Kattaqo‘rg‘on davlat pedagogika instituti Aniq va tabiiy fakulteti

3-bosqich Matematika yo‘nalishi talabalariga 5-semestr uchun

« Matematika fizika tenglamalari » fanidan yakuniy nazorat savollari

Imtihon shakli: yozma-og‘zaki

TASDIQLAYMAN
O‘quv-uslubiy boshqarma boshlig‘i
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№	**1-QISM** “NAZARIY SAVOLLAR 1” deb nomalanadi va semestrda o‘qitilishi rejalashtirilgan mavzularning kirish va 1-reja qismidan asosan nazariy savollardan iborat bo’ladi (tayanch iborasi bo’ladi).	**2-QISM** “NAZARIY SAVOLLAR 2” deb nomalanadi va semestrda o‘qitilishi rejalashtirilgan mavzularning 2-rejasidan asosan ++mulohazaviy savollardan iborat bo’ladi (tayanch iborasi bo’ladi).	**3-QISM** “AMALIY SAVOLLAR 1” deb nomalanadi va semestrda o‘qitilishi rejalashtirilgan mavzularning asosan misol, masala kabi savollardan iborat bo’ladi (tayanch iborasi bo’lmaydi).	**4-QISM** “AMALIY SAVOLLAR 2” deb nomalanadi va semestrda o‘qitilishi rejalashtirilgan mavzularning misol hamda masala kabi savollardan iborat bo’ladi (tayanch iborasi bo’lmaydi).	**5-qism** “AMALIY SAVOLLAR 3” deb nomalanadi va semestrda o‘qitilishi rejalashtirilgan mavzularning misol masala savollardan iborat bo’ladi (tayanch iborasi bo’lmaydi).
1.	Birinchi tartibli birjinsli xususiy hosilali differensial tenglamalar haqida ma’lumot	Birinchi tartibli birjinsli xususiy hosilali differensial tenglamalar yechimi haqidagi 1-teorema isboti bilan	Tenglama umumiy yechimini toping. $xy\frac{\partial z}{\partial x}+(x-2z)\frac{\partial z}{\partial y}=yz$	Tenglamani kanonik shaklga keltiring. $\frac{\partial^2 u}{\partial x^2}-2\frac{\partial^2 u}{\partial x\partial y}+\frac{\partial^2 u}{\partial y^2}-3\frac{\partial u}{\partial x}+$ $+12\frac{\partial u}{\partial y}+27u=0$	Aralash masalani yeching: $\begin{cases} u_{tt}=a^2u_{xx},\ t>0,\ 0<x<l \\ u(o,t)=0,\ u(l,t)=0, \\ u(x,o)=\sin\frac{2\pi}{l}x,\ u_t(x,o)=0 \end{cases}$
	Birinchi tartibli birjinsli bo‘lmagan	Simmetrik sistemaning birinchi	Tenglama umumiy yechimini toping.	Tenglamani kanonik shaklga keltiring.	Aralash masalani yeching:

