

מבחן עיוני – אחידות ותקנים

רישיון טייס תובלה בנתיבי אויר

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

1. הקדמה

חוברת "מבחן עיוני – אחידות ותקנים - רישיון טייס תובלה בנתיבי אויר" נועדה לספק את המידע הדרוש על מבחני הידע העיוניים לצורך קבלת רישיון טייס תובלה בנתיבי אויר, להכרת מבנה המבחן ומהלכו. בחוברת הסברים כלליים על המבחן וכן פירוט של הידע הנדרש.

2. התנאים למבחן עיוני

(מתוך תקנה 29 תקנות הטיס – רשיונות לעובדי טיס)

"לא יגש אדם למבחן עיוני אלא אם הוכיח, להנחת דעת רשות הרישוי, כי מילא אחר כל אלה:

(1) הוא השלים עשרים וחמשה אחוזים מדרישות הנסיון הקבועות בתקנות אלה לגבי הרישיון או ההגדר המבוקשים, אלא אם נקבע אחרת בתקנות אלה;

(2) היה המבחן העיוני מבחן למבקש רישיון עובד טיס שהוא טייס — הוא השלים לימודי קרקע במסגרת קורס אימונים מאושר מתאים והמציא אישור מדריך מוסמך של הקורס על כך, או השלים לימודי קרקע במסגרת לימוד עצמי בנושאי הידע המקצועי, כנדרש בתקנות אלה, והמציא אישור מאת מדריך מתאים - כאמור בתקנה 34 (2) (ב) (1) כי המבקש מסוגל לעמוד במבחן עיוני."

3. המבחנים

לצורך קבלת רישיון טייס תובלה בנתיבי אויר יש לעמוד בהצלחה בשמונה מבחנים בנושאים הבאים:

שם המבחן	מספר שאלות *	זמן מוקצב	ציון מעבר
חוקה	39	2:30	70
מטאורולוגיה	40	2:30	70
נווטות + מרשם	19	4:00	70
ידע טכני כללי	50	3:00	70
תכנון טיסה	15	4:00	80
עזרי רדיו לניווט	30	2:30	70
מכשירים ומגנטיזם	40	3:00	70
הכרת מטוס- ספר פתוח	תלוי בסוג מטוס	תלוי בסוג מטוס	80
הכרת מטוס- ספר סגור	תלוי בסוג מטוס	תלוי בסוג מטוס	80
גורמי אנוש	20	2:00	70

* מספר השאלות נכון ליום כתיבת חוברת זו ויכול להשתנות מעת לעת.

המבחנים מבוצעים על גבי מחשב. השאלות במבחנים הן שאלות בחירה מרובה (מבחן אמריקאי). לכל שאלה מוצגות מספר אפשרויות ויש לבחור מתוכן את התשובה הנכונה ביותר. פירוט הניקוד מופיע בגוף הבחינה, לא לכל שאלה משקל זהה בשקלול הסופי.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

4. תנאים מותאמים בבחינה

בעל מוגבלות מסוימת (לדוגמה, דיסלקציה) שבידיו מסמכים מגורם רשמי המאשרים זאת ומעוניין לקבלה הקלה (לדוגמה, תוספת זמן במבחן, מבחן לא ממוחשב וכו'), יעביר מבעוד מועד בקשה בכתב לקבלת ההקלה המבוקשת למנהל מחלקת רישוי עובדי טיס. הבקשה תישקל על ידי מנהל המחלקה ובעת הצורך גם על ידי רופא רשות התעופה. התשובה תישלח למבקש. לאחר קבלת התשובה (חיובית או שלילית) ניתן יהיה לתאם תאריך למבחן.

5. רישום למבחן

- להרשמה ראשונה למבחן עיוני לקבלת רישיון או הגדר חדש, יש למלא את טופס ההרשמה הנמצא באתר רת"א בקישור הבא:
http://caa.gov.il/index.php?option=com_docman&task=doc_download&gid=2377&Itemid
- בקשת אגרה באמצעות האינטרנט - ניתן ואף מומלץ להגיש בקשה לקבלת אסמכתאות לתשלום אגרה באמצעות האינטרנט, בקישור הבא:
<http://www.forms.gov.il/globaldata/getsequence/getsequence.aspx?formType=VoucherRequest@aviation.gov.il>
- הפניה לתקבל במחלקת רישוי עובדי טיס והפונה יקבל מייל חוזר עם אסמכתאות לתשלום וקישור לאתר התשלומים הממשלתי שבו יבוצע התשלום.
- אישור ממדריך מוסמך על קבלת הדרכה (לפי תקנה 29 לתקנות הטיס – רישונות לעובדי טיס), בקישור הבא:
http://caa.gov.il/index.php?option=com_docman&task=doc_download&gid=2209&Itemid
- את טופס ההרשמה המלא, אישור על תשלום האגרה ואישור מדריך תיאוריה מאושר יש להחזיר לפקס 03-9774511 או לדוא"ל agrot_mivhan_teorya@mot.gov.il
- לאחר העברת המסמכים הנדרשים יש להתקשר לטלפון 03-9774504 ולתאם תאריך למבחן המבוקש.
- המבחנים העיוניים נערכים בימים ב', ג', ה' בשעה 08:00 בבוקר, במשרדי רשות התעופה האזרחית מחלקת רישוי עובדי טיס, בניין "בית גולן", רח' גולן פינת רח' הנגב, קריית שדה התעופה, בכיתת המבחנים אשר בקומה הראשונה.
- תאריך למבחן יש לתאם לפחות שבועיים מראש.

6. אישור מבחן עיוני

ציון המבחן יימסר לנבחן בעל פה ביום ביצוע המבחן. במקרה של מעבר בהצלחה במבחן העיוני, יישלח לנבחן אישור בכתב. האישור יישלח בדואר ישראל לכל המאוחר בתום שלושים יום מיום המבחן. תוקפו של האישור יהיה לתקופה של שישה חודשים מיום המבחן האחרון ובתנאי שהזמן שעבר בין המבחן הראשון למבחן האחרון לא יעלה על שנים עשר חודשים.

7. מבחן עיוני חוזר

במקרה של כישלון במבחן עיוני ניתן להגיש בקשה למבחן עיוני חוזר בתום שלושים יום מהיום בו בוצע המבחן.

ניתן להגיש בקשה למבחן עיוני חוזר כעבור פחות משלושים יום מיום הכישלון במבחן, בתנאי שמצורפת הצהרה המעידה על קבלת הדרכה נוספת ומוכנות למבחן חוזר.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

ההצהרה תיחתם על ידי מחזיק ברישיון מדריך טיס עם הגדר מתאים או מי שרשות הרישוי הסמיכה אותו לכך.

8. עיון חוזר בתוצאות מבחן עיוני

למרות שתוצאת המבחן נקבעת על ידי מחשב בהתאם לתשובות הנבחן, ניתן להגיש בקשה לעיון חוזר במבחן תוך 14 יום מיום ביצוע המבחן. לשם כך יש:

- למלא טופס בקשה
- לשלם אגרה (ניתן לבקשה דרך אתר רת"א)
- לתאם פגישה עם מפקח מחלקת רישוי עובדי טיס

9. העתקה במבחן עיוני או מעשה מרמה אחר (מתוך תקנה 32 תקנות הטיס – רישיונות לעובדי טיס)

"(א) לא יעתיק אדם מאחר במבחן עיוני, לא יתנו לאדם אחר אלא אם הורשה לכך, לא יעזור לאדם אחר בזמן המבחן, לא יכתוב מבחן כאמור במקום אדם אחר, לא ישתמש באמצעי עזר בלתי מאושר בזמן המבחן ולא יסייע לאחר באחד המעשים האמורים.

(ב) ביצע אדם מעשה כאמור בתקנת משנה (א), רשאית רשות הרישוי לפסול את המבחן העיוני של אותו אדם וכן לעכב את מתן הרישיון או ההגדר, חידושם או אישורם על פי תקנות אלה, עד לתקופה של שנתיים מיום ביצוע המעשה, וכן להתלות או לבטל את רישיון עובד הטיס שהוצא לו."

10. הוראות והמלצות

- בזמן ביצוע המבחן כדאי לשים לב לנקודות הבאות:
- יש לקרוא בעיון את ההוראות המופיעות במבחן.
 - לענות על כל שאלה בהתאם לתקנות ופרסומי המידע התעופתי.
 - יש לקרוא כל שאלה בעיון לפני הסתכלות על התשובות האפשריות. מומלץ להבין בבירור את הבעיה לפני בחירת הפתרון.
 - לאחר גיבוש התשובה, יש לקבוע איזו אפשרות מתאימה ביותר לתשובה. התשובה שתיבחר צריכה לתת פתרון שלם ומלא לשאלה.
 - מבין אפשרויות התשובה שניתנות, עשויות להופיע מספר תשובות הנותנות מענה חלקי לבעיה. עם זאת, יש רק תשובה אחת שנכונה במלואה. התשובות האחרות הן או חלקיות או שגויות או נגזרות מתפיסות מוטעות ופופולאריות.
 - במקרה של קושי בשאלה מסוימת, מומלץ לסמן את השאלה לבדיקה נוספת מאוחרת יותר ולהמשיך לשאלה הבאה. לאחר מענה על השאלות הפחות קשות, יש לחזור לשאלות שסומנו לביקורת ולענות עליהן.
 - יש לוודא כי לכל שאלה יש תשובה.
 - בעת פתרון בעיית חישוב, יש לבחור את התשובה הקרובה ביותר לפתרון השאלה. הבעיה נבדקה על ידי אנשים שונים ובסוגים שונים של מחשבוני, ולכן פתירת השאלה בצורה נכונה, תיתן תשובה שתהיה הקרובה ביותר לתשובה הנכונה מכל האפשרויות האחרות.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

11. חומר עזר

במהלך המבחנים ניתן לעשות שימוש בעזרים במסגרת ההנחיות המפורטות להלן:

- ככלל, מלבד ספר מטוס ומחשבון, כל חומר העזר הנדרש לצורך פתרון המבחן יינתן על ידי רת"א.
- כל דגמי מחשבוני הניווט התעופתיים מותרים לשימוש. בנוסף, מחשבוני אלקטרוניים קטנים המבצעים פונקציות אריתמטיות בלבד (חיבור, חיסור, כפל וחילוק). מחשבוני המאפשרים שליפת מספר אחד מהזיכרון, ביצוע פונקציות פשוטות, כמו שורש ריבועי ומקשי אחוזים מותרים גם כן.
- דפי טיוטה - ניתן להשתמש אך ורק בדפים שיסופקו על ידי רת"א.
- ניתן להשתמש בכל חומרי העזר הניתנים בבחינה. (נספחים, פמ"ת וכדומה)
- אין להכניס מילונים לבחינה.
- אין להכניס למבחן טלפונים סולריים (גם לא לשימוש בתור מחשבון או שעון), מכשירי זימונית, שעונים מצפצפים או כל חפץ העשוי להפריע לנבחנים אחרים.
- חל איסור על שימוש במחשבים ניידים או טאבלטים במהלך המבחן.

12. ידע נדרש

1. COMPULSORY BASIC KNOWLEDGE.

The basic knowledge consists of a compulsory revision in all basic subjects, as detailed hereby, to provide and prepare the applicant with adequate knowledge. for the aeronautical ALTP subjects and lessons.

1.1 MATHEMATICS

- 1.1.1 Arithmetical terms and signs; method of multiplication and division; ordinary and decimal fractions; factors and multiples.
- 1.1.2. Ratio; proportions; averages and percentages.
- 1.1.3. Square; cubes; square and cube roots.
- 1.1.4. Evaluating simple algebraic expressions; addition; subtraction; multiplication and use of brackets.
- 1.1.5. Simple algebraic fractions.
- 1.1.6. Linear equations and their solution.
- 1.1.7. Solution of second degree equations with one unknown.
- 1.1.8. Indices and powers; negative and fractional indices.
- 1.1.9. The binomial theorem of Newton for the second and third power,
- 1.1.10. Logarithm: use of log by scientific calculator. Log of products; quotients; powers and roots; natural logarithm.
- 1.1.11. Basic trigonometry, use of scientific calculator.
- 1.1.12. Trigonometric identities, sine theorem; cosine theorem; solution of plane triangles; right angled, acute and obtuse.
- 1.1.13. Trigonometric functions; sine cosine, tangent, cotangent; secant; cosecant; double angle formulae.
- 1.1.14. Simple geometrical constructions; angular bisector; side bisector; external angle; internal angles; triangle inscribed circle and circumscribed circle.
- 1.1.15. The x and y axes; simple functions; second power functions; third power functions graphs.
- 1.1.16. Plane geometry; the triangle; the square; the rectangle; the circle, the

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

- ellipse; proportions in the triangle.
- 1.1.17. Surfaces and volumes; the Cartesian equation of the circle and the ellipse.
- 1.1.18. The ellipse, its axes; its equation; the normal to the ellipse; flattening; ellipticity; ellipticity squared; its foci; its perimeter; measurement of latitude on Earth meridians.
- 1.1.19. Use of the scientific calculator: brackets; powers; roots; logs; Napierian logs; exponent of 10.
- 1.1.20. Graphs of algebraic functions; polar coordinates; the parabola; the hyperbola; the squared equation.
- 1.1.21. Calculations based on Earth dimensions WGS 84.

