ZUBOV, V.G., inzh.; MIZYUK, L. Ya., inzh.

Miniature high-speed automatic transistor compensator.
Priborostroenie no.6:10-12 Je '61. (MIRA 14:6)
(Electric instruments)
(Transistor circuits)

S/169/62/000/007/075/149
D228/D307

AUTHORS: Mizyuk, L. Ya. and Zubov, V. G.

TITLE: Transistorized computing autocompensator (KSR-T1) KCP-T1

PERIODICAL: Referativnyy zhurnal, Geofizika, no. 7, 1962, 33, abstract 7A217 (V sb. Razved. i promysl. geofiz., no. 42, M., 1961, 41-47)

TEXT: In the described KSR-T1 transistor autocompensator division and multiplication operations are accomplished by means of a variable instrument shunt. When there is such a circuit the converting unit is independent of the measuring limit and allows the equation $\rho_k = K(\Delta U/I)$ to be solved in one stage. A negative direct-current feedback is employed to compensate temperature changes in the device. This ensures the instrument's stable operation in the temperature range from -20 to +60°C. The principle of the device's circuit is given. [Abstracter's note: Complete translation.]

Card 1/1

S/651/62/000/006/004/010
E140/E135

AUTHOR: Zubov, V.G.

TITLE: Numerical system with fractional base

SOURCE: Akademiya nauk Ukrayins'koyi RSR. Instytut mashynoznavstva i avtomatyky, L'viv. Avtomaticheskiy kontrol' i izmeritel'naya tekhnika. no.6. 1962. 93-97.

TEXT: The author proposes the base $\sqrt{10}$ for indicator type instruments and analogue computers, in a "floating-point" representation. The dial reading is a fraction of unity, using an auxiliary representation of the particular power of $\sqrt{10} = 3.16....$

There is 1 table.

Card 1/1

45294

9.4310

S/651/62/000/006/005/010
E140/E135

AUTHOR: Zubov, V.G.

TITLE: Experimental study of residual parameters of a transistor used as a small-signal switch

SOURCE: Akademiya nauk Ukrayins'koyi RSR. Instytut mashynoznavstva i avtomatyky, L'viv. Avtomaticheskiy kontrol' i izmeritel'naya tekhnika. no.6. 1962. 98-104.

TEXT: The author has found discrepancies between the theoretical and the experimental behaviour of transistors used as small-signal switches (e.g. in d.c.-amplifier choppers). In particular the drifts of the collector current in the cut-off state and the saturation voltage with temperature are far less than expected, so that such applications can in fact be realised even though it would appear theoretically impossible. The author claims to have found a slow process in cut-off transistors which renders the a.c. and d.c. properties different, hence the d.c. parameters have no significance in rapidly switched transistors. The time constant of the d.c. process is about three minutes for the Soviet transistor П13А (P13A), during which the residual current in the

X

Card 1/2

cut-off transistor grows from a value of the order of 3 μA to one of the order of a few tens μA at 80 °C. The author claims this is not a thermal phenomenon, since the transistor is "cut-off", but the value of collector voltage used in the experiment is not given. However, the use of a mechanical chopper in the base circuit at 50 - 400 c.p.s. appears to confirm the author's analysis, in that the residual cut-off current remains constant with time and does not exceed 2 μA at 80 °C. No conjectures are advanced concerning the nature of the phenomenon observed.
There are 7 figures.

ZUBOV, V.G.

Temperature stability of a transistorized converter. Avtom.kont. i izm.tekh. no.6:114-121 '62. (MIRA 16:2)
(Transistor circuits)

45295

9,6000

S/651/62/000/006/007/010
E140/E135

AUTHORS: Blazhkevich, B.I., and Zubov, V.G.

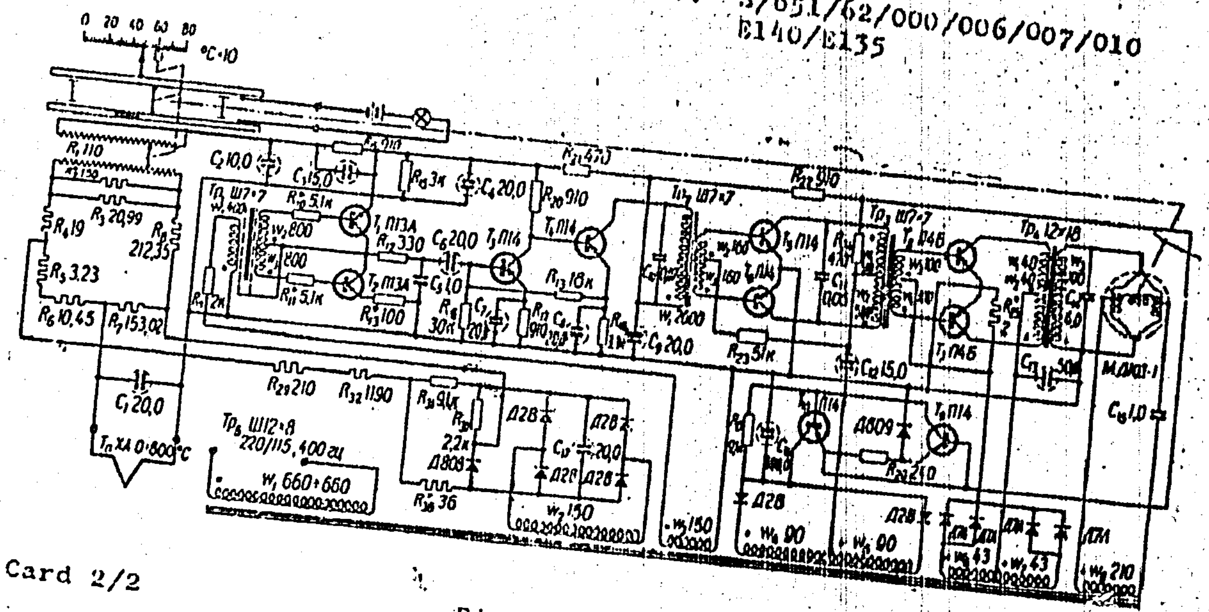
TITLE: New transistorized self-balancing potentiometer for thermocouple measurements

SOURCE: Akademiya nauk Ukrayins'koyi RSR. Instytut mashynoznavstva i avtomatyky, L'viv. Avtomaticheskiy kontrol' i izmeritel'naya tekhnika. no.6. 1962. 128-132.

TEXT: The article describes МПАК (MPAK), a miniature transistorized self-balancing potentiometer for use in the range 0 to 800 °C, with an error not exceeding 0.5% of full scale indication. This potentiometer was developed at the Institut mashinovedeniya i avtomatiki AN USSR (Institute of Science of Machinery and Automatics, AS Ukr.SSR). Fig.1 shows the principle of the device. There are 2 figures.

Card 1/2

New transistorized self-balancing ... S/651/62/000/006/007/010
E140/E135



Card 2/2

Fig.1

ZUBOV, V.G.

Stable two-stage transistor amplifier with direct coupling.
Vop. pered. inform. 2:155-158 '63. (MIRA 16:12)

L 08427-67 EWT(m)/EWP(j) IJP(c) GD/RM

ACC NR: AT6034430 SOURCE CODE: UR/0000/66/000/000/0122/0140

AUTHOR: Zubov, V. G. (L'vov)

67
65
B+1

ORG: none

TITLE: Microvolt transistor inverter with microthermostatic control

SOURCE: AN UkrSSR. Termostoykiye radiotelemetricheskiye sistemy (Heat resistant radiotelemetering systems). Kiev, Naukova dumka, 1966, 122-140

TOPIC TAGS: thermostat, thermal stability, thermal degradation, electronic transformer, transistor

ABSTRACT: A microthermostat for close temperature control of a transistorized inverter is described in detail. Special care was taken in circuit design and layout to insure maximum thermal stability of the transistor and associated components, in order that input signals on the order of microvolts could be reliably handled. A cross section of the microthermostat is shown in Fig. 1. With an internal ambient control point of 70C, the circuit was found to operate satisfactorily over an outside

Card 1/2

L 08427-67

ACC NR: AT6034430

2

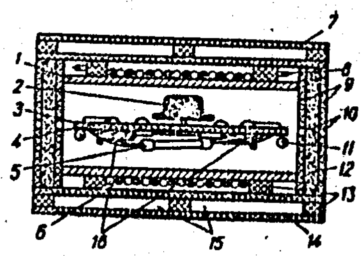


Fig. 1. Microthermostat

1 - Aluminum cylinder with outside lacquer insulation; 2 - P201A triode; 3 - micarta plate; 4 - lead connections; 5 - MMT-1 thermistor; 6 - heating coil; 7, 9 - asbestos walls; 8 - heating coil terminals; 10 - feed-through for leads; 11 - detents for mounting micarta plate; 12 - asbestos filler; 13 - micarta rings; 14 - polyamide resin; 15 - dead air space; 16 - diodes.

ambient range of 0--60C. Zero drift over this range does not exceed ±10 μv, and inverter operation is within specification limits for line voltage changes up to ±10%. Thermostat dimensions are 105 x 150 x 50 mm, and its weight is not over 1 kg. Orig. art. has: 7 figures.

SUB CODE: 09/ SUBM DATE: 05Apr66/ ORIG REF: 004/ OTH REF: 002/ ATD PRESS: 5103

Card 2/2 ls

L 07839-67 EWT(1) IJP(c)
ACC NR: AP6024670 SOURCE CODE: UR/0070/66/011/004/0628/0631

AUTHOR: Govorova, Ye. Z.; Zubov, V. G.; Firsova, M. M.

ORG: Moscow State University im. V. M. Lomonosov (Moskovskiy gosudarstvennyy universitet)

TITLE: Certain features of acoustic wave interaction in crystals

SOURCE: Kristallografiya, v. 11, no. 4, 1966, 628-631

TOPIC TAGS: acoustic wave, ultrasonic wave propagation, ammonium compound, acoustic diffraction, single crystal, quartz crystal

ABSTRACT: This is a continuation of earlier work (Kristallografiya v. 9, no. 4, 459 -- 465, 1964), where the authors observed in α-quartz, by an ultrasonic diffraction method, the appearance of longitudinal oscillation modes accompanying transverse oscillations. The present article is devoted to a similar study with single-crystal ADP, in which there are no piezocoefficients causing longitudinal oscillations, and in which the elastic nonlinearity is larger than in quartz. The results have shown that the transverse mode is continuously accompanied by a second harmonic of a longitudinal mode in the same direction. In the general case this

Card 1/2 UDC: 548.0:539.37

L 07839-67
ACC NR: AP6024670

3

longitudinal mode is weaker than the mode exciting it, but under certain geometrical resonance conditions the diffraction maxima on the longitudinal mode become comparable in brightness with the original transverse mode. The result is shown to agree with a general formula derived for the propagation of an elastic wave in a nonlinear crystalline medium, whereby under certain conditions the second-harmonic longitudinal oscillation can increase spontaneously and give rise eventually to a first harmonic, which was not present hitherto. This energy transfer from one harmonic to another is in good agreement with the results of E. Fermi, J. Pasta and S. M. Ulam (Studies of Nonlinear Problems, LA-1940, OTS, US Department of Commerce, Washington, D. C.), who investigated directly the energy transitions in the spectrum of a vibrating string with nonlinear parameters. The present experiments, like the observations of Fermi et al., only permit observation of this process but still offer no theoretical explanation. The authors thank I. S. Rez, E. I. Feygina, and R. D. Zaytsova for preparing the high grade ADP crystals. Orig. art. has: 2 figures and 4 formulas.