	xususiy hosilali differensial tenglamalar. Kvazichiziqli tenglamalar	integrallari. Birinchi integral birinchi tartibli birjinsli xususiy hosilali differensial tenglamalar yechimi haqidagi 2-teorema isboti bilan	$yz\frac{\partial z}{\partial x}-xz\frac{\partial z}{\partial y}=e^z$	$\frac{\partial^2 u}{\partial x^2}-2\frac{\partial^2 u}{\partial x\partial y}+\frac{\partial^2 u}{\partial y^2}+3\frac{\partial u}{\partial x}+10\frac{\partial u}{\partial y}=0$	$\begin{cases} u_{tt}=u_{xx},\ t>0,\ 0<x<l \\ u(o,t)=0,\ u(l,t)=0, \\ u(x,o)=\sin\frac{5\pi}{l}x,\ u_t(x,o)=0 \end{cases}$
2.	Birinchi tartibli birjinsli va birjinsli bo‘lmagan xususiy hosilali differensial tenglamalar uchun Koshi masalasini yechish	Xususiy hosilalai differensial tenglamalar uchun Koshi Kovalevskaya teoremasi	Tenglama umumiy yechimini toping. $x^2z\frac{\partial z}{\partial x}+y^2z\frac{\partial z}{\partial y}=x+y$	Usbu Koshi masalasini yeching. $\frac{\partial^2 u}{\partial x^2}+2\frac{\partial^2 u}{\partial y\partial x}-\frac{\partial^2 u}{\partial y^2}=0$ $u(x,y)\big\|_{y=0}=3x^2,\quad u_y(x,y)\big\|_{y=0}=0$	Aralash masalani yeching: $\begin{cases} u_{tt}=a^2u_{xx},\ t>0,\ 0<x<l \\ u_x(o,t)=0,\ u(l,t)=0, \\ u(x,o)=x,\ u_t(x,o)=1 \end{cases}$
3.	Ikkinchi tartibli bir jinsli, bir jinsli bo‘lmagan, chiziqli, chiziqli bo‘lmagan, kvazi chiziqli xususiy hosilali differensial tenglamalarhaqida ma'lumot	Matematik fizikaning asosiy tenglamalari.	Tenglama umumiy yechimini toping. $(u-x)\frac{\partial u}{\partial x}+(u-y)\frac{\partial u}{\partial y}-$ $-z\frac{\partial u}{\partial z}=x+y$	Tenglamani kanonik shaklga keltiring. $\frac{\partial^2 u}{\partial x^2}+4\frac{\partial^2 u}{\partial x\partial y}+5\frac{\partial^2 u}{\partial y^2}-$ $-2\frac{\partial u}{\partial x}-2\frac{\partial u}{\partial y}+u=0$	Aralash masalani yeching: $\begin{cases} u_{tt}=81u_{xx},\ t>0,\ 0<x<l \\ u(o,t)=0,\ u_x(l,t)=0, \\ u(x,o)=A-x,\ \ u_t(x,o)=0 \end{cases}$

	Matematik fizikaning asosiy tenglamalari uchun qo'yiladigan asosiy masalalar	Tor tebranishi tenglamasini keltirib chiqorish	Tenglama umumiy yechimini toping. $2y^4\frac{\partial z}{\partial x}-xy\frac{\partial z}{\partial y}=x\sqrt{z^2+1}$	Usbu Koshi masalasini yeching. $u_{xx}-6u_{xy}+5u_{yy}=0,$ $u(x,y)\big\|_{y=x}=\sin x,$. $u_y(x,y)\big\|_{y=x}=\cos x$	Aralash masalani yeching: $\begin{cases} u_{tt}=144u_{xx},\ t>0,\ 0<x<l \\ u_x(o,t)=0,\ u_x(l,t)=0, \\ u(x,o)=2023x,\ u_t(x,o)=0 \end{cases}$
4.	Ikkinchi tartibli ko'p ozgaruvchili xususiy hosilali differensial tenglamalarning klassifikatsiyasi.	Ikkinchi tartibli ikki ozgaruvchili xususiy hosilali differensial tenglamalarning klassifikatsiyasi	Tenglama umumiy yechimini toping. $(x^2+y^2)\frac{\partial z}{\partial x}+2xy\frac{\partial z}{\partial y}=-z^2$	Usbu Koshi masalasini yeching. $3u_{xx}-5u_{xy}+2u_{yy}=0,$ $u(x,y)\big\|_{y=x}=\frac{x}{1+x^2},$ $u_y(x,y)\big\|_{y=x}=\sin x$	Aralash masalani yeching: $\begin{cases} u_{tt}=a^2u_{xx},\ t>0,\ 0<x<l \\ u(o,t)=0,\ u(l,t)=0, \\ u(x,o)=\sin\frac{7\pi}{l}x,\ u_t(x,o)=0 \end{cases}$
	Birinchi tartibli xususiy hosilali differensial tenglamalar sistemalarining klassifikatsiyasi	Ikkinchi tartibli ko'p ozgaruvchili Giperbolik va parabolik tipli tenglamalarni ta'riflarini keltiring va misollar bilan asoslang	Tenglama umumiy yechimini toping. $x\frac{\partial z}{\partial x}+2y\frac{\partial z}{\partial y}=x^2y+z$	Usbu Koshi masalasini yeching. $u_{xx}+2\cos xu_{xy}-\sin^2 xu_{yy}$ $+u_x+(1+\cos x-\sin x)u_y=0,$ $u(x,y)\big\|_{y=\sin x}=\cos x,$ $u_y(x,y)\big\|_{y=\sin x}=\sin x$	Aralash masalani yeching: $\begin{cases} u_{tt}=a^2u_{xx},\ t>0,\ 0<x<l \\ u_x(o,t)=u_x(l,t)=0, \\ u(x,o)=\frac{1}{n}2026x,\ u_t(x,o)=0, n>0 \end{cases}$
5.	Ikki o'zgaruvchili ikkinchi tartibli xususiy hosilali differensial tenglamalarning kanonik shaklga keltirish. (asosiy	Ikki o'zgaruvchili ikkinchi tartibli xususiy hosilali differensial tenglamani giperbolik bo'lganda kanonik shaklga keltirish	Tenglama umumiy yechimini toping. $xy\frac{\partial z}{\partial x}-x^2\frac{\partial z}{\partial y}=yz$	Tenglama umumiy yechimini toping $2\frac{\partial^2u}{\partial x^2}-5\frac{\partial^2u}{\partial x\partial y}+3\frac{\partial^2u}{\partial y^2}=0$	Aralash masalani yeching: $u_{tt}=a^2u_{xx},\quad 0<x<\ell,\ \ t>0$ $u_x(0,t)=\alpha, u(\ell,t)=\beta,$ $u(x,0)=2026x,\ u_t(x,0)=0,$

