fabric with long, soft, slanted (sometimes patterned) pile, used for women’s and children’s coats, furniture, and curtains.

Artificial fur – distinguished by the length of its pile [7].

Velvet – features a pile layer on the surface in the form of strips or grooves [8].

## RESEARCH METHODOLOGY

For pile fabric identification, the directions of warp and weft threads are determined, and the pile’s arrangement is analyzed to classify the fabric as warp-pile or weft-pile [9].

Tools used:

- “Prior” light microscope.
- Sharp scissors.
- Needle for sample preparation.
- Digital camera.

Sample collection. The sample was taken as a single piece that fully reflects the characteristics of the pile fabric. The sample was collected across the length and width of the fabric, including warp and weft threads, as well as the selvage.

The selvage refers to the reinforced edges of the fabric formed during the weaving process, which prevents the fabric threads from unraveling. Selvages are formed on both sides of the fabric and run along the entire length of the roll. For analysis, a pile fabric sample was taken with a length of no less than 20 cm and across the entire width of the fabric. The sample was cut according to the type of laboratory test to be conducted, ensuring its suitability for testing. Using sharp scissors, the sample was cut without any tearing, along its full width and the specified length. The sample must be in a condition suitable for research purposes.

Sequence of research. The prepared sample is separated from the weft threads along the selvage. During this process, attention is given to whether the pile is attached to the warp or weft threads.

Weft-pile fabrics. Weft-pile fabrics consist of three thread systems: one warp thread and two weft threads. The first weft forms the fabric in combination with the warp threads, while the second creates long loops, which, when cut, produce the pile surface.

All weft-pile fabrics have high-density weft threads and low linear density cotton fibers. Examples of such fabrics include traditional velvet, which features a pile coating along the weft direction, and semi-velvets with a uniform pile covering the entire surface (Figure 1).

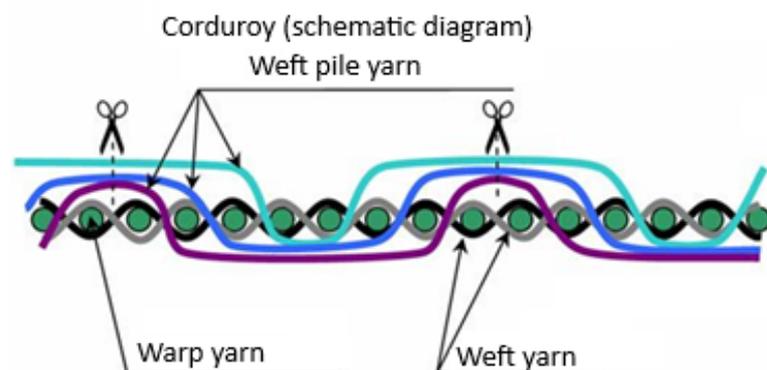


Figure 1. Arch-pile thread

The prepared sample is separated along the warp threads. Attention is paid to whether the pile is attached to the warp threads or the weft threads (Figure 2).

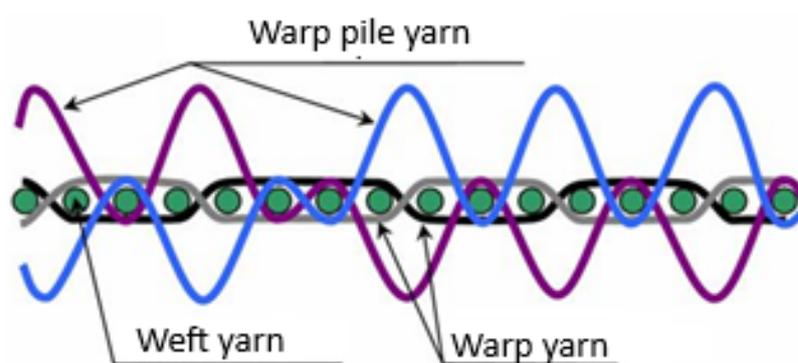


Figure 2. Crosswise pile thread

**Warp-pile fabrics.** Warp-pile fabrics are formed using a system of five threads: three warp threads and two weft threads. Two warp threads and two weft threads create separate base fabrics, while the third pile-forming warp is cut with a blade, producing two pile fabrics with pile surfaces on the textile. Pile fabrics woven from natural silk or artificial threads include materials such as duchess satin, plush, and faux fur.

#### Analysis and results

If the pile in our sample separates along the weft threads, the sample is classified as a warp-pile fabric. This is because the pile is attached to the weft threads and woven parallel to the warp threads (Figure 3).

