

TOPICS OF COURSES FOR FINAL STATE EXAMINATIONS

FOR STUDENTS AT FACULTY OF TRANSPORTATION SCIENCES CTU IN PRAGUE

B1041A040004 – PROFESSIONAL PILOT

(valid from 1. 3. 2024)

I. COMPULSORY COURSE AIR LAW

1. Law and the legal system with a focus on aviation law, regulation of the international air transport, European and Czech national law - sources of law, international conventions and agreements, international organizations.
2. European aviation law – legal acts, legislative procedures, EASA – jurisdiction, rulemaking, structure of regulation, hard law and soft law, application to national regulations. Czech aviation Act, L-regulations, binding and scope of the regulations, state supervision and state administration, ÚCL
3. Instrument flight procedures – holding pattern, visual maneuvering, low visibility operations, planning criteria, operational, minimums, time on duty
4. International legal and European regime of protection against illegal acts and unlawful interference against civil aviation (Tokyo, Hague, Montreal and Beijing Conventions) and development attitudes, safety in traffic and at the airport - regulations.
5. Flight crew licensing – ICAO requirements, EASA requirements – Part-FCL, licensing and qualifications, medical fitness, training facilities – Part-ORA, Part-DTO.
6. Rules of Air – scope of ICAO, scope of EASA and national regulations, airspace classification, VMC and IMC, VFR and IFR rules, minimum fuel and emergency fuel.
7. Commercial Air Transportation – Annex 6 and implementing regulation No. 965/2012 – CAT, SPA, NCC, NCO and SPO – characteristics of the operation.
8. Commercial Air Transportation – implementing regulation No. 965/2012 – Part-CAT.OP – adequate and suitable airport, airport operating minimums, fuel/energy program, principles of planning and replanning, airport selection, management principles with fuel.
9. Commercial Air Transportation – implementing regulation No. 965/2012 – Part-ORO, Part- CAT.GEN, POL, IDE - Air Operator's Certificate, time limit flight services, documents, manuals and information, take off, en route flight with one by engine, landing on contaminated runways, instruments and equipment for operation.
10. Arrival and final approach procedure -, protective areas, approach phase maneuvers in the initial approach phase, final approach course, decision altitude.

11. Regulation (EU) No. 1321/2014 – interpretation, management of continued airworthiness, airworthiness review, organizational rights, premises and equipment, personnel, record keeping, quality system, organizational changes.
12. Airports – airport code markings, airport dimensions and physical characteristics of airports, CAN and PCN runway and taxiway – explanation and use, declared distance, reference point of airport, reference temperature of the airport, obstacle clearance areas / protection areas of the airport.
13. Airport support for the operation – approach, circuit and guidance lighting systems, LVO, RVR measurement and usability, approach systems VASIS and PAPI, airport signs, ecological aspects of the airport.
14. Minima - difference between airport minima, planning minima and minima for category CAT I, II, III; difference between DA and MDA; meaning of OCH; Doc 8168 Volume I, Part II, Section 4 and 5 and Doc 8168 Volume III, Section 9
15. ICAO PANS Doc 8168/I – document characteristics, departures – SID, enroute flights, arrivals – STAR, missed approach procedure and missed approach segments
16. ICAO PANS Doc 8168/III – procedures for the altimeter setting, operation on parallel or nearly parallel instrument runway – depend and independent RWY, procedures for use transponders (SSR), obstacle clearance areas or protection areas,
17. ICAO PANS Doc 4444 – document characteristics – flight permit, procedures for altimeter settings, vertical and horizontal separation - types and minimums separation, procedures in the vicinity of airports, minimum fuel and emergency fuel status
18. Environmental protection at international, European and national level - noise of aircraft, emissions, CO₂, procedures for reducing the impact of air traffic.
19. Annex 19 – hazard analysis and risk management – hazards, errors and risk definition, analyse of the hazards and risk, models, methods of risk mitigation, risk management and use in aviation.
20. UAS – regulations at the international and national regulation – UAV classification, basic characteristics, operation, risk assessment, U-Space.

II. COMPULSORY COURSE AIRCRAFT GENERAL KNOWLEDGE

1. History and development of aircraft structures.
2. Aircraft classification. Basic structural components and their function.
3. Airplane wings. Construction scheme. Shapes and components. The formation of lift on the wing.
4. De-icing, anti-icing and fire protection systems. Detection systems. Emergency equipment.
5. Lift control. Wing mechanization. Flaps, ground spoilers, speed brakes, ailerons. Increase of lift and drag.
6. Lateral stability and controllability.
7. Airframes. Pressurization. Cabin altitude.
8. Landing gear. Types of landing gear. Brakes.
9. Tail plane. Lateral stability and controllability elements.
10. Manoeuvre flight envelope. Gust envelope. Structural loads in operations.
11. Aircraft structure materials. Advantages and disadvantages of most used materials.
12. Fuel systems. Oil systems. Power distribution systems.
13. The principle of air instruments. Velocities IAS, TAS, CAS, GS
14. Instrument categorization. Basic principles of instrument and instrument panel design.
15. Engine indicators. Airframe indicators. Compasses.
16. Gyroscopic instruments. Inertial systems.
17. Radionavigation instruments. Transponders.
18. Protection and detection systems. Warning systems. ACAS, GPWS
19. Automatic flight systems and flight envelope protection systems. FMS.