1.2. PHYSICS.

1.2.1. MECHANICS.

- 1.2.1.1. Forces as vectors; scalars; vectors; resultants; triangle of vectors; polygon of vectors; resolution of a vector.
- 1.2.1.2. Forces and moments, composition and resolution.
- 1.2.1.3. Centre of gravity; center of pressure.
- 1.2.1.4. Uniform motion in a straight line; acceleration; Newton's laws; momentum; force; mass and weight; work; energy; power; potential energy; kinetic energy; relative velocity; angular velocity;
- 2.1, .5., Aeronautical SI units for mass; force; speed; acceleration; work; power; pressure, as, detailed in Annex 5 of ICAO.
- 2.1, .6., Torque; moments of inertia; center of mass; radius of gyration; couples; conservation of momentum; centrifugal force; centripetal force; Coriolis.
- 2.1, 7., Specific gravity and density; pressure and buoyancy in liquids (barometers)
- 2.1, 8., Viscosity; fluid resistance; rolling resistance; friction.
- 2.1, 9., Elements of fluid dynamics; streamlines; Bernoulli's theorem; venturi tube; pitot tube; speed of sound.
- 2.1, 10. Velocity ratio; relative velocity
- 1.2.1.3. Centre of gravity; center of pressure,
- 1.2.1.4. Uniform motion in a straight line; acceleration; Newton's laws; momentum; force; mass and weight; work; energy; power; potential energy; kinetic energy; relative velocity; angular velocity;

1.2.2. HEAT.

- 1.2.2.1 Temperature; thermometers and temperature scales (Celsius; Fahrenheit; Kelvin) conversion from one scale to another.
- 1.2.2.2 Expansion: linear expansion; surface expansion; volume expansion.
- 1.2.2.3 Quantity of heat; units of heat; specific heat; latent heat.
- 1.2.2.4 Heat transfer; conduction; radiation; convection.
- 1.2.2.5 Mechanical equivalent of heat; first and second law of thermodynamics.
- 1.2.2.6 Properties of fluids: solid; liquid and gaseous states; melting; boiling; evaporation and reverse processes; vapor pressure and absolute and relative humidity.
- 1.2.2.7 Gases: ideal gas; Charles' law; Boyle's law; internal energy of gas, specific heat of a gas.
- 1.2.2.8 Specific heat of gas at constant volume; specific heat of gas at constant pressure; (γ), or the ratio between those two, in atmospheric range;

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

- thermodynamic formulae for dry air.
- 1.2.2.9 Thermodynamics: isothermal; adiabatic and isobaric expansion and compression.
- 1.2.2.10 Nature of matter; the chemical elements; structure of atoms; molecules ; crystals; solutions; solvents; Avogadro's number; atomic weight.

1.2.3. **ELECTRICITY AND MAGNETISM.**

- 1.2.3.1 Fundamentals: atoms and electrons; conductors and insulators; electric currents; electromotive force; difference of potential; electric units; power, work and energy Ohm's law ; series; parallel and combined DC circuits; Kirchhoff's law; Wheatstone bridge.
- 1.2.3.2 Batteries and thermal EMF: primary cells; secondary cells; lead acid and alkaline accumulators; thermocouples.
- 1.2.3.3 Magnetism: Loadstone-permanent magnets; laws of magnetism; poles flux direction; Earth magnetism; magnetic field of earth; polarity rules ; electromagnetism; field's strength and flux density; permeability; hysteresis; reluctance.
- 1.2.3.4 Electrostatics: positive and negative charges; charges developed by friction electrostatic induction; surface charges; electrostatic fields; static charges on aircrafts and methods of discharging them.
- 1.2.3.5 Electromagnetic induction; Faraday's law; Lenz's law; magnitude and direction of induced EMF; generators.
- 1.2.3.6 Inductance and capacitance; units of capacitance; units of inductance; condensers; dielectric strength and efficiency.
- 1.2.3.7 Outline of AC theory: generation; measurements: current and voltage, frequency period; inductive circuits; capacitive circuits; general circuits; series and parallel resonance; simple transformers; rectification.
- 1.2.3.8 Resistance, inductance and capacitance in AC circuits: Inductive reactance; resistance and inductance in series; impedance; power factor and true power; capacitive reactance; resistance; resistance and capacitance in series; resonance; voltage developed at resonance.
- 1.2.3.9 Transformers: primary and secondary EMF; load on secondary; resistive, inductive and capacitive loads; transformer losses.

1.3 **GEOGRAPHY AND ASTRONOMY.**

- 1.3.1 The milky way galaxy; the solar system.
- 1.3.2 Size and shape of the earth; WGS 84.
- 1.3.3 Earth rotation and revolution; the civil year.
- 1.3.4 Latitude; longitude; equator; parallels of latitude; prime meridian, meridians.
- 1.3.5 Geographical position by coordinates.
- 1.3.6 True North; cardinal points; direction in angular degrees with reference to true north.
- 1.3.7 The tropical year; the sidereal year; the anomalistic year; the definition of the second; UT₀; UT₁ ; UT₂; UTC.
- 1.3.8 The continents; the oceans.
- 1.3.9 The major mountain formations; seas; rivers; lakes.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

2.1. INTERNATIONAL AND NATIONAL AIR LAWS.

2.1.1 ICAO

- 2.1.1.1 The formation and history.
- 2.1.1.2 The Chicago convention; related acts; the 5 freedoms.
- 2.1.1.3 The contracting states; council; air navigation commission (ANC); and standing committees.
- 2.1.1.4 The annexes; PANS; documents; circulars; SARPs.
- 2.1.1.5 International conventions and final acts.
- 2.1.1.6 International and multilateral agreements.
- 2.1.1.7 **Annex 2** - General rules; VFR; IFR; table of cruising levels; interception procedures (unlawful interference).
- 2.1.1.8 **Annex 5** S.I. units used in aviation.
- 2.1.1.9 **Annex 10** -Telecommunications, Radio telephony procedures. Vol II - chapter 5 Aeronautical mobile service; and according to the published CAA RTF syllabus.
- 2.1.1.10 **Doc. 8168 - Volume I** - Part I - chapters 1 and 2; PART II - chapters 1 and 2, except 2.5 chapters 3 and 5 ; Part III - Approach procedures-chapter 1, chapter 2: 2.1.2.2.2.4. chapters 3 , 4 , 5 , 7 ; Part IV- chapters 1 and 2; Part V- chapter 3; Part VI-chapters 1 and 2 ; Part VIII - chapters 1, 2 and 3.
- 2.1.1.11 **Doc. 4444** - Procedures for Air Traffic Management. Part II-8 , 9 , 10 , 12.1 , 13 , 14 , 15 and 17; Part III-6 , 13 , 16 and 17; Part IV-2.2 , 4 , 8 , 9 , 10.2 , 10.3 , 11.5 and 12; Part V- 10.3, and 13.5 ; Part VII-1 and 2 ; Part X- entirely; Part XI-entirely and appendices 1 , 2 , 4 and 5.
- 2.1.1.12 The Jeppesen Airway Manual-chapter - **Introduction and enroute chart legend approach chart legend**; radio aids; meteorology; tables and codes; Air traffic control; entry requirements; **emergency** and airport directory.

2.2. NATIONAL Air Navigation Regulations

- 2.2.1 National organization of Civil Aviation Authority.
- 2.2.2 Air Navigation law, 2011; Airport Authority Law, 1988; Air Navigation Regulations (Safety at Aerodromes of the Airport Authority),1992; and Civil Aviation Authority directives.
- 2.2.3 **Air Navigation Regulations (Operation of aircraft and Rules of Flight), 1981:**
 - chapter 1 - Definitions;
 - chapter 2 - General rules, paragraphs 1 to 6 inclusive; from par. 8 to 14 and from par. 17 to 31 **inclusive**; par. 33 ; 36 to 39; 43 to 47;
 - chapter 3, chapter 4 entirely except for Para. 81 and 87 and agricultural VFR;
 - chapters 5, 6, 8, 13
- 2.2.7 Air Navigation Regulations (Personnel Licensing), 1981:
 - Part A: chapter 1: definitions; chapters 2, 3, 4, 5, 6 and 8.
 - Part B: chapter 4;
 - Part D: chapter 1 marks B and C; chapter 2 (IFR) except for Para. 192, 193, and 195.
 - Part H appendices 4 and 5.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

2.2.8 Air Navigation Regulations (Flight Time Limitations in Air Transport Services), 1971

2.3. FEDERAL AVIATION REGULATIONS.

- 2.3.1 FAR 1 - definitions and abbreviations.
- 2.3.2 FAR 25- Airworthiness standards; transport category airplanes: paragraphs 25.29 ; 25.103 ; 25.105 ; 25.107 ; 25.109 ; 25.111; 25.115 ; 25.117 ; 25.119 ; 25.121 ; 25.123 ; 25.125 ; 25.149 ; 25.207 ; 25.803 ; 25.851 ; 25.857; 25.1322 ; 25.1323 25.1411 ; 25.1415 .
- 2.3.3 FAR 97 paragraphs: 97.3; 97.5
- 2.3.4 FAR 121 Operating requirements: DOMESTIC, FLAG AND SUPPLEMENTAL AIR CARRIER OPERATIONS, paragraphs 121.171 ; 121.189 ; 121.191 ; 121.193 ; 121.195 ; 121.197 ; 121.285 ; 121.287 ; 121.289 ; 121.309 ; 121.310 ; 121.311 ; 121.318 ; 121.319 ; 121.318 ; 121.319 ; 121.323 ; 121.325 ; 121.329 ; 121.333 ; 121.339 ; 121.341 ; 121.342 ; 121.343 ; 121.345 ; 121.349 ; 121.351 ; 121.353 ; 121.356 ; 121.357 ; 121.358 ; 121.359 ; 121.383 ; 121.385 ; 121.570 ; 121.595 ; and appendices E and F.

3. GENERAL TECHNICAL KNOWLEDGE

3.1. AIRCRAFT GENERAL KNOWLEDGE.

- 3.1. This chapter includes the following subjects:
Airframe and systems; Electrics; Powerplant; Emergency equipment- Principles of flight-AEROPLANES.

3.1.1. AIRFRAME AND SYSTEMS.

- 3.1.1.1 **Fuselage**-types of constructions; structural components and materials; stress.
- 3.1.1.2 **Cockpit and cabin windows**-construction (laminated glass); structural limitations.
- 3.1.1.3 **Wings**-types of construction; structural components and materials; stress relief of engines, etc...; stress.
- 3.1.1.4 **Stabilizing surfaces**-vertical, horizontal and V-tail surfaces; construction materials; efforts; flutter; compensation system; Mach trim.
- 3.1.1.5 **Landing gear**-types; construction; locking devices and emergency extension systems; accidental retraction preventing devices; position; movement lights and indicators; nose wheel steering wheels and tires (construction and limitations);
- 3.1.1.6 **Braking systems**-construction; parking brake; mode of operation of anti-skid system; mode of operation of autobrake system; operation, indication and warning systems.
- 3.1.1.7 **Flight controls**-(construction and operation).
- 3.1.1.8 **Primary controls**: elevator, aileron and rudder; trims; mode of actuation (mechanical hydraulic, electrical, fly by wire); operation; indicators; warning devices and controls' efforts to transmit.
- 3.1.1.9 **Secondary controls**- lift augmentation and wing flaps: lift dumping and

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

speed brakes; variable elevator; mode of actuation (mechanical (hydraulic, electrical, fly by wire); operation, indicators; warning devices; dangerous situations and potential failures.

- 3.1.1.10 **Hydraulics** - basic principles of hydromechanics; hydraulic fluids schematic construction and functioning of hydraulic systems.
- 3.1.1.11 **Hydraulic systems** - main, stand-by and emergency systems; operation ; indicators warning systems; ancillary systems.
- 3.1.1.12 **Air driven systems** - (piston engines only).
- 3.1.1.13 **Pneumatic systems**-power sources; schematic construction and functioning of pneumatic systems.
- 3.1.1.14 **Air conditioning system**-heating and cooling; construction, functioning and controls.
- 3.1.1.15 **Pressurization**-cabin altitude; maximum cabin altitude; differential pressure pressurized zones in the aircraft; operation and indicators; safety devices and warning systems; rapid decompression; cabin altitude warning; emergency procedures.
- 3.1.1.16 **Deice systems**-pneumatic leading edge deicing of wings and control surfaces schematic construction; operational limitations initiation/timing of deicing; system usage.
- 3.1.1.17 Air driven systems-(turbopropeller and jet aircraft).
- 3.1.1.18 **Pneumatic system**-power sources; schematic construction; potential failure, warning devices; operation; indicators; warning systems; pneumatic operated systems.
- 3.1.1.19 **Air conditioning system**-construction; functioning; operation; indicators and warning devices; heating and cooling; temperature regulation-automatic and manual; ram air ventilation; schematic construction.
- 3.1.1.20 **Anti ice system**-aerofoil and control surfaces; powerplant; air intake; windshield schematic construction; operating limitations and initiation; timing of deicing; system usage; ice warning system.
- 3.1.1.21 **Non-pneumatic operated** deice and anti-ice systems; schematic construction functioning and operation of: air intake; propellers; pitot; static pressure sensor and stall warning devices; windshield; wiping wing system; rain repellent system.
- 3.1.1.22 **Fuel system**-fuel tanks; structural components and types; location of tanks on single and multi-engine aircraft; sequence and types of refueling; unusable fuel.
- 3.1.1.23 **Fuel feed**-gravity and pressure feed; crossfeed; schematic construction; fuel dumping system.
- 3.1.1.24 **Fuel system monitoring**-operation; indicators; warning systems; fuel management (sequencing of fuel tank switching); dipstick; and dipstick.

3.2. ELECTRICS.

3.2.1. Direct current (DC) General.

- 3.2.1.1 **DC**-Electric circuits; voltage; current; resistance; Ohm's law; resistive circuits; resistance as a function of temperature; electrical work; electrical power; fuses (function, types and operation; the electrical field; the capacitor (function).
- 3.2.1.2 **Batteries**-types; characteristics; uses; hazards.
- 3.2.1.3 **Magnetism**-permanent magnetism; electromagnetism; relay; circuit breaker; solenoid valve (principle, function and application); electromagnetic power;

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

- electromagnetic induction.
- 3.2.1.4 **Generators**-Alternators-principle; function and application; monitoring devices regulation; control and protection; modes of excitation; starter generator.
- 3.2.1.5 **Distribution**-current distribution (buses); monitoring of electrical flight instruments /systems; ammeter; voltmeter; annunciators; electrical consumers; DC power distribution: construction; operation and system monitoring; elementary switching circuits.
- 3.2.1.6 **Inverters** (application).
- 3.2.1.7 **The aircraft structure** as an electrical conductor.

3.2.2. ALTERNATING CURRENT (AC).

- 3.2.2.1 **General:** Single and multi phase AC; frequency; phase shift; AC components.
- 3.2.2.2 **Generators:** 3-phase generator; brushless generator (construction and operation) generator drive: constant speed drive (CSD); integrated drive.
- 3.2.2.3 **AC power distribution**-construction; operation and monitoring; protection circuits; paralleling of AC generators.
- 3.2.2.4 **Transformers**-function; types and applications.
- 3.2.2.5 Synchronous and asynchronous motors-operation; application; transformer rectifier units.
- 3.2.2.6 **Semi-conductors**-principle of semi-conductors; semiconductor resistors (properties and application); rectifier (functions and applications; transistor (function and applications); diodes (function and applications)
- 3.2.2.7 **Basic knowledge of computers**-logic circuits; logical symbols; switching circuits and logical symbols;
- 3.2.2.8 **Basic radio propagation theory**-basic principles: electromagnetic waves; wave length; amplitude; phase angle; frequency; frequency bands; sidebands; single sidebands; pulse characteristics; carrier; modulation; demodulation; kinds of modulation (amplitude; frequency, pulse; multiplex); oscillation circuits.
- 3.2.2.9 **Antenna**-characteristic; polarization; types of antenna.
- 3.2.2.10 **Wave propagation**- ground waves; sky waves; propagation with the frequency band; fading; factors affecting propagation ; (reflection ; absorption; interference; twilight; shoreline; mountain; static).