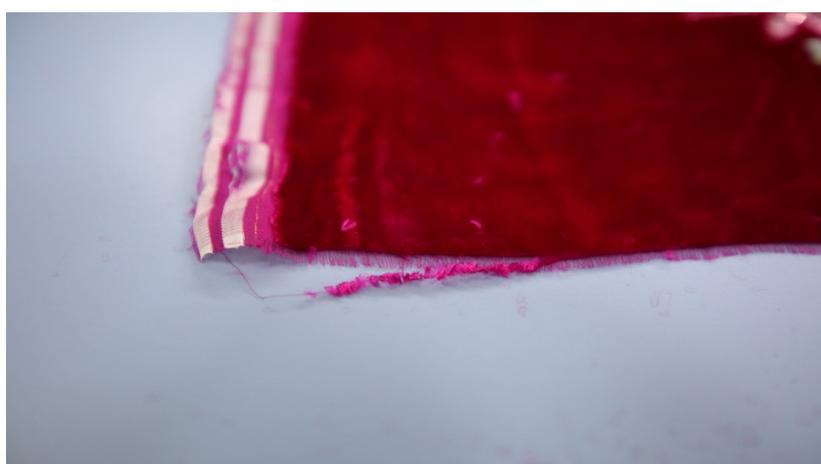


Figure 3. Warp-Pile Fabric

If the pile in our sample separates along the warp threads, the sample is classified as a weft-pile fabric. This is because the pile is attached to the warp threads and woven parallel to the weft threads (Figure 4).

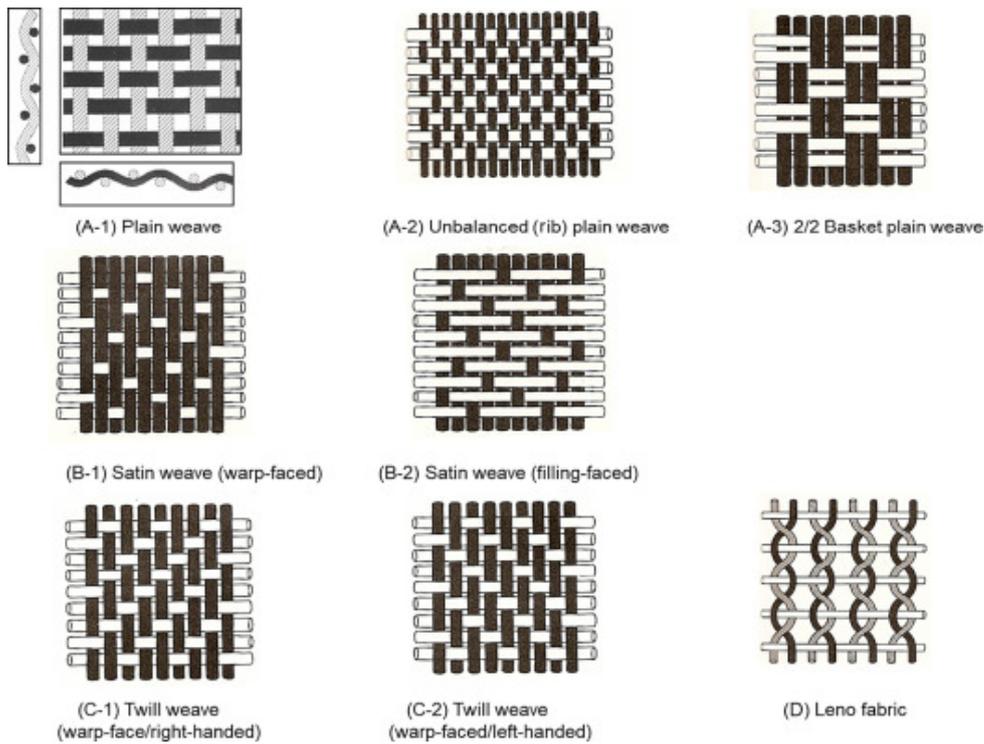


Figure 4. Types of woven fabrics distinguished by the arrangement of yarns and weaving method

The range of pile fabrics today is very diverse, and with the development of modern technology and science, it continues to expand. Pile fabrics such as velvet, plush, velour, and faux fur vary depending on the raw materials and production technology. The production of such fabrics, their structure, and pile arrangement allow them to be classified as warp pile fabrics or weft pile fabrics.