III. ELECTIVE COURSE

(the student opts for one of the following elective courses)

A. METEOROLOGY

1. Atmosphere – composition, vertical division, atmospheric elements. Temperature, heat transfer, temperature gradients, density, ISA.
2. Atmospheric pressure, redukce tlaku. Barometric measurement of altitudes. Pressure and temperature correction. Atmospheric pressure systems, atmospheric pressure distribution on the Earth.
3. Wind – definition and measurement. Forces causing wind, gradient and geostrophic wind. Effect of wind on flight.
4. Thermodynamics – humidity, water vapor pressure. Specific, relative a absolute humidity. Dew point, changes of state of water, latent heat.
5. Adiabatic processes. Saturated and unsaturated adiabat. Air stability and instability. Convection.
6. Cloud formation and types of clouds. Influence of air stratification on the development and shape of clouds. Precipitation formation and types.
7. Visibilities used in aviation. Visibility reducing phenomena, mist. Formation and types of fogs (radiative, advection, steam, frontal, orographic...)
8. General circulation in the atmosphere, secondary circulation, local winds. Mountain winds, breeze. CAT.
9. Air masses – types and their properties. Atmospheric fronts – definition, classification and description. Frontal system, occlusion. Life cycle of front.
10. Climatology – tropical climatology, ITCZ, monsoons, trade winds, eastern winds. Mid-latitude climate – local and seasonal winds.
11. Icing in flight, formation, icing conditions, types and shapes, intensity, deicing. Risks of flight in icing.
12. Turbulence - formation and types. Mountain waves, CAT, intensity. Windshear. Risks for flight.
13. Thunderstorms – conditions of formation, structure, development stages. Types of thunderstorms. Dangerous phenomena. Downburst, tornadoe. Forecasting models.
14. Meteorological observations – ground, high-altitude, satellite, radar observations. Aircraft reports. Weather charts.
15. Flight planning information – meteorological reports, forecasts, warnings. Pre-flight meteorological documentation.
16. Dangerous weather phenomena in aviation. Jet stream, Tropical Cyclone. Ground and height inversion. Danger of flying in mountains.

B. NAVIGATION

1. Solar system, ecliptic, Kepler's laws. Earth, ellipsoids used in aviation. Coordinate reference systems (Position Reference System-PRS, Cartesian coordinates), their use in air navigation.
2. Aeronautical charts. Projection methods, scale, distortion. SID, STAR, MRVA. Information in final approach chart. En-route chart. Time, GMT, UTC, civil. Time zones. Speeds used in aviation. (TAS, IAS, CAS, Vat, aircraft approach category). Speed limitations.
3. Nav log for a VFR flight. IFR flight plan. Navigation points. Minimal flight altitudes
4. Drift. Triangle of velocities. Relative and absolute bearing. Differences between Heading and course. Magnetic, compass and earth North.
5. Great circle and rhumb lines (formulae for the calculation of great circle distance, initial track, vertices and tracks along the line), plotting of different bearings in the chart.
6. Radionavigation aids NDB/ADF, VOR/DME, ILS. RNAV/RNP
7. PBN concept. Navigation specification. Approach navigation specification.
8. GNS systems. Principles of operation. Advantages, disadvantages and limitations.
9. SBAS. Principles of operation. Advantages, disadvantages and limitations.
10. GBAS. Principles of operation. Advantages, disadvantages and limitations.
11. INS/IRS. Principles of operation. Advantages, disadvantages and limitations.
12. Types of final approaches. Decision minima.
13. RNAV and RNP. Principles of operation. Advantages, disadvantages and limitations.
14. Voice vs. Data Communication Systems in Aviation and Their Utilization. RCP – required communication performance, PBCS (Performance-based Communication and Surveillance).
15. Data communication in aviation: Data applications and services in aviation (ATC applications: CPDLC, ADS-C, ..., AOC applications). Systems and technologies used for data communication in aviation: VDL (VHF Datalink), SATCOM (Satellite Communication), HFDL (High-Frequency Data Link). HMI for data communication on aircraft.
16. Non-cooperative independent surveillance systems: Primary surveillance radar (PSR). Pulse radars – principles and signal processing techniques, transmitters, and antennas used in aviation radar technology. Onboard weather radar (AWR). Radio altimeter.
17. Secondary surveillance radar (SSR mode A/C, SSR mode S): Information transmitted within mode S and in mode A/C. Explanation of "All-Call" and "Roll-Call" periods in SSR mode S. Utilization of mode S data in ATS systems.