SUB CODE: 20/ SUBM DATE: 08Sep64/ ORIG REF: 004/ OTH REF: 003

7/2 bc

L 3053-66 EWT(1)/ETC(F) GD

ACC NR: AT6008315 SOURCE CODE: UR/0000/65/000/000/0061/0066

AUTHOR: Zubov, V. G. (L'vov) (Candidate of technical science)

ORG: none

TITLE: A semiconductor converter of small d.c. voltages

SOURCE: AN UkrSSR. Elementy sistem otbora i peredachi informatsii (Elements of systems for selecting and transferring information). Kiev, Naukova dumka, 1965, 61-66

TOPIC TAGS: voltage converter, electronic circuit, circuit design, semiconductor device

ABSTRACT: Although semiconductor voltage converters still exhibit numerous shortcomings, the fast response and the almost infinite lifetime of such devices make the continuous efforts for the perfection of such devices meaningful. The author discusses in considerable detail the theory and operation of the thermally compensated converter forming a bridge circuit. The theoretical conclusions were tested on an experimental circuit, shown in Figure 1, containing the heat-sensitive resistor R_t. Tests show that the circuit is quite insensitive to the choice of triodes, the residual (false) signals at normal operating temperatures does not exceed ±10 μV, and a temperature change of the order of 500 causes an additional zero drift within the ±10 μV limits. Orig. art. has: 8 formulas and 2 figures.

Card 1/2

ACC NR: AT6008315

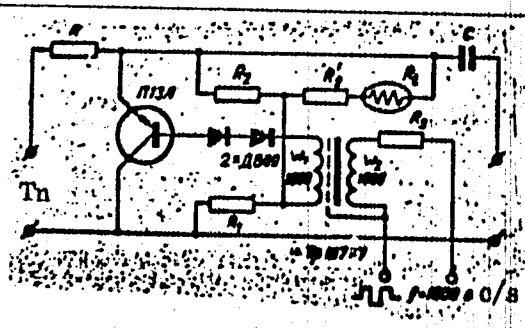


Figure 1. Small d.c. voltage semiconductor converter

SUB CODE: 09/ SUBM DATE: 6Nov65/ ORIG REF: 002/ OTH REF: 002

ACC NR: AP6018772 WH

AUTHOR: Zubov, V. G.; Ivanov, A. T. SOURCE CODE: UR/0070/66/011/003/0422/0424

ORG: Moscow State University im. M. V. Lomonosov (Moskovskiy gosudarstvennyy universitet)

41
B

TITLE: Dilatation of quartz caused by bombardment with fast neutrons

SOURCE: Kristallografiya, v. 11, no. 3, 1966, 422-424

19

TOPIC TAGS: quartz crystal, neutron absorption, neutron flux, lattice defect, FAST NEUTRON, NEUTRON BOMBARDMENT

ABSTRACT: The dilatation of quartz exposed to fast neutrons (integral flux densities of 0 to 20 n/cm^2) was studied. The analysis of the results was based on the formation of submicroscopic amorphous regions and their effect on neighboring crystal lattice sites; the number of amorphous sites was proportional to the increase in volume. Data on the % volume expansion and % decrease in density as functions of integral flux density of fast neutrons are presented. Theoretically, the number (dn) of amorphous regions formed in a dose interval from ϕ to $\phi+d\phi$ was proportional to the number of unformed amorphous regions ($N-n$), i. e., $dn=(\alpha+\beta n)(N-n)d\phi$, where α and β are constants. Integrating and letting $\xi=kn$ be the relative volume expansion so that $\xi_{max}=kN$,

$$\xi = \frac{a\xi_{max}[\exp(b\varphi)-1]}{\xi_{max}+a\exp(b\varphi)},$$

Card 1/2

UDC: 548.0

L 34816-66

ACC NR: AP6018772

where the new constants $a=k\alpha/\beta$ and $b=N\beta+\alpha$. From experimental data, a=0.272% and b=0.45·10^{-19} cm^2/n for the results of Wittels (light environment) and a=0.898% and b=0.42·10^{-19} cm^2/n for the results of Primak (darkness); ε_{max} in all cases was equal to 17.65%. The above equations agreed well with the experimental results and the amorphous region hypothesis, with the constants a and b adjusting for any rate changes in amorphous quartz accumulation as a function of light exposure. Orig. art. has: 2 figures, 4 formulas. [14]

SUB CODE: 20,11/ SUBM DATE: 10Apr64/ OTH REF: 005/ ATD PRESS: 5031

Card 2/2

1. ZUBOV, V. G.

2. USSR (600)

4. Science

7. Physics problems. Moskva, Gostekhizdat, 1952.

9. Monthly List of Russian Accessions, Library of Congress, April 1953. Unclassified.

ZUBOV, V.G.; SHAL'NOV, V.P.; KUZNETSOVA, Ye.B., redaktor; YUGOV, V.A., redaktor; NEGRIMOVSKAYA, R.A., tekhnicheskiy redaktor.

[Physics problems] Zadachi po fizike. Moskva, Gos. izd-vo tekhniko-teoret. lit-ry, 1954. 320 p. (MLRA 7:11)
(Physics--Problems, exercises, etc.)

ZUBOV, Viktor Gennadiyevich; SHAL'NOV, Vladimir Petrovich; KUZNETSOVA, Ye.B., redaktor; GAVRILOV, S.S., tekhnicheskiy redaktor

[Problems in physics; textbook for self-instruction] Zadachi po fizike; posobie dlia samoobrazovaniia. Izd- 3-e, ispr. Moskva, Gos. izd-vo tekhniko-teoret. lit-ry, 1955. 320.p. (MIRA 8:7)
(Physics--Problems, exercises, etc.)

Name: ZUBOV, V. G.

Dissertation: Investigation of the dynamic elastic properties of quartz

Degree: Cand Phys-Math Sci

~~Affiliation~~ defended at: Moscow State U imeni M. V. Lomonosov, Physics Faculty

~~Defense~~ Publication Date, Place: 1956, Moscow

Source: Knizhnaya Letopis', No 45, 1956

ZUBOV, V.G.; SHENFEL'D, TS.A.

Dielectric losses in ice near the melting temperature. Report No.1. Vest.Mosk.un. Ser.mat.,mekh.,astron.,fiz.,khim. 11 no.1:181-185 '56. (MIRA 10:12)
(Ice--Electric properties)

Zubov, V. G.

USSR/Radiophysics - Generation and Conversion of RF Oscillations, I-4

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 35275

Author: Zubov, V. G.

Institution: Moscow State University

Title: On the Temperature Behavior of the Elastic Constants of Quartz

Original Periodical: Dokl. AN SSSR, 1956, 107, 103, 392-393

Abstract: Report on the results of a new measurement of the temperature behavior of the natural frequencies of quartz resonators in the temperature range from 20 to 573° using the method of observing the diffraction of light by ultrasonic waves. The quartz cubes, oriented along the principal axes, were excited by an alternating field with a frequency of 8-10 mc. The light source employed was a mercury lamp with a green filter. The photographs of the diffraction pattern were used to calculate the velocity of the quasi-longitudinal and quasi-transverse waves and the values of all the 9 effective elastic coefficients. The resultant experimental curves make it possible to

Card 1/2

ZUBOV, V.G.

Category : USSR/Solid State Physics - Mechanical Properties of Crystals and Polycrystalline Compounds E-9

Abs Jour : Ref Zhur - Fizika, No 3, 1957, No 6771

Author : Zubov, V.G., Firsova, M.M.
Inst : Moscow University, USSR
Title : Concerning the Elastic Properties of High Temperature Quartz

Orig Pub : Dokl. AN SSSR, 1956, 109, No 3, 493-494

Abstract : The Bergman-Schafer method was used to study the temperature behavior of the elastic constants of β quartz in the temperature range from 578 -- 635°. As the temperature is increased, C_{11}, C_{33}, and C_{12} increase monotonically. C_{44} remains constant within the limits of experimental error. At 580°, $C_{11} = C_{33}$ and C_{12} reverses its sign. $C(66) = (C_{11}-C_{12})/2$ increases monotonically from 50×10^{10} to 51×10^{10} dyne/cm^2. C_{12} increases from 17×10^{10} dyne/cm^2 at 580° to 36×10^{10} dyne/cm^2 at 615 -- 620°. The elasticity of β quartz increases with temperature.

Card : 1/1

ZUBOV, Viktor Gennadiyevich; SHAL'NOV, Vladimir Petrovich; KUZNETSOVA, Ye.B., redaktor; GAVRILOV, S.S., tekhnicheskiy redaktor

[Problems in physics; a manual for self-education] Zadachi po fizike; posobie dlia samoobrazovaniia. Izd.4-oe, ispr. Moskva, Gos.izd-vo tekhniko-teoret.lit-ry, 1957. 320 p. (MLRA 10:9)

(Physics--Problems, exercises, etc.)

SOV/70-3-6-11/25

AUTHORS: Zhdanov, G.S., Zubov, V.G., Ivanov, A.T. and Firsova, M.M.

TITLE: On the Elastic Properties of Quartz Irradiated by Neutrons (Ob uprugikh svoystvakh kvartsa, obluchennogo neytronami)

PERIODICAL: Kristallografiya, 1958, Vol 3, Nr 6, pp 720-725 (USSR)

ABSTRACT: The elastic constants of quartz, irradiated in a reactor by fast neutrons, have been measured by the mthod of Bergmann and Schaeffer. After irradiation by 2.10^{19} neutrons/cm^2 increasing errors which lay in the limits of 0.9 to 1.7% for a relative decrease in the density of quartz of 0.18% were found in the experiment for measuring the elastic constants. Comparison with the temperature variation of the elastic constants showed that the temperature and radiation changes in the elastic constants corresponding to the same change in density were sharply distinguished. The results agree qualitatively with the work of Mayer and Gigon (J. Phys.Rad., 1957, Vol 18, p 109) on the elastic moduli of irradiated quartz. Measurements were made on blocks about 20 x 20 x 4 mm cut perpendicular to the crystallographic axes. Four series each of three plates were used, careful controls being kept. The frequencies used were 8-10 Mc/s. Wittels and Sherill (Phil.Mag., 1957, Vol 48, p 24) contrasted the

Card1/2

SOV/70-3-6-11/25

On the Elastic Properties of Quartz Irradiated by Neutrons

changes in the elastic constants produced by thermal and radiation-produced expansion of the crystal lattice. Although qualitatively the anistropy is the same the actual values for it are quite different. This is shown experimentally. The structural meaning of the results obtained is not discussed. Acknowledgments to Academician I.K. Kikoin and V.L. Karpov. There are 4 tables. There are 11 references, 3 of which are Soviet, 8 English.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet im. M.V. Lomonosova (Moscow State University imeni M.V. Lomonosov)

SUBMITTED: June 12, 1958

Card 2/2

ZUBOV, V.G.; OSIPOVA, L.P.

