Target equation:

$$-ia_1u^{(1,0)}(x,t)+a_{10}u^{(10,0)}(x,t)-ia_{11}u^{(11,0)}(x,t)+a_{12}u^{(12,0)}(x,t)-ia_{13}u^{(13,0)}(x,t)+a_{14}u^{(14,0)}(x,t)-$$
$$ia_{15}u^{(15,0)}(x,t)+a_{16}u^{(16,0)}(x,t)-ia_{17}u^{(17,0)}(x,t)+a_{18}u^{(18,0)}(x,t)-ia_{19}u^{(19,0)}(x,t)+a_2u^{(2,0)}(x,t)+$$
$$a_{20}u^{(20,0)}(x,t) - ia_3u^{(3,0)}(x,t) + a_4u^{(4,0)}(x,t) - ia_5u^{(5,0)}(x,t) + a_6u^{(6,0)}(x,t) - ia_7u^{(7,0)}(x,t) +$$
$$a_8u^{(8,0)}(x,t) - ia_9u^{(9,0)}(x,t) - bu(x,t)\left|u(x,t)\right|^2 + iu^{(0,1)}(x,t) = 0$$

Substitutions:

$$\mathrm{N} = 10$$
$$u(x,t) \to y(z)e^{i(kx-\omega t)}$$
$$z \to x - \mathrm{C0}t$$
$$y(z) \to AR(z)^{10}$$
$$R'(z)^2 = R(z)^2\left(1-\chi R(z)^2\right)$$

Imaginary part of equation after substitutions:

$$15504a_{20}y^{(5)}(z)k^{15}-11628a_{19}y^{(5)}(z)k^{14}-8568a_{18}y^{(5)}(z)k^{13}-77520a_{20}y^{(7)}(z)k^{13}+6188a_{17}y^{(5)}(z)k^{12}+$$
$$50388a_{19}y^{(7)}(z)k^{12}+4368a_{16}y^{(5)}(z)k^{11}+31824a_{18}y^{(7)}(z)k^{11}+167960a_{20}y^{(9)}(z)k^{11}-3003a_{15}y^{(5)}(z)k^{10}-$$
$$19448a_{17}y^{(7)}(z)k^{10}-92378a_{19}y^{(9)}(z)k^{10}-2002a_{14}y^{(5)}(z)k^9-11440a_{16}y^{(7)}(z)k^9-48620a_{18}y^{(9)}(z)k^9-$$
$$167960a_{20}y^{(11)}(z)k^9+1287a_{13}y^{(5)}(z)k^8+6435a_{15}y^{(7)}(z)k^8+24310a_{17}y^{(9)}(z)k^8+75582a_{19}y^{(11)}(z)k^8+$$
$$792a_{12}y^{(5)}(z)k^7+3432a_{14}y^{(7)}(z)k^7+11440a_{16}y^{(9)}(z)k^7+31824a_{18}y^{(11)}(z)k^7+77520a_{20}y^{(13)}(z)k^7-$$
$$462a_{11}y^{(5)}(z)k^6-1716a_{13}y^{(7)}(z)k^6-5005a_{15}y^{(9)}(z)k^6-12376a_{17}y^{(11)}(z)k^6-27132a_{19}y^{(13)}(z)k^6-$$
$$252a_{10}y^{(5)}(z)k^5 - 792a_{12}y^{(7)}(z)k^5 - 2002a_{14}y^{(9)}(z)k^5 - 4368a_{16}y^{(11)}(z)k^5 - 8568a_{18}y^{(13)}(z)k^5 -$$
$$15504a_{20}y^{(15)}(z)k^5 + 126a_9y^{(5)}(z)k^4 + 330a_{11}y^{(7)}(z)k^4 + 715a_{13}y^{(9)}(z)k^4 + 1365a_{15}y^{(11)}(z)k^4 +$$
$$2380a_{17}y^{(13)}(z)k^4+3876a_{19}y^{(15)}(z)k^4+56a_8y^{(5)}(z)k^3+120a_{10}y^{(7)}(z)k^3+220a_{12}y^{(9)}(z)k^3+364a_{14}y^{(11)}(z)k^3+$$
$$560a_{16}y^{(13)}(z)k^3+816a_{18}y^{(15)}(z)k^3+1140a_{20}y^{(17)}(z)k^3-21a_7y^{(5)}(z)k^2-36a_9y^{(7)}(z)k^2-55a_{11}y^{(9)}(z)k^2-$$
$$78a_{13}y^{(11)}(z)k^2-105a_{15}y^{(13)}(z)k^2-136a_{17}y^{(15)}(z)k^2-171a_{19}y^{(17)}(z)k^2-6a_6y^{(5)}(z)k-8a_8y^{(7)}(z)k-$$
$$10a_{10}y^{(9)}(z)k-12a_{12}y^{(11)}(z)k-14a_{14}y^{(13)}(z)k-16a_{16}y^{(15)}(z)k-18a_{18}y^{(17)}(z)k-20a_{20}y^{(19)}(z)k+$$
$$(a_1 - \mathrm{C0} + k\,(k\,(k\,(4a_4 + k\,(5a_5 + k\,(k\,(k\,(8a_8 + k\,(9a_9 + k\,(k\,(20a_{20}k^9 - 19a_{19}k^8 - 18a_{18}k^7 + 17a_{17}k^6 + 16a$$
$$(a_3 + k\,(k\,(k\,(20a_6 + k\,(35a_7 + k\,(k\,(k\,(120a_{10} + k\,(-1140a_{20}k^9 + 969a_{19}k^8 + 816a_{18}k^7 - 680a_{17}k^6 - 560a_{16}k$$
$$a_5y^{(5)}(z)+a_7y^{(7)}(z)+a_9y^{(9)}(z)+a_{11}y^{(11)}(z)+a_{13}y^{(13)}(z)+a_{15}y^{(15)}(z)+a_{17}y^{(17)}(z)+a_{19}y^{(19)}(z) = 0$$

Real part of equation after substitutions:

$$4845a_{20}y^{(4)}(z)k^{16}-3876a_{19}y^{(4)}(z)k^{15}-3060a_{18}y^{(4)}(z)k^{14}-38760a_{20}y^{(6)}(z)k^{14}+2380a_{17}y^{(4)}(z)k^{13}+$$
$$27132a_{19}y^{(6)}(z)k^{13}+1820a_{16}y^{(4)}(z)k^{12}+18564a_{18}y^{(6)}(z)k^{12}+125970a_{20}y^{(8)}(z)k^{12}-1365a_{15}y^{(4)}(z)k^{11}-$$
$$12376a_{17}y^{(6)}(z)k^{11}-75582a_{19}y^{(8)}(z)k^{11}-1001a_{14}y^{(4)}(z)k^{10}-8008a_{16}y^{(6)}(z)k^{10}-43758a_{18}y^{(8)}(z)k^{10}-$$
$$184756a_{20}y^{(10)}(z)k^{10}+715a_{13}y^{(4)}(z)k^9+5005a_{15}y^{(6)}(z)k^9+24310a_{17}y^{(8)}(z)k^9+92378a_{19}y^{(10)}(z)k^9+$$
$$495a_{12}y^{(4)}(z)k^8+3003a_{14}y^{(6)}(z)k^8+12870a_{16}y^{(8)}(z)k^8+43758a_{18}y^{(10)}(z)k^8+125970a_{20}y^{(12)}(z)k^8-$$
$$330a_{11}y^{(4)}(z)k^7-1716a_{13}y^{(6)}(z)k^7-6435a_{15}y^{(8)}(z)k^7-19448a_{17}y^{(10)}(z)k^7-50388a_{19}y^{(12)}(z)k^7-$$