- 18. Automatic dependent surveillance ADS: Difference between ADS-B and ADS-C. Technology 1090 ES, information transmitted within ADS-B 1090 ES messages. Ground-based/Space-based ADS-B. Current utilization of ADS-B.**
- 19. Onboard collision avoidance system (ACAS / TCAS): Principle of conflict detection. Levels of warning of the ACAS system (TA/RA). Presentation of outputs to the aircraft crew. Obligation to equip with the ACAS system.**

C. FLIGHT PERFORMANCE AND PLANNING

1. Mass and balance, centre of gravity, mass and balance limitations, units used in centre of gravity determination in large aeroplanes
2. Effect of centre of gravity on stability and controllability, neutral point, centre of gravity calculation.
3. Mass and balance documents – contents, responsibilities of signatories, allowed changes, EU regulations related to documentation in commercial air transport.
4. Masses used in aviation (BEM, DOM, ZFM, TOM, LM), procedures and responsibilities related to determining fleet masses, aircraft weighing.
5. Standard and actual masses of useful load, crew and operational equipment of aircraft, associated regulations applicable to commercial air transport aeroplanes.
6. Loading – aeroplane limitations, equipment, load compatibility, special load, transportation of dangerous goods.
7. Aeroplane performance – take-off, general performance theory, take-off distances, climb performance, factors affecting performance, minimum and maximum take-off speeds.
8. Aeroplane performance – performance class A, take-off distance calculation requirements, take-off climb requirements.
9. Aeroplane performance – performance class B, take-off distance calculation requirements, take-off climb requirements.
10. Aeroplane performance – cruise, optimum and maximum level, range, endurance, speeds for max. performance in cruise flight, cruise climb, drift down, gliding.
11. Aeroplane performance – landing, general performance theory, landing distance and missed approach performance, factors affecting performance and reference speed.
12. Aeroplane performance – performance class A, landing distance calculation requirements, missed approach climb requirements.
13. Aeroplane performance – performance class B, landing distance calculation requirements, missed approach climb requirements.
14. Minimum required fuel – basic fuel scheme in commercial air transport in EU, fuel components and their determination.
15. Fuel schemes with variations – RCF, isolated aerodromes, in-flight fuel monitoring, procedures when remaining fuel is found to be insufficient, conditions for declaring emergency.
16. ICAO ATS flight plan, flight plan filling, submission and closing, adherence to flight plan.

- 17. Operational flight plan, contents, purpose, use in flight, responsibilities for its production and checking.**
- 18. Alternate aerodromes, planning and operating minima for IFR flights in commercial air transport in EU except for ETOPS.**
- 19. ETOPS flights – description, determination of ETOPS parameters, alternate aerodrome planning and operating minima, ETP, critical fuel.**
- 20. Application of aerodrome forecast for the determination of aerodrome useability in commercial air transport – windows of useability, applicable and disregarded phenomena, differences of applicability to different types of approaches, planning procedures for aerodromes below minima, procedures after flight commencement related to adverse weather forecasts/reports.**

D. OPERATIONAL PROCEDURES

1. Documentation on board the aircraft and its division. Manuals and handbooks (aircraft, operator). Responsibilities of the aircraft commander. Operation according to MEL/CDL.
2. Noise abatement strategies and procedures to reduce noise at the airport and its vicinity. Noise hygienical limits.
3. Minimum flight altitudes. Distance from obstacles. Operational areas – RVSM, MNPS, ETOPS.
4. Fuel for the flight. Re-planning in-flight. Minimum fuel, MayDay fuel. Fuel monitoring in-flight. Refuelling with passengers on board.
5. Transport of dangerous goods. Ground handling requirements. Bird strike prevention.
6. Operational minima. Planning minima and applicable minima. Temperature correction. CMV, RVR, visibility.
7. Visual references. Required visual references for landing. Visual references for different types of approaches. Lights systems on aerodrome.
8. Circling approach, visual manoeuvring. Basic pattern. Operational minima. Protection area.
9. Operations in low visibility. Low visibility take-off (LVTO). Low visibility approach and landing (LVO - CAT I/II/III). Operational minima. Crew briefing.
10. Icing. Ground icing conditions. In-flight icing conditions and flight in icing conditions. Severe icing. In-flight deicing and anti-icing systems.
11. Icing, ground deicing. De-ice, anti-ice, HOT, types of deicing fluids.
12. Emergency equipment of the aircraft. Oxygen and its use in flight. Regulatory requirements for emergency equipment.
13. Windshear, microburst. Windshear during take-off, approach, and landing. Windshear escape manoeuvre. Predictive windshear, reactive windshear. TCAS, bird strike. Flight crew procedures, phraseology.
14. Contaminated runway. Take-off and landing on contaminated runways. Types of contaminants. SNOWTAM, RWYCC, RCAM. Impact of contamination on TOD and LDA.
15. Engine fire. Flight crew actions before and after V1. Engine fail procedure. Driftdown. Fire, smoke, fumes in the cabin. Flight crew procedures.

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