Intensity and line width of the Raman effect in α-quartz.
Kristallografiia 6 no.3:418-425 My-Je '61. (MIRA 14:8)

1. Moskovskiy gosudarstvennyy universitet imeni M.V. Lomonosova.
(Quartz crystals--Spectra)
(Raman effect)

ZUBOV, V.G.; OSIPOVA, L.P.; FIRSOVA, M.M.

Effect of constant voltage on the intensity and width of Raman spectrum lines of α-quartz. Kristallografiia 6 no.5:777-778 S-O '61. (MIRA 14:10)

1. Moskovskiy gosudarstvennyy universitet imeni M.V.Lomonosova.
(Raman effect) (Quartz)

36141

S/070/62/007/002/007/022
E132/E160

24,7100

AUTHORS: Zubov, V.G., and Grishina, A.P.

TITLE: The dielectric susceptibility and refractive indices of quartz irradiated by fast neutrons

PERIODICAL: Kristallografiya, v.7, no.2, 1962, 238-241

TEXT: For comparison with measurements by W. Primak (Ref.2: Phys. Rev., v.110, no.6, 1958, 1240-1254) the d.c., density and refractive indices of quartz crystals after irradiation by 2 x 10^{19} neutrons/cm^2 have been studied. As the density and refractive indices depend on the two effects of irradiation - the general breaking up of the structure and the distortion of the interatomic forces by defects - it is concluded that the dielectric constant is a more sensitive index by which to follow the irradiation. The d.c. changes by 1% for this dose while the density changes by 0.18%, the r.i. by about 0.05% and the elastic constants by about 1%. There are 5 tables.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet im. M.V. Lomonosova (Moscow State University imeni M.V. Lomonosov)

SUBMITTED: June 30, 1960

Card 1/1

ZUBOV, V. G.; FIRSOVA, M. M.

Characteristics of the elastic behavior of quartz in the $\alpha-\beta$ -transition region. Kristallografiia 7 no.3:469-471 My-Je '62. (MIRA 16:1)

1. Moskovskiy gosudarstvennyy universitet imeni M. V. Lomonosova.

(Quartz—Elastic properties)

S/070/62/007/004/012/016
E021/E435

AUTHORS: Zubov, V.G., Osipova, L.P.

TITLE: Intensity and width of lines of combination scattering in synthetic quartz

PERIODICAL: Kristallografiya, v.7, no.4, 1962, 630-631

TEXT: Low pressure mercury lamps with a very low background were used. This resulted in a considerable decrease of the parasitic scattering and enabled measurements on the lines 128, 206, 266, 357, 466, 696, 795-805, 1061, 1081 and 1159 cm^{-1}; these were carried out on a ДФС-4 (DFS-4) spectrometer. The intensity of the lines 206, 266, 357, 466 and 696 cm^{-1} on the spectra of synthetic and natural quartz agreed; the total intensity of the band 1061-1081 cm^{-1} was greater in synthetic than in natural quartz. The intensity of the doublet 795-805 cm^{-1} was somewhat less in synthetic than in natural quartz. The intensity and the width of the line 128 cm^{-1} were both greater for synthetic than for natural quartz. The synthetic quartz possessed a layer structure, which might explain the appearance of a weak line with

Card 1/2

24.3100
15.2110

S/020/62/144/004/010/024
B125/B108

AUTHORS: Zubov, V. G., and Osipova, L. P.

TITLE: The Raman scattering in α-quartz irradiated by fast neutrons

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 144, no. 4, 1962, 763-765

TEXT: The spectrum of the Raman scattering on a quartz single crystal was investigated. Irradiation of the crystal by fast neutrons diminished the density of the sample from 2.65 to 2.49 g/cm^3. The sample retained a residual γ-activity, turned light-violet, and began to absorb ~50 % of the incident light of 5800 - 4000 Å. The intense fluorescence with its maximum at 5750 Å decreased monotonically. Owing to the intense background, only the brightest peaks of the spectrum could be determined with an ИСП-51 (ISP-51) spectrograph. The very reliable photoelectric method, however, gave the whole (continuous) spectrum of the Raman scattering up to 1500 cm^{-1} (Fig.1). Many of the peaks are caused by the very diffuse lines of the non-irradiated quartz. New peaks at 540, 930, 1050, 1350 cm^{-1} were found. The diffuse maxima of the irradiated quartz spectra are 20 - 30 times less intense than

Card 1/2

ZUBOV, Viktor Gennadiyevich; SHAL'NOV, Vladimir Petrovich; KUZNETSOVA, Ye.B., red.; LIKHACHEVA, L.V., tekhn. red.

[Problems in physics] Zadachi po fizike; posobie dlia samoobrazovaniia. Izd.7. Moskva, Gos.izd-vo fiziko-matemat. lit-ry, 1963. 271 p. (MIRA 16:10)
(Physics--Problems, exercises, etc.)

45679

S/070/63/008/001/020/024
E132/E460

24,7800

AUTHORS: Zubov, V.G., Firsova, M.M., Molokova, T.M.

TITLE: The temperature dependence of the dielectric permeability of crystalline and fused quartz

PERIODICAL: Kristallografiya, v.8, no.1, 1963, 112-114

TEXT: In order to clear up discrepancies in the earlier literature, measurements were made of the dielectric constants e_{11} and e_{33} of quartz at 1 Mc/s over the temperature range 20 to 700°C. Y- and Z-cut plates about 20 x 20 x 4 mm having platinized surfaces were used. Fused quartz showed hardly any rise in e with temperature and for crystalline α-quartz the change was slight until 500°C. There is a slight discontinuity in e_{11} at about the α-β transition temperature of 573°C. e_{33} did not rise as rapidly as early workers found for 1 to 90 Kc/s. To get the best values of e_{33} specimens of quartz were cleaned by L.G.Chentsova's method of applying a constant potential of 2 kV/cm along the optic axis at 700°C. This had the effect of reducing e_{33} steadily with each treatment until it became substantially the same as e_{11} and also showed a small discontinuity at 573°C. The effect of foreign ions in the structure on e_{33} is

Card 1/2

S/070/63/008/002/003/017
E039/E435

AUTHORS: Zhdanov, G.S., Zubov, V.G., Kolontsova, Ye.V., Osipova, L.P., Telegina, I.V.

TITLE: Radiation effects in α-quartz

PERIODICAL: Kristallografiya, v.8, no.2, 1963, 207-212

TEXT: A comparison of the Raman spectra of α-quartz before and after exposure to neutrons is carried out. The structural characteristics are obtained by the Laue method and the anomalous X-ray scattering method. The investigated sample is cut from a [illegible] of optical quality Brazilian quartz in the form of a cube [illegible] x 30 mm with the edges parallel to the principle axes and is subjected to a fast neutron flux of [illegible] x 10^{19} n/cm². This [illegible] a change in density of the quartz from 2.65 to 2.40 g/cm³. [illegible] acquires an insignificant [illegible] activity, a smoky violet [illegible] The main features of the spectrum of the irradiated α-quartz are: a) the spectrum is continuous up to 1500 cm⁻¹; b) it contains a number of blurred wide maxima; c) in the region 700 to 1500 cm⁻¹ the scattering is very similar in character to that of molten

Card 1/2

quartz; d) the intensity of scattering in the irradiated quartz depends on the orientation of the crystal. The X-ray analysis shows that the third order symmetry C_3 is changed to sixth order C_6 by the irradiation and there is a significant change in the distribution of diffuse scattering. As a result of neutron irradiation, the structure of α-quartz is thought to change in the following manner: 1) Initially, defects develop which lead to the weakening and breaking of the Si-O bond and hence to the possibility of rearrangement in the Si-O tetrahedrons. 2) At a definite stage of the exposure the α-quartz becomes unstable and there is a transition to the more symmetrical high temperature modification. This remains stable at room temperature. 3) There is a complete loss of orientation in parts of the crystal. There are 4 figures.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet im. M.V.Lomonosova (Moscow State University imeni M.V.Lomonosov)

SUBMITTED: July 10, 1962

Card 2/4

ACCESSION NR: AP4036721 S/0020/64/156/002/0300/0301

AUTHOR: Zubov, V. G.; Osipova, L. P.

TITLE: Regularities in spectrum changes of Raman effect in alpha-quartz caused by irradiation with fast neutrons.

SOURCE: AN SSSR. Doklady*, v. 156, no. 2, 1964, 300-301

TOPIC TAGS: fast neutron irradiation, quartz Raman spectrum, alpha-quartz, beta quartz, irradiated quartz Raman spectrum, Raman spectrum

ABSTRACT: The authors have recorded the Raman spectra in alpha-quartz irradiated by neutron fluxes of 4.5 and $7 \times 10^{19} n/cm^2$, respectively. It was found that irradiation causes a gradual decrease of maxima corresponding to Raman lines of a nonirradiated quartz and an increase of their widths. The maxima are shifted toward smaller frequencies; the continuous spectrum is increasing. The Raman spectra of the specimen irradiated with $7 \times 10^{19} n/cm^2$ approaches that of beta-quartz. Heating has a similar effect. It seems that the end result of neutron irradiation is the creation of regions of amorphous quartz. Orig. art. has: 1 figure and 1 table.

APPROVED FOR RELEASE: 09/01/2001 CIA-RDP86-00513R002065610004-7"

ZUBOV, V.G.; GOVOROVA, Ye.Z.

Effects of third-order anharmonicity in crystals. Kristallografiia 10 no.1:56-58 Ja-F '65. (MIRA 18:3)

1. Moskovskiy gosudarstvennyy universitet imeni Lomonosova.

L 22091-66 EWT(1)/T IJP(c) GG

ACC NR: AP6012940 SOURCE CODE: UR/0070/65/010/001/0056/0058

AUTHOR: Zubov, V. G.; Govorova, Ye. Z.

ORG: Moscow State University im. M. V. Lomonosov (Moskovskiy gosudarstvennyy universitet)

TITLE: Third-order anharmonicity effects in crystals

SOURCE: Kristallografiya, v. 10, no. 1, 1965, 56-58

TOPIC TAGS: phase transition, ultrasonics, crystallography

ABSTRACT: The conditions are formulated for resonant interaction between two intersecting waves in a crystal. A numerical solution is given of the equation for the interaction between X3 and Y3 waves in α-quartz. This solution is verified experimentally by the Bergman-Scheffer ultrasonic diffraction method. Photographs at room temperature and near the phase transition (500° C) are given which support the numerical calculation. Orig. art. has: 2 figures and 10 formulas. [JPRS]

SUB CODE: 20 / SUBM DATE: 20Jun64 / ORIG REF: 003 / OTH REF: 002

UDC: 548.0: 535.2

Card 1/1 BLG

ZUBOV, V. I., ENG.