3 3. POWERPLANT.

3.3.1. PISTON ENGINE

- 3.3.1.1 General: design types; principle of the 4 strokes internal combustion engine mechanical components.
- 3.3.1.2 **Lubrication system**-function; schematic construction; monitoring instruments and indicators; lubricants.
- 3.3.1.3 **Air cooling-system**-monitoring; cylinder head temperature; cowl-flaps.
- 3.3.1.4 **Ignition**-schematic construction and function; types of ignition; magneto check.
- 3.3.1.5 **Engine fuel system**-carburetor: construction and modes of operation; carburetor icing; fuel injection; construction and modes of operation; alternate air.
- 3.3.1.6 **Engine performances**-pressure and density altitudes; performance as a

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

- function of pressure and temperature.
- 3.3.1.7 **Power augmentation devices**-turbocharger; supercharger (construction and effect on engine performance).
- 3.3.1.8 **Fuel**-types; grades; detonation characteristics; octane rating; color coding ; additives water contents; water contamination; ice formation ; fuel density; alternate fuels differences in specifications; limitations.
- 3.3.1.9 **Mixture**-rich; lean; ideal; maximum power and fuel economy; mixture settings and leaning out procedures.
- 3.3.1.10 **Propellers**-fixed pitch; constant pitch; principle of operation of propellers (on single and multi engine); propeller check; propeller efficiency as a function of airspeed; aircraft and engine/s protection (overspeed; inadvertent reverse pitch; pitch locking mechanism); propeller operation (ground, air, coarse, fine, feather, flat pitch; centrifugal twisting moment; limitations); CSU construction and operation-overspeed, under-speed, on-speed; effective pitch vs. actual pitch.
- 3.3.1.11 **Engine handling and manipulation**-power setting; power range; mixture settings leaning out procedures; operational limitations.
- 3.3.1.12 **Operational criteria**-maximum and minimum RPM; induced engine vibration; RPM; resonance; critical RPM; remedial actions for abnormal engine start; run-up; inflight.

3.3.2. TURBINE ENGINE

- 3.3.2.1 Principle of operation.
- 3.3.2.2 **Types of construction**-compressor: centrifugal, axial; twin-spool; turboprop turbojet; turbofan.
- 3.3.2.3 **Engine construction**-air inlet; function; compressors: function; construction; mode of operation; effects of damage; compressor stall and surge (cause and avoidance) compressor characteristics.
- 3.3.2.4 **Diffuser**-function; types: centrifugal, axial.
- 3.3.2.5 **Combustion chamber**-function; types and working principles; mixing ratio; fuel injectors; thermal load.
- 3.3.2.6 **Turbine**-function; construction and working principles; thermal and mechanical stress; effects of damage; monitoring of exhaust gas temperatures.
- 3.3.2.7 **Jet pipe**-function; different types: convergent, divergent; convergent-divergent; noise silence devices.
- 3.3.2.8 **Detailed pick-up stations**-pressure, temperature and airflow in the turbine engine.
- 3.3.2.9 **Reverse thrust**-function; types and principle of operation; degree of efficiency ; use and monitoring; risks: flame-out on RSC of slush, water, snow, ice on 4 engines aircraft with swept-back wings; overheat.
- 3.3.2.10 **Performance and thrust augmentation**-water injection; principles of operation use and system monitoring.
- 3.3.2.11 **Bleed air**-effect of use on thrust, exhaust temperature, RPM and EPR.
- 3.3.2.12 **Auxiliary gear box**-function.
- 3.3.2.13 **Engine systems**-ignition: function, types, components, operation safety devices.
- 3.3.2.14 **Starter**-function; type; construction and mode of operation; control and monitoring self sustaining and idle speeds.
- 3.3.2.15 **Engine start malfunctions**-causes and avoidance.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

- 3.3.2.16 **Fuel system**-construction components; operation and monitoring; malfunctions.
- 3.3.2.17 **Lubrication**-construction; components; operation and monitoring; malfunctions.
- 3.3.2.18 **Fuel**-types of jet fuel; effects of temperature; impurities; additives.
- 3.3.2.19 **Thrust**-thrust formula; flat rated engine; thrust as a function of: airspeed, air density pressure, temperature and RPM.
- 3.3.2.20 **Powerplant**-operation and monitoring.
- 3.3.2.21 **Auxiliary power unit (APU)**-general; function; types; operation and monitoring.
- 3.3.2.22 **Ram air turbine**-function.

3.3.3. PROPELLERS.

- 3.3.3.1 **Conversion** of engine **torque to thrust**; meaning of prop's pitch blade twist; fixed pitch and variable pitch/constant speed; prop's effective pitch; propeller efficiency vs. speed; effects of ice on propeller; engine failure or engine stop; windmilling drag; influence on yaw moment when asymmetric power; feathering: influence on: glide performance, yaw moment when asymmetric power; TP equivalent thrust HP.
- 3.3.3.2 **Design features** for power absorption; aspect ratio of blades; diameter of prop; number of blades; moments and couples due to propeller operation; centrifugal twisting moment; prop's noise; torque reaction on airplane; gyroscopic precession; asymmetric slipstream effect; asymmetric blade effect P-factor; reduced thrust at high angles of attack; windmilling beyond RPM limits vs. TAS; centrifugal root weights; mechanism of CSU - oil pressure and spring; oil-spring and nitrogen; reduction gear engine/prop; beta range; reverse and flat pitch control; limitations .

3.4. EMERGENCY EQUIPMENT

- 3.4.1 **Doors and emergency exits**-accessibility; normal and emergency operation markings; floor exit markings; crew emergency exits; passengers' emergency exits; evacuation slides; general usage: as slides, as life rafts or as floatation devices.
- 3.4.2 **Smoke detection**-location; indicators; function test.
- 3.4.3 **Fire detection**-location; warning modes; function test.
- 3.4.4 **Fire fighting equipment**-location; operation; contents; gauge; function test.
- 3.4.5 **Aircraft oxygen equipment**-principles of operation ; protection and surveillance devices; drill; use of equipment in case of rapid decompression; comparison of constant flow and demand outlet masks; quick donning masks; oxygen generators danger of oxygen use; safety measures.
- 3.4.6 **Emergency onboard equipment**-portable hand-held fire extinguishers; smoke masks; smoke protection hood; portable oxygen system; ELT; emergency radio transmitter on life rafts (**VHF.UHF** or SARSAT); life jackets; life rafts; pocket lamp; emergency lighting; megaphone; crash axe; fireproof gloves.

AP 1.3.006B		PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

3.5 INSTRUMENTATION AEROPLANES.

3.5.1. FLIGHT INSTRUMENTS.

3.5.1.1. Air DATA instruments.

- 3.5.1.1.1 **Pitot and static system**-pitot tube: construction and principles of operation; static source; malfunctions; heating; alternate static source.
- 3.5.1.1.2 **Altimeter**-construction and principle of operation; display and setting ; errors correction tables; tolerances.
- 3.5.1.1.3 **Airspeed indicator**-construction and principle of operation; speed indications (IAS); meaning of color arcs; max. speed indicator Vne; Vmo/Mmo pointer; errors.
- 3.5.1.1.4 **Mach meter**-Mach number formula; temperature rise; construction and principle of operation; display; construction types; errors.
- 3.5.1.1.5 **Vertical speed indicator**-aneroid and instantaneous VSI; (IVSI); construction and principle of operation; display; errors.(lag)
- 3.5.1.1.6 **Air DATA computer**-principle of operation; input and output data; signals; uses of output data; block diagram; system monitoring.

3.5.2. GYROSCOPIC INSTRUMENTS.

- 3.5.2.1 **Gyro fundamentals**-theory of gyroscopic forces (stability, precession); types; construction and principles of operation of the following: vertical gyro, directional gyro, rate gyro, rate integrating gyro; single degree of freedom gyro; two planes freedom gyro; fully articulated 3 planes freedom gyro; ring laser gyro; errors: apparent drift random drift; eastbound/westbound drift; latitude drift; mountings; drive types, monitor-ring; erection mechanism (air driven shutters, electrical).
- 3.5.2.2 **Directional gyro**-construction and principle of operation.
- 3.5.2.3 **Slaved gyro compass**-construction and principle of operation; components; mounting and modes of operation; turn and acceleration errors; application; uses of output data.
- 3.5.2.4 **Attitude indicator (vertical gyro)**-construction and principles of operation; display types; turn and acceleration errors; application; uses of output data; erection mechanism.
- 3.5.2.5 **Turn and bank indicator (rate gyro)**-construction and principles of operation; display types; application errors; application; uses of output data; turn coordinator.
- 3.5.2.6 **Gyro stabilized platform**-(gimbaled platform)-types in use; accelerometer measurement systems; construction and principles of operation ; platform alignment; applications; uses of output data.
- 3.5.2.7 **Fixed installations (strap down systems)**-construction and principles of operation types in use; input signals; application, use of output data.
- 3.5.2.8 **Emergency magnetic compass**-construction and principles of operation ; magnetic variation; magnetic inclination; compass deviation; compass dev. card; compass errors: acceleration, turning; effects on display by electrical systems (windshield heating).

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

- 3.5.2.9 **RMI and repeaters**-the flux-valve; position; principle of operation: magnesynd; autosyn; gyrosyn; AC feeding the system; construction and functioning of repeaters of the flux-valve through the master gyro compass; adjustment and alignment of RMI's cards; effects on readings of the VOR and ADF needles.
- 3.5.2.10 **Radio altimeter**-components; frequency band; principle of operation; display; errors.
- 3.5.2.11 **Electronic flight instrument system (EFIS)**-information display types; data input control panel; display unit; example of a typical aircraft installation.
- 3.5.2.12 **Flight management system (FMS)**-general principles; inputs and outputs of data.

3.5.3. **AUTOMATIC FLIGHT CONTROL SYSTEM.**

- 3.5.3.1 **Flight director**-function and application; block diagram; mode of operation; components; operation set-up for various flight phases; command bars; mode indicator; system monitoring; limitations; operational restrictions.
- 3.5.3.2 **Autopilot**-function and application; types (different axes); block diagram; components lateral modes; longitudinal modes; autoland; sequence of operation; system concepts for autoland; go-around; take-off; fail passive; fail operational (redundant); control modes ; signal interfacing to control surfaces; operation and programming for various flight phases; limitations; operational restrictions.
- 3.5.3.3 **Ground proximity warning system(GPWS)**-function; block diagram components input data; signals; warning modes; system integrity test.
- 3.5.3.4 **Traffic collision avoidance system (TCAS)**-principles;
- 3.5.3.5 **Overspeed warning**-function; input data; signals; display; indicators; function test; effects on operation in case of failure.
- 3.5.3.6 **Stall warning**-function; constituent components of a simplified system; block diagram; components of a system with angle of attack indicator; operation.
- 3.5.3.7 **Flight data recorder**-function; block diagram; components; operation; system monitoring.
- 3.5.3.8 **Cockpit voice recorder**-function; block diagram; components; operation.

3.5.4. **POWERPLANT AND SYSTEMS MONITORING INSTRUMENTS.**

- 3.5.4.1 **Pressure gauge**-sensors; pressure indicators; meaning of colored arcs.
- 3.5.4.2 **Temperature gauge**-sensors; ram rise; recovery factor; temperature indicators meaning of colored arcs.
- 3.5.4.3 **Flight envelope protection**-function; input data; signals; output data; signals; system monitoring.
- 3.5.4.4 **Yaw damper**-function; block diagram; components; signal interfacing to vertical stabilizer.
- 3.5.4.5 **Automatic pitch trim**-function; input data; signals; mode of operation; horizontal stabilizer; trim tab actuator; system monitoring; safety of operation.
- 3.5.4.6 **Thrust computation**-function; components; input data; signals; output data; signals; system monitoring.
- 3.5.4.7 **Auto-thrust**-function and applications; block diagrams; components; mode of operation; automatic operation mode selection; signal interfacing to

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

throttle level mechanism; operation and programming for various flight phases; system monitoring; limitations; operational restrictions.

3.5.5. WARNING AND RECORDING EQUIPMENT.

- 3.5.5.1 **Warnings general**-classification of warning; display; indicator systems; types of panel; typical panel.
 - 3.5.5.2 **Altitude alert system**-function; block diagram; components; operation and system monitoring.
 - 3.5.5.3 **RPM indicator**-interfacing of signal pick-up to RPM gauge; RPM indicators; piston and turbine engines; meaning of colored arcs.
 - 3.5.5.4 **Consumption gauge**-fuel-flow meter (function, indication); high pressure line fuel-flow meters (function, indication, failure warning).
 - 3.5.5.5 **Fuel gauge**-measurements of volume/mass units; measuring sensors; contents; quantity indicators; reasons for incorrect indications.
 - 3.5.5.6 **Torque meter**-indicators; units; meaning of colored arcs.
 - 3.5.5.7 **Flight hour meter**-drive source; indicators.
 - 3.5.5.8 **Vibration monitoring**-indicators; units; interfacing to bypass; turbofan engines; warning system.
 - 3.5.5.9 **Remote (signal) transmission system**-mechanical; electrical.
 - 3.5.5.10 **Electronic display**- EICAS; ECAM.
-

3.6. FLIGHT PERFORMANCE AND PLANNING.

3.6.1. MASS AND BALANCE -AEROPLANES.

- 3.6.1.1 **Introduction to mass and balance**-center of gravity; definition importance in regard of aircraft stability; mass and balance limits; C of G position within the MAC; LEMAC; TEMAC; typical aircraft example of CG in the MAC; calculations of CG for different airplanes.
 - 3.6.1.2 **CG limits**- for take-off; landing and cruise; effect on cruise performance; maximum floor load; maximum ramp mass; maximum taxi mass; maximum landing mass; maximum cruise mass for cruise level.
 - 3.6.1.3 **Factors determining maximum permissible mass**-structural limitations performance limitations such as runway available for take-off and landing; weather conditions (temperature, wind, precipitation); rate of climb and altitude requirements for obstacle clearance; engine out performance requirements.
 - 3.6.1.4 **Factors determining centre of gravity limits**-aircraft stability; ability of flight controls and surfaces to overcome mass and lift pitching moments under all flight conditions ; changes in CG location during flight due to fuel consumption ; raising and lowering of landing gear; intentional relocation of passengers, or cargo, and transfer of fuel; moment of centre of lift due to changes in wing flap position.
-

3.6.2. LOADING.

- 3.6.2.1 **Terminology**-dry empty weight; dry weight; basic weight; basic operational weight; zero wing-fuel weight; payload; max. ramp weight; max. Take-off weight; max. Landing weight, aircraft mass checks procedure (in general terms).