In the study, the fabric type was analyzed under a microscope to observe the alignment of the pile with respect to warp and weft threads. According to the results, if the pile aligns with the warp thread, the fabric is classified as warp pile. If the pile aligns with the weft thread, the fabric is classified as weft pile.

The alignment of the pile with warp or weft threads plays a key role in the classification of pile fabrics in the Commodity Nomenclature of Foreign Economic Activity (HS), where codes 5801 33 and 5801 37 are assigned to such fabrics.

For example, if the warp yarns of the fabric consist of polyefir fibers and the weft yarns are made of cotton, the method of IR spectroscopy is used in practice to identify the separated yarns. In our practice, spectra in such cases were obtained using the Perkin Elmer Spectrum Two FTIR Spectrometer (Figure 5).

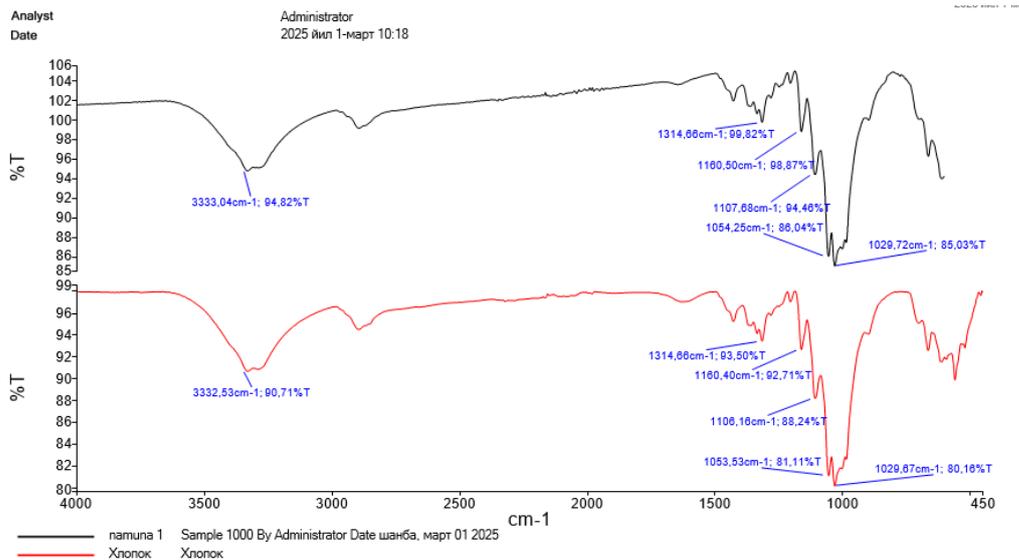


Figure 5. IR spectrum of cotton

Cotton IR spectrum (Infrared spectrum) analysis can be as follows: Infrared (IR) spectroscopy is widely used to determine the chemical composition and structure of cotton material. This method identifies the main functional groups in cotton and their vibrational spectral signals.

~3300-3500  $\text{cm}^{-1}$  range - A broad and strong signal in this region indicates water ( $\text{H}_2\text{O}$ ) or moisture in cotton. O–H peaks may also be present, as cotton consists of natural fibers with hygroscopic properties. ~2900-3000  $\text{cm}^{-1}$  - This signal typically represents vibrations of  $\text{CH}_2$  and  $\text{CH}_3$  groups, related to organic fibers and carbon chains in cotton. ~1730-1650  $\text{cm}^{-1}$  range (strong signal) - Vibrational signals of carbonyl ( $\text{C}=\text{O}$ ) groups may be present in this region. However, since cotton is a natural fiber, carbonate or other substances are more likely to be present here rather than carbonyl groups. ~1600-1500  $\text{cm}^{-1}$  (mixed signals) - May be related to aromatic or other conjugated groups. For cotton as the primary fiber, carbonate or other deformational vibrations may be present in this region. ~1200-1000  $\text{cm}^{-1}$  range - Vibrations of O–H, C–O, and other oxidized groups are located in this region. May be related to polysaccharides and lignin in cotton.

Cotton's IR spectrum helps study its chemical composition and structural characteristics. Among the main spectral lines, vibrational signals of water, organic fibers, and polysaccharides are identified. Spectral data can be used to evaluate cotton quality, moisture content, and compositional components (Figure 6).

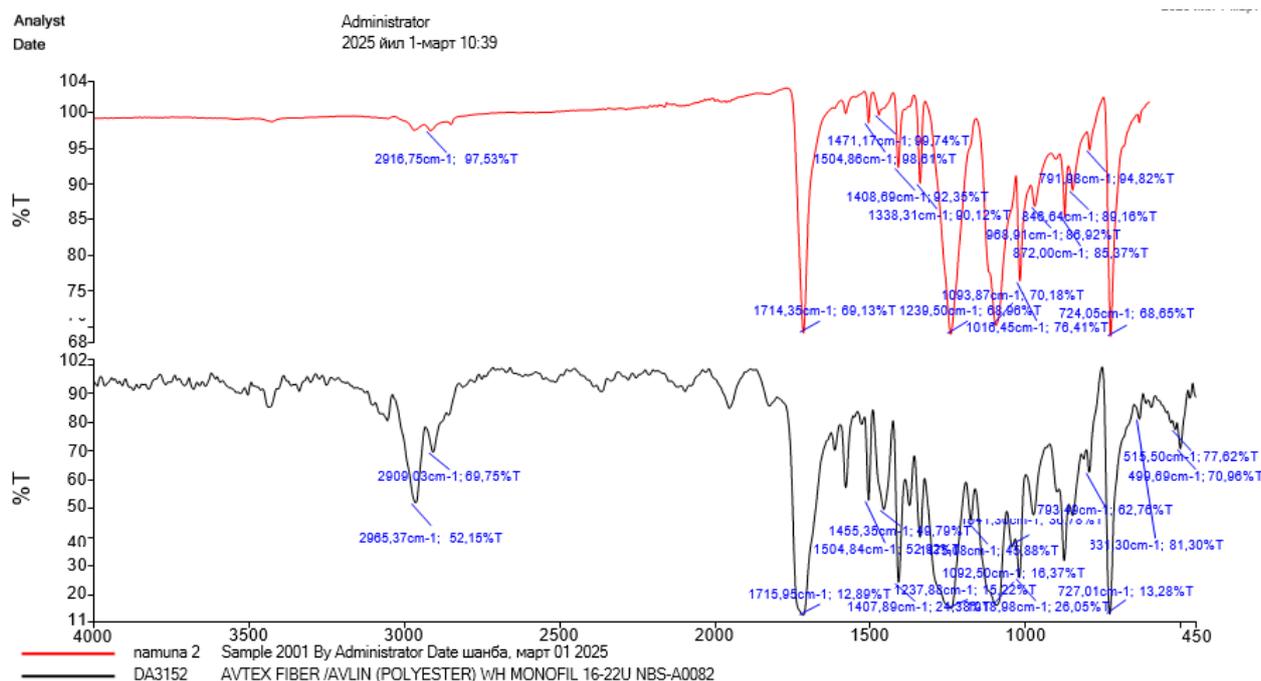


Figure 6. IR spectrum of polyester

Polyester IR spectrum analysis is as follows - the main lines and signals in the spectrum correspond to the chemical structure of polyester. IR spectroscopy is used to identify the main functional groups and bonds in polyester.

~2916-2917  $\text{cm}^{-1}$  - Vibrations of  $\text{CH}_2$  and  $\text{CH}_3$  groups are present in this region. This indicates the presence of ethyl or methyl groups in polyester. ~1714  $\text{cm}^{-1}$  - This signal represents vibration of the carbonyl ( $\text{C}=\text{O}$ ) group. For polyesters, this is the most fundamental and strong signal, being their main characteristic. This signal is specific to the ester groups in polyesters. ~1455  $\text{cm}^{-1}$  and ~1370-1380  $\text{cm}^{-1}$  - Deformational vibrations of  $\text{CH}_2$  and  $\text{CH}_3$  groups may be present in these regions. ~1245-1248  $\text{cm}^{-1}$  - This frequency corresponds to carbonate bonding or ethyl ester groups. Characteristic of ester bonds in polyesters. ~1084-1094  $\text{cm}^{-1}$  - Vibrations of C–O and oxidized groups are present in this region, which is one of the main bonds in polyesters. ~720-730  $\text{cm}^{-1}$  - Deformational vibrations of  $\text{CH}_2$  groups may be present in this region.

## CONCLUSIONS AND SUGGESTIONS

The IR spectrum of polyester is distinguished by strong and broad spectral signals of the carbonyl ( $\text{C}=\text{O}$ ) group, indicating its ester bonding. Vibrations of  $\text{CH}_2$  and  $\text{CH}_3$  groups are clearly visible in the spectrum. C–O bonds and deformational vibrations are identified in the spectrum. This spectrum provides information about the chemical structure and compositional components of polyester.

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