Machinery Industry

Introducing advanced Stakhanov practices in limited quantity production, Vest. mash., 32, no. 1, 1952

Monthly List of Russian Accessions, Library of Congress October 1952 UNCLASSIFIED

Applied Mechanics Reviews
June 1954
Theoretical and
Experimental Methods

8-24-54
LV

1606. Zubov, V. I., Some sufficient criteria for stability of a nonlinear system of differential equations (in Russian), *Prikl. Mat. Mekh.* 17, 4, 506–508, July–Aug. 1953.

Consider the n-vector, $n \times n$ matrix system $\dot{x} = A(x; t)x$ and set $B = \frac{1}{2}(A + A')$. Let $\lambda_i(x; t)$ be the characteristic roots of B. Theorem 1: If the $\lambda_i \leq 0$, the origin is stable. The proof rests upon the immediate relation in which x is considered as a column vector: $\frac{1}{2}d(x' \cdot x)/dt = x'Bx$. An orthogonal transformation is applied normalizing B. In the new unknowns z_i, one finds (Euclidean norm)

$$||z(t)||^2 = ||z(t_0)||^2 \exp 2 \int_{t_0}^{t} \frac{\Sigma \lambda_i z_i^2(t)}{||z(t)||^2} dt$$

leading at once to the theorem. Noteworthy consequences: (1) If $\lambda_i < -\delta < 0$, then the origin is asymptotically stable. (2) A need not satisfy the conditions for the uniqueness of solutions. Under the circumstances a trajectory may reach the origin in finite time, but under the conditions of the theorem it will not be able to leave the origin. (3) Consider a system $\dot{x} = X(x; t)$, where $X(0; t) = 0$. Let $J = (\partial X_i/\partial x_j)$. If the characteristic roots of $\frac{1}{2}(J + J')$ are ≤ 0, the origin is asymptotically stable. (4) Let $\lambda(t) \geq \lambda_i(x; t)$ $[\leq \lambda_i(x; t)]$ for $t_0 \leq t < +\infty$. If $\int_{t_0}^{t} \lambda(t)dt < +\infty$ $[= +\infty]$, then the origin is stable [unstable].

Let $A(0; \infty) = C$, a constant matrix, and let $\nu_1, \ldots, \nu_n$ be the characteristic roots of C. Theorem 2: If $A(0; \infty)$ is continuous at $x = 0$, $t \to +\infty$, and if the ν_i all have negative real parts, then the origin is asymptotically stable. Noteworthy consequence: Take again $\dot{x} = X(x; t)$ as before. If the characteristic roots $f_i(x; t)$ of J are such that the $f_i(0; \infty)$ have negative real parts, then the origin is asymptotically stable for the system.

S. Lefschetz, USA

ZUBOV, V.I.

A methed of integrating differential equatiens describing the vibratiens of mechanical systems with distributed parameters. Vest.Len.un.9 no.2:69-75 F '54. (MIRA 9:7)
(Vibratien) (Differential equations)

ZUBOV, V. I.

USSR/Mathematics - Asymptotic stability

Card 1/1 Pub. 22 - 1/40

Authors : Zubov, V.I.

Title : Regarding the theory of A.M. Lyapunov's second method

Periodical : Dok. AN SSSR 99/3, 341-344, Nov 21, 1954

Abstract : A second Lyapunov method for solving systems of differential equations of the $\frac{dxi}{dt}$ = fi (x_1, x_2, ...x_r, t) type where i = 1, 2, ... r, is analyzed. The obvious solution of the system, i.e., x_1 = x_2 = ... = 0, has been called, after Lyapunov, a solution of the asymptotic stability. Definitions and sufficient conditions from the latter are given, and another Lyapunov's criterion (method), for the asymptotic stability, is presented and discussed by means of a series of theorms. Three Russian references (1946-1954).

Institute: ......

Presented by: Academician V.I. Smirnov, September 3, 1954

ZUBOV, V.I.

Zubov [illegible] [illegible] Lyapunov's second [illegible] I - F, 8

[illegible]

[illegible] The treatment is first given for [illegible] systems [illegible] where [illegible] may be taken as a definite positive form of [illegible]. For the general case [illegible] when the [illegible] and suitable unicity conditions hold wherever one considers the system [illegible] [illegible]

Z[illegible]BOV V I

Some of the theorems follow [illegible] are stated for [illegible] [illegible]

[illegible]

[illegible] general method is also given for obtaining the collection of all differential equations with a given d[illegible] as region of asymptotic stability.

S. Lefschetz

Zubov, V. I. On the theory of A. M. Lyapunov's second method. Dokl. Akad. Nauk SSSR (N.S.) 100, 857-859 [illegible]

L - F/F

[illegible]

ZUBOV, V.I.

SUBJECT USSR/MATHEMATICS/Differential equations CARD 1/1 PG - 568
AUTHOR ZUBOV W.I.
TITLE Qualitative investigation of a system of ordinary differential equations.
PERIODICAL Doklady Akad.Nauk 109, 899-901 (1956)
reviewed 2/1957

Let be given the system

$$\frac{dx}{dt} = f_1(x,y), \quad \frac{dy}{dt} = f_2(x,y), \quad \frac{dz}{dt} = f_3(x,y,z),$$

where the functions f_i $(i=1,2,3)$ satisfy some conditions such that among others the system has a unique solution $x = x(t,x_o,y_o)$, $y = y(t,x_o,y_o)$, $z = z(t,x_o,y_o,z_o)$ for $t = 0$. The author investigates the asymptotic stability of the trivial solution in the large and with a sketchy proof he gives six sufficient and one necessary and sufficient condition of stability. Then under further assumptions the existence and number of boundary surfaces are investigated which separate the stable domain from the instable one. Furthermore it is established whenthe obtained qualitative image is stable at little changes of the function f_i $(i=1,2,3)$.- In a certain regard the obtained results are more general than the well-known results of Erugin (Priklad.Mat.Mech 14, 5, (1950)),Krasovski (Priklad.Mat.Mech.17, 6, (1953)) and Pliss (ibid. 17, 5,(1953)).

ZUBOV, V.I.

SUBJECT USSR/MATHEMATICS/Differential equations CARD 1/2 PG - 499
AUTHOR ZUBOV V.I.
TITLE The representation of the solutions of the systems of differential equations in the neighborhood of a singular point.
PERIODICAL Doklady Akad.Nauk 109, 1095-1097 (1956) reviewed 1/1957

The author considers the system

$$(1)\quad \sum_{s=1}^{n} \frac{\partial z_j}{\partial x_s}\Big(\sum_{i=1}^{n} p_{si}(t)x_i + X_s(x_1,\ldots,x_n,z_1,\ldots,z_k,t)\Big) + \frac{\partial z_j}{\partial t} =$$

$$= \sum_{i=1}^{k} q_{ji}(t)z_i + \sum_{i=1}^{n} r_{ji}(t)x_i + Z_j(x_1,\ldots,x_n,z_1,\ldots,z_k,t) \qquad (j=1,\ldots,k).$$

It is assumed that X_s and Z_j admit series developments with respect to integral positive powers of $x_1,\ldots,x_n,z_1,\ldots,z_k$, where the coefficients of these series are real, continuous and bounded functions of t for $t \geqslant 0$. Also $p_{si}(t)$, $q_{ji}(t)$ and $r_{ij}(t)$ are real, continuous and bounded for $t \geqslant 0$. It is stated that under certain assumptions there exists a group of functions $z_j(x_1,\ldots x_n,t,c_1,\ldots c_\beta)$ $(j=1,\ldots,k)$ having the following property: Every z_j depends on β constants, in a region $|x_s| \leq x_0(t) \neq 0$, $t \in [0,+\infty]$ it can be developed in a series and it satisfies (1). If especially p_{sl}, q_{ji} and r_{ji} are constants and X_s, Z_j are independent of t and analytic in a neighborhood of zero; if further λ_s ($s=1,\dots,n$) and μ_l ($l=1,\dots,k$) are the eigennumbers of the matrices $P = \|p_{sl}\|$ and $Q = \|q_{ji}\|$, then the following theorem is valid: If 1) Re $\lambda_s < 0$ ($s=1,\dots,n$), 2) $\lambda_\gamma = \mu_\gamma$, $\gamma \leq \beta$, then there exists a group of functions $z_j(x_1,\dots,x_n,c_1,\dots,c_\beta)$ $j=1,\dots,k$ with the following properties:

a. The function z_j can be developed in a convergent series

$$z_j = \sum_{m=1}^{\infty} z_j^{(m)}(x_1,\dots,x_n,c_1,\dots,c\ ) \qquad j=1,2,\dots,k,$$

where $z_j^{(m)}$ are forms of m-th degree with respect to $x_1,\dots,x_n$ and their coefficients are polynomials in $c_1,\dots,c_\beta$ and in x_1.

b. The functions z_j satisfy the system with constant coefficients.

ZUBOV, V. I.

"Conditions for Asymptotic Stability in the Case of Nonsteady-State Motion and an Evaluation of the Rate of Diminishment of the General Solution," by V. I. Zubov, *Vestnik Leningradskogo Universiteta, Seriya Matematiki, Mekhaniki i Astronomii*, No 1, Issue 1, 1957, pp 110-129

Studies the system of n-differential equations

$$\frac{dx_i}{dt} = X_i(x_1, \ldots x_n, t), \quad i = 1, \ldots n$$

where $X_i(x,t)$ are given when $x_i \in (-\infty, +\infty)$, $t \in (-\infty, +\infty)$ $i = 1, \ldots n$, satisfy the conditions guaranteeing the existence of the single solution

$$x(t, x_0, t_0) = \{x_1(t, x_1^0, \ldots x_n^0, t_0), \ldots x_n(t, x_1^0, \ldots x_n^0, t_0)\},$$

reverting to x_0 when $t = t_0$, where x_0, t_0 are any finite values.

This article, which was presented at a conference on general mechanics held in May 1955, formulates conditions of nonlocal asymptotic stability with which it is possible to determine the entire region of asymptotic stability. The author presents a method of estimating the general solution to cases of asymptotic stability.

SUM. 1287

PHASE I BOOK EXPLOITATION 10

Zubov, Vladimir Ivanovich

Metody A.M. Lyapunova i ikh primeneniye (Methods of A.M. Lyapunov and Their Use) [Leningrad] Izd-vo Leningradskogo univ-ta, 1957. 240 p. 2,800 copies printed.

Sponsoring Agency: Leningradskiy ordena Lenina Gosudarstvennyy Universitet imeni A.A. Zhdanova

Resp. Ed.: Khavin, V.P.; Ed.: Moiseyeva, L.V.; Tech. Ed.: Vodolagina, I.S.

PURPOSE: This book is intended for students of advanced University courses, graduate students and scientific workers; it may also be used by engineers desirous of a deeper understanding of stability theory.

Card 1/8

COVERAGE: The monograph is closely related to the well-known work by A.M. Lyapunov, General Problems of Stability of Motion. The author attempts to aquaint the reader with recent results in the theory of stability of motion and to give some results of his own investigation in this field of mathematics. He presents an extension of Lyapunov's second method, which makes it possible to develop a theory of the stability of invariant sets of dynamical systems and of more general systems in metric space. He proposes a method of construction of a family of solutions of a system of ordinary differential equations. Results obtained are applied to the solution of the problem of stability for systems of ordinary and partial differential equations. The author thanks the following for their help in preparing the book: N.P. Yerugin, V.V. Nemytskiy, Academician V.I. Smirnov, Docent A.P. Tuzov, V.R. Petukhov, graduate student, and D.A. Vladimirov, instructor in mathematics and mechanics at Leningrad State University. The foreword is by Academician Smirnov. The book has 41 references, 36 of which are Soviet, 3 French and 1 German.

ZUBOV, V.I.

Subject of existence and approximate representation of implicit function. Vest.Len.un. 11 no.19:48-54 '56. (MIRA 10:1)
(Functions)

Zubov V I

SUBJECT	USSR/MATHEMATICS/Differential equations	CARD 1/1	PG - 702
AUTHOR	ZUBOV V.I.		
TITLE	The investigation of the neighborhood of the state of equilibrium of a system of differential equations.		
PERIODICAL	Doklady Akad.Nauk 110, 169-171 (1956) reviewed 4/1957		

Let be given the system

$$\frac{dx_s}{dt} = \sum_{m=\mu}^{\infty} X_s^{(m)} \qquad (s=1,\dots,n),$$

where $X_s^{(m)}$ are homogeneous forms of m-th order in the variables $x_1,\dots,x_n$. Here the coefficients of the $X_s^{(\mu)}$ are real constants while the coefficients of the $X_s^{(m)}$, $m>\mu$ are bounded functions of t which are defined on $(0,+\infty]$ and continuous on $[0,+\infty]$. The series in the right sides of the equations converge for $t \geqslant 0$ and sufficiently small $|x_i|$. The author gives necessary and sufficient conditions for the asymptotic stability of the trivial solution of (1) for arbitrary forms $X_s^{(m)}$, $m>\mu$.

INSTITUTION: University Leningrad.

ZUBOV, V.I.

20-5-7/60

AUTHOR ZUBOV, V.I.

TITLE An Investigation of the Stability Problem for Systems of Equations with Homogeneous right-hand Terms. (Issledovaniye zadachi ob ustoychivosti dlya sistem uravneniy s odnorodnymi pravymi chastyami.- Russian)

PERIODICAL Doklady Akademii Nauk SSSR 1957, Vol 114, Nr 5, pp 942-944 (USSR)

ABSTRACT The present paper determines the conditions of the asymptotic stability of the zero solution of a system of ordinary differential equations with homogeneous right sides. The author further provides exact evaluations of the distance from the integral curve up to position of equilibrium and reports on various applications of the results obtained.
The author at first defines the conceptions of the homogeneous order and the positive order respectively. He then investigates the system of the ordinary differential equations

$$dx_s/dt = X_s^{(\mu)} (x_1,\dots\dots,x_n) \ (s = 1,\dots\dots,n).$$

CARD 1/2

20-5-7/60

An Investigation of the Stability Problem for Systems of Equations with Homogeneous right-hand Terms.

Such an integral curve of the above mentioned systems (1) is here denoted with

$$X = X(t, X^{(o)}),$$

so that $X(0, X^{(o)}) = X^{(o)}$ is true. X here is the real n-dimensional vector $(x_1, \ldots, x_n)$. Naturally a family of integral curves exists together with the integral curves of the system (1) mentioned above which depends upon an arbitrary constant c. Next 7 theorems and 2 corrollaries are given. (No Illustrations)

ASSOCIATION: Leningrad State University "A.A.ZHDANOVA" (Leningradskiy gosudarstvennyy universitet im. A.A. Zhdanova.- Russian)

PRESENTED BY: V.I.SMIRNOV, member of the Academy, 7.1.1957

SUBMITTED: 2.1. 1957

AVAILABLE: Library of Congress.

CARD 2/2

AUTHOR: Zubov, V.I. SOV/140-58-1-8/21

TITLE: On Systems of Ordinary Differential Equations With Generalized-Homogeneous Right Sides (O sistemakh obyknovennykh differentsial'nykh uravneniy s obobshchenno-odnorodnymi pravymi chastyami)

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy Ministerstva vysshego obrazovaniya SSSR, Matematika, 1958, Nr 1, pp 80-88 (USSR)

ABSTRACT: A real continuous function $f(x_1,\ldots,x_n)$ defined in E_n is denoted as generalized-homogeneous of class $(m_1,\ldots,m_n)$ and order m, if for all c, $-\infty < c < +\infty$ it holds: $f(c^{m_1}x_1,\ldots,c^{m_n}x_n) = c^m f(x_1,\ldots,x_n)$, where m_i and m are positive rational numbers with odd denominators.
Theorem: In order that $f(x_1,\ldots,x_n)$ be generalized-homogeneous of class $(m_1,\ldots,m_n)$ and order m, it is necessary and sufficient that it satisfies the equation

$$\sum_{i=1}^{n} m_i x_i \frac{\partial V}{\partial x_i} = mV .$$

Card 1/4

On Systems of Ordinary Differential Equations With Generalized-Homogeneous Right Sides SOV/140-58-1-8/21

Let the system

$$(1) \quad \frac{dx_i}{dt} = X_i\,(x_1,\dots,x_n)\ ,\ i = 1,\dots,n$$

be considered, where X_i are generalized-homogeneous of class $(m_1,\dots,m_n)$ and order $\sigma + m_i$; $\sigma + m_i \geqslant 0$, $\sigma = \frac{p_1}{q_1}$, q_1 – odd.

Let A(c) denote the diagonal matrix with the elements $c_1^{m_1},\dots,c_n^{m_n}$.

Theorem: If $X = X(t,X^{(0)})$ is an integral curve of (1), then $Y(t) = A(c)X(tc^{\sigma},X^{(0)})$ is a family of integral curves of (1), so that $Y = A(c)X^{(0)}$ for t = 0 and consequently $Y = X(t,A(c)X^{(0)})$.

The last theorem is used for the determination of the asymptotically stable systems (1).

Theorem: The zero solution of (1) can be asymptotically

Card 2/4

stable for arbitrary complex disturbances only if $\sigma = 0$. The zero solution of (1) can be asymptotically stable for arbitrary real disturbances only if $\sigma = \frac{2k}{q_1}$, k - integer.

Theorem: In order that the zero solution of (1) be asymptotically stable, it is necessary and sufficient that there are two continuous functions V and W defined on E_n which possess the following properties: 1. $W(x_1,\ldots,x_n)$ is negative-definite, $V(x_1,\ldots,x_n)$ is positive-definite; 2. V and W are generalized-homogeneous of class $(m_1,\ldots,m_n)$ and orders $m - \sigma$ and m respectively; 3. V is continuously differentiable along the integral curves of (1), where

$$\frac{dV}{dt} = W .$$

Theorem: For the asymptotic stability of the zero solution of (1) for $\sigma > 0$ it is necessary and sufficient that the domain of the asymptotic stability of the zero solution of the system

$$\frac{dy_i}{dt} = - m_i y_i - X_i (y_1,\dots,y_n)$$

is bounded.

The developed theory is applied in two further theorems to stability investigations in the first approximation. The asymptotic stability and boundedness of the solutions of

$$(2) \qquad \frac{dx_i}{dt} = X_i (x_1,\dots,x_n) + f_i (t,x_1,\dots,x_n)$$

is concluded for sufficiently small f_i from the asymptotic stability of (1).

There are 3 Soviet references.

SUBMITTED: October 16, 1957

Stability Conditions Over Finite Time Intervals (Differential Equations) 16 2 1-FW

7136:

Zubov, V.I. Über die Stabilitätsbedingungen in einer endlichen Zeitstrecke und über die Bestimmung der Länge des Intervalls. Bul. Inst. Politehn. Iaşi (N.S.) 4(8) (1958), 69–74. (Russian. German and Romanian summaries)

The system dealt with is the n-vector system

$$\dot{x}=P(t)x+X(x,t),$$

where $P(t)$ is bounded continuous, and the components of X are convergent power series in the x_i beginning with terms of degree ≥ 2 whose coefficients are continuous and bounded functions of t. The problem under discussion has already been dealt with by Kamen [Akad. Nauk SSSR. Prikl. Mat. Meh. 17 (1953), 529–540; MR 15, 795], Lebedev [ibid. 18 (1954), 75–94, 139–148; MR 16, 132] and Kamenkov and Lebedev [ibid. 18 (1954), 512; MR 16, 361], but they did not determine accurately the time interval in which the origin is stable. In the present note the author determines necessary and sufficient conditions of stability for a finite interval and also gives a method for computing the length of the interval.

The author uses the following definition of stability: Given a definite positive quadratic form, $V(x)$, the origin is stable relative to V on the time interval τ if

$$V(x(t, t_0, x_0))<A$$

for $t \in [t_0, t_0+\tau]$ and $V(x_0)\leq A$, where A is sufficiently small. Theorem 1: A sufficient condition for the stability just stated whatever X for suitable small τ and A is that the characteristic roots of $P(t_0)$ have negative real parts. The calculation of A and τ is outlined. Theorem 2: If not all of the characteristic roots of $P(t_0)$ have negative real parts, th. 1 does not hold. *S. Lefschetz* (Mexico, D.F.)

11/1/58

AUTHOR: Zubov, V.I. SOV/140-58-6-9/27

TITLE: On the Theory of Linear Stationary Systems With a Retarding Argument (K teorii lineynykh statsionarnykh sistem s zapazdyvayushchim argumentom)

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Matematika 1958, Nr 6, pp 86-95 (USSR)

ABSTRACT: The author joins the well-known paper of Myshkis [Ref 2] and considers the equation

$$(1) \qquad \frac{dX(t)}{dt} = \int_{-h}^{0} [dG(\vartheta)] X(t+\vartheta),$$

where X is an n-dimensional vector, $G(\vartheta)$ is a matrix, the elements $G_{se}(\vartheta)$ of which are functions of bounded variation on $[-h,0]$. Let

$$A(\lambda) = \int_{-h}^{0} e^{\lambda\vartheta} dG(\vartheta) - \lambda E,$$

let $\lambda_1, \lambda_2, \dots$ be the roots of $\Delta A(\lambda) = 0$ appearing with multiplicities $s_1, s_2, \dots$.

Card 1/3

Theorem: To every root λ_j there corresponds a solution of (1):

$$X_j(t) = \frac{1}{2\pi i} \int_{\overline{C}_j^+} e^{\lambda t} A^{-1}(\lambda)F(\lambda)d\lambda \qquad j=1,2,\ldots,,$$

where $F(\lambda)$ is an analytic function unique in $\overline{C}_j^+$, where $\overline{C}_j^+$ is a circle containing no roots λ beside of λ_j.