	lemma isboti bilan)				
	Ikki o‘zgaruvchili ikkinchi tartibli xususiy hosilali differensial tenglamani parabolik bo’lganda kanonik shaklga keltirish	Ikkinchi tartibli ko’p ozgaruvchili elliptik tipli tenglamani ta’rifini keltiring va misollar bilan asoslang	Tenglama umumiy yechimini toping. $2x\frac{\partial z}{\partial x}+(y-x)\frac{\partial z}{\partial y}-x^2=0$	Tenglama umumiy yechimini toping $2\frac{\partial^2 u}{\partial x^2}+6\frac{\partial^2 u}{\partial x\partial y}+4\frac{\partial^2 u}{\partial y^2}+\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}=0$	Aralash masalani yeching: $\begin{cases} u_{tt}=u_{xx},\ t>0,\ 0<x<l \\ u(o,t)=u_x(l,t)=0,\ u(x,o)=x, u_t(x,o)=0 \end{cases}$
6.	Ikkinchi tartibli ikki o’zgaruvchili xususiy hosilali o‘zgarmas koeffitsientli differensial tenglamalarning kanonik (soddaroq) ko‘rinishga keltirish.	Ikkinchi tartibli ikki o’zgaruvchili xususiy hosilali o‘zgarmas koeffitsientli differensial tenglama elliptik bo’lganda soddaroq ko‘rinishga keltirish.	Tenglama umumiy yechimini toping. $e^x\frac{\partial z}{\partial x}+y^2\frac{\partial z}{\partial y}=ye^x$	Tenglama umumiy yechimini toping $3\frac{\partial^2 u}{\partial x^2}-10\frac{\partial^2 u}{\partial x\partial y}+3\frac{\partial^2 u}{\partial y^2}-2\frac{\partial u}{\partial x}+$ $+4\frac{\partial u}{\partial y}+\frac{5}{16}u=0$	Aralash masalani yeching: $\begin{cases} u_{tt}=a^2u_{xx},\ t>0,\ 0<x<l \\ u(o,t)=u_x(l,t)=0,\ u(x,o)=\sin\frac{\pi x}{l}, u_t(x,o)=0 \end{cases}$
	Ikkinchi tartibli ikki o’zgaruvchili xususiy hosilali	Ikki o‘zgaruvchili ikkinchi tartibli xususiy hosilali differensial	Tenglamani umumiy yechimini toping. $\frac{\partial U}{\partial x}+(x-ytgx)\frac{\partial U}{\partial y}=0.$	Tenglama umumiy yechimini toping	Aralash masalani yeching $\begin{cases} u_{tt}=a^2u_{xx}+xt,\ t>0,\ 0<x<l \\ u(o,t)=u_x(l,t)=0,\ u(x,o)=0, \\ u_t(x,o)=0 \end{cases}$

