412 APLA Laser Applications, W, 2+0, Jelínková, Jančárek, credits: 2
Laser beam quality characterizies areas of its application, Industrial and laboratory lasers, Focusation of laser radiation, Absorption of laser radiation in matter, Theory of heat propagation, Laser cutting and welding, Laser surface treatment, Lithography, stereolithography and laser marking, Laser thin film deposition, its advantage and disadvantage, Lasers in medicine and biology, Lasers in remote sensing, Laser military applications.

412 APP Computer Applications, W, 3, Procházka, credits: 3
Database for nuclear techniques, INIS database structure hierarchy, thesaurus, database creation and update methods, INIS database scanning, Institute of Nuclear Information, Zbraslav. National economy databases, access to the individual databases, customer services, recherches, National Information Centre, Prague. Computer information network development strategy, Digital Eq. Prague. Data base and information flow in banking, Československá obchodní banka, education centre, Prague.

412 DRP Differential equations on computer, W, 2+1, Liska, credits: 3
Course will be opened for 4 or more students. Ordinary differential equations, analytical methods; Ordinary differential equations, numerical methods, Runge-Kutta methods, stability; Partial differential equations, analysis, hyperbolic, parabolic and elliptic equations, posedness of differential equations; Partial differential equations, numerical solution, finite difference methods, difference schemes, order of approximation, stability, convergence, modified equation, diffusion, dispersion, conservation laws, 1D problems, example of 2D problem, practical computation in Matlab system for numerics and Maple for analysis of schemes.

412 ELD1 Electrodynamics 1, W, 4, Kálal, credits: 4
The Maxwell equations in macroscopic media. Special theory of relativity and the electromagnetic theory. Plane waves in homogeneous isotropic media. Energy flow and conservation laws. Polarisation of electromagnetic waves. Wave propagation in dispersion media. Electromagnetic waves in anisotropic media. Dispersion relations. Electromagnetic waves in non-homogeneous media. Equations of eiconal, transfer and beam propagation. Scalar theory of diffraction. Fresnel diffraction. Fraunhofer diffraction.

412 ELD2 Electrodynamics 2, S, 4, Čtyroký, credits: 4
Electromagnetic theory of metallic waveguides. Microwave cavity resonators. Gaussian beams, open laser resonators. Theory of planar dielectric waveguides. WKB method. Basic wave theory of optical fibres, multimode and monomode fibre waveguides. Dispersion of optical fibres. The effect of Kerr nonlinearity, the principle of soliton propagation.

412 EP12 Electronics laboratory 1,2, W+S, 2, Procházka, Blažej, credits: 2
Electronics lab exercise, basic electronic instruments operation, simple circuits wiring and debugging, semiconductor components properties, power supply, transistor amplifier, operational amplifier, trigger circuits, logical circuits. Individual work on problem guidelines, protocol formatting.

412 FDET Detection and Detectors, W, 2+1, Pína, credits: 3
Spectrum of electromagnetic radiation. Radiometric and photometric units. Ideal detector. Internal and external photoeffect. Fluorescence. Thermal effects. Quantum fluctuations. Blackbody radiation and background noise. Detector noise. Electronic circuits noise. Basic detector characteristics. Photocathodes. Vacuum photodiodes. Photomultipliers. Channeltrons. Gas chambers. Semiconductor detectors. CCDs. Photographic emulsions. Calorimeters. Pyrodetectors. Detectors based on light-light conversion. Scintillators. Quantum amplifiers. Electro-optic convertors. Spectral sensitivity. IR, VIS and UV detectors. X-ray detectors. Detector electronic circuits. Human eye.

412 INF Informatics, W, 2, Hamal, credits: 2
Introduction, basic computer technology, office environment, computer science terminology, academic environment, software engineering terminology, product development environment, miscellaneous, hardware, software terminology, system integration environment.

412 INF2 Informatics 2, S, 2, Hamal, credits: 2
Principles, construction and future development trends of hardware for information technology, processors, memories, optical and magnetic storage media, printers, scanners, data networks.

412 INS1 Information Systems 1, W, 1+1, Novotný, credits: 2
Information technologies and their mutual binding, principles of database information services, principles of information management, introduction to project of management systems, economical aspects of the information systems, e-commerce, new and upgraded information technologies, mutual binding of the office and database software into Intranet and Internet.

412 INS2 Information Systems 2, S, 2, Novotný, credits: 2
Advanced topics of Information Systems 1, fresh upgrades, additional topics chosen by students to support their university projects.

412 INTO Integrated optics, W, 2, Čtyroký, credits: 2
Planar and channel waveguides. General properties of modes of dielectric waveguides. Basics of integrated optics technology. Diagnostic methods. Basic waveguide structures and their operation principles. Principles of operation of passive, dynamic and active waveguide devices. Applications of Integrated optics in optical communications, signal processing, and sensors.

412 KSFP Quantum and statistical physics via computers, S, 2, Drška, Šiňor, credits: 2
A supplementary course to the courses "Modern Physics Using Computers" and "Quantum Physics" devoted to application of information technology in quantum mechanics and physical kinetics. Education software based on integrated computing systems is strongly used in the course.

412 KVE1 Quantum electronics 1, S, 3, Vrbová, Richter, credits: 3
Dirac formulation of quantum mechanics, observables, expansion in eigenkets. Elementary quantum systems, harmonic oscillator, orbital angular momentum, electron spin. Electrons in electromagnetic fields. Quantization of electromagnetic field. Density operator. Heisenberg, Schrodinder and interaction pictures. Perturbation theory. Interaction of radiation with matter. Dirac theory of interaction between light and an atom, absorption, spontaneous a stimulated emission. Quantum description of light scattering on an atom. Rayleigh, Thomson and Raman scattering.

412 KVE2 Quantum electronics 2, W, 2+1, Richter, Vrbová, credits: 3
Classical theory of coherence, Van Cittern-Zernike theorem. Quantum description of optical radiation, quasi-probability density, Glauber-Sudarshan representation, operator ordering, quantum characteristic functions, multimode field. Specific state of the field, thermal equilibrium radiation. Theory of optical detection, one- and multi-atom two-level detector. Quantum theory of coherence, quantum correlation functions, generalised theory of coherence. Coherent properties of specific fields, photocounting, intensity interferometry, Hanbury Brown-Twiss effect, stellar correlation interferometer, correlation spectroscopy. Damped harmonic oscillator, Heisenberg-Langevin approach

412 KVE3 Quantum electronics 3, S, 2+1, Vrbová , Richter, credits: 3
Quantum theory of dumping. Markovian system. Master equation for the statistical operator. Dumped two-level system. Bloch's vector. Heisenberg-Langevin equations. Fokker-Planck equation. Semi-classical theory, equations for polarisation and inversion, dispersion, saturation. Coherent and non-coherent pulse propagation. Optical solitons. Photon echo. Superradiation. Amplified spontaneous emission. Laser threshold in system without optical resonator. Semi-

classical theory of laser. Mode-locking, stability, ultrashort pulse forming, phase modulation, dispersion, pulse compression. Quantum theory of laser. Dynamic and reservoir parts of laser system, master equation, quasidistribution function, solution of Fokker-Plank equation. Correlation functions, spectral properties. Laser threshold as a phase transition. Synergetics.

412 LAPT Seminar of laser, plasma and beam technology, W, 4, Jelínková, Král, Jančárek, credits: 4

Lessons: plasma coating, Van de Graff generator, new problematics. Individual work: CO_2 laser -- cutting of plastics. Visits: plasma coating, Van der Graff generator, stomatology, ophtalmology, photorefractive ceratectomy, thin film deposition, laser marking, powerful CO_2 laser, new problematics.

412 LAS Laser systems, S, 4, Vrbová, Kubeček, credits: 4

Amplified spontaneous emission. Ultraviolet lasers. X-ray lasers. High power amplifiers. Limited output power. Free electron lasers. Lasers with high degree of coherence. Control of the laser pulse duration. Methods of generation of ultrashort laser pulses. High energy laser systems. Diode-pumped solid state lasers.

412 LT1 Laser Technique 1, W, 2+2, Kubeček, Vrbová, credits: 4

Open Resonators. Stability. Transverse and Longitudinal Modes. Elements of Open Resonators. Threshold of laser oscillations. Gaussian beam as an approximation of the fundamental mode. ABCD method. Optical radiation propagation in resonant medium. Two-level approximation. Equations for polarisation and inversion, dispersion, saturation. Coherent and non-coherent pulse propagation. Optical solitons. Photon echo. Superradiation. Amplified spontaneous emission. Lasers without optical resonator.

412 LT2 Laser Technique 2, S, 2, Jelínková, credits: 2

Laser Amplifier. Pulse and Steady State Regime. Signal Distortion. Laser Oscillator. Laser Generation Dynamics. Laser Rate Equations' Modification and Solutiton for Different Regimes of Generation. Q- switching. Mode-locking. Acoustooptic and Electrooptic Modulators and Q-switches. Non-linear Elements for Q-modulation and Harmonic Generation. Examples of Lasers.

412 MEME Measurements Methods of Physical Electronics and Optics, S, 2+2, Pína, credits: 4

Detection and detectors of charged particles. Detection and detectors of neutral particles. Electron and ion spectrometry. Measurement of ion and electron beam parameters. Detectors of optical and X-ray radiation. Photon detection in IR, VIS, UV, XUV and X-ray region. Radiometry and photometry. Measurement of power, energy, spectrum and coherence of optical beams. Measurement of extremely low and extremely high photon fluxes. Transmission and measurement of signals with nanosecond, picosecond and femtosecond resolution. Synchrodetection. Multichannel analysis. Applications.

412 MFP Modern Physics Using the Computer, W, 4, Drška, credits: 4

Scientific computing as a language of modern physics, numerical computing and computer algebra, numerical simulation, integrated computing system, intensive computing, theoretical modern physics, non-linear systems, algorithmic physics and the study of complex systems, principles of quantum physics, analytic and numerical quantum mechanics, physical kinetics, numerical kinetics, molecular dynamics, stochastic particle simulation. * Comment: Computerised course.

412 MODO Selected Topics From Modern Optics, W, 2 zk, Kálal, Kubeček, credits: 2

Complex Interferometry (Kálal): principles of CI, methods of complex interferogram analysis, FFT, Abel inversion, application of CI in laser plasma diagnostics. Ultrashort laser pulses (Kubeček): methods of mode-locking, linear and nonlinear pulse propagation, picosecond and femtosecond solid state lasers and parametric generators, methods of pulse measurements.

412 MPF Methods of Computational Physics, S, 4, Drška, credits: 4
Computer as a tool for study physical systems, compact systems for scientific computing (CSSC), examples of CSSC, numerical simulation as a research method, numerical physical libraries, examples of simulation programs, integrated computing systems (ICS), examples of ICS, intensive computing (IC) as a new methodology for physical sciences, examples of the use of IC, prospects of information physics. *Comment: Computerised course.

412 MPP Microprocessor Laboratory, W+S, 0+3, Voltr, credits: 3
Arithmetic-logic unit, modular system on basis Z80, its programming, peripheral devices, data transfer IBM PC, analogue input and output, assembler and high-level programming.

412 MP1 Microprocessors 1, W, 4, Čech, credits: 4
Microprocessor and microcomputer, microprocessor classes, CPU, memory, Input output. Code and data, addressing modes(direct, indirect, register, relative,..., stack memory, procedure calls, IO devices - program control, interrupt. Microprocessor Intel 8080, Z80, 16-bit microprocessor 8086-486.

412 MP2 Microprocessors 2, S, 2, Čech, credits: 2
Instruction codes, differences, programming languages Assembler and Macroassembler, memory segmentation and paging, math coprocessor, IO coprocessor. IBM PC technical description, MS-DOS operating system and services, resident programs and drivers, applications.

412 NME Numerical Methods, S, 2+2, Limpouch, credits: 4
Mathematical and numerical problems, correctness of problem, condition number, truncation error, floating point representation of numbers, roundoff error, stability of algorithms, numerical methods of linear algebra, sorting, interpolation and splines, integration of functions, evaluation of functions, root finding of nonlinear equations, optimisation, integration of ordinary differential equations, initial and boundary value problems.

412 OPEL Optoelectronics, S, 4, Čtyroký, Schroefel, credits: 4
Introduction to optoelectronics. Kinds of optical fibres and their parameters. Basics of fabrication technology of optical fibres and cables. Components of fibre-optic systems. Splicing of fibres and cables. Measurement of fibres, cables, and links. Semiconductor sources and detectors of optical radiation. Dynamic waveguide devices. Optoelectronic and fibre-optic sensors.