Let C_o be the class of continuous functions $\varphi(t)$, $\varphi(-h_1) = 0$ satisfying the Dirichlet conditions on $[-h_1,0]$. Let

$$B(\lambda,\varphi) = \int_{h_1}^{0} e^{\lambda\vartheta} dG \int_{-h_1}^{\vartheta} e^{-\lambda\tau}\varphi(\tau)d\tau - \lambda\int_{-h_1}^{0} e^{-\lambda\tau}\varphi(\tau)d\tau - \varphi(0),$$

where $G(\vartheta) = G(-h)$ for $\vartheta\in[-h_1,-h]$.

Theorem: The function $X(t) = \frac{\text{V.P.}}{2\pi i}\int_{\sigma-i\infty}^{\sigma+i\infty} e^{\lambda t}A(\lambda)^{-1}B(\lambda,\varphi)d\lambda,$

On the Theory of Linear Stationary Systems With a Retarding Argument SOV/140-58-6-9/27

$\sigma > c$, is a continuous solution of (1) satisfying the condition $x(t) = \varphi(t)$, $t \in [-h, 0]$, $\varphi \in C_0$.

Theorem: If all λ lie in the left half-plane, then the zero solution of (1) is asymptotically stable, where a certain estimation is valid.

Five further theorems contain assertions on the asymptotic developments of the solutions with respect to certain functions and on the existence of periodic and almost-periodic solutions.

There are 7 references, 5 of which are Soviet, 1 American, and 1 English.

ASSOCIATION: Leningradskiy gosudarstvennyy universitet imeni A.A.Zhdanova (Leningrad State University imeni A.A.Zhdanov)

SUBMITTED: February 26, 1958

Card 3/3

AUTHOR: Zubov, V. I. (Leningrad) 40-22-1-4/15

TITLE: On a Method for the Investigation of the Stability of Zero Solutions in Doubtful Cases (Ob odnom metode issledovaniya ustoychivosti nulevogo resheniya v somnitel'nykh sluchayakh)

PERIODICAL: Prikladnaya Matematika i Mekhanika, 1958, Vol 22, Nr 1, pp 46 - 49 (USSR)

ABSTRACT: The author investigates a method for the investigation of the stability of zero solutions of a system of n+k ordinary differential equations which is suitable even for doubtful cases. The method consists in the investigation of the stability of the zero solution of systems of k and n equations separately, whereby these systems of equations are obtained from the initial system. The author investigates systems of the form

$$(1) \quad \frac{dy_s}{dt} = f_s(x_\nu, y_\nu, t) \quad ; \quad \frac{dx_j}{dt} = g_j(x_\nu, y_\nu, t) \quad (s=1..k)(j=1..n)$$

The functions on the right sides are assumed to be defined in a certain domain and to be continuous. At first the notions of the stability according to Lyapunov and of the so-called "strong"

Card 1/2

On a Method for the Investigation of the Stability of Zero Solutions in Doubtful Cases 40-22-1-4/15

stability are defined and then four theorems are proved which hold for the connection of the stability of the zero solution of the initial system with the properties of the partial systems. The investigation method is similar to Lyapunov's methods. A similar method for the investigation of the zero solution of differential equations was really already given by Lyapunov in his paper [Ref 3] . This method was developed by Malkin [Ref 4] and some parts of the results of Malkin were directly taken over by the author. There are 4 Soviet references.

SUBMITTED: April 29, 1957

Card 2/2

AUTHOR: Zubov, V.I. 20-118-2-5/60

TITLE: On the Reduction Principle (O printsipe svedeniya)

PERIODICAL: Doklady Akademii Nauk SSSR, 1958, Vol 118, Nr 2, pp 228-230 (USSR)

ABSTRACT: The author considers the system

$$\frac{dy_s}{dt} = f_s(t, x_1,\ldots,x_n; y_1,\ldots,y_k) \qquad s = 1,\ldots,k$$

$$(1) \quad \frac{dx_j}{dt} = g_j(t,x_1,\ldots,x_n; y_1,\ldots,y_k) \qquad j = 1,\ldots,n$$

where the right sides are assumed to be continuous in a certain domain. In the case $f_s \equiv 0$ for $y_1 = .. = y_k = 0$ and $g_j \equiv 0$ for $x_1 = \ldots = x_n = y_1 = .. = y_k = 0$ which is difficult for stability investigations the author reduces the stability problem to the consideration of the partial systems of order k and j respectively arising from (1), e.g. $\frac{dx_j}{dt} = g_j(t,x_1,\ldots,x_n,0,\ldots,0)$. The method can be denoted as a development of Lyapunov's ideas and of a paper of Malkin

Card 1/2

On the Reduction Principle 20-118-2-5/60

[Ref 1] . There are 6 Soviet references.

ASSOCIATION: Leningradskiy gosudarstvennyy universitet imeni A.A. Zhdanova (Leningrad State University imeni A.A. Zhdanov)

PRESENTED: July 1, 1957, by V.I. Smirnov, Academician

SUBMITTED: June 26, 1958

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Zubov, V.I.

16(1) PHASE I BOOK EXPLOITATION SOV/2660

Vsesoyuznyy matematicheskiy s"yezd. 3rd, Moscow, 1956

Trudy. t. 4: Kratkoye soderzhaniye sektsionnykh dokladov. Doklady inostrannykh uchenykh (Transactions of the 3rd All-Union Mathematical Conference in Moscow. vol. 4: Summary of Sectional Reports. Reports of Foreign Scientists) Moscow, Izd-vo AN SSSR, 1959. 247 p. 2,200 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Matematicheskiy institut.

Tech. Ed.: G.N. Shevchenko; Editorial Board: A.A. Abramov, V.G. Boltyanskiy, A.M. Vasil'yev, B.V. Medvedev, A.D. Myshkis, S.M. Nikol'skiy (Resp. Ed.), A.G. Postnikov, Yu. V. Prokhorov, K.A. Rybnikov, P. L. Ul'yanov, V.A. Uspenskiy, N.G. Chetayev, G. Ye. Shilov, and A.I. Shirshov.

PURPOSE: This book is intended for mathematicians and physicists.

COVERAGE: The book is Volume IV of the Transactions of the Third All-Union Mathematical Conference, held in June and July 1956. The book is divided into two main parts. The first part contains summaries of the papers presented by Soviet scientists at the Conference that were not included in the first two volumes. The second part contains the text of reports submitted to the editor by non-Soviet scientists. In those cases when the non-Soviet scientist did not submit a copy of his paper to the editor, the title of the paper is cited and, if the paper was printed in a previous volume, reference is made to the appropriate volume. The papers, both Soviet and non-Soviet, cover various topics in number theory, algebra, differential and integral equations, function theory, functional analysis, probability theory, topology, mathematical problems of mechanics and physics, computational mathematics, mathematical logic and the foundations of mathematics, and the history of mathematics.

Card 6/31

28(1) PHASE I BOOK EXPLOITATION SOV/2657

Zubov, Vladimir Ivanovich

Matematicheskiye metody issledovaniya sistem avtomaticheskogo regulirovaniya (Mathematical Methods of Investigation of Automatic Control Systems) Leningrad, Sudpromgiz, 1959. 323 p. Errata slip inserted. 6,500 copies printed.

Scientific Ed.: V. I. Chernetskiy; Ed.: Yu. S. Kazarov; Tech. Ed.: A. I. Kontorovich.

PURPOSE: This book is intended for scientific workers and engineers in the field of automatic control.

COVERAGE: In the book a study is made of the mathematical methods of studying the stability of steady-state motions in nonstationary systems and an evaluation of the deviations of transient processes from steady-state motions is given. Methods are presented for constructing the solutions of certain nonstationary systems of differential equations, to the study of

Card 1/6

which a wide class of automatic control systems is reduced. Certain methods of finding the probability characteristics of stochastic transient processes are described, as well as methods of finding stability regions in the space of initial data and in the space of allowable values of the parameters. The author thanks Yu. O. Shterenberg, V. K. Chesnokov, V. V. Khomenyuk, B. I. Korobochkin, and L. T. Tarushkina for their help in producing the book. There are 68 references: 62 Soviet, 3 English, 2 French, and 1 German.

TABLE OF CONTENTS:

APPROVED FOR RELEASE: 09/01/2001 CIA-RDP86-00513R002065610004-7"

Mathematical Methods (Cont.) SOV/2657

Card 4/6

16(1) SOV/39-48-2-3/9

AUTHOR: Zubov, V.I.

TITLE: Some Problems of Motion Stability

PERIODICAL: Matematicheskiy sbornik, 1959, Vol 48, Nr 2, pp 149-190 (USSR)

ABSTRACT: Chapter I. The representation of the solutions of systems of differential equations in the neighborhood of singular initial values. Given the system

$$(1) \qquad z\frac{dy_s}{dz} = \sum_{i=1}^{n} p_{si}(z)y_i + p_s(z)z + Y_s(z,y_1,\ldots,y_n) \qquad s=1,2,\ldots,n ,$$

where $Y_s = \sum_{m+m_1+\ldots+m_n\geq 2} P_s^{(m,m_1,\ldots,m_n)}(z)z^m y_1^{m_1}\ldots y_n^{m_n}$ for $|z|<z_1$, $z_1>0$ constant, and let $|y_j|<y_0$ converge; let the functions $p_{si}(z)$, $p_s(z)$, $P_s^{(m,m_1,\ldots,m_n)}(z)$ be defined, real, continuous and bounded on $z\in(0,1]$. Let $\mu_1,\ldots,\mu_n$ be the characteristic numbers of

$$(2) \qquad \frac{dy_s}{dt} = -\sum_{i=1}^{n} p_{si}(e^{-t})y_i , \qquad s=1,\ldots,n .$$

Card 1/3

Theorem: Let $\mu_i > 0$ for $i \leqslant l$; let (2) be regular. Then (1) has a family of solutions depending on l constants and being representable by series

$$y_s = \sum_{m+m_1+\dots+m_l \geqslant 1} K_s^{(m,m_1,\dots,m_l)}(z) z^{m+\sum_{i=1}^{l} m_i \mu_i} c_1^{m_1} \dots c_l^{m_l}$$

converging for $|z| \leqslant z_o$, $|c_j| \leqslant c_o$, where $z_o < \beta$ and $c_o z_o < \beta$, where β is a sufficiently small constant, $c_o > 0$, $z_o > 0$ constant. It holds: $K_s^{(m,m_1,\dots,m_l)}(z) z^{\alpha} \to 0$ for $z \to 0$, where $\alpha > 0$ is constant.

The author gives several conclusions, especially for the case where p_{si}, p_s, P_s are constants.

Chapter II: Investigation of the stability in some critical cases. The author joins the papers of A.M.Lyapunov, N.P.Yerugin, and A.A.Shestakov and considers: the qualitative image of the state of equilibrium for $x_s' = f_s(x_1,\dots,x_n)$; the asymptotic

Some Problems of Motion Stability SOV/39-48-2-3/9

stability of $x_s' = \sum_{m=\mu}^{\infty} X_s^{(m)}(t,x_1,\ldots,x_n)$, where the $X_s^{(m)}$ are homogeneous forms of m-th degree; the analytic representation of O-curves of this system (compare Nem tskiy [Ref 6]); the case of some pairs of purely imaginary roots. The paper contains 25 theorems and numerous conclusions, lemmas, and remarks. A part of the results overlaps with known results. The author thanks V.I.Smirnov, and V.V.Nemytskiy for the interest in this paper.

There are 21 references, 15 of which are Soviet, 3 German, and 3 French.

SUBMITTED: September2, 1957

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16.2600

AUTHOR: Zubov, [redacted]

TITLE: On Periodic and Almost Periodic Forced Oscillations Arising Under the Influence of an External Force

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Matematika, 1960, No. 6, pp. 93 - 102

TEXT: The author considers the system

(1.1) $$\frac{dX}{dt} = F(X, t) ,$$

where

$$X = \{x_1, \ldots, x_n\} ,$$

$$F(X, t) = \{f_1(X, t), \ldots, f_n(X, t)\} .$$

Let the $f_s(X, t)$ be defined real and continuous for all finite real values of the arguments; let them be almost periodic in t for arbitrary finite fixed values of X ; in every finite region of the variables $x_1, \ldots, x_n$ let them be uniformly continuous in t ; let them in $x_1, \ldots, x_n$ satisfy the Lipschitz condition with a fixed

Card 1/6

88181

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C111/C222

On Periodic and Almost Periodic Forced Oscillations Arising Under the Influence of an External Force

constant.

Definition 2 : Let (1.1) have the property of convergence if (1.1) has a unique almost periodic solution $X = \phi(t)$, where 1. For every $\varepsilon > 0$ exists a $\delta(\varepsilon) > 0$ so that from $|X_0 - \phi(t_0)| < \delta(\varepsilon)$ it follows $|X(t,X_0,t_0) - \phi(t)| < \varepsilon$ for $t \geqslant t_0$. 2. In every finite domain of variation of X_0 for $t - t_0 \to +\infty$ uniformly in $t_0 > -\infty$ it holds : $|X(t,X_0,t_0) - \phi(t)| \to 0$.

Theorem 1 : In order that (1.1) has the property of convergence it is necessary and sufficient that

1. every solution $X(t,X_0,t_0)$ of (1.1) is bounded for $t \geqslant t_0$;
2. to every $r > 0$ and $\varepsilon > 0$ there exists a $\delta(\varepsilon,r) > 0$ so that if $|X_0 - Y_0| < \delta(\varepsilon,r)$ is satisfied then it holds $|X(t,X_0,t_0) - X(t,Y_0,t_0)| < \varepsilon$ for $t \geqslant t_0$ and $|X(t,X_0,t_0) - X(t,Y_0,t_0)| \to 0$ converges uniformly with respect to $t_0 > -\infty$ for $t - t_0 \to +\infty$; $|X_0| < r$; $|Y_0| < r$.

Card 2/6

88181
S/140/60/000/006/007/018
C111/C222

On Periodic and Almost Periodic Forced Oscillations Arising Under the Influence of an External Force

3. for a fixed X_0, for every $\varepsilon > 0$ there exist such numbers l and T that in every interval $(\alpha, \alpha + l)$ there exists at least one τ so that $|X(t + \tau, X_0, t_0) - X(t, X_0, t_0)| < \varepsilon$ holds for $t \geqslant t_0 + T$ and $t + \tau \geqslant t_0 + T$. The magnitudes τ are the almost-periods of the right sides of (1.1) in a certain region.

Theorem 2 : Let the following conditions be satisfied :

1. There exists a function $V_1(X,t)$ so that :

a) it is defined, real and continuous for all real X,t ;

b) $V_1 \to +\infty$ for $|X| \to +\infty$ uniformly in $t > -\infty$;

c) in the region $|X| \geqslant r_1$, where r_1 is a certain positive constant, V_1 has a non-positive total derivative in which the derivatives $\frac{dX}{dt}$ are substituted according to (1.1) ;

d) V_1 is uniformly bounded with respect to $t < +\infty$ in every finite region $r_1 < |X| < r$.

Card 3/6

S/140/60/000/006/007/018
C111/C222

On Periodic and Almost Periodic Forced Oscillations Arising Under the Influence of an External Force

2. There exists a function $V(X,Y,Z,t)$ so that

α) V is positive definite and admits an infinitely small upper limit in every finite region $|Z| < \varrho$;

β) the function $W(X,Y,Z,t) = \frac{\partial V}{\partial t} + \sum_{i=1}^{n} \Big[\frac{\partial V}{\partial X_i} f_i(X,t) + \frac{\partial V}{\partial Y_i} f_i(Y,t) + \frac{\partial V}{\partial Z_i}(f_i(Z+Y,t) - f_i(Y,t))\Big]$ is negative definite in Z in every finite region $|Z| < \varrho$;

γ) the partial derivatives of V with respect to all arguments are continuous and uniformly bounded in t in every bounded region of the X,Y,Z .

Then (1.1) has the property of convergence.

Theorem 3 : Let the following conditions be satisfied :

1) There exists a $V_1(X,t)$ so that

a_1) $V_1(X,t)$ has the properties a) b) d) of theorem 2 ;

b_1) there exists an $r_1 > 0$ so that the total derivative of V_1 in which

88181

On Periodic and Almost Periodic Forced Oscillations Arising Under The Influence of an External Force

S/140/60/000/006/007/018
C111/C222

for $\frac{dX}{dt}$ the values (1.1) are substituted, in $|X| > r_1$ satisfies the inequation $\frac{dV_1}{dt} < -\alpha$, α = const > 0 ;

c_1) there exist such $r_3 > r_2 \geq r_1$ so that

$$\inf_{\substack{|X| = r_3 \\ t \in (-\infty, \infty)}} V_1 > \sup_{\substack{|X| = r_2 \\ t \in (-\infty, \infty)}} V_1$$

2) The condition 2 of theorem 2 is satisfied in $|Z| > 2r_3$. Then (1.1) has the property of convergence.

Theorem 4 relates to systems (1.1) representable in the form

(3.8) $$\dot{X} = A(t)X + H(X, t) + P(t) ,$$

Card 5/6

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C111/C222

On Periodic and Almost Periodic Forced Oscillations Arising Under the Influence of an External Force

and gives sufficient conditions that (3.8) has the property of convergence.
There are 3 references : 2 Soviet and 1 Czecho-Slovakian.

ASSOCIATION: Leningradskiy gosudarstvennyy universitet (Leningrad State University)

SUBMITTED: November 29, 1958

Card 6/6

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C 111/ C 333

16.3400

AUTHOR: Zubov, V. I.

TITLE: On almost periodic solutions of systems of differential equations

PERIODICAL: Leningrad. Universitet. Vestnik. Seriya matematiki, mekhaniki i astronomii, no. 1, 1960, 104-106

TEXT: The author considers

$$\frac{dX}{dt} = F(X,t) \tag{1}$$

where

$$X = (x_1, \ldots, x_n),$$
$$F(X,t) = \{f_1(X,t), \ldots, f_n(X,t)\}.$$

Let the $f_s(X,t)$ be defined for all finite real values of the arguments, real and continuous; almost periodic for fixed X in t; uniformly continuous in t in every finite domain of the $x_1, \ldots, x_n$. The $f_s(X,t)$ satisfy a Lipschitz condition with a fixed constant in $x_1, \ldots, x_n$.

Card 1/4

Definition: (1) is said to possess the property of convergence if it has a unique almost periodic solution $x = \phi(t)$ and 1.) to every $\mathcal{E} > 0$ there exists a $\delta(\mathcal{E}) > 0$ so that from $|x_o - \phi(t_o)| < \delta(\mathcal{E})$ it follows $|X(t, X_o, t_o) - \phi(t)| < \mathcal{E}$ for $t \geqq t_o$. 2.) $|X(t, X_o, t_o) - \phi(t)| \to 0$ for $t - t_o \to +\infty$ uniformly in $t_o > -\infty$ in every finite domain of X_o.

Theorem 1: In order that (1) possesses the property of convergence it is necessary and sufficient that 1.) every solution $x(t, X_o, t_o)$ of (1) is bounded for $t \geqq t_o$; 2.) to every $r > 0$, $\mathcal{E} > 0$ there exists a $\delta(\mathcal{E}, r) > 0$ so that from $|x_o - y_o| < \delta(\mathcal{E}, r)$ it follows: $|X(t, x_o, t_o) - X(t, y_o, t_o)| < \mathcal{E}$ for $t \geqq t_o$ and $|X(t, x_o, t_o) - X(t, y_o, t_o)| \to 0$ for $t - t_o \to +\infty$ uniformly in $t_o > -\infty$, $|x_o| < r$, $|y_o| < r$. 3.) For fixed x_o there exist l and T to every $\mathcal{E} > 0$ such that in every interval $(\alpha, \alpha + l)$ there exists at least one τ so that

89502

S/043/60/000/001/008/014
C 111/ C 333

On almost periodic solutions . . .

$|X(t+\tau, x_0, t_0) - X(t, x_0, t_0)| < \varepsilon$ for $t \geq t_0 + T$ and $t + \tau \geq t_0 + T$.

Theorem 2: Assume that the following conditions are satisfied: 1. There exists a function $V_1(X,t)$ which is real and continuous for all finite values of the arguments, uniformly bounded relative to $t < +\infty$ in every domain $r_1 < |X| < r$, tends uniformly to $+\infty$ relative to $t > -\infty$ for $|X| \to +\infty$, and which possesses a nonnegative total derivative $\frac{dV_1}{dt}$ in $|X| \geq r_1 > 0$ (in which the $\frac{\partial x}{\partial t}$ are substituted according to (1)). 2. There exists a function $V(X,Y,Z,t)$ with the properties a.) V is positive definite and admits an infinitely small upper bound in every domain $|Z| < \varrho$; b.) the function

$$W(X,Y,Z,t) = \frac{\partial V}{\partial t} + \sum_{i=1}^{n} \left[\frac{\partial V}{\partial x_i} \cdot f_i(X,t) + \frac{\partial V}{\partial Y_i} \cdot f_i(Y,t) + \frac{\partial V}{\partial Z_i} (f_i(Z+Y,t) - f_i(Y,t))\right]$$

is negative definite in Z in every finite domain $|Z| < \varrho$; c.) the partial derivatives of V relative to all arguments are continuous and uniformly bounded in t in every

Card 3/4

89502

S/043/60/000/001/008/014
C 111/ C 333

On almost periodic solutions . . .

bounded domain of X, Y, Z. Then (1) possesses the property of convergence. Theorem 3 and 4 are simple consequences. The proofs of the theorems 1-4 are not given.

N. Ya. Lyashchenko is mentioned in the paper.

SUBMITTED: October 5, 1959

Card 4/4

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16.4200

AUTHOR: Zubov, V.I.