	o‘zgarmas koeffitsientli differensial tenglama giperbolik bo’lganda soddaroq ko‘rinishga keltirish.	tenglamani elliptic bo’lganda kanonik shaklga keltirish (umumiy hol)		$\frac{\partial^2 u}{\partial x^2}-6\frac{\partial^2 u}{\partial x\partial y}+8\frac{\partial^2 u}{\partial y^2}+\frac{\partial u}{\partial x}-$ $-2\frac{\partial u}{\partial y}+4e^{5x+\frac{3}{2}y}=0$	
7.	Issiqlik tarqalish tenglamasini keltirib chiqarish.	Tot tebranish tenglamasi uchun asosiu korrekt masalalar	Tenglamani umumiy yechimini toping. $x\frac{\partial U}{\partial x}+(xy+xe^x)\frac{\partial U}{\partial y}=0.$	Tenglama umumiy yechimini toping $\frac{\partial^2 u}{\partial x^2}-2\cos x\frac{\partial^2 u}{\partial x\partial y}-(3+\sin^2 x)\frac{\partial^2 u}{\partial y^2}+$ $\frac{\partial u}{\partial x}+(\sin x-\cos x-2)\frac{\partial u}{\partial y}=0$	Aralash masalani yeching $\begin{cases} u_{tt}=a^2u_{xx}+7xt,\ t>0,\ 0<x<l \\ u(o,t)=u(l,t)=0,\ u(x,o)=0, \\ u_t(x,o)=0 \end{cases}$
	Puasson va Laplas tenglamasiga keladigan masalalar hamda bu tenglamalar uchun qo’yilgan korrekt masalalar	Ikkinchi tartibli ikki o’zgaruvchili xususiy hosilali o‘zgarmas koeffitsientli differensial tenglama parabolik bo’lganda soddaroq ko‘rinishga keltirish.	Usbu Koshi masalasini yeching. $x\frac{\partial z}{\partial x}-y\frac{\partial z}{\partial y}=z^2\left(x-3y\right),$ $x=1,\ yz+1=0$	Tenglamani o’zini tipini saqlaydigan sohada kanonik shaklga keltiring. $y\frac{\partial^2 u}{\partial x^2}+x\frac{\partial^2 u}{\partial y^2}=0$	Aralash masalani yeching $\begin{cases} u_{tt}=a^2u_{xx}+2xt,\ t>0,\ 0<x<l \\ u_x(o,t)=u_x(l,t)=0,\ u(x,o)=0, \\ u_t(x,o)=0 \end{cases}$
8.	Bir jinsli tor tebranish tenglamasi uchun Koshi masalasini yechish.	To‘lqin tarqalish tenglamasi uchun qo‘yilgan Koshi masalasini yechish. Kirxgof formulasi.	Usbu Koshi masalasini yeching. $x\frac{\partial z}{\partial x}+y\frac{\partial z}{\partial y}=z-x^2-y^2,$ $y=-2,\ z=x-x^2$	Tenglamani o’zini tipini saqlaydigan sohada kanonik shaklga keltiring. $(1-x^2)\frac{\partial^2 u}{\partial x^2}-2xy\frac{\partial^2 u}{\partial x\partial y}+(1-y^2)\frac{\partial^2 u}{\partial y^2}-$ $-2x\frac{\partial u}{\partial x}-2y\frac{\partial u}{\partial y}=0$	Aralash masalani yeching $\begin{cases} u_{tt}=a^2u_{xx}+xt,\ t>0,\ 0<x<l \\ u_x(o,t)=u(l,t)=0,\ u(x,o)=0, \\ u_t(x,o)=0 \end{cases}$

	Dalamber formulasi.				
	Bir jinsli bo'lmagan tor tebranish tenglamasi uchun Koshi masalasini yechish.	Tor tebranish tenglamasi uchun Koshi masalasi yechimining turg'unligi haqidagi teorema isboti bilan	Usbu Koshi masalasini yeching. $yz\frac{\partial z}{\partial x}+xz\frac{\partial z}{\partial y}=xy,$ $x=a,\ y^2+z^2=a^2$	Tenglamani kanonik shaklga keltiring. $\frac{\partial^2 u}{\partial x^2}+4\frac{\partial^2 u}{\partial x\partial y}-5\frac{\partial^2 u}{\partial y^2}-2\frac{\partial u}{\partial x}-$ $-2\frac{\partial u}{\partial y}+u=0$	Aralash masalani yeching $\begin{cases} u_{tt}=a^2u_{xx}+Ae^{-t}\sin\frac{\pi}{l}x,\ t>0,\ 0<x<l \\ u(o,t)=u(l,t)=0,\ u(x,o)=0, \\ u_t(x,o)=0 \end{cases}$
9.	Tor tebranish tenglamasi uchun Gursaning 1-masalasi	Tor tebranish tenglamasi uchun Darbu1- masalasi yechimining mavjudligi va turg'unligi haqidagi teorema	$u_{tt}=u_{xx}-4x,$ $u\big\vert_{t=0}=e^x,$ $u_t\big\vert_{t=0}=x$ Koshi masalasini yeching	Tenglamani kanonik shaklga keltiring. $5\frac{\partial^2 u}{\partial x^2}+16\frac{\partial^2 u}{\partial x\partial y}+16\frac{\partial^2 u}{\partial y^2}+24\frac{\partial u}{\partial x}+$ $+32\frac{\partial u}{\partial y}+64u=0$	Aralash masalani yeching $\begin{cases} u_{tt}=a^2u_{xx}+8x,\ t>0,\ 0<x<l \\ u_x(o,t)=u(l,t)=0,\ u(x,o)=0, \\ u_t(x,o)=0 \end{cases}$
	Tor tebranish tenglamasi uchun Darbuning 1-masalasi	Tor tebranish tenglamasi uchun Gursa 1- masalasi yechimining mavjudligi va turg'unligi haqidagi teorema	$u_{tt}=25u_{xx}+2026x,$ $u\big\vert_{t=0}=x^2,$ $u_t\big\vert_{t=0}=5x$ Koshi masalasini yeching	Tenglamani umumiy yechimini toping. $U_{xx}-6U_{xy}+2U_y=0$	Aralash masalani yeching $\begin{cases} u_{tt}=a^2u_{xx},\ t>0,\ 0<x<l \\ u_x(o,t)=u(l,t)=0,\ u(x,o)=\cos\frac{\pi}{2l}x, \\ u_t(x,o)=0 \end{cases}$

1(	Bir jinsli bo'lmagan tor tebranish tenglamasi uchun birinchi boshlang'ich – chegaraviy masalning qo'yilishi. Energetik tengsizlik	Bir jinsli tor tebranish tenglamasi uchun birinchi boshlang'ich – chegaraviy masala yechimining mavjudligi (Chegaraviy shartlar birjinsli bo'lgan hol)	$u_{tt} = 49u_{xx} - 2x,$ $u\big\|_{t=0} = \sin x,$ $u_t\big\|_{t=0} = \cos x$ Koshi masalasini yeching	Tenglamani umumiy yechimini toping. $U_{xx} + 8U_{xy} + 3U_x = 0$	Aralash masalani yeching $\begin{cases} u_{tt} = a^2 u_{xx},\ t > 0,\ 0 < x < l \\ u_x(o,t) = u(l,t) = 0,\ u(x,o) = 0, \\ u_t(x,o) = \cos\dfrac{3\pi}{2l}x + \cos\dfrac{5\pi}{2l}x \end{cases}$
	Bir jinsli tor tebranish tenglamasi uchun birinchi boshlang'ich – chegaraviy masala yechimining yagonaligi	Tor tebranish tenglamasi uchun birinchi boshlang'ich – chegaraviy masala yechimining turg'unligi haqidagi teorema	$u_{tt} = 144u_{xx} + 2xt,$ $u\big\|_{t=0} = \sin x,$ $u_t\big\|_{t=0} = x\cos x$ Koshi masalasini yeching	Tenglamani umumiy yechimini toping. $U_{xx} - 4U_{yy} + 10U_x = 0.$	Aralash masalani yeching $\begin{cases} u_{tt} = a^2 u_{xx},\ t > 0,\ 0 < x < l \\ u_x(o,t) = u(l,t) = 0,\ u(x,o) = 0, \\ u_t(x,o) = \cos\dfrac{3\pi}{2l}x + \cos\dfrac{5\pi}{2l}x \end{cases}$
1	Bir jinsli bo'lmagan tor tebranish tenglamasi uchun bir jinsli chegaraviy shartli birinchi boshlang'ich – chegaraviy	Shturm- liuvill masalasi. Xos qiymatlar va xos funksiyalar	$u_{tt} = 9u_{xx} + xt,$ $u\big\|_{t=0} = e^x,\quad u_t\big\|_{t=0} = x^2$ Koshi masalasini yeching	Tenglamani umumiy yechimini toping. $2U_{xx} - 6U_{xy} + 4U_{yy} = 0.$	Aralash masalani yeching $\begin{cases} u_{tt} = a^2 u_{xx},\ t > 0,\ 0 < x < l \\ u(o,t) = u_x(l,t) = 0,\ u(x,o) = x, \\ u_t(x,o) = \sin\dfrac{\pi}{2l}x \end{cases}$

	masalaning qo’yilishi				
	Bir jinsli bo’lmagan tor tebranish tenglamasi uchun bir jinsli chegaraviy shartli birinchi boshlang‘ich – chegaraviy masala yechimining mavjudligi	Tor tebranish tenglamasi uchun birinchi, ikkinchi va uchinchi tur chegaraviy masalaning qo’yilishi	Usbu Koshi masalasini yeching. $(y+2z^2)\frac{\partial z}{\partial x}-2x^2z\frac{\partial z}{\partial y}=x^2,$ $x=z,\ y=x^2$	Tenglamani kanonik shaklga keltiring. $\frac{\partial^2u}{\partial x^2}-2\frac{\partial^2u}{\partial x\partial y}+\frac{\partial^2u}{\partial y^2}-\frac{\partial u}{\partial x}+$ $+\frac{\partial u}{\partial y}+20u=0$	Aralash masalani yeching $\begin{cases} u_{tt}=a^2u_{xx},\ t>0,\ 0<x<l \\ u_x(o,t)=u_x(l,t)=0,\ u(x,o)=x, \\ u_t(x,o)=1 \end{cases}$
1	Tor tebranish tenglamasi uchun Darbu 2-masalasi	Tor tebranish tenglamasi uchun Gursa 2- masalasi yechimining mavjudligi va turg’unligi haqidagi teorema	Tenglamani umumiy yechimini toping. $-y^2\frac{\partial U}{\partial x}+2x^2y\frac{\partial U}{\partial y}=0.$	Tenglamani kanonik shaklga keltiring. $\frac{\partial^2u}{\partial x^2}-2\frac{\partial^2u}{\partial x\partial y}+\frac{\partial^2u}{\partial y^2}+\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}=0$	Aralash masalani yeching: $\begin{cases} u_{tt}=a^2u_{xx},\ t>0,\ 0<x<l \\ u(o,t)=T,\ u(l,t)=U,\ u(x,o)=0 \\ u_t(x,o)=0 \end{cases}$
	Tor tebranish tenglamasi uchun Gursa 2-masalasi	Tor tebranish tenglamasi uchun Darbu2- masalasi yechimining mavjudligi va turg’unligi haqidagi teorema	Tenglamani umumiy yechimini toping. $(x^2-1)\frac{\partial U}{\partial x}+(-x+yx)\frac{\partial U}{\partial y}=0.$	Usbu Koshi masalasini yeching. $e^yu_{xy}-u_{yy}+u_y=0,$ $u(x,y)\big\vert_{y=0}=-\frac{x^2}{2},$ $u_y(x,y)\big\vert_{y=0}=-\sin x.$	Aralash masalani yeching: $\begin{cases} u_{tt}=25u_{xx},\ t>0,\ 0<x<l \\ u(o,t)=T,\ u(l,t)=U, \\ u(x,o)=1,\ u(x,o)=0 \end{cases}$