412 OPS Optical spectroscopy, S, 4, Fidler, credits: 4
Basic spectroscopic properties of the solid state. Homogeneous and inhomogeneous broadening, localised states, transport processes. Structure of molecules and molecular spectra. Rotational and vibrational spectra, IR absorption and Raman spectroscopy. Electronic spectra, fluorescence and phosphorescence. Polarisation and chiroptical methods. Experimental methods of laser optical spectroscopies. Laser systems and techniques for high time resolution (up to femtoseconds). Nonlinear and ultrafast spectroscopies, relaxation processes in molecular systems and solids.

412 ORP Microwave Circuits, W, 4, Pavel, credits: 4
Fourier and Laplace transformation, sampling, digital signal processing, negative and positive feedback, sensitivity, step response, zeros and poles, power gain and stability consideration, negative resistance, equivalent models of semiconductor elements, switching, pulse circuits, scattering parameters, transmission lines, Smith chart, filter networks, dielectric resonators, microstrip matching networks, microwave oscillators and amplifiers design, microwave measurements.

412 OS Optical Signal Processing, S, 2+2, Fiala, credits: 4
Fourier transform and its physical interpretation, analysis of optical linear transfer (espec. imaging) systems; optical wave and diffraction in Fourier optics, diffraction gratings; coherent and incoherent transfer systems, Optical Transfer Function for diffraction limited systems and systems

with abberations, coherent and incoherent optical information recording, holographical transfer of information; applications of Fourier optics - spatial filtering, image restoration, image recognition; optical processors.

412 OSY Operating Systems, W, 3, Čech, credits: 3
Operating systems kernel, memory management, process, multitasking systems interprocess communication, input/output, queues, client-server, internet communication, multilanguage environment, multitasking, user interface, system security, open systems. OS DOS: files CONFIG.SYS and AUTOEXEC.BAT, UMB,XMS,EMS,HMA memory management and using. OS Novell Netware: Disc organisation, NLM installation, Novell and TCPIP, network printers, system administration, user environment configuration, backup, optimisation. UNIX: File system, introduction to system programming, shells, maintenance and backup, system administration, X-windows

412 PIN1 Practical informatics for technics 1, W, 1+1, Liska, credits: 2
Course will be opened for 4 or more students. Computer and operating systems. Personal computer, workstation and supercomputers. Processor, memory, bus, devices, hard disk, network interface. Hardware and software. Principles of operating systems. Requirements on operating system for research and technical computing. Operating system UNIX. Basic principles, kernel, kernel services. Documentation. File system, file attributes, working with files. Text editors: vi, emacs. Command interpreter (shell) sh, csh and its programming (scripts). Controlling processes, process status, computer load a process priorities. Standard tools. Graphical user interface X-windows. Computer networks. Local computer networks. Global computer networks: Internet. Addresses and protocols TCP/IP. Network configuration of a computer. Network services: hardware sharing, mail, ftp, etc. Network applications.

412 PIN2 Practical informatics for technics 2, S, 1+1, Šiňor, credits: 2
Integrated computing systems. Scientific computing, algebraic and numeric computation, graphics. Integrated computing systems Maple and Mathematica, Symbolic expressions, variables, functions and procedures. Simplification and manipulation with expressions, systems of equations, fields and matrices, visualisation and animation, programming. Interpreted and compiled languages. Basic concepts of language C, C as a instrument for scientific computing. Basic concepts of language Java, elementary numerical calculations and applications. Representation of numbers in computers, IEEE arithmetic, rounding errors, interval arithmetic, error accumulation. Basic numerical methods: non-linear equations, derivation and integration, ordinary differential equations ... Application to problem solving in physics.

412 PIN3 Practical informatics for technics 3, W, 1+1 z, Šiňor, credits: 2
Visualisation and multimedia, computer graphics, software for computer graphics, animation and virtual reality in science and technology, graphics formats, data compression. Scientific documents and computer presentations, text processors for scientific documents, mathematics and graphics in documents, DTP tools, typography system TeX, language PostScript, tools for computer presentations, hypertext, WWW as a publishing environment, language HTML, HTML editors, document conversion into HTML. Databases in science and technology, character of scientific and technical data, data structures and architecture of scientific databases, user interface, data mining, sources on the Internet.

412 PLT Laser Technique Laboratory, S, 0+4 kz, Kubeček, Gavrilov, Blažej, credits: 4
Pulsed Nd:YAG laser: free running regime, Q-switched regime, pulse amplification, second harmonic generation, dye laser pumping. Laser diode, diode pumped Nd:YAG laser. He-Ne laser, glow discharge characterization. CO_2 laser marking.

412 POAL Computer Algebra, W, 1+1, Liska, credits: 2
Course will be opened for 4 or more students. Lisp, representation of basic objects (integers, rational and algebraic numbers, polynomials, rational functions, radicals, algebraic functions), arithmetic, simplification, greatest common divisor, resultant, derivation, series summation, integration, ordinary differential equations, factorisation, equations solving, quantifier elimination, substitution and pattern matching, algebraic programming, graphics, Reduce - detailed introduction and solving of practical examples, applications, overview of other systems (Axiom, Macsyma, Maple, Mathematica), miniproject.

412 PROP Optics and Optoelectronics Classes, S, 4, Richter, Jančárek, credits: 4
Laser radiation coherence. Laser radiation polarisation. Characteristics of optical fibres. Difraction of coherent radiation. Hologram recording. Optical fibres and telecommunications I. Optical fibres and telecommunications II.

412 RSEN Automatic Control And Sensors, W, 4+0, Hiršl, credits: 4
Automatic control, analogue signals, modulation, demodulation, digitalisation, discrete systems, continuous automatic control, system function, poles and zeros, stability, discontinuous automatic control, Z-transform, sensors, characteristics of sensors, principles of sensors, measurement with sensors

412 SIG Signal and Data Processing, W, 2+1, Limpouch, Procházka, credits: 3
Measurement accuracy and errors, random errors, foundations of probability theory, characteristics of probability distributions, transfer of errors, measures of association between random variables, point and interval estimation, testing of statistical hypotheses, modelling of data, linear and nonlinar fits, Fourier transform spectral methods, small signal detection against noise, introduction into stochastic processes.

412 SIO Circuit Simulation and Analysis, S, 4, Pavel, credits: 4
Simulation for: alternating and direct current, poles and zeros, steady state, transient, time and frequency analysis, optimisation loops, sensitivities and worst case. Solution: system of algebraic differential equations - corrector predictor, fast Fourier transform, LU factorisation, pivoting etc. Models: Gummel - Poon for bipolar junction transistor, Dang for MOSFET etc. Programs: Circuit Interactive Analyser + OrCAD, PSpice for Windows, PUFF for microwave applications.

412 TEXT Computer Aided Publishing, W, 1+1, Novotný, credits: 2
Text coding standards, Czech coding norms. Optical character recognition. Interactive DTP tools vs. typographical languages (TeX, LaTeX, HTML, XML, MS WORD). Basic concepts of typography, features specific for the computer typography. Demonstrating the concepts on typesetting system. Fonts, tables, mathematical equations, document styles. Floating bodies, cross-references,… HTML -- the name of the game. Graphical formats, output formatting (PDF, PS, DOC, RTF), multimedia presentation.

412 UINF Introduction to Informatics, S, 1+1, Novotný, credits: 2
Introduction to terminology (both Czech and English), information technologies overview. Computer as a basic instrument for information society. Operating systems, their theoretical background. LAN, WAN (hardware, net software), information resources. Network operation systems, network application programs. On line information systems (DIALOG). The goal of this course is to gain skills and experience in networking.

412 ULAT Introduction to laser technique, W, 1+1, Jelínková, Vrbová, credits: 2
Interaction of optical radiation with matter. Laser principle. Laser classification. Solid state lasers. Liquid lasers. Gas lasers. Plasma lasers. Semi-conductor lasers. Laser applications. Laser safety.

412 ULT Introduction to laser technique, W, 2+1, Jelínková, Vrbová, credits: 3

Light as electromagnetic radiation. Matter as a collective of quantum systems. Interaction of optical radiation with matter. Detection of optical radiation. Classical sources of optical radiation. Laser principle. Solid state lasers. Liquid lasers. Gas lasers. Plasma lasers. Semiconductor lasers. Laser applications. Laser safety.

412 UMF Introduction to Modern Physics, S, 2+1, Drška, credits: 3
The course is intended to be a concise introduction to concepts of modern physics for students who have already had basic classical physics course. The course is mandatory for students who plan to study the study branch "Information Physics".

412 UPP Introduction to Computers, W, 0+2, Novotný, credits: 2
Internet and NetWare network services and their applications. Microsoft Windows 2000 operating system. Historical review, binary representation, basic operations, computer architecture, operating systems. Personal Computer: characteristics, configuration, main components. DOS: main characteristics, performance and limitations, peripherals, files, file structures, DOS commands and their applications. Practical training: networking, operating systems, application software (e.g. Office2000).

412 UZP Users Programs, W, 2, Jelínková, credits: 2
Text and graphics program for laboratory exercises, projects and diploma work. Word, Excel -- writing text by help of the computer -- principle, writing of equations; preparation of figures and tables; headers and footers; contents; numbering pages. Origin -- image processing information. PowerPoint -- preparation of project's presentation.

412 VEL Selected Topics from Electronics, W, 2, Pavel, credits: 2
Computer automation, data acquisition, data analysis, basic of programmable languages -- Delphi, C++ Builder and Visual Basic, optoelectronic devices, electronics sensors, stepper motors, special digital and analogue circuits for computer communication.

412 VTV Scientific Calculations, S, 2, Procházka, credits: 2
Main goals, characterisation of calculation for science and technology, requirements on speed, code compatibility, scientific libraries. Fortran language: historical review, main characteristics, language structure, line format, variables, commands, input output formatting, subprograms, code commenting.

412 ZEL1 Introduction to electronics 1, W, 2+1, Resl, Pavel, credits: 3
Law of electrical circuits, elements of passive type, solution of linear circuits in time domain, harmonics regime, power in electrical circuits, transmission and frequency characteristics in linear circuits, theory of semiconductors, PN junction, semiconductor diodes, bipolar and unijunction transistors, nonharmonics periodical signals, Fourier and Laplace transformation, feedback, sensitivity and stability of feedback circuits, sampling, transformation of time depended signals, electrical rotating machines.

412 ZEL2 Introduction to electronics 2, S, 2+1, Resl, Pavel, credits: 3
Impulse signals in linear circuits, bipolar and unijunction transistors switching, thyristor, operational amplifiers, harmonic and nonharmonic signal generation, guidelines, digital analogue convertors and analogue digital convertors, logic digital circuits, microcomputers.

412 ZFP Principles of Plasma Physics, S, 4, Limpouch, credits: 4
Basic plasma parameters, Debye screening, astrophysical and laboratory plasmas, motion of charged particles in external fields, kinetic description of particle systems, Vlasov equation, Boltzmann equation, Fokker-Planck equation and Landau collision integral, fluid equations, transport processes, waves in plasmas, plasma and ion sound waves, CMA diagram, high parameter plasma, fusion reaction, computational experiments.

412 ROP12 Class work 1,2, W+S, 4 , Procházka, credits: 4
Individual work on a scientific project, review in winter semester, problem solving contribution in summer semester. Individual work on project guidelines, public presentation of results, presentation in foreign language, protocol formatting.

412 BAP12 Bachelor work 1,2, W+S, W 2, S 20, credits: W 2, S 20
Bc degree closing work, individual supervisors.

412 SBA12 Seminar to bachelor work 1,2, W+S, 2, Hamal, credits: 2
Individual work on a Bc degree closing project, periodic checks of the progress, foreign language presentation, protocol formatting.

412 RESE Review work, S, 0+2, credits: 2
Individual review work on a scientific project.

412 VYZ12 Research Project 1,2, W+S, 4, Král, credits: 4
Introduction to the methods of scientific work for undergraduate students. Every student works for one year in some of laboratories at the faculty or at the academy of sciences. He is considered as a member of research team and he participates on research connected to a selected project of the laboratory. At the end of his work he writes a report (paper) about methods and results which he presented at a seminar.

412 DIP12 Diploma work 1,2, W+S, W 2, S 10, credits: W 2, S 10
Master degree closing work, individual supervisors.

412 DSEM Diploma seminar, S, 2, Hamal, credits: 2
Individual work on a Bc degree closing project, periodic checks of the progress, foreign language presentation, protocol formatting.

412 SEM Seminar, W+S, 2, Jelínková, credits: 2
Individual work on Master degree project. Periodic checks of the progress, protocol formatting, detail preparation of the master theses defence.