

Report of “Applied mathematics” department of IMM for 2018.

On scientific activity.

The staff of “Applied mathematics” department consists of 6 employes: 2 prof:doct.phys.math.sci., 1 cond.of techn.sci., sen.res.ass., 3 laboratory assisstants and 1 engineer.

In she first Semi- annual in she department scientific researches are carried out In two themes .

Theme 1: Principles of viscous fluid hydrodynamics with regard to physical media in nano-sistems.(doct.phys.math.sci.prof.Aliyev G.G.).

Work A. Mathematical. Simulation of the motion of viscous fluid with regard quantum-mechanical effects in nano tubes.

(doct.phys.math.sci.prof.Aliyev G.G.).

In the report period, flow of viscous fluid in $10^{-9} \text{ m} \leq d \leq 10^{-4} \text{ m}$ diameter pipes was studied with regard to quantum-mechanical effects.

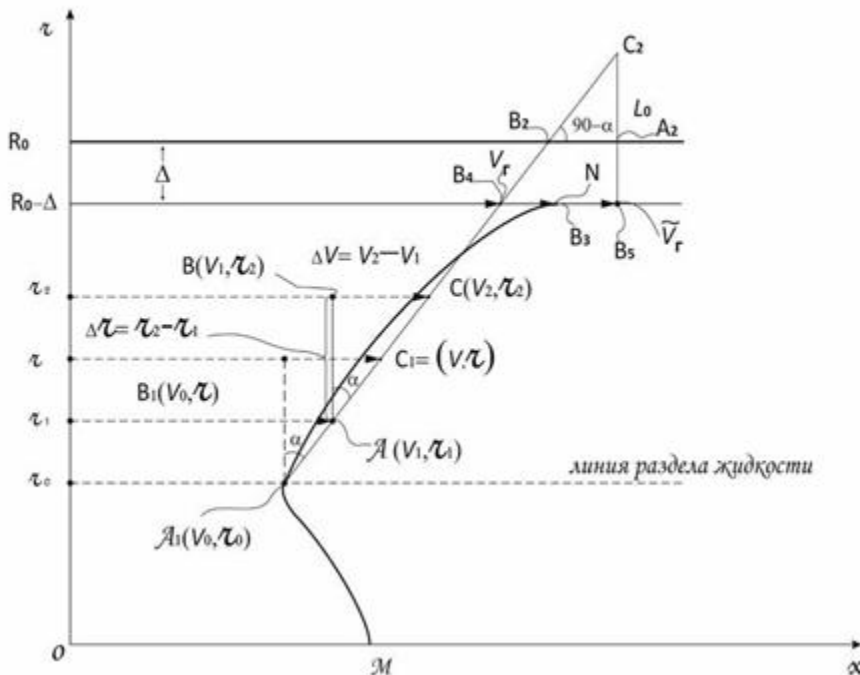


Fig.1. Character of viscous fluid with respect to coordinate of the pipes depth with regard to quantum-mechanical effects.

Mathematical-physical model of sliding condition of a viscous fluid in the wall boundary with regard to quantum-mechanical effects in nanotubes (generalized Navier model) was offered

$$v(r) = a + b \cdot \frac{\partial v}{\partial r}$$

It was proved that the sliding velocity of the fluid in the pipe wall is in the form of the sum of three velocities: the first velocity appears from the inhomogeneity of the fluid and equals $v_1 = v_0 + (R_0 - \Delta - r_0) \cdot \frac{dv}{dr}$

The second velocity is formed by the internal length $\Delta = 0,12 \cdot R_0$ of sliding of the fluid between spaces and fluid and equals $v_2 = \Delta \cdot \frac{dv}{dr}$

The third velocity is formed by the external length of sliding of the velocity diagram of the complete system of the fluid and was offered by Navier in the form $v_3 = L_0 \cdot \frac{dv}{dr}$

The lists of papers published in the theme in 2018:

1. Aliyev G.G., Aliyev A.G.. *Generalized Navier condition with regard to influence of quantum-mechanical effects in nonhydrodynamics*. [IJSET - International Journal of Innovative Science, Engineering & Technology](#), Vol. 5 Issue 5, May (Tamilnadu India)-2018, ISSN (Online) 2348-7968, Impact Factor (2016) --5.264, pp. 17-27. (<http://ijset.com/articlesv5/articlesv5s5.html>).
2. Aliyev G.G., Aliyev A.G.. *Обобщенное условие Навье с учетом влияния квантово-механических эффектов в наногидродинамике*; [EESJ-East European Science Journal](#), vol -№5(33), May, (Poland- Warsaw)-2018, [ISSN 2468-5380](#), Impact Factor (2017) – 1.572, p.p. 60-65.

Work B. Elaboration of monitoring system of intellectual system of general toxicology and carrying out experiments on statistical data

(cand. techn. sci., lead. res. as., ass.prof. Mirzazadeh I.H.)

Stage 1. Elaboration of monitoring system and carrying out experiments in statistical data

Similar symptoms of a class of toxic substances including carbon monoxide were revealed and information data was based on it. Two approaches were offered for differential diagnostics of poisoning with toxic substances: simple probabilistic and some complex probabilistic-determined approaches. In differential diagnostics the Bayes method and neural nets were used.

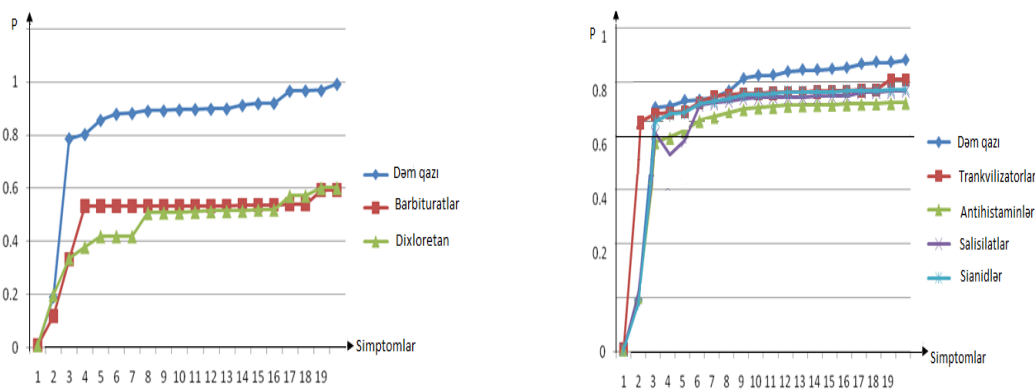


Fig.1. Fragments of diagnostic with simple diagnostic method.

Monitoring of patients was carried out for complication committed by poisoning with carbon monoxide was substantiated. The time series method was used for monitoring.

During monitoring, the change dynamics of indicators within the time intervals was traced.

Difference of indicators within time intervals was revealed by means of parametric and non-parametric methods of biostatistics.

Determination of change dynamics of indicators in time series allows to choose the more important ones between them, to reveal the ones that don't obey to treatment and not to carry out additional analyses.

Intellectual-information system of poisoning with carbon monoxide was carried out, program package of the system was worked out and numerous experiments affirmed the adequacy of the system.

The lists of papers published in the theme in 2018:

- 1.Mirzazada İ.H.. *Conducting of monitoring and experiments in toxic substances of poisoning*. [Caspian Journal of Applied Mathematics, Ecology and Economics, Vol. 6, №1, December 2018, ISSN: 1560-4055, P3-16.](#)
- 2.Mirzəzadə İ.H.. *Toksiki maddələrlə zəhərlənmələrdə biostatik üsullar*. [Azərbaycan xalqının Ümummilli Lideri Heydər Əliyevin anadan olmasının 95-ci ildönümünə həsr olunmuş “Riyaziyyat və Mexanikanın aktual problemləri” adlı elmi konfrans. Səh 73, 17-18 may. Bakı-2018.](#)
- 3.Mirzazada İ.H.. *Development of neural network in diagnostics carbon monoxide poisonings*. [MADEA-8, June 17-23, 2018, Bishkek, Kyrgyz Republic, p.87-88.](#)
- 4.Mirzazada İ.H.. *Organization of monitoring for toxic poisonings*. [International Conference on Control and Optimization With Industrial Applications. 11-13 July, Baku, Azerbaijan, P 2022.](#)

Theme 2. Integral simulation of fietration systems in oil-gas recovery

(doct. phys. math. sci.prof.Aliyev G.G., cand.techn.sci. sen. res. ass. Abbasov.E.M.).