$$210a_{10}y^{(4)}(z)k^6 - 924a_{12}y^{(6)}(z)k^6 - 3003a_{14}y^{(8)}(z)k^6 - 8008a_{16}y^{(10)}(z)k^6 - 18564a_{18}y^{(12)}(z)k^6 -$$
$$38760a_{20}y^{(14)}(z)k^6 + 126a_9y^{(4)}(z)k^5 + 462a_{11}y^{(6)}(z)k^5 + 1287a_{13}y^{(8)}(z)k^5 + 3003a_{15}y^{(10)}(z)k^5 +$$
$$6188a_{17}y^{(12)}(z)k^5 + 11628a_{19}y^{(14)}(z)k^5 + 70a_8y^{(4)}(z)k^4 + 210a_{10}y^{(6)}(z)k^4 + 495a_{12}y^{(8)}(z)k^4 +$$
$$1001a_{14}y^{(10)}(z)k^4 + 1820a_{16}y^{(12)}(z)k^4 + 3060a_{18}y^{(14)}(z)k^4 + 4845a_{20}y^{(16)}(z)k^4 - 35a_7y^{(4)}(z)k^3 -$$
$$84a_9y^{(6)}(z)k^3 - 165a_{11}y^{(8)}(z)k^3 - 286a_{13}y^{(10)}(z)k^3 - 455a_{15}y^{(12)}(z)k^3 - 680a_{17}y^{(14)}(z)k^3 - 969a_{19}y^{(16)}(z)k^3 -$$
$$15a_6y^{(4)}(z)k^2 - 28a_8y^{(6)}(z)k^2 - 45a_{10}y^{(8)}(z)k^2 - 66a_{12}y^{(10)}(z)k^2 - 91a_{14}y^{(12)}(z)k^2 - 120a_{16}y^{(14)}(z)k^2 -$$
$$153a_{18}y^{(16)}(z)k^2 - 190a_{20}y^{(18)}(z)k^2 + 5a_5y^{(4)}(z)k + 7a_7y^{(6)}(z)k + 9a_9y^{(8)}(z)k + 11a_{11}y^{(10)}(z)k +$$
$$13a_{13}y^{(12)}(z)k + 15a_{15}y^{(14)}(z)k + 17a_{17}y^{(16)}(z)k + 19a_{19}y^{(18)}(z)k - by(z)^3 + (a_{20}k^{20} - a_{19}k^{19} - a_{18}k^{18} + a_{17}k^{17} +$$
$$(a_2 + k\,(3a_3 + k\,(k\,(15a_6 + k\,(21a_7 + k\,(k\,(k\,(45a_{10} + k\,(-190a_{20}k^9 + 171a_{19}k^8 + 153a_{18}k^7 - 136a_{17}k^6 -$$
$$a_4y^{(4)}(z) + a_6y^{(6)}(z) + a_8y^{(8)}(z) + a_{10}y^{(10)}(z) + a_{12}y^{(12)}(z) + a_{14}y^{(14)}(z) + a_{16}y^{(16)}(z) + a_{18}y^{(18)}(z) +$$
$$a_{20}y^{(20)}(z) = 0$$

Constraints on coefficients from imaginary part of equation:

$$a_{19} \to 20a_{20}k$$
$$a_{17} \to 6\,(3a_{18}k + 380a_{20}k^3)$$
$$a_{15} \to 16\,(a_{16}k + 102a_{18}k^3 + 15504a_{20}k^5)$$
$$a_{13} \to 2\,(7a_{14}k + 560a_{16}k^3 + 68544a_{18}k^5 + 10542720a_{20}k^7)$$
$$a_{11} \to 4\,(3a_{12}k + 182a_{14}k^3 + 17472a_{16}k^5 + 2164032a_{18}k^7 + 333232640a_{20}k^9)$$
$$a_9 \to 2\,(5a_{10}k + 220a_{12}k^3 + 16016a_{14}k^5 + 1555840a_{16}k^7 + 192924160a_{18}k^9 + 29711452160a_{20}k^{11})$$
$$a_7 \to 8\,(30a_{10}k^3 + 1584a_{12}k^5 + 116688a_{14}k^7 + 11348480a_{16}k^9 + 1407384576a_{18}k^{11} + 216748400640a_{20}k^{13} +$$
$$a_5 \to 2\,(2016a_{10}k^5 + 107712a_{12}k^7 + 7943936a_{14}k^9 + 772681728a_{16}k^{11} + 95825608704a_{18}k^{13} + 147579266826$$
$$a_3 \to 4k\,(8160a_{10}k^6 + 436480a_{12}k^8 + 32195072a_{14}k^{10} + 3131555840a_{16}k^{12} + 388366491648a_{18}k^{14} + 5981162$$
$$\text{C0} \to a_1 - 79360a_{10}k^9 - 4245504a_{12}k^{11} - 313155584a_{14}k^{13} - 30460116992a_{16}k^{15} - 3777576173568a_{18}k^{17} -$$
$$2a_2k - 581777702256640a_{20}k^{19} - 8a_4k^3 - 96a_6k^5 - 2176a_8k^7$$

Constraints on coefficients from real part of equation:

$$b \to \frac{24365525776399090483200000a_{20}\chi^{10}}{A^2}$$
$$a_{18} \to -10a_{20}\,(19k^2 + 394)$$
$$a_{16} \to 3\,(1615a_{20}k^4 + 200940a_{20}k^2 + 2247712a_{20})$$
$$a_{14} \to -40\,(969a_{20}k^6 + 301410a_{20}k^4 + 20229408a_{20}k^2 + 164687312a_{20})$$
$$a_{12} \to 26\,(4845a_{20}k^8 + 2813160a_{20}k^6 + 472019520a_{20}k^4 + 23056223680a_{20}k^2 + 156108843136a_{20})$$
$$a_{10} \to -52\,(3553a_{20}k^{10} + 3315510a_{20}k^8 + 1038442944a_{20}k^6 + 126809230240a_{20}k^4 + 5151591823488a_{20}k^2 +$$
$$a_8 \to 2\,(62985a_{20}k^{12} + 86203260a_{20}k^{10} + 43392080160a_{20}k^8 + 9891119958720a_{20}k^6 + 1004560405580160a_{20}$$
$$a_6 \to -8\,(4845a_{20}k^{14} + 9142770a_{20}k^{12} + 6749879136a_{20}k^{10} + 2472779989680a_{20}k^8 + 468794855937408a_{20}k^6$$
$$a_4 \to 4845a_{20}k^{16} + 12056400a_{20}k^{14} + 12272507520a_{20}k^{12} + 6594079972480a_{20}k^{10} + 2009120811160320a_{20}k^8 +$$
$$345262912169011200a_{20}k^6 + 309592350545826611 20a_{20}k^4 + 116710322788492247 0400a_{20}k^2 + 85429229933656$$

$a_2 \to -2\,(95a_{20}k^{18} + 301410a_{20}k^{16} + 404588160a_{20}k^{14} + 299730907840a_{20}k^{12} + 133941387410688a_{20}k^{10} + 3$

$\omega \to -a_1 k - 19a_{20}k^{20} - 66980a_{20}k^{18} - 101147040a_{20}k^{16} - 85637402240a_{20}k^{14} - 44647129136896a_{20}k^{12} - \blacksquare$

$14796981950100480a_{20}k^{10} - 3095923505458266112a_{20}k^{8} - 389034409294974156800a_{20}k^{6} - 2562876898009699$

$52707884614839749836800 0a_{20}k^{2} + 13835476912905325117440000a_{20}$

y(z) - function:

$$\frac{1048576a^{10}A}{\left(4a^2e^{z} + \chi e^{-z}\right)^{10}}$$

u(x, t) - function:

$$\frac{1048576a^{10}Ae^{i(kx-\omega t)}}{\left(4a^2e^{\mathrm{C0}t+x} + \chi e^{-\mathrm{C0}t-x}\right)^{10}}$$