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

- 3.6.2.2 **Documentation** for determining aircraft mass and balance.
- 3.6.2.3 **Effects of overloading**-higher take-off and safety speeds; longer take-off and landing distances; lower rate of climb; influence on range and endurance; decreased engine-out performance; possible structural damage in extreme cases.

3.6.3. CENTRE OF GRAVITY.

- 3.6.3.1 **Basis of CG determination and calculation**-datum; LEMAC; TEMAC; MAC; explanation of terms; location; moment, arm, mass; explanation of CG in percentage of MAC; movement of CG with loading; determination of CG from mass and moment; use of algebraic signs.
- 3.6.3.2 **Practical methods of calculation**-computation using either mathematical computations or specially designed slide-rule; graph method; table method.
- 3.6.3.3 **Equipment for cargo aircraft**-equipment for the cargo compartment; containers; pallets.
- 3.6.3.4 **Effect of load shift**-movement of CG possible out of limits; possible damage due to inertia of moving load; effect of acceleration on the aircraft load.
- 3.6.3.5 Area load; running load; supporting.

3.6.4 PERFORMANCE OF AEROPLANES. PERFORMANCE OF AEROPLANES CERTIFIED UNDER JAR/FAR 25-

3 6 4.1 PERFORMANCE FOR AEROPLANES GROUP C TURBINE POWERED.

- 3.6.4.1.1 **Take-off and landing**-all definitions used of V speeds; V_1 ; V_2 ; V_r ; V_{mca} ; V_{mcg} ; V_{mu} ; V_{lof} ; V_s ; V_{s1} ; V_{so} ; V_{mcl} ; V_{mbe} .
- 3.6.4.1.2 **Appropriate distances definitions**- associated with take-off: balanced field length; take-off run; take-off distance; accelerate/stop distance; clearways; stopways; mass/altitude/temperature limits.
- 3.6.4.1.3 **Runway variables**-length; slope; surface; surface covering; load classification number; single isolated wheel load; PCN; LCN.
- 3.6.4.1.4 **Aeroplane variables**-mass; flap-angle; reduced power/thrust settings; increased V_2 use of anti-ice; use of de-ice; use of bleed-air.
- 3.6.4.1.5 **Meteorological variables**-pressure altitude and temperature; (density altitude); wing gust factor; surface covering conditions: standing water; snow; ice; slush; etc...;
- 3.6.4.1.6 **Take-off speeds**-computation of V_1 ; V_r and V_2 ; initial climb speed; landing gear and flap retraction speeds.
- 3.6.4.1.7 **Take-off distances**-computation of take-off distances: include consideration of aeroplane; runway; meteorological variables; effects of late or early rotation on T/O distances; effects of flaps on T/O distance; possibility of ground stall with early rotation; possibility of being below V_{mca} with early rotation.
- 3.6.4.1.8 **Accelerate/stop distance**-concept of balanced field length; review of definitions; relationship between balanced/unbalanced field length and V_1 .
- 3.6.4.1.9 **Use of flight manual charts**-computing accelerate/stop distances, decision time and deceleration procedure assumptions; time to decide: allowance (2-3 seconds); use of brakes; use of reverse thrust; brake energy absorption limits; delayed temperature rise; tire limitations.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

3.6.5.1. INITIAL CLIMB.

- 3.6.5.1.1 **Climb segments**-undercarriage and flap retraction; take-off mass limits regarding climb requirements.
- 3.6.5.1.2 **All engines operating**-climb speed; rate of climb requirements; noise abatement procedures.
- 3.6.5.1.3 **Engine inoperative operation**-best angle of climb speed; best rate of climb speed; rates of climb: effect of density altitude on climb performance; effect of weight on climb speed.
- 3.6.5.1.4 **Obstacle clearance requirements**-climb to clear obstacles; height above obstacles; turning to avoid obstacles; effect of turn on climb performance.

3.6.5.2. CLIMB.

- 3.6.5.2.1 **Use of flight manual performance charts**-effects of aeroplane mass; effect of density altitude change; time to climb calculations to reach cruise altitude.
- 3.6.5.2.2 **Significant airspeeds for climb**-flap retraction speed; normal (all engines operating climb speeds); best angle of climb; best rate of climb.
- 3.6.5.2.3 **One engine inoperative climb**-climb airspeeds: best rate of climb; best angle of climb; maximum cruise altitude/height/flight level.

3.6.5.3. CRUISE.

- 3.6.5.3.1 **Use of cruise charts**-determination of cruise heights; maximum attainable cruise height; increase of maximum cruise speeds and power settings.
- 3.6.5.3.2 **Cruise control**-maximum range: power settings; speeds; fuel consumption maximum endurance: power settings; speeds; fuel consumption; speed-range trade-offs, for cruise power settings; maximum cruise power settings: resultant speeds, fuel consumption.
- 3.6.5.3.3 **Enroute one engine inoperative**-engine inoperative charts; range and endurance; one engine-out service ceiling; maximum continuous power settings; ETOPS operations.
- 3.6.5.3.4 **Obstacle clearance enroute**-net flight path; vertical and horizontal; overhead mass limitations; drift-down procedures.
- 3.6.5.3.5 **Enroute-Airplanes with 3 or more engines-two engines out** requirements and limitations.

3.6.5.4. DESCENT AND LANDING.

- 3.6.5.4.1 **Use of descent charts**-time to start descent; fuel consumption in descent; limiting speeds: normal operating airspeed; maximum operating airspeed; speed for maximum glide ratio; maximum rate of descent speed (cabin pressure rate of descent).
- 3.6.5.4.2 **Maximum permitted landing mass**-structural limit specified by manufacturer, and/or by State airworthiness Authorities.
- 3.6.5.4.3 **Approach and landing data calculations**-suitability of selected landing runway, landing distance available; computation of the max. Landing mass for the given runway conditions; computation of minimum runway length for

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

the given aircraft mass conditions; other factors: runway slope, surface conditions, wind, temperature, density altitude.

- 3.6.5.4.4 **App. & landing data calculations cont'd**-computation of expected actual landing mass. computation of approach and landing speeds; computations should be completed for alternate aerodromes as well; definition of terms and speed used: V_{th} threshold speed; discontinued approach climb speed; landing-climb; landing distance: dry, wet and contaminated runways; landing distance required: destination airport; alternate airport; landing-climb performance; landing configuration (all engines); approach configuration (one engine out).

3.6.6.1. PRACTICAL APPLICATION FROM AIRPLANE'S PERFORMANCE MANUAL.

- 3.6.6.1.1 **Use of typical turbojet or turboprop aeroplane performance manual**-T/O and LDG mass calculations; take-off data computations: effect of runway variables; aeroplane variables; and meteorological variables; computation of the various V speeds for take-off and initial climb; computation of runway distance factors; rate and gradient of initial climb; obstacle clearance; appropriate engine out calculations; climb computations: climb rates and gradients; time-to-climb; fuel used; engine-out calculations.
- 3.6.6.1.2 **Cruise computations**-power settings and speeds for maximum range; maximum endurance and normal cruise; fuel consumption; engine-out operation ; pressurization failure; effect of lower altitude on range and endurance; ETOPS flight.
- 3.6.6.1.3 **Additional considerations concerning fuel consumption** effects of altitude and aircraft mass; fuel for holding; approach and cruise to alternate: ^ normal and abnormal conditions i.e. after jet engine failure; after decompression.

4.1. IFR (AIRWAYS) FLIGHT PLANNING.

- 4.1.1 Meteorological considerations.
- 4.1.2 Analysis of existing weather patterns along planned routes.
- 4.1.3 Analysis of winds aloft along prospective routes.
- 4.1.4 Analysis of existing forecast weather conditions at destination and possible alternates-selection (FAR **121**).
- 4.1.5 Selection of routes to destination and alternates.
- 4.1.6 Preferred airways routings.
- 4.1.7 Extraction of tracks and distances from JEPPESEN AIRWAY MANUAL charts.
- 4.1.8 Frequencies and identifiers of enroute radio navigation aids.
- 4.1.9 Minimum enroute altitudes, minimum crossing and reception altitudes (MEA ; MCA ; MRA ; MOCA ; MORA)
- 4.1.10 Standard instrument departure routes (SIDs); and standard instrument arrival routes (STARS).
- 4.1.11 General flight planning tasks: Checking of AIP and NOTAMs, for latest airfield and enroute **status information** of: routes; nav. aids; airports; special procedures (i.e. CYPRUS//TURKEY; YUGOSLAVIA//ALBANIA, etc...); radio frequencies: (ATC, ATS, BROADCASTS); interception

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

- procedures; two-way radio failure procedures etc...
- 4.1.12 Selection of altitudes/flight levels for each leg of the flight.
 - 4.1.13 Application of wind velocity on each leg of the flight to obtain headings and ground speeds.
 - 4.1.14 Calculation of the enroute times for each leg to the destination and to the alternate/s; determination of the total time enroute.
 - 4.1.15 Completion of the fuel plan, including appropriate reserves.
 - 4.1.16 Preliminary study of the instrument approach procedures, at the destination and the possible alternates.
 - 4.1.17 Filing correctly the ICAO ATC flight plan form.

4.2.3 ET AEROPLANES FLIGHT PLANNING (additional considerations).

FLIGHT DISPATCH.

- 4.2.1 **Additional flight planning aspects for jet aeroplane**-(advanced flight planning)-fuel planning: enroute contingency fuel, destination, holding and diversion fuel; island reserves; importance of altitude selection when planning for diversion to alternate; use of performance charts to plan fuel usage and, requirements based on planned climb, enroute cruise and descent; reserve fuel requirements; influence of CG on fuel consumption; landing distance at alternate and at destination, dry runway and wet runway; landing weight-destination; weather and notams-destination and alternate; IFR approaches and approach aids-destination and a Item ate ; a Item ate minimums.
- 4.2.2 **Computation of:** point of equal time (PET); point of no return (PNR); and point of safe return (PSR).
- 4.2.3 **Computerized flight planning**-general principles of present systems; advantages; shortcomings and limitations.

5. BASIC AVIATION PHYSIOLOGY AND HEALTH MAINTENANCE.

5.1. BASICS OF FLIGHT PHYSIOLOGY.

- 5.1.1 **Basics**-the atmosphere; composition; gas laws; oxygen requirements of tissues.
- 5.1.2 **Respiratory and circulatory systems**-functional anatomy; low pressure environment; pressurization; decompression; rapid decompression; entrapped gases; barotrauma countermeasures; hypoxia symptoms; time of useful consciousness; hyperventilation; accelerations.
- 5.1.3 **High altitude environment**-ozone; radiation; humidity.
- 5.1.4 **Man and environment**- the sensory system-central and peripheral nervous system; sensory threshold; sensitivity; adaptation; habituation; reflexes and biological control systems.
- 5.1.5 **Vision**-functionary anatomy; visual field: foveal and peripheral vision; night vision.
- 5.1.6 **Hearing**-functional anatomy; flight related hazards to hearing; equilibrium: functional anatomy; motion; acceleration; verticality; motion sickness.
- 5.1.7 **Vertigo**-spatial disorientation; illusions; physical origin; physiological origin psychological origin; approach and landing problems.

AP 1.3.006B		PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

5.2. HEALTH AND HYGIENE.

- 5.2.1 **Personal hygiene**-common minor ailments: cold; influenza; gastro-intestinal upset.
- 5.2.2 **Problem areas for pilots**-hearing loss; defective vision; hypo- tension ; hypertension; coronary disease; obesity; nutrition hygiene; tropical climates; epidemic diseases.
- 5.2.3 **Intoxication**- tobacco; alcohol; drugs and self-medication; various toxic materials.
- 5.2.4 **Incapacitation**-symptoms and causes; recognition; operating coping procedures.

6. METEOROLOGY.

6.1. THE ATMOSPHERE.

- 6.1.1 Composition; extent; vertical division; temperature: vertical distribution of temperature; temperature scales: Celsius; Fahrenheit; Kelvin (absolute); interrelationship of °C; °F; °K; common formulae for temperature T, pressure p and density ρ of dry air, lapse rate with altitude, up to the stratosphere 1 , upper limit of 32 Km, (according to the ISA 1993 extended to 80 Km)
- 6.1.2 **Transfer of heat**-solar and terrestrial radiation; conduction; convection; advection and turbulence.
- 6.1.3 **Lapse rate** stability; instability; conditional instability; dry adiabatic lapse rate ; saturated adiabatic lapse rate; environmental lapse rate; standard lapse rate; development of inversion; types of inversions.
- 6.1.4 **Temperature near the earth's surface**; surface effects; diurnal variation; effect of clouds; effect of wind.
- 6.1.5 **Atmospheric pressure**-barometric pressure, meter; Newton; Pascal; Bar; Millibar; Hectopascal; specific gravity of Mercury; measurement of atmospheric pressure; isobars; variation with altitude; variation with temperature; variation with density.
- 6.1.6 **Surface** low; upper-air low; surface high; upper-air high.
- 6.1.7 **Air density**-dry air; mixed air with water vapor; variation of air density with pressure; with temperature.
- 6.1.8 **Interrelation**-between temperature, pressure, and density; pressure ratio; temperature ratio; density ratio (σ) sigma.
- 6.1.9 **ISA-International standard atmosphere-1993**- Altimetry: temperature; pressure; density; universal gas constant; air constant; acceleration due to gravity; formulae for temperature lapse rate, pressure lapse rate; density lapse rate; pressure altitude; density altitude.
- 6.1.10 **Height; altitude; flight level**-definitions; calculation of PA (pressure altitude)from QNH and ambient temperature; calculation of density altitude from PA and temp.; rules of thumb; definitions of QNH; QFE; QNE.
- 6.1.11 **Calculation**-of terrain clearance; lowest usable flight level; rules of thumb for temperature and pressure influence; flight from high pressure to low pressure, and vice versa; flight from high temperature to low temperature and vice versa.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

6.2. WIND.

- 6.2.1 **Definition and measurement**-wind: true, magnetic, grid; application;
- 6.2.2 **Primary cause of wind**-pressure gradient; Coriolis; gradient wind.
- 6.2.3 **Types of wind**-geostrophic wind; Cyclostrophic wind; gradient wind; thermal wind; all appropriate formulae.
- 6.2.4 **Relationship**-between isobars and wind; effects of divergence/convergence; northern hemisphere; southern hemisphere.
- 6.2.5 **General circulation around the globe**-tropical lows; sub tropical highs; sub polar lows; polar highs; circulation by Hadley; trade winds; westerlies; easterlies; intertropical convergence zone. Global semi-permanent pressure systems; description; origin; seasonal movement; cyclogenetic pressure systems.
- 6.2.6 **Turbulence**-and gustiness; types of turbulence; origin and location of turbulence.
- 6.2.7 **Variation of wind**-with height; veering; backing; the friction layer.
- 6.2.8 **Local winds**-Bora-bora; sirocco; mistral; sea breeze; land breeze; anabatic wind; katabatic wind; foehn wind; venturi effect.
- 6.2.9 **Jet stream**-location; origin; thermal wind; description and definition.
- 6.2.10 **Names; height and seasonal occurrence**-of jet streams; jet stream recognition.
- 6.2.11 **CAT**-cause; location and forecasting; standing waves; origin of standing waves.