Work A: Integral simulation of gas wall in production prosses

(cand.techn.sci. sen. res. ass. Abbasov.E.M.).

The integrated model of processes is established to analyze the interaction of separate dynamic processes occurring during oil extraction. The integrated model incorporates the process of gas injection, the filtration of oil, and the extraction of the liquid-gas mixture to the well. This approach allows for more precise definition of the impact of each parameter of the system on the well operation.

Gaslif was in l deptn was considered. The gas was injected from annular space. The monstationary motion equations of fluid-gas system was composed, differential equations were obtained and they were solved.

The lists of papers published in the theme in 2018:

1. Baghir A. Suleimanov, Arif A. Suleymanov, Elkhan M. Abbasov, Erlan T. Baspayev. *A mechanism for generating the gas slippage effect near the dewpoint pressure in a porous media gas condensate flow*. [Natural Gas Science and Engineering 2018.03.003, \(TOMSON Reuters\).](#)

2.Э.М.Аббасов, Ш.А.Керимова, Н.А.Агаева. *Интегральное моделирование работы газовых скважин с учетом деформируемости коллектора пласта. SOCAR Proceedings – (rəydən qayıdıb və çара qəbul olunub).*

3.Э.М.Аббасов, Ш.А.Керимова, Н.А.Агаева. *Интегральное моделирование процесса восстановления давления. Инженерно-Физический Журнал (ИФЖ), (SCOPUS Reuters). (rəydən qayıdıb və çара qəbul olunub).*

4.Elkhan M. Abbasov, Shusha A. Kerimova, Nurlana A. Agayeva. *Integral modeling of the pressure recovery process. The 6th International Conference on Control and Optimization with Industrial Applications 11-13 July, 2018, Baku, Azerbaijan—tezis.*

5.Э.М.Аббасов, Ш.П.Казымов, Н.Р. Абдуллаева, Л.Г.Гаджикеримова. *Утечка жидкости в скважинном штанговом насосе. Журнал Нефтяное хозяйство. (SCOPUS Reuters). (rəydən qayıdıb və çара qəbul olunub).*

6.Э.М.Аббасов, Т.С.Кенгерли. *Интегральное моделирование процесса вытеснения нефти водой. Инженерно-Физический Журнал (ИФЖ), МИНСК, №1, 2019. (SCOPUS Reuters). (rəydən qayıdıb və çара qəbul olunub).*

7. Elkhan M. Abbasov, Tarana S. Kengerli, Nargiz R. Abdullayeva. *Modeling of hydrodynamics of motion of gaz-liquid mixture by pipeline of the sea bottom with regard to heat exchange process. The 6th International Conference on Control and Optimization with Industrial Applications 11-13 July, 2018, Baku, Azerbaijan—tezis.*

8. Elkhan Abbasov. *Integral Modeling of the Filtration Process in Gas Wells IX International Conference of The Georgian Mathematical Union Dedicated to 100-th Anniversary of Ivane Javakhishvili Tbilisi State University Batumi – Tbilisi, September 3 – 8, 2018 – tezis.*

Work B. Solving the problem of stability of a sea vessel using the methods of the synergetic theory of information.

(doct.phys.math.sci.prof.Naghiyev F.B.)

The main theme of this study will be using the analysis of rolling of ships to develop models that will help in making decisions during the operation, as well

as to predict the susceptibility of the vessel to parametric rolling at the design stage.

Irregular sea waves are considered in the works of McCue and Bulian, who used Lyapunov's finite time to detect the beginning of parametric rolling. Subsequently, the results of this method were not confirmed experimentally.

The studies used the results of the experiments below in Figures 1-5.

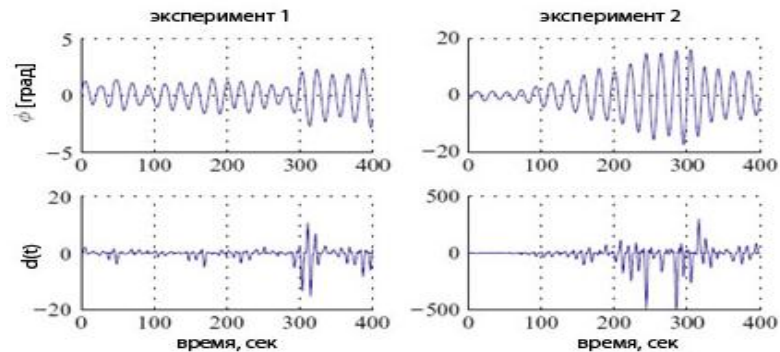


Fig. 1. The dependence of the amplitude of the onboard oscillations of time. Experimental data in the pool $d(t)$ - a driving signal.

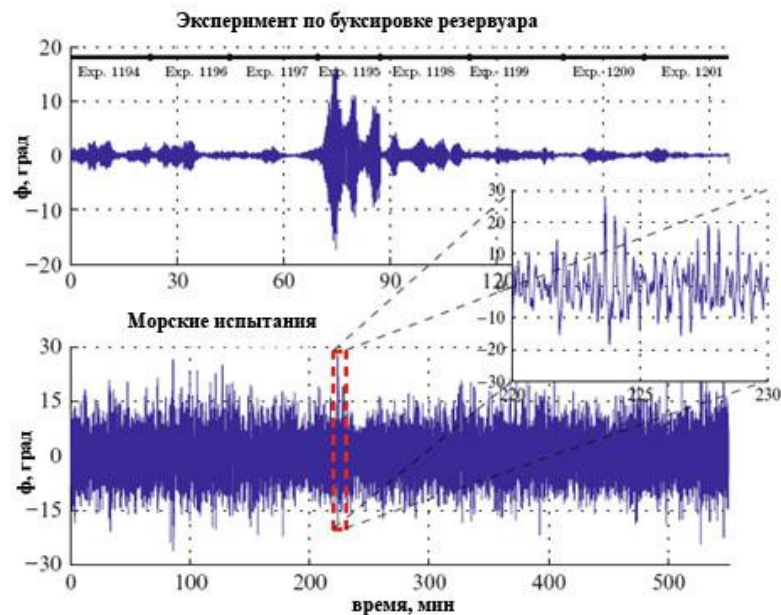


Fig. 2. Dependence of the amplitude of the onboard oscillations on time (time series are recorded from experiments).

The experiment in fig. 2 is the only one in which the parametric roll is well developed.

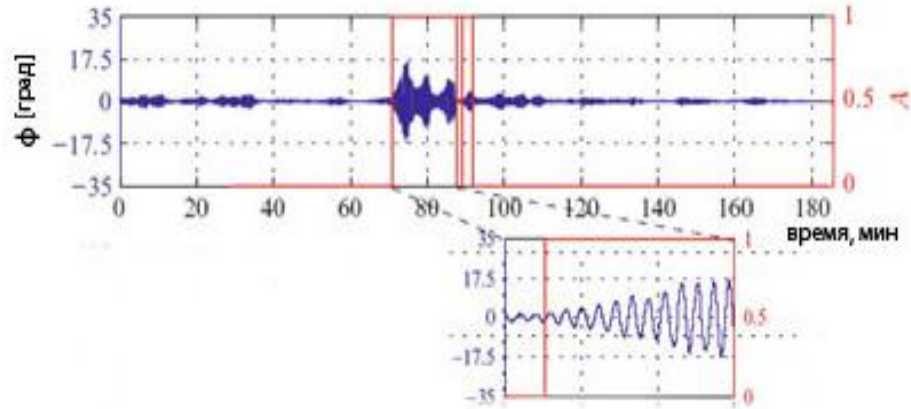


Fig.3. The data obtained on the experimental setup.

The dependence of the amplitude of the onboard oscillations on time in Fig. 2 recorded while navigating the North Atlantic Ocean.

The onset of parametric roll on the experimental setup shown in Fig. 4 is detected in a timely manner when the roll angle is only about 3° .

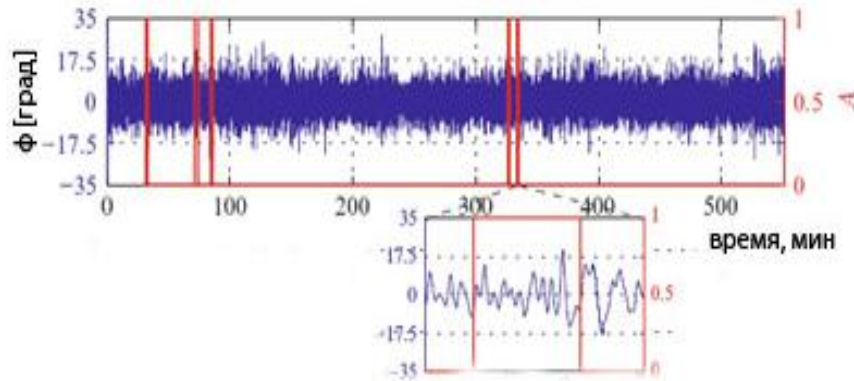


Fig. 4. Results of sea trials.

A visual inspection shows that in this case a false alarm occurred, there is no parametric resonance.

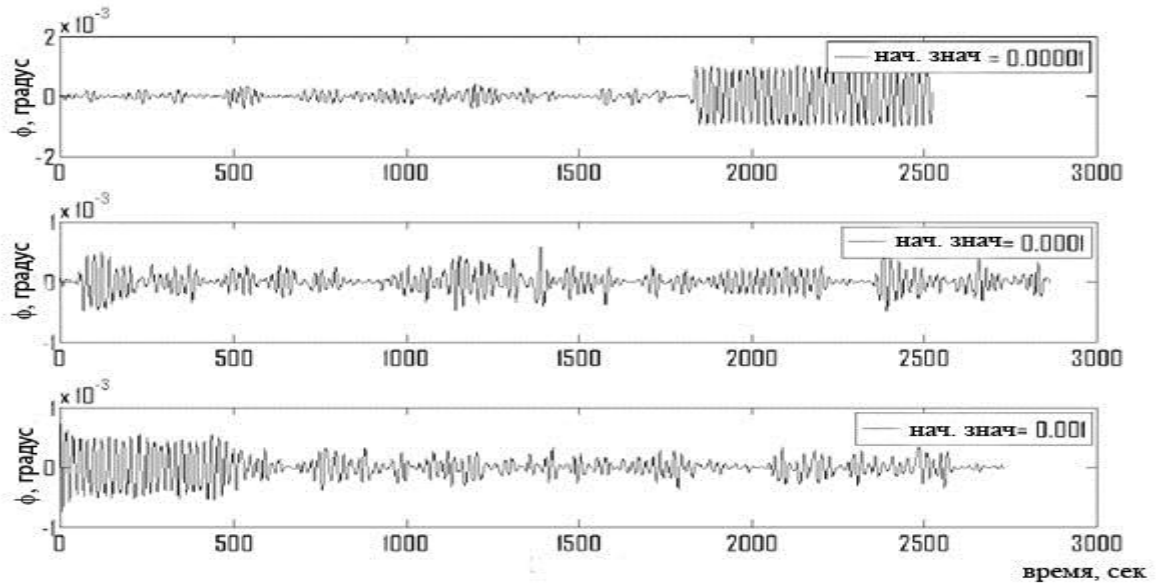


Fig. 5. Modeling near the equilibrium point.

The dynamics of pitching are analyzed using the methods of synergetic information theory.

Calculations show that the behavior of the dependence of pitching on time to a period of $2,5 \leq t \leq 250$ sec. order and chaos are mutually balanced. Therefore, the system is approximately equilibrium.

Starting at 250 seconds, the behavior of the time series changes to chaotically ordered. Chaos begins to exceed order.

Thus, the results of calculations show that it is precisely from 250 seconds that the behavior of the pitching takes the form of steady chaos. Consequently, the calculation of the values of entropy and negentropy allows us to predict the beginning of a fundamental change in the nature of pitching and the onset of parametric resonance of the vessel.

The lists of papers published in the theme in 2018:

1. Nağıyev F.B., Khabeev N.S. *The growth of vapor layer around the droplet of liquefied gas in a liquid*. *International Journal of Pure and Applied Mathematics*, (SCOPUS Reuters). Impact per Publication (IPP): 0.379 (2013), Volume 118, No. 3, 2018, DOI: 10.12732/ijpam.v.118i3.27; p.p. 837-840.
2. Nağıyev F.B., Khabeev N.S. *The growth of vapor shell around heated particle in a liquid*. *International Journal of Pure and Applied Mathematics*, (SCOPUS Reuters). Impact per Publication (IPP): 0.379 (2013), Volume 118, No. 3, 2018, DOI: 10.12732/ijpam.v.118i3.28; p.p.841-844.
3. Nağıyev F.B. Анализ и прогнозирование температуры земли методами

математической статистики и синергетической теории информации.

Инженерно- физический журнал, (SCOPUS Reuters), 2018 (çapda).

4. Nağıyev F.B., *A mathematical model of two-component fluid filtering and forecasting oil production*. *Journal of Engineering Research and Applications*. Impact factor 5.179, 1918, (çapda).

5. Nağıyev F.B., *Амплитудно-частотные характеристики колебаний газовых пузырьков метана в нефти*. «Ученые записки» НИИ «Геотехнологические проблемы нефти, газа и химия», 2018 (rəydən qayıdıb və çara qəbul olunub).

6. Nağıyev F.B., *Mathematics, Part 1 and Part 2*. *Schoolbook*, 2018 (çapda).

**Prof Head of “Applied Mathematics” department doct.phys.math.sci.
G.G.Aliyev**

On organisational activity

In 2018, the department has conducted a seminar every two weeks on Wednesdays at 14:00 hrs. Here some topics are discussed by the department staff and, in some cases, reports from other academic staff. Employees of the department participate in the general seminar and scientific conferences of the institute and deliver lectures.

Employees of "Applied Mathematics" department actively participate in public affairs of the republic:

Mirzazade Irada H. is chairman of the Trade Union Institute of Mathematics and Mechanics.

Professor Aliyev G.G. has been a guest of the NTV culture program.

In 2018, the staff of the department has published 20 articles. 7 of them were printed abroad, 7 are being printed in present (5 of them have been received back from editors and will be published this year), 5 theses were published, and one textbook titled 'Mathematics' was published in English.

In 2018, Doctoral dissertation by Elkhan Abbasov was submitted and defended by him.

The dissertation for the degree of Doctor of Philosophy on the specialty "Gas and Measurement Mechanics" was submitted to the Defense Board of the RMC (scientific supervisor Nagiev F.B.) for the dissertation of

G.A.Ahundova on "Application of Mechanical Methods of Gas and Liquidation to Some Ships' Problems" (scientific supervisor Nagiev F.B). Professor Gabil Aliyev, Professor Faig Nagiyev and Associate Professor Irada Mirzazade participated in the 40-day practice with reading lectures for BSU students (March-April 2018).

Regarding master's degree: the topic of "Mathematical Modeling of Liquid and Gas Flow in Nanostructures Considering Quantum-Mechanical Effects" has been approved for

In 2018, the grant project of the Science Foundation of the Republic of Azerbaijan Dozat Oil Company was implemented. The cost is 20000 AZN. Head of the project Professor Nagiev F.B.

The lists of papers of the collaborators of “Applied Mathematics” department of IMM published in 2018

1. Published papers

1. Aliyev G.G., Aliyev A.G.. *Generalized Navier condition with regard to influence of quantum-mechanical effects in nonhydrodynamics*. [IJISSET - International Journal of Innovative Science, Engineering & Technology, Vol. 5 Issue 5, May \(Tamilnadu India\)-2018, ISSN \(Online\) 2348-7968, Impact Factor \(2016\) -- 5.264, pp. 17-27. \(<http://ijiset.com/articlesv5/articlesv5s5.html>\)](#).
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3. Mirzazada İ.H. *Conducting of monitoring and experiments in toxic substances of poisoning*. [Caspian Journal of Applied Matematics, Ecology and Economics, Vol. 6, №1, December 2018, ISSN: 1560-4055, P3-16.](#)
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6. Nağıyev F.B., Khabeev N.S. *The growth of vapor shell around heated particle in a liquid*. International Journal of Pure and Applied Mathematics, SCOPUS Impact per Publication (IPP): 0.379 (2013), Volume 118, No. 3, 2018, DOI: 10.12732/ijpam.v.118i3.28; p.p.841-844.

2. Papers submitted to publication

1. Nağıyev F.B., *Анализ и прогнозирование температуры земли методами математической статистики и синергетической теории информации*. Инженерно- физический журнал, (SCOPUS Reuters), 2018 (çapda).
2. Nağıyev F.B. *A mathematical model of two-component fluid filtering and forecasting oil production*. Journal of Engineering Research and Applications. Impact factor 5.179, 1918 (çapda).
3. Nağıyev F.B. *Амплитудно-частотные характеристики колебаний газовых пузырьков метана в нефти*. «Ученые записки» НИИ «Геотехнологические проблемы нефти, газа и химия», 2018 (rəydən qayıdıb və çара qəbul olunub).
4. Э.М.Аббасов, Ш.А.Керимова, Н.А.Агаева. *Интегральное моделирование работы газовых скважин с учетом деформируемости коллектора пласта*. SOCAR Proceedings – (rəydən qayıdıb və çара qəbul olunub).
5. Э.М.Аббасов, Ш.А.Керимова, Н.А.Агаева. *Интегральное моделирование процесса восстановления давления*. Инженерно-Физический Журнал (ИФЖ), (SCOPUS Reuters). (rəydən qayıdıb və çара qəbul olunub).
6. Э.М.Аббасов, Ш.П.Казымов, Н.Р. Абдуллаева, Л.Г.Гаджикеримова. *Утечка жидкости в скважинном штанговом насосе*. Журнал Нефтяное хозяйство. (SCOPUS Reuters). (rəydən qayıdıb və çара qəbul olunub).

7.Э.М.Аббасов, Т.С.Кенгерли. *Интегральное моделирование процесса вытеснения нефти водой. Инженерно-Физический Журнал (ИФЖ), МИНСК, №1, 2019. (SCOPUS Reuters). (rəydən qayıdıb və çapa qəbul olunub).*

8. Nağıyev F.B. *Mathematics, Part 1 and Part 2. Schoolbook, 2018 (çapda).*

3. Abstracts

1.Mirzazada İ.H. Biostatistical methods in poisonings with toxic substanses Scientific Conferense “Actual problems of Mathematics and Mechanics” devoted to 95 years of the national leader of Azerbaijan Heydar Aliyev, 17-18 May, 2018 – Baku. p.73.

2.Mirzazada İ.H. Development of neural network in diagnostics carbon monoxide poisinings. [MADEA-8, June 17-23, 2018, Bishkek, Kyrgyz Republic, p.87-88.](#)

3.Mirzazada İ.H.. Organization of monitoring for toxic poisonings. [International Conference on Control and Optimization With Industrial Applications. 11-13 july, Baku, Azerbaijan, P 2022.](#)

4.Elkhan M. Abbasov, Shusha A. Kerimova, Nurlana A. Agayeva. *Integral modeling of the pressure recovery process. The 6th International Conference on Control and Optimization with Industrial Applications 11-13 July, 2018, Baku, Azerbaijan—tezis.*

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