TITLE: Ergodic Classes of Recurrent Motions

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 132, No. 3, pp. 507-509

TEXT: A continuous function $f(t)$, $-\infty < t < \infty$ is called recurrent if to every $\varepsilon > 0$ and every t there exists an L_ε so that in every interval with the length L_ε there exists at least one $\tau_{t,\varepsilon}$ so that

(1) $|f(t + \tau_{t,\varepsilon}) - f(t)| < \varepsilon$.

Theorem 1 : Every recurrent function is bounded and the set of such functions forms a complete space on the whole real axis in the sense of the uniform convergence.

Definition 2 : Let $\gamma_1(t), \ldots, \gamma_N(t)$ be arbitrary real continuous functions, $-\infty < t < \infty$, with the property that for all $\lambda_1, \ldots, \lambda_N$ which satisfy the condition $\sum\limits_{k=1}^{N} \lambda_k \gamma_k(t) \not\equiv 0$ it holds uniformly in $c \in (-\infty, \infty)$

Card 1/3

$$(3) \quad \lim_{T\to\infty} \frac{1}{T} \int_{c}^{c+T} \left[\exp i \sum_{k=1}^{N} \lambda_k \gamma_k(t)\right] dt = 0$$

The class $H_N = H(\gamma_1(t),\ldots,\gamma_N(t))$ is the set of all recurrent functions $f(t)$ which have the property that to every $\varepsilon > 0$ there exists a finite set of real linear forms $p_{1\varepsilon}$, $1 \leq k_\varepsilon$ in $\gamma_1(t),\ldots,\gamma_N(t)$ and a $\delta > 0$ so that all compatible solutions of the system of inequations

$$(2) \quad |p_{1\varepsilon}(t+\tau) - p_{1\varepsilon}(t)| < \delta \pmod{2\pi},\ 1 \leq k_\varepsilon$$

for every fixed t satisfy the condition (1).
Theorem 2 asserts that to every $f(t) \in H_N$ there exist at most countably many linear forms of the mentioned kind.
Theorem 3 states that H_N is a complete linear space on the whole real axis in the sense of the uniform convergence.
Theorem 4 : If $f(t) \in H_N$, then for every $\varepsilon > 0$ there exists a trigonometric polynomial

$$p_\varepsilon = \sum_{k=1}^{N_\varepsilon} c_k e^{i\bar{\lambda}_k(t)} \quad N_\varepsilon < \infty$$

Card 2/3

so that $|f(t) - p_{\varepsilon}(t)| < \varepsilon$; $\pi_k(t)$ are finite linear forms of the functions $p_1(t)$, $p_2(t)$, ... of theorem 2.

Theorem 5 asserts that for every $f \in H_N$ or $f \in H_{\infty}$ there exists the mean value $M_t(f(t)) = \lim_{T \to \infty} \frac{1}{T} \int_0^T f(t)dt$.

Theorem 6 : Every $f \in H_N$ has at most countably many Fourier exponents and a unique Fourier series

$$f \sim \sum_{k=1}^{\infty} c_k e^{ip_k(t)} \quad \text{where} \quad M_t(|f(t)|^2) = \sum_{k=1}^{N} |c_k| \; .$$

Theorem 7 and 8 treat Feyer sums of $f \in H_N$ and the representation of $f \in H_N$ by functions periodic in the limit value.

The author mentions A.A. Markov, N.N. Bogolyubov, V.V. Stepanov and B.Ya. Levitan. There are 7 references: 5 Soviet, 1 Swedish and 1 English.

PRESENTED: January 28, 1960, by N.N. Bogolyubov, Academician

SUBMITTED: January 28, 1960

Card 3/3

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16.340

AUTHOR: Zubov, V.I. (Leningrad)

TITLE: On the behavior of integral curves in a neighborhood of periodic motion

PERIODICAL: Prikladnaya matematika i mekhanika, v. 25, no. 2, 1961, 303 - 31

TEXT: The basic case is considered,

$$\dot{x} = f_1(x, y), \quad \dot{y} = f_2(x, y) \qquad (1.1)$$

where the $f_i(x, y)$ are defined in some region G of the xy plane, and are real, continuous and twice differentiable with continuous derivatives. There are 2 continuously differentiable real periodic functions

$$x = \varphi_1(t), \qquad y = \varphi_2(t) \qquad (1.2)$$

obtained by solving (1.1) with period 2π, whose graph M lies with-

Card 1/7

in G. (1.2) is said to be isolated if there exists a sufficiently small δ-neighborhood $S(M, \delta) \subset G$ of the set M which does not contain the graphs of the second solution of (1.1). Isolated periodic solutions of (1.1) are called extreme cycles. An extreme cycle is 1) stable if there exists a sufficiently small neighborhood $S(M, \delta) \subset G$ such that all integral curves of (1.1) lying in $S(M, \delta)$ approach M without limit as $t \to \infty$. Alternatively, if $\rho((x, y), M)$ is the distance of (x, y) from M, then for $(x_0, y_0) \in S$ $\rho((x, y), M) \to 0$ as $t \to +\infty$

$$x = x(t, x_0, y_0), \; y = y(t, x_0, y_0) \qquad (1.3)$$

is a solution of (1.1) passing through (x_0, y_0) for $t = 0$; 2) Unstable if there exists a sufficiently small neighborhood $S(M, \delta)$ such that for $(x_0, y_0) \notin S(M, \delta)$, $\rho((x, y), M) \to 0$ as $t \to -\infty$; 3) Semi-stable if there exists a sufficiently small neighborhood $S(M, \delta)$ such that it is divided by M into 2 regions S_1 and S_2, such that $((x, y), M) \to 0$ as $t \to +\infty [-\infty]$, $(x_0, y_0) \in S_1$, $[(x_0, y_0) \in S_2]$. Examination of all possible curves shows that Lyapunov's stability conditions apply in this case. The general form of the equation of motion is

$$\frac{d\tau}{dt} = \frac{f_1^2(t) + f_2^2(t) - z_1 df_1(t)/dt - z_2 df_2(t)/dt}{f_1(t) f_1(z_1 + \varphi_1, z_2 + \varphi_2) + f_2(t) f_2(z_1 + \varphi_1, z_2 + \varphi_2)} \quad (2.6)$$

$$\frac{dz_1}{dt} = \frac{d\tau}{dt} f_1(z_1 + \varphi_1, z_2 + \varphi_2) - f_1(t),$$

$$\frac{dz_2}{dt} = \frac{d\tau}{dt} f_2(z_1 + \varphi_1, z_2 + \varphi_2) - f_2(t) \quad (2.7)$$

where $\tau = \tau(t)$ (2.1). Lemma: $H(z_1, z_2, t)$ defined by

$$H(z_1, z_2, t) = z_1 f_1(t) + z_2 f_2(t), \quad (f_1(t) = f_1(\ _1(t), \ _2(t)) \quad (2.3)$$

is a solution of (2.7). Theorem: A periodic solution of the system (1.1) is stable in the Lyapunov sense if and only if the null solution $\theta = 0$, $\xi = 0$ of

$$\frac{d\xi}{dt} = [f_1(a_1^\circ\xi + \varphi_1(t), a_2^\circ\xi + \varphi_2(t))\, f_2(t) - f_2(a_1^\circ\xi + \varphi_1(t), a_2^\circ\xi + \varphi_2(t))\, f_1(t)] \times$$
$$\times \frac{[f_1^2(t) + f_2^2(t) - (a_1^\circ df_1(t)/dt + a_2^\circ df_2(t)/dt)\,\xi]}{[f_1(t)\, f_1(a_1^\circ\xi + \varphi_1, a_2^\circ\xi + \varphi_2) + f_2(t)\, f_2(a_1^\circ\xi + \varphi_1, a_2^\circ\xi + \varphi_2)]} + \tag{2.15}$$
$$+ \left[a_1^\circ \frac{df_2(t)}{dt} - a_2^\circ \frac{df_1(t)}{dt}\right]\xi$$

$$a_1^\circ = \frac{f_2(t)}{f_1^2(t) + f_2^2(t)}, \qquad a_2^\circ = -\frac{f_1(t)}{f_1^2(t) + f_2^2(t)}$$

$$d\theta/dt = F(\xi, t) - 1 \tag{2.16}$$

are stable in the Lyapunov sense, where ξ is defined by

$$\xi = z_1 f_2(t) - z_2 f_1(t), \quad \eta = z_1 f_1(t) + z_2 f_2(t). \tag{2.11}$$

[Abstractor's note: θ not defined]. If the right-hand-side of (1.1) is analytic, then (2.15), (2.16) become

$$\frac{d\theta}{dt} = \sum_{k=1}^{\infty} a_k(t)\,\xi^k, \qquad \frac{d\xi}{dt} = \sum_{k=1}^{\infty} b_k(t)\,\xi^k \tag{3.1}$$

where the series converge for $/\xi/ < r$, $r > 0$. Writing

$$G_1 = \int_0^{2\pi} b_1(t)\,dt = \int_0^{2\pi} \left[\frac{\partial f_1(\varphi_1(t), \varphi_2(t))}{\partial x} + \frac{\partial f_2(\varphi_1(t), \varphi_2(t))}{\partial y} \right] dt \tag{3.3}$$

where

$$b_1(t) = \frac{\partial f_1(\varphi_1(t), \varphi_2(t))}{\partial x} + \frac{\partial f_2(\varphi_1(t), \varphi_2(t))}{\partial y} + \frac{1}{2}\frac{\partial}{\partial t}\ln\left[f_1^2(t) + f_2^2(t)\right] \tag{3.2}$$

it follows that for $G_1 < 0$, (1.2) is a stable extreme cycle and is stable in the Lyapunov sense, and for $G_1 > 0$, (1.2) is an unstable

28503
S/040/61/025/002/014/022
D201/D302

extreme cycle, stable in the Lyapunov sense as $t \to -\infty$. Writing

$$\xi = \eta \exp \int_0^t b_1(t)\, dt \quad (3.4)$$

$$\frac{d\theta}{dt} = \sum_{k=1}^{\infty} a_k^0(t)\eta^k, \qquad \frac{d\eta}{dt} = \sum_{k=2}^{\infty} b_k^0(t)\eta^k \quad (3.5)$$

$$\eta = c + g_2(t)c^2 + \dots + g_k(t)c^k + \dots \quad (3.6)$$

it follows that $G_m \neq 0$ for $m \geqslant 2$. Theorem: If m is odd and $G_m < 0$, then (1.2) is a stable extreme cycle. If $l + 1 > m$ then it is stable in the Lyapunov sense, and if $l + 1 < m$ it is unstable in the Lyapunov sense. If m is odd and $G_m > 0$, then (1.2) is an unstable extreme cycle. If $l + 1 > m$ it is stable in the Lyapunov sense as $t \to -\infty$, and if $l + 1 < m$ it is unstable in the Lyapunov sense.

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On the behavior of integral ...

If m is even, then (1.2) is semi-stable. If $l + 1 > m$ then (1.2) is conditionally stable in the Lyapunov sense in the direction, in which the integral curves of (1.1) approach M. If $l + 1 < m$ the conditions for stability do not occur. This theorem is necessary and sufficient. There are 5 Soviet-bloc references.

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Card 7/7

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