6.3. THERMODYNAMICS.

- 6.3.1 **Humidity**-water vapor in the atmosphere; temperature/dew point; mixing ratio formulae for the density of dry air and density of a mixture of dry air and water vapor Universal gas constant; dry air gas constant; gravity in the ISA (Lambert's formula); derivation of all formulae relating to pressure (hPa); density (grams/m³); temperature lapses for the 3 lower layers (troposphere, tropopause; and stratosphere 1 Km up to 32 Km)
- 6.3.2 **Change of state of aggregation**-condensation; evaporation; sublimation; freezing and melting; specific heat; latent heat; formation of water droplets; water condensation nuclei; ice nuclei; supercooled water droplets.

6.4. CLOUDS AND FOG.

- 6.4.1 Cloud formation and description.
- 6.4.2 Cooling by adiabatic process; formation of base of clouds: relationship between temp, and dew point; relationship between DALR; SALR; EALR and DP; release of latent heat; altitude of free convection.
- 6.4.3 Cloud types; cloud classification
- 6.4.4 Influence of inversions on cloud development.
- 6.4.5 Flying condition in each cloud type.
- 6.4.6 Fog; mist; haze: definition and description.
- 6.4.7 Types of fog: radiation fog; advection fog; steam fog; frontal fog; orographic fog.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

6.5. PRECIPITATIONS.

- 6.5.1 Development of precipitation.
- 6.5.2 Types of precipitations.
- 6.5.3 Types of precipitation-relationship with cloud types.

6.6. AIRMASSES AND FRONTS.

- 6.6.1 Types of airmasses.
- 6.6.2 Description; factors affecting the properties of airmasses.
- 6.6.3 Classification of airmasses; modification of airmasses; areas of origin.
- 6.6.4 **Fronts**- boundaries between airmasses; frontogenesis; general wind circulation: Northern and Southern hemispheres; geographic differentiation.
- 6.6.5 Warm front; associated clouds and weather,
- 6.6.6 Cold front; associated clouds and weather.
- 6.6.7 Weather behind the cold front.
- 6.6.8 Occlusions: types; associated clouds and weather.
- 6.6.9 Stationary fronts; associated clouds and weather.
- 6.6.10 Severe line squall; associated weather and clouds.
- 6.6.11 Movement of fronts and pressure systems; life cycle.

6.7. PRESSURE SYSTEMS.

- 6.7.1 Location of the principal pressure systems on the globe.
- 6.7.2 Formation of the principal pressure systems due to global circulation; semi-permanent pressure systems.
- 6.7.3 **Anticyclone**-types; general properties; cold and warm anticyclones; ridges and wedges; subsidence.
- 6.7.4 Non frontal depressions.
- 6.7.5 Thermal; orographic and secondary depressions; cold air pools; troughs.
- 6.7.6 Tropical revolving storms.
- 6.7.7 Development of the tropical revolving storm.
- 6.7.8 Origin and local names; location and period of occurrence.

6.8. CLIMATOLOGY.

- 6.8.1 Climatic zones on the globe.
- 6.8.2 General seasonal circulation in the troposphere and the lower stratosphere.
- 6.8.3 Tropical rain climate; dry climate; mid latitudes climate; sub-arctical climate with cold winter; snow climate.
- 6.8.4 Tropical climatology.
- 6.8.5 Cause and development of tropical showers; humidity; temperature; tropopause.
- 6.8.6 Seasonal variation of weather and wind, typical synoptic situations.
- 6.8.7 Intertropical convergence zone (ITCZ); weather in the ITCZ; general seasonal movement.
- 6.8.8 Climatic elements relative to the area (monsoon, tradewinds; sandstorms; cold air outbreaks.
- 6.8.9 Easterly waves-typical weather situation in the mid latitudes.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

- 6.8.10 High pressure area.
- 6.8.11 Uniform pressure pattern.
- 6.8.12 Local seasonal weather and winds: foehn; mistral; bora-bora; sirocco; harmattan; ghibli ; pampero.
- 6.8.13 Aviation climatology-effects of local seasonal weather on aviation; trunk weather for the Mediterranean; Atlantic African; and Far East from ISRAEL.

6.9 **FLIGHT HAZARDS.**

- 6.9.1 Icing.
- 6.9.2 Weather conditions of ice accretion, topographic effect.
- 6.9.3 Types of ice accretion.
- 6.9.4 Hazards of ice accretion; avoidance.
- 6.9.5 Turbulence-effects on flight; avoidance.
- 6.9.6 CAT; effects on flight.
- 6.9.7 Windshear: weather condition for vertical windshear; effects on flight; horizontal windshear-cold front, effects on flight; microburst-effects on flight.

6.10. **THUNDERSTORMS.**

- 6.10.1 Structure of thunderstorms; squall lines; life cycle; storm cells; electricity in the atmosphere; static charges of the lightning strike: leader/follower.
- 6.10.2 Conditions for TS and process of development; forecast; location; type; specification.
- 6.10.3 Thunderstorms avoidance; ground/airborne radar; stormscope.
- 6.10.4 Development and effect of microbursts.
- 6.10.5 Development of lightning discharges and effect of lightning strike on aircraft and flight execution.
- 6.10.6 Tornadoes-occurrence; low and high level inversions; influence on aircraft performance ; tropical revolving storm.
- 6.10.7 Stratospheric conditions: tropopause influence on aircraft performance; effect of ozone; radioactivity.
- 6.10.8 Hazards in mountainous areas; influence of terrain on clouds and precipitation; frontal passage.
- 6.10.9 Vertical movements; mountain wave; windshear; turbulence; ice accretion.
- 6.10.10 Development and effect of valley inversions.
- 6.10.11 Visibility reducing phenomena: reduction of visibility caused by mist, smoke, dust, sand; volcanic ashes; precipitation.
- 6.10.12 Reduction of visibility caused by low drifting snow; and by blowing snow.

6.11. **METEOROLOGICAL INFORMATION.**

- 6.11.1 Observations Annex 3 of ICAO; transfer of meteorological information from MET. offices to WAFs and RAFCs and worldwide dissemination.
- 6.11.2 On the ground observations: surface wind; visibility; runway visual range; transmissometers. Clouds: type amount; height of base and tops, movement. Weather: including all types of precipitation; air temperature; relative humidity; dew point; atmospheric pressure.
- 6.11.3 Upper air observations: satellite observation-interpretation; weather radar observations ground and airborne, interpretation Aircraft observations and

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

- reporting: data link system; PIREPS.
- 6.11.4 Weather charts: charts of significant weather; tropopause; winds; tropopause maximum winds; WINTEN code.
 - 6.11.5 Surface charts; upper air charts; symbols and signs on analyzed and prognostic charts.
 - 6.11.6 Information for flight planning; aeronautical codes: METAR; TAF; SPECI; SIGMET; SNOWTAM; RUNWAY REPORT.
 - 6.11.7 Meteorological broadcasts for aviation: VOLMET; ATIS; HF-VOLMET; ACARS.
 - 6.11.8 Contents and use of preflight meteorological documents.
 - 6.11.9 Meteorological briefing and advice.
 - 6.11.10 Measuring and warning systems for low level windshear; inversion.
 - 6.11.11 Special meteorological warnings.
 - 6.11.12 Information for computer flight planning.

7. NAVIGATION.

7.1 GENERAL NAVIGATION

7.1.1. BASICS OF NAVIGATION.

- 7.1.1.1 **The solar system**-the sun; the planets; the revolution of the planets; the Earth; the moon; the earth's orbit; seasonal and apparent movement of the sun; the first point of Aries; the equinoxes; the solstices.
- 7.1.1.2 **The Earth**: great circle; small circle; Rhumbline; convergence; conversion angle; latitude; longitude; diff. of latitude; diff. of longitude; use of long, and lat. coordinates to locate any specific position.
- 7.1.1.3 **Time**-the solar day; the sidereal day; relationship between the two; the tropical year; the anomalistic year; the sidereal year; the civil year; the Gregorian correction; apparent time; UTC; LMT; standard time; zone time; dateline; determination of sunrise and sunset and civil twilight.
- 7.1.1.4 **Directions**: terrestrial magnetism; declination; inclination; position of the earth magnetic poles; polarity of the earth magnetic poles; max mag. variation; isogonals; isoclinals; aclinic line; compass deviation; relationship between true, magnetic, compass, grid and relative directions; gridlines; isogrives.
- 7.1.1.5 **Distances**: units of distances and length both in SI units, and in British units-used in navigation: the nautical mile; the statute mile; the kilometer; meter; yard; foot; inch and conversion from one to another; relationship between the nautical mile and latitude.

7.2. MAGNETISM AND COMPASSES.

- 7.2.1 **General principles**-terrestrial magnetism; resolution of the earth magnetic force into vertical and horizontal components; the flux on earth and through the magnetic poles; the effect of change of latitude on these components; directive force; magnetic dip variation-northern and southern hemispheres; magnetic variation on earth; locations of 180° magnetic variation.
- 7.2.2 **Aircraft magnetism**-hard iron and vertical soft iron; the resulting magnetic fields; the variation in magnetic force; change of deviation with change of latitude, and with change of the aircraft heading; turning and acceleration

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

- errors; keeping magnetic materials clear of the compass.
- 7.2.3 **Knowledge of the principles of:** stand-by compass; the remote reading compass; detailed knowledge of the use of these compasses; serviceability tests; adjustments and compensation of direct reading magnetic compass; repeaters of magnetic remote compass; RMI; HSI.

7.3. CHARTS.

- 7.3.1 **General properties of miscellaneous types of projection** Mercator; Lambert conformal conic; Polar stereographic; transverse Mercator; oblique Mercator.
- 7.3.2 **The representation of:** meridians; parallels; great circles and Rhumbline on: Mercator, Lambert Conformal and Polar stereographic charts.
- 7.3.3 **The use of current aeronautical charts-**plotting positions; methods of indicating scales and relief; conventional signs; measuring tracks and distances; plotting bearings.
- 7.3.4 **Scales:** Natural scale; map's scale; the reduced earth; calculations by formulae of: change of scale on Mercator; and Polar stereographic, with change of latitude: length of a straight line on same projections; constant of the cone on Lambert conformal.

7.4. DEAD RECKONING NAVIGATION (PR).

- 7.4.1 **Basics of dead reckoning-**track; heading (compass, magnetic, true grid); wind velocity; airspeeds (IAS, CAS, TAS, MACH NUMBER); ground speed; drift; wind correction angle; ETA; DR position; air position; fix.
- 7.4.2 **Use of the navigational computer-** speed; time; distance; fuel consumption; conversions; headings; airspeed; wind velocity; Mach number
- 7.4.3 **The triangle of velocities-**heading; ground speed; wind velocity; track and drift angle; time and distance problems.
- 7.4.4 **Interception-**aircraft on perpendicular tracks; and on acute angle tracks, using the proportion and/or sine or cosine formulae.
- 7.4.5 **Determination of DR position – (PLOT)** on North Atlantic grid maps; confirmation of flight progress by heading TAS and forecast and actual wind vectors; plotting lines of position using different nav. aids; transfer of LOPs plotting a fix.
- 7.4.6 **Measurements of DR elements –** calculation of TAS ground speed, heading, track, given FL temperature and Mach number plotting on map PNR DR; PET DR; PET DR two alternates on engine out last time to turn to destination maintaining a constant heading.
- 7.4.7 **Filling of navigation flight log;** recording of all tracks; positions (DR, or FIXES); EETs; ETAs; distances; speed heading; altitudes/flight levels; temperatures; Mach number; points of departure; points of destination; upper winds etc... all lines of position (LOPs) of nav. aids used to derive above positions.

7.5. INERTIAL NAVIGATION SYSTEM (INS).

- 7.5.1 **Principles and practical application-**gyroscopic principles; platform

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

- mounting; accelerometers principles; integrator principles; Shuler-tuned platform; navigation computer.
- 7.5.2 **Alignment procedures**-gyrocompassing; leveling; accuracy; reliability; errors and coverage.
- 7.5.3 **Flight deck equipment and operation**-mode selector unit (MSU); control display unit (CDU); horizontal situation indicator, (HSI).
- 7.5.4 **INS operation**-normal flight position and waypoint entries; flight plan changes; bypassing waypoint; change of waypoints data; system check and updating. Conversions; headings; airspeeds; wind velocity; Mach number.

7.6. RADIO NAVIGATION.

- 7.6.1 Ground DF (including classification of bearings)- principles; presentation and interpretation ; radio spectrum; range; errors and accuracy; factors affecting range and accuracy.
- 7.6.2 ADF - (including associated beacons and use of the RMI)-principles: loop, sense; cardioid , zero null; presentation and interpretation; radio spectrum; range; errors and accuracy ; factors affecting range and accuracy; ADF's needle and RMI card relationship.
- 7.6.3 VOR (including use of the RMI)-principles; presentation and interpretation on the RMI.HSI and FDI; radio spectrum; range; errors and accuracy; buffer; factors affecting range and accuracy (i.e. cross radials buffer).
- 7.6.4 DME-principles, including saturation; presentation and interpretation; radio spectrum; range; errors and accuracy; factors affecting range and accuracy.
- 7.6.5 ILS-principles; presentation and interpretation on HSI; FDI; and raw data; radio spectrum; range; errors and accuracy; factors affecting range and accuracy.
- 7.6.6 MLS-principles; presentation and interpretation; radio spectrum range; errors and accuracy; factors affecting range and accuracy.
- 7.6.7 RNAV-principles; presentation and interpretation; radio spectrum; range; errors and accuracy; factors affecting range and accuracy.
- 7.6.8 DOPPLER-principles; presentation and interpretation; radio spectrum; range; errors and accuracy; factors affecting range and accuracy.

7.7 BASIC RADAR PRINCIPLES.

- 7.7.1 Pulse-techniques and associated terms.
- 7.7.2 Ground radar-principles; presentation and interpretation; radio spectrum; range: maximum and minimum; errors and accuracy; factors affecting range and accuracy.
- 7.7.3 Airborne weather radar-principles; presentation and interpretation; radio spectrum; range; errors and accuracy; factors affecting errors and accuracy; application for navigation.
- 7.7.4 SSR (secondary surveillance radar and transponder)-principles; presentation and interpretation; modes and codes including mode C.

7.8. AREA NAVIGATION SYSTEMS.

- 7.8.1 General philosophy-use of radio navigation systems including INS and IRS.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

- 7.8.2 Typical flight deck equipment and operation-means of entering and selecting waypoints and desired tracks information (keyboard entry system); means of selecting, tuning and identifying ground stations; instrumentation for enroute course/track guidance; extracting information from systems related to: distance travelled, distance to go, ground speed; inertia; drift; wind etc. Extraction of positions; ground and airborne.
- 7.8.3 Instrument indications-types of area navigation systems inputs; self contained onboard: INS, IRS, DOPPLER; external systems VOR, DME, OMEGA, GPS, RNAV; Air data inputs: TAS; altitude; magnetic heading.

8. PRINCIPLES OF FLIGHT.

8.1 SUBSONIC AERODYNAMICS.

- 8.1.1 **Basics, laws and definitions**-units used in aviation Ann.5 of ICAO; laws of Newton; ideal gas equation; the ISA and associated pressure, temperature and density ratios(δ ; Θ ; σ); the Venturi tube; the Bernoulli theorem for incompressible flow; static pressure; dynamic pressure; kinematic viscosity; density; IAS; CAS; EAS; TAS.
- 8.1.2 **Basics about airflow**-stationary airflow; not stationary airflow; streamline; two dimensional airflow; three dimensional airflow.
- 8.1.3 **Aerodynamic forces on surfaces**-resulting airforce; lift; drag; angle of attack; upwash; downwash; lift circulation around the wing: chordwise and spanwise (Prantdl and Lanchester); angle of attack (α); forces and equilibrium of forces during climb, level, descent and turns.
- 8.1.4 **Shape of an aerofoil**-thickness to chord ratio; chordline; camberline; leading edge radius; leading edge; trailing edge; maximum camber; maximum thickness ; effects of camber and thickness on lift pressure (NACA specifications); angle of incidence; geometric and aerodynamic twisting (wash-out).
- 8.1.5 **The wing shape**-span; mean chord; aspect ratio; root chord; tipchord; MAC and calculation for non-rectangular wings (i.e.(tapered)); angle of attack; different wing shapes.
- 8.1.6 **The two-dimensional airflow about an aerofoil**-streamline pattern; stagnation points; pressure distribution; centre of pressure; lift and downwash/upwash; drag and wake (loss of impulse); influence of angle of attack; flow separation at high angles of attack; the lift vs. graph; the lift coefficient; the lift formula; C_l vs. angle of attack; C_l max: max.; calculation of C_l max (given weight, dynamic pressure and stall speed); normal values of C_l and C_l max.; aerodynamic center; aerodynamic center position in an airfoil in a subsonic incompressible flow.
- 8.1.7 **Drag**-the drag formula; drag coefficient; zero lift drag; lift induced drag; the C_d vs. a graph; normal values of the C_d . the C_l vs. C_d graph; aerodynamic efficiency (C_l / C_d max.).
- 8.1.8 **The three dimensional airflow about an aeroplane**-streamline pattern; spanwise flow and causes; tip vortices and local ; tip vortices and total angle of attack; upwash and downwash effects on tip vortices; spanwise lift distribution; wake turbulence behind an aircraft (causes; pattern; maximum; rate of subsidence; dissipation; duration of phenomenon.
- 8.1.9 **Induced drag**-influence of tip vortices on effective angle of attack; the induced local angle of attack (i); influence of the induced angle of attack on the lift vector; induced drag and angle of attack; induced drag and speed;

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

induced drag and wing aspect ratio; induced drag and wing planform; induced drag coefficient (C_{di}); induced drag coefficient and angle of attack; induced drag graph and formula; influence of plan section; winglets; upper camber fences flow restrictors; tip tanks; wing span loading; influence of aerodynamic and geometric twist.

- 8.1.10 **The parasite drag**-profile drag ; interference drag; friction drag; boundary layer drag effect; streamline pattern; flow separation; the profile drag and speed; the parasite drag vs. the induced drag and speed.
- 8.1.11 **The total drag**-and speed; minimum drag speed; the ground effect; effect on C_L ; , effect on C_d ; effect on total drag; effect on range; effect on best glide angle and best glide ratio; effect on take-off and landing performances.
- 8.1.12 **The relationship between:** lift coefficient and speed for constant lift: as a formula; as a graph.
- 8.1.13 **The stall**-flow separation at increasing angle of attack; the boundary layer: laminar layer. Turbulent layer; transition, separation point; influence on angle of attack; influence on: pressure distribution, location of centre of pressure; pitch moments; aerodynamic centre; downwash at horizontal stabilizer; buffet; inefficiency of controls.
- 8.1.14 **The stall speed**-in the lift formula; 1g stall speed; FAR stall speed; influence on: the centre of gravity; power setting; altitude(IAS); wing loading (W/S); Load factor: definition; stall during turns; forces.
- 8.1.15 **The initial stall in spanwise direction**-influence of plan form; use of ailerons; influence of fences; vortilons; and vortex generators.
- 8.1.16 **Stall warning**-importance of stall warning; speed margin; buffet; flapper switch; AOA vane; AOA probe; stick-shaker; recovery from stall.
- 8.1.17 **Special phenomena of stall**-the power-on stall; climbing and descending turns; swept-back wings; canards; T-tail aircrafts; **avoidance of spins:** spin development. Spin recognition; spin recovery; ice (in stagnation point and on surface): chordwise ice accretion, spanwise ice accretion-effects on stall speed; absence of stall warning; abnormal behavior of the stall; stabilizer stall; super stall.
- 8.1.18 C_L **augmentation**-trailing edge flaps and the reasons for use in take-off and landing; different types of flaps: plain flap, split flap, slotted flap; Fowler flap; their influence on the C_L vs. graph; their influence on the C_d vs. graph; flap's asymmetry; influence on pitch moments, and resultant pitch movements (extension and retraction); influence on stall speed; influence on wing tip vortices; effect on angle of attack vs. plain wing.
- 8.1.19 **Leading edge devices**-and the reason for use in take-off and landing; different types: Krueger flaps; variable camber flaps; slats; slots; their influence on the C_L vs. graph; their influence on the C_d vs. graph; leading edge flaps/slats asymmetry; normal and automatic operation.
- 8.1.20 **Vortex generators**-aerodynamic principles; advantages; disadvantages.
- 8.1.21 **Means to decrease the spanwise flow**-spoilers and the reasons for use in the different phases of flight; different functions' spoilers: flight spoilers(speedbrakes), ground spoilers (lift dumpers), roll spoilers; spoiler mixer; their influence on the C_L/C_d ratio; influence on the 3 dimensional airflow; influence on the C_L vs. graph.
- 8.1.22 **Speed brakes**-as a means of increasing drag and the reasons for use in the different phases of flight; the boundary layer: different types: laminar, turbulent; advantage!5 and disadvantages
- 8.1.23 **Special circumstances**-ice and other contamination : ice on stagnation points, ice on the surface (frost, snow, clear-ice) effects on stall; effect on loss on controllability; effect on control surfaces moment and movement;

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

influence on high lift devices during take-off and landing and low speeds;
effect on lift/drag ratio; deformation and ageing of airframe aged aircraft.

8 2 TRANSONIC AERODYNAMICS.

- 8.2.1 **The Mach number definition**-the Mach number formula; speed of sound: influence of temperature and altitude; compressibility; normal shockwaves; critical Mach number; exceeding critical Mach number; Mach number/excess on: control deflection-reversal effect; angle of attack; aerodynamic centre; aerofoil thickness; angle of sweep; centre of pressure; tuck under.
- 8.2.2 **Mach critical**-aerodynamic heating; shock stall/Mach buffet; influence on: drag; pitch (Mach trim); contribution of the: angle of sweep, movement of the centre of pressure; downwash; buffet margin; aerodynamic ceiling.
- 8.2.3 **Means to avoid the effects of critical Mach**-vortex generators; super critical profiles: profiles: shape, influence of aerofoil shape on shockwaves; advantages and disadvantages of super critical aerofoil.

8 3 SUPERSONIC AERODYNAMICS.

- 8.3.1 **Oblique Shockwaves; Mach cone**; influence on aircraft's weight; expansion waves; centre of pressure; wave drag: control surface hinge moment; control surface efficiency.

8.4. STABILITY.

- 8.4.1 **Condition of equilibrium in stable horizontal flight**-precondition for static stability; sum of moments: lift and weight. Drag and thrust; sum of forces: in horizontal plane, in vertical plane; methods of achieving balance; wing and empennage (tail and canard); control surfaces; ballast or weight trim.
- 8.4.2 **Longitudinal stability**-basics and definition; static stability: positive, neutral, negative; precondition for dynamic stability; dynamic stability: positive, neutral negative; damping: phugoid, short period; effect of high altitude on dynamic stability.
- 8.4.3 **Static stability**-neutral point; location of neutral point; definition; contribution of: aircraft geometry; down-wash; aerodynamic centre of the wing; location of the CG: aft limit, forward limit, minimum stability margin, effect on static and dynamic stability.
- 8.4.4 **The coefficient of moment vs. graph**-contribution of: the location of the CG; control deflection; major aircraft parts (wings fuselage, tail); configuration: flap deflection, gear extension.
- 8.4.5 **The elevator position vs. speed graph (IAS)**-contribution of: location of CG; trim (trim tab); trim (stabilizer trim).
- 8.4.6 **The stick force vs. speed graph**-contribution of: location of CG; trim (trim tab); trim (stabilizer trim); Mach number/Mach trim; friction in the system; downspring; bob weight.
- 8.4.7 **Stick force per g**-and the limit load factor; category of certification; special circumstances: ice-effect on flap extension, effect of stabilizer ice; rain; deformation of the airframe.

AP 1.3.006B	 רשות התעופה האזרחית Civil Aviation Authority	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

- 8.4.8 **Directional stability**-slip angle ; Yaw moment coefficient; C_y vs. graph: contribution of-location of CG, angle of sweep of the wing, fuselage at high angles of attack, strakes; dorsal fin and angle of sweep of fin, major aircraft parts.
- 8.4.9 **Static lateral stability**-bank angle ; the coefficient of roll; contribution of angle of slip the C_r vs. graph: contribution of-angle of sweep of wing; ventral fin; location of the wing dihedral/unhedral; effective lateral stability; dynamic lateral stability; effects of asymmetric propeller slipstream; tendency to spiral dive; Dutch-roll: causes; Mach; yaw damper; effect of altitude on dynamic stability.

8.5.1. CONTROL.

- 8.5.1.1 **General**-basics: the three planes and three axis, camber change; angle of attack change; pitch control; elevator; down-wash effects ice on tail; location of CG.
- 8.5.1.2 **Yaw control**-pedal/rudder ratio change; moments due to engine thrust direct, indirect; one engine-out rudder limitations at asymmetric thrust. Meaning of V_{mca} and V_{mcg} .
- 8.5.1.3 **Roll control**-ailerons: inboard ailerons, outboard ailerons. Function in different phases of flight; spoilers: adverse yaw means to avoid adverse yaw: frises ailerons; differential aileron deflection, coupling ailerons to rudder by spring, roll spoilers, effect of asymmetric propeller slipstream.
- 8.5.1.4 **Interaction**-in different planes; limitations of asymmetric power.
- 8.5.1.5 **Means to reduce control forces-Aerodynamic** balance: nose balance, horn-balances, internal balances, balance tab. Anti-balance tab, servo tab, spring tab; **Artificial** balance: power assisted controls, fully powered controls, artificial feel: inputs, dynamic pressure q , stabilizer setting.
- 8.5.1.6 **Mass balance**-reasons to balance, means; trimming: reasons to trim. Trim tabs, stabilizer trim/trim rate vs. IAS; position of CG influence on trim/stabilizer setting for take-off.

8 5.2. LIMITATIONS.

- 8.5.2.1 **Operating limitations**: flutter; aileron reversal; gear/flaps operation; V_{mo} ; V_{no} ; V_{ne} ; M_{mo} ; maneuvering envelope; maneuvering load diagram: load factor, accelerated stall speed; V_s ; V_c ; V_d ; maneuvering load factor/certification category contribution of: mass, altitude, Mach number.
- 8.5.2.2 **Gust envelope**-gust load diagram: vertical gust speeds; accelerated stall speed; V_s ; V_c ; V_d ; gust limit load factor; V_{ra} , contribution of: mass, altitude, Mach number.

8.6. FLIGHT MECHANICS.

- 8.6.1 **Forces acting on an airplane**-straight horizontal steady flight; straight steady climb; straight steady glide; steady coordinated turn: bank angle, load factor. Turn radius, angular velocity, rate-one-turn.
- 8.6.2 **Asymmetric thrust**-forces and moments about the vertical axis; forces on vertical fin; influence of bank angle: overbanking, fin stall; influence of aircraft weight; influence of using ailerons; influence of special propeller effects on

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

roll moments: propeller torque, propeller wash on flaps, influence of P factor; parallelogram of forces: in V_{mca} (5° degrees bank), at 0° slip angle ($\beta = 0^\circ$); at zero rudder deflection; V_{mca} ; V_{mcl} ; V_{mcg} ; influence of altitude; emergency descent; influence of configuration; influence on best rate and best angle of climb.

9. HUMAN PERFORMANCE

9.1 HUMAN FACTORS BASIC CONCEPTS

9.1.1 **Human Factors in aviation**

- State that Human Factors training is an ICAO and CAA requirement.
- Justify the relevance of Human Factors in aviation.

9.1.2 **Competence and limitations**

- Define the roles played by various participants in aviation activities with respect to flight safety and the limitations of individuals and organizations in the improvement to flight safety.

9.1.3 **Becoming a competent pilot**

- Describe the general classification of the factors to be considered in assessing the competency of any individual pilot.
- Outline the factors in training that will ensure the future competency of the individual pilot, e.g. the relationship between self-confidence and expertise.

9.1.4 **Accident statistics**

- Give an estimate of the accident rate in commercial aviation in comparison to other means of transport.
- State in general terms the percentage of aircraft accidents which are caused by human factors and commonly described as 'pilot error.'
- Name the major single cause for a pilot induced accident.
- Summarize the accident trend in modern aviation.
- Identify the role of accident statistics in developing a strategy for future improvements to flight safety.
- Name the most significant item of technical equipment introduced in the 1980s and 1990s which has contributed to the reduction of accidents.

9.1.5 **Flight safety concepts**

- Analyze the flight accident statistics and point out the proportion of human error. Discuss its implication for flight safety concepts.
- Indicate the importance of error detection and list various methods of detection.
- Explain the importance for flight safety of understanding the causes and categories of accidents and incidents.
- Describe and compare the elements of the SHELL model.
- Summarize the relevance of the SHELL model to work in the cockpit.
- Analyze the interaction between the various components of the SHELL model.
- Explain how the interaction between individual crew members can affect flight safety.
- Identify and explain the interaction between flight crew and management as a factor in flight safety.

AP 1.3.006B		PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

9.2 **BASIC AVIATION PHYSIOLOGY AND HEALTH MAINTENANCE**

9.2.1 **Basics of flight physiology**

-List those factors which may affect the normal working of the human body when in flight.

9.2.2 **The atmosphere**

-State the units used in measuring total and partial pressures of the gases in the atmosphere.

-State in terms of % and mm Hg the values of Oxygen, Nitrogen and other gases present in the atmosphere.

-State that the volume percentage of the gases in ambient air will remain constant for all altitudes at which conventional aircraft operate.

-State the physiological significance of the following Laws and be able to carry out calculations using those laws:

-Boyle's Law

-Dalton's Law

-Henry's Laws

-The General Gas Law

-State the ICAO standard temperature at Mean Sea Level and the Standard Temperature Lapse Rate.

-State at what altitudes in the standard atmosphere the atmospheric pressure will be 1/4, 1/3 and 1/2 of MSL pressure.

-State the effects of increasing altitude on the overall pressure and partial pressures of the various gases in the atmosphere.

-Explain the differences in gas expansion between alveolar and ambient air when climbing.

-State the condition required for human beings to be able to survive at any given altitude.

-With regard to respiration, identify the most important gases of the atmosphere.

9.2.3 **Respiratory and circulatory systems**

-List the main components of the respiratory system and their function.

-Identify the different volumes of air in the lungs which are important for determining pulmonary function.

-State the values for the normal rate of breathing and the volume of air exchanged with each normal breath ('tidal volume.')

-State how oxygen and carbon dioxide are transported throughout the body.

-Explain the process by which oxygen is transferred to the tissues and carbon dioxide is eliminated from the body.

-Explain the role of carbon dioxide in the control and regulation of respiration.

-Describe the process of inhalation and exhalation ('external respiration') and the metabolism of carbohydrates in the body ('internal respiration.')

-List the factors determining pulse rate.

-Name the major components of the circulatory system and describe their function.

State the values for a normal pulse rate and the average cardiac output (heart rate x stroke volume) of an adult at rest.

-Name the four chambers of the heart and state the function of the individual chambers.

-Differentiate between arteries, veins, and capillaries in their structure and function.

-State the functions of the coronary arteries and veins.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test		Revision 1
Standards		21 AUG 12

- State the function of carotid and aortic sinus pressoreceptors.
- Define 'systolic' and 'diastolic' blood pressure and give standard values for an adult at rest.
- State the normal blood pressure ranges and units of measurement.
- Classify the effects of age on normal blood pressure range.
- List the symptoms of a person in circulatory shock.
- List the composition of the blood and the purpose of the constituent parts.
- Explain the function of the hemoglobin and state the percentage of oxygen saturated in the blood at MSL and at 10,000 ft.
- Indicate the effect of increasing altitude on hemoglobin oxygen saturation.
- Define the following terms associated with failures in the respiratory/circulatory systems and analyze their significance for the conduct of a safe flight:

-Hypoxia

- Define 'hypoxia' and state why living tissues require oxygen.
- State that healthy people are able to compensate for altitudes up to 10 - 12,000 ft.
- Identify at least three conditions causing hypoxia in flight.
- List the signs and symptoms of hypoxia, define their characteristics and determine their role in flight safety.
- Name the three physiological thresholds and allocate the corresponding altitudes for each of them.
- State the altitude at which short term memory begins to be affected by hypoxia.
- Define the terms 'Time of Useful Consciousness' (TUC) and 'Effective Performance Time' (EPT).
- State the TUC for 20,000 ft, 30,000 ft, 35,000 ft and 43,000 ft for a person at rest and for 25,000 ft when the person is moderately active.
- Explain why it is unsafe to fly above 10 - 12,000 ft without using additional oxygen or being in a pressurized cabin.
- List the factors determining the severity of hypoxia.
- State the precautions to be taken when giving blood.
- State the equivalent altitudes when breathing ambient air and 100% oxygen for MSL, 10,000 ft, 35,000 ft, and 38,000 ft.

-Hyperventilation

- Describe the role of carbon dioxide in hyperventilation.
- Describe the effects of hyperventilation on the acid-base balance of the blood, the capacity of the hemoglobin to transport oxygen and the supply of oxygen to the cells.
- Define the term 'hyperventilation.'
- List the factors causing hyperventilation.
- List the signs and symptoms of hyperventilation and define their characteristics.
- Identify symptoms of hyperventilation for given flight conditions.
- Describe the effects of hyperventilation on muscular coordination.
- List measures which may be taken to counteract hyperventilation.

-Decompression Sickness

- State the normal range of cabin pressure altitude in pressurized commercial aircraft and describe their protective function for aircrew and passengers
- Identify the causes of decompression sickness in flight operation.
- State how decompression sickness can be prevented.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

- State the threshold for the onset of decompression sickness in terms of altitude.
- List the symptoms of decompression sickness.
- Indicate how decompression sickness symptoms may be treated.
- List the vital actions the crew has to perform when cabin pressurization is lost.
- Define the hazards of diving and flying and give the regulations associated with these activities.
- Acceleration
 - Define 'linear', 'angular' and 'radial acceleration.'
 - Describe the effects of acceleration on the circulation and blood volume distribution.
 - Describe measures which may be taken to increase tolerance to positive acceleration.
 - List the effects of positive acceleration with respect to type, sequence and the corresponding G-load.
- Anemic hypoxia
 - Define 'anemia.'
 - State how carbon monoxide may be produced.
 - State how the presence of carbon monoxide in the blood affects the distribution of oxygen.
 - List the signs and symptoms of carbon monoxide poisoning.
 - Indicate how carbon monoxide intoxication can be treated.
- 9.2.4 High altitude environment**
 - Ozone
 - State how an increase in altitude may change the proportion of ozone in the atmosphere.
 - List the possible harmful effects of ozone.
 - List the means by which the effects of ozone may be counteracted.
 - Radiation
 - State the sources of radiation at high altitude.
 - List the effects of excessive exposure to radiation.
 - State the effect of sun storms on the amount of radiation at high altitude.
 - List the harmful effects that may result from the extra radiation that may be generated as the result of a sun storm (solar flares.)
 - List methods of reducing the above effects.
 - Humidity
 - Define the terms 'humidity' and 'relative humidity.'
 - List the factors which affect the relative humidity of both the atmosphere and cabin air.
 - State the methods of reducing the effects of excessive or insufficient humidity.
 - List the physiological effects of dry cabin air on the human body and indicate measures to diminish these effects.
 - Extreme Temperatures
 - Explain the change in the need for oxygen of the human body when exposed to extreme environmental temperatures.

9.3 Man and environment: the sensory system

- List the different senses.
- State the multi-sensory nature of human perception.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

9.3.1 Central and peripheral nervous system

- Name the main parts of the central nervous system.
- State the basic functions of the central nervous system.
- State that the main functions of the brain are to process information from sensory input and to generate cognitive processes using retained information from memory.
- State the part that the cerebellum plays in balance and coordination.
- Define the division of the peripheral nerves into sensory and motor nerves.
- State that a nerve impulse is an electro-chemical phenomenon.
- Define the term 'sensory threshold.
- Define the term 'sensitivity', especially in the context of vision.
- Give examples of sensory adaptation.
- Define the term 'habituation' and state its implication for flight safety.
- State the basic functions of the autonomous (vegetative) nervous system.
- Define biological control systems as neuro-hormonal processes that are highly self regulated in the normal environment.
- Define the reaction called 'reflex.'

9.3.2 Vision

- Name the most important parts of the eye and the pathway to the visual cortex.
- State the basic functions of the parts of the eye.
- Define 'accommodation.'
- State the effect of speed on the function of the photosensitive cells.
- Distinguish between the functions of the rod and cone cells.
- Describe the distribution of rod and cone cells in the retina and explain their relevance on perception.
- Explain the terms 'visual acuity', 'visual field', 'central vision', 'peripheral vision', 'fovea' and explain their function in the process of perception.
- List the factors which may degrade visual acuity.
- State the limitations of night vision.
- Explain the adaptation mechanism in vision to cater for reduced levels of illumination.
- State the time necessary for the eye to adapt to the dark.
- State the effect of hypoxia and smoking on night vision.
- Explain the basic principles of color vision and their relevance to flight duties.
- Explain the nature of color blindness.
- Distinguish between monocular and binocular vision.
- Explain the basis of depth perception and its relevance to flight performance.
- List possible monocular cues for depth perception.
- State the problems of vision associated with higher energy blue light and ultra violet rays.

9.3.3 Hearing

- State the audible range of the human ear.
- State the unit of measure for the intensity of sound.
- Name the most important parts of the ear and the associated neural pathway.
- State the basic functions of the different parts of the auditory system.
- Differentiate between the functions of the vestibular apparatus and the cochlea in the inner ear.
- Define the main causes of the following hearing defects:
 - 'Conductive deafness'

AP 1.3.006B		PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

-'Noise Induced Hearing Loss' (NIHL)

-'Presbycusis.'

- Summarize the effects of environmental noise on hearing.
- State the decibel level of received noise that will cause NIHL.
- Indicate the factors, other than noise level, which may lead to NIHL.
- Identify the potential occupational risks which may cause hearing loss.
- State the role of the Eustachian tube in equalizing pressure between the middle ear and the environment Indicate the effects of colds or flu on the ability to equalize pressure in the above.

9.3.4 **Equilibrium**

- List the main elements of the vestibular system.
- State the functions of the vestibular organ on the ground and in flight.
- Distinguish between the component parts of the vestibular system in the detection of linear and angular acceleration as well as on gravity.
- Explain how the semicircular canals are stimulated.
- Describe air-sickness and its accompanying symptoms.
- Indicate the range (Hertz) where vibration can cause undesirable human responses because of the resonance of the skull and the eyeballs.
- List the causes of motion sickness.
- Describe the necessary actions to be taken to counteract the symptoms of motion sickness.

9.3.5 **Integration of sensory inputs**

- State the interaction between vision, equilibrium, proprioception and hearing to obtain spatial orientation in flight.
- Define the term 'illusion.'
- Give examples of visual illusions based on shape constancy, size constancy, aerial perspective, atmospheric perspective, the absence of focal or ambient cues, autokinesis, vectional false horizons and surface planes;
- Relate these illusions to problems that may be experienced in flight and identify the danger attached to them.
- State the conditions which cause the 'black hole' effect and 'empty field myopia.'
- Give examples of approach and landing illusions, state the danger involved and give recommendations to avoid or counteract these problems.
- State the problems associated with flickering lights (strobe-lights, anti-collision lights, etc).
- List the type of external stimuli that the components of the inner ear are able to perceive.
- Give examples of vestibular illusions such as somatogyral, coriolis, somatogravic, and g-effect illusions as well as inversion and 'the leans;'
- Relate the above mentioned vestibular illusions to problems encountered in flight and state the dangers involved.
- Be familiar with oculogyral and oculogravic illusions and the associated risks involved in flight.
- List and describe the function of the proprioceptive senses ('Seat-of-the-Pants-Sense.')
- Relate illusions of the proprioceptive senses to the problems encountered during flight.
- State that the 'Seat-of-the-Pants-Sense' is completely unreliable when visual contact with the ground is lost or when flying in IMC.
- Define 'vertigo', list the corresponding symptoms and identify the flight maneuvers provoking it.
- Differentiate between vertigo, coriolis effect and spatial disorientation.

AP 1.3.006B		PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

- Explain flicker-vertigo and give counter measures.
- Explain how spatial disorientation can result from a mismatch in sensory input and information processing.
- List the measures to prevent and/or overcome spatial disorientation and/or vertigo in flight.

9.4 Health and hygiene

9.4.1 **Personal hygiene**

- Summarize the role of personal hygiene as a factor in human performance.

9.4.2 **Common minor ailments**

- List the negative effects of suffering from colds or flu on flight operations especially with regard to the middle ear, the sinuses, and the teeth.
- Explain the effects of pressure changes to structures in the ear and the implications of these effects.
- State the role of the Eustachian tube in equalizing pressure between the middle ear and the environment.
- Indicate the effects of colds or flu on the ability to equalize pressure between the middle ear and the environment.
- Describe the measures to prevent and/or clear problems due to pressure changes during flight.
- Define 'Barotrauma.'
- Indicate the major sources of gastro-intestinal upsets , state the effects that may result during flight and list the precautions that should be observed to reduce the occurrence of these problems.

9.4.3 **Problem areas for pilots**

-Hearing loss

- List the main cause of hearing loss.
- List the main sources of hearing loss in the flying environment.
- List the precautions that may be taken to reduce the probability of onset of hearing loss.

-Defective vision

- List the major causes of defective vision in:

- Long sightedness (Hypermetropia)
- Short sightedness (Myopia)
- Presbyopia
- Cataracts
- Glaucoma
- Astigmatism.

- State the corrective action necessary to compensate for defective vision.

- Differentiate between the corrective lenses for long/short sightedness.

- List the type of sunglasses which could cause perceptual problems in flight.

- List the measures which may be taken to protect oneself from flashblindness.

- State the possible effects that low relative humidity may have on the efficient functioning of the eye.

-Techniques in visual perception

- Define the term 'scanning technique.'

- Explain, why it is important to visually scan the area by using regularly spaced eye movements each covering an overlapping sector of about 10 degrees.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

- State the rule, at present in force, for the wearing of corrective spectacles or contact lenses when operating as a pilot.
- Describe the requirements of good sunglasses being used in modern 'glass cockpits.'
- State the duration of a saccade (dwelling time) while performing the outside visual scan.
- Explain the difference between the scanning technique used during the day and the appropriate technique to be used when flying at night.
- Describe the significance of the 'blind spot' on the retina in detecting other traffic in flight.
- State the effect that the duration of a saccade has on determining scanning patterns both inside and outside the cockpit.
- Hypo- and Hypertension
 - Define 'hypotension.'
 - List the effects that low blood pressure may have on some normal functions of the human body.
 - Define 'hypertension.'
 - List the effects that high blood pressure will have on some normal functions of the human body.
 - State that hypotension as well as hypertension may disqualify the pilot from obtaining a medical clearance to fly.
 - List the factors which can lead to hypertension in an individual.
 - State the corrective actions that may be taken to reduce high blood pressure.
 - Stress that hypertension is the major factor in 'strokes' in the general population.
- Coronary disease
 - Differentiate between 'angina' and 'heart attack.'
 - List the major factors that may make an individual vulnerable to a heart attack.
 - State the techniques that may be used to control or reduce the effect of coronary disease.
 - State the role played by physical exercise in reducing the chances of developing coronary disease.
 - List the symptoms of a person in circulatory shock.
- Obesity
 - Define 'obesity.'
 - State the cause of obesity.
 - State the harmful effects of obesity on:
 - Possibility of developing coronary problems
 - Increased chances of developing diabetes
 - Ability to withstand g forces
 - The development of problems with joints of the limbs
 - General circulation problems
 - Higher risk of developing gout
 - Ability to cope with hypoxia or DCS
 - State the relationship between obesity and Body Mass Index (BMI.)
 - Calculate the BMI of an individual (given weight in Kg and height in meters) and state whether this BMI indicates that the individual is underweight, overweight, obese or within the normal range of body weight.
- Nutrition hygiene
 - State the major constituents of a healthy diet.
 - State the measure to avoid hypoglycemia.

AP 1.3.006B		PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

- State the role vitamins and trace elements are playing in a healthy diet.
 - List the major contaminating sources in foodstuffs.
 - State the actions to be taken to avoid food contamination.
 - Tropical climates
 - List the problems associated with operating in tropical climates.
 - State the possible causes/sources of incapacitation in tropical or poorly developed countries with reference to:
 - Standards of hygiene
 - Quality of water supply
 - Insect-borne diseases
 - Parasitic worms
 - Rabies or other diseases that may be spread by contact with animals.
 - State the precautions to be taken to reduce the risks of developing problems in tropical areas.
 - Epidemic diseases
 - State the major epidemic diseases that may kill or severely incapacitate individuals.
 - State which preventative hygienic measures, vaccinations, drugs, and other measures, reduce the chances of catching these diseases.
 - State the precautions which must be taken to ensure that disease carrying insects are not transported between areas.
- 9.4.4 Intoxication**
- Tobacco
 - State the harmful effects of using tobacco on:
 - The respiratory system
 - The cardio-vascular system
 - The ability to resist hypoxia
 - The ability to tolerate g forces
 - Night vision
 - Caffeine
 - Indicate the level of caffeine dosage at which performance is degraded.
 - Besides coffee, indicate other beverages containing caffeine.
 - Alcohol
 - Give a general rule governing flying and drinking alcohol.
 - State the effects of consuming alcohol on:
 - Ability to reason
 - Inhibitions and self control
 - Vision
 - Sense of balance and sensory illusions
 - Sleep patterns
 - Hypoxia
 - State the effects alcohol may have if consumed together with other drugs.
 - Identify the WHO definition of 'alcoholism.'
 - List the signs and symptoms of alcoholism.
 - List the factors which may be associated with the development of alcoholism.
 - Define the 'unit' of alcohol and state the most effective factor determining the rate of metabolism.
 - State the maximum daily and weekly intake of units of alcohol which may be consumed without causing damage to organs and systems in the body.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

-State the actions to be taken if a crew member is suspected of being an alcoholic.

-Drugs and self medication

-State the dangers associated with the use of non prescription drugs.

-State the side affects of common non prescription drugs used to treat colds, flu, hay fever and other allergies especially medicines containing anti-histamine preparations.

-Interpret the general rule that 'if a pilot is so unwell that he/she requires any medication then he/she should consider him/herself unfit to fly.

-Toxic materials

-List those materials present in an aircraft which may, when uncontained, cause severe health problems.

-State the dangers of mercury spillage in an aircraft.

-List the possible sources of mercury in an aircraft.

-List those aircraft component parts which if burnt may give off toxic fumes.

9.4.5 **Incapacitation in flight**

-State that incapacitation is most dangerous when its onset is insidious.

-List the major causes of in-flight incapacitation.

-Differentiate between 'fits' and 'faints.'

-State how EEG tracings may indicate a person's susceptibility to fits.

-Indicate the benefit of procedural simulator training which will qualify the crew to recognize and promptly react upon incapacitation of either crew member, should it

LEARNING OBJECTIVES

occur in flight.

9.5 **BASIC AVIATION PSYCHOLOGY**

9.5.1 **Human information processing**

9.5.1.1 **Attention and vigilance**

-Differentiate between 'attention' and 'vigilance.'

-Define 'hypovigilance.'

-Identify the factors which may affect the state of vigilance.

-List the factors that may forestall hypovigilance during flight.

-Indicate signs of reduced vigilance.

-Name factors that affect a person's level of attention.

-Distinguish between selective and divided attention.

-Discuss the effects of performing simultaneous tasks in respect to the level of consciousness involved and demonstrated level of performance.

-Discuss consequences for work in a multi-task environment, bearing attention and vigilance in mind. Name procedures which increase safety.

9.5.1.2 **Perception**

-Name the basis of the perception process.

-Describe the mechanism of perception ('bottom-up'/'top-down' process)

-Illustrate why perception is subjective and state the relevant factors which influence interpretation of perceived information.

-Describe some basic perceptual illusions.

-Illustrate some basic perceptual concepts and laws.

-Give examples where perception plays a decisive role in flight safety.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

9.5.1.3 Memory

- List the three types of memory.
- Explain the link between the three types of memory.
- Describe the differences between the three types of memory in terms of capacity and retention time.
- Justify the importance of sensory store memories in processing information.
- State the average maximum number of separate items that may be held in working memory.
- Give examples of items that are important for pilots to hold in working memory during flight.
- Describe how the capacity of the working memory store may be increased.
- State the sub-divisions of long term memory and give examples of their content.
- Define the three different categories of information stored in long term memory.
- Name the common problem with long term memory and how to counteract it.

9.5.1.4 Response selection

- Define 'learning.'
- Explain and distinguish between the following basic forms of learning:
 - Classical and operant conditioning (behaviorist approach)
 - Learning by insight (cognitive approach)
 - Learning by imitating (modeling)
- Find pilot related examples for each of these learning forms.
- State factors which are necessary for and promote the quality of learning.
- Explain ways to facilitate the memorization of information by the following learning techniques:
 - Mnemonics
 - Mental training
- Explain the relationship between motivation and learning, performance, and attention
- Describe the advantage of planning and anticipation of future actions.
- Define the term 'skills.'
- State the phases of learning a skill (ANDERSON)
- Explain the term 'motor-programme' or 'mental schema.'
- Explain the following phases in connection with the acquisition of automated behavior:
 - Cognitive phase
 - Associative phase
 - Automatic phase.
- Describe the advantages and disadvantages of mental schemata.
- Explain the model by RASMUSSEN which describes the guidance of a pilot's actions in different situations.
- State possible problems or risks associated with skill-based, rule-based, and knowledge-based behavior.

9.5.2 Human error and reliability

9.5.2.1 Reliability of human behavior

- Summarize the current approach to human error in aviation. Identify the consequences in respect of the current approach.
- Name and explain factors which influence human reliability.

AP 1.3.006B		PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

9.5.2.2 Hypotheses on reality

- Cite examples of the relationship between perception and reality in given circumstances.
- List factors which influence one's sense of reality.
- Define the term 'mental model' in relation to a surrounding complex situation.
- Describe the advantage/disadvantage of mental models.
- Explain the relationship between personal 'mental models' and the creation of cognitive illusions.

9.5.2.3 Theory and model of human error

- Define the term 'error.'
- Explain the concept of the error chain.
- Differentiate between an isolated error and an error chain.
- State examples of an isolated error and an error chain.
- Distinguish between different forms/types of errors (e.g. RASMUSSEN, REASON.)
- Compare unintended and intended deviations from standards, leading to negative consequences.
- Distinguish between an active and a latent error and give examples.

9.5.2.4 Error generation

- Distinguish between internal and external factors in error generation
- Identify possible sources of internal error generation.
- Define the term 'environmental capture.'
- Define the term 'deterioration effect.'
- List the three main sources for external error generation.
- Give examples to illustrate the following factors in external error generation in the cockpit:
 - Ergonomics
 - Economics
 - Social environment.
- Name major goals in the design of human centered man-machine interfaces.
- Define the term 'error tolerance.'
- List (and describe) strategies which are used to reduce human error.

9.5.2.5 Decision making

- Define the term 'deciding' and 'decision making.'

9.5.2.6 Decision making concepts

- Describe the major factors on which a decision-making should be based during the course of a flight ('Judgment Concept')
- Describe the main positive capabilities in an individual's decision making mechanism.
- Describe the main error sources and limits in an individual's decision making mechanism.
- State the factors upon which an individual's risk assessment is based.
- Explain the relationship between risk assessment, commitment, and pressure of time on decision making strategies.
- Describe the positive and negative influences exerted by other group members on an individual's decision making process.
- Explain the general idea behind the creation of particular models' guidelines for decision making processes.
- Illustrate a practical approach for decision making between crew members.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

9.5.3 Avoiding and managing errors: cockpit management

9.5.3.1 **Safety awareness**

- Justify the need for being aware of one's own performance before and during a flight and possible consequences of its result as part of a pilot's professionalism.
- Define the term 'situation(al) awareness.'
- Name the three cognitive elements which are necessary to create an adequate situation awareness.
- Identify factors which interfere with being 'situationally aware.'
- List cues which indicate the loss of situation awareness.
- Name the main steps towards regaining lost situation awareness.
- Justify the value of situation awareness in the context of flight safety

9.5.3.2 **Co-ordination (multi-crew concept)**

- Name the objectives of the multi-crew concept.
- State and explain the elements of multi-crew concepts.
- Explain the concept "Standard Operating Procedure" (SOP)
- Illustrate the purpose and procedure of crew briefings.
- Illustrate the purpose and procedure of checklists.
- Compare the team coordination during the flight training phase and commercial flight operation.
- Describe the function of communication in a coordinated team.

9.5.3.4 **Co-operation**

- Distinguish between co-operation and co-action.
- Define the term 'group.'
- Illustrate the influence of interdependence in a group.
- List the advantages and disadvantages of team work.
- Explain the term 'synergy.'
- Define the term 'cohesion.'
- Define the term 'groupthink.'
- Define the term 'risky shift.'
- State the essential conditions for good teamwork.
- Explain the function of role and norm in a group.
- Name the different role patterns which occur in a group situation.
- Explain how behavior can be affected by the following factors:
 - Persuasion
 - Conformity
 - Compliance
 - Obedience.
- Distinguish between status and role.
- Explain the terms 'leadership' and 'followership.'
- Describe the trans-cockpit authority gradient and its affiliated leadership styles.
- Illustrate different leadership styles (BLAKE & MOUTON) and judge their influence on communication patterns and behavior of crew members.
- Name the most important attributes for a positive leadership style.
- Explain the duty and role of the Pilot in Command (PIC)
- Explain the duty and role of the First Officer (FO) and other crew members.

9.5.3.5 **Communication**

- Explain the function and measurement of 'information.'
- Define the term 'communication.'
- List the four most basic components of interpersonal communication (e.g.,

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

BERLO).

- Explain the advantages of two-way communication as opposed to one-way communication.
- Interpret the statement "One cannot not communicate." (Watzlawick)
- Distinguish between verbal and non-verbal communication.
- Name the functions of non-verbal communication.
- Describe general aspects of non-verbal communication.
- Explain the various levels of communication (SCHULZ VON THUN):
 - Factual level
 - Appeal level
 - Self-disclosure level
 - Relation level.
- Describe the advantages/disadvantages of implicit and explicit communication.
- State the attributes of a 'professional' language.
- Name practical interpersonal communication rules to obtain and maintain a good grasp of the situation (picture).
- Name and explain major obstacles to effective communication.
- Construct examples for misunderstandings arising from inadequate communication in the cockpit.
- Explain the effect of incompatibility on the difference between verbal and non-verbal communication.
- Explain the difference between intra- and interpersonal conflict.
- Describe the escalation process in a destructive conflict.
- List typical consequences of conflicts between crew members.
- Explain the following terms as part of communication practice in regard to preventing or solving conflicts:
 - Inquiry
 - Active listening
 - Advocacy
 - Feedback
 - Metacommunication
 - Negotiation
 - Arbitration.

9.5.4 Personality

9.5.4.1 **Personality and attitudes**

- Describe the factors which determine an individual's behavior.
- Define and distinguish between personality, attitude, and behavior.
- State the origin of personality and attitudes.
- Summarize the influence of pilot relevant personality traits and dangerous attitudes on pilots' performance in the cockpit environment.

9.5.4.2 **Individual differences in personality**

- Describe the individual differences in personality by the mean of a common trait model (e.g., EYSENCK's personality factors) and use it to describe today's ideal pilot.
- State the most important personality trait for effective crew decision making.
- Motivation
 - Define motivation.
 - Explain the influences of different level of motivation on performance in taking into consideration arousal and task difficulty.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

- Explain the 'Model of human needs' (MASLOW.)
- Distinguish between the stages of the 'Model of human needs' by citing practical examples.
- Illustrate the influence of human needs on flight safety.
- Explain the basic model that identifies two independent sources of motivation; justify its conclusion on possible developments concerning an individual's job satisfaction.
- Summarize the advantages and disadvantages of extreme need for achievement.

-Self-concept

- Define the term 'self-concept.'
- Describe the likely influence of promotion (e.g., FO to Cpt) on an individual's self-concept.

-Self-discipline

- Define 'self-discipline' and justify its importance for flight safety.
- Summarize examples of mental states and behavior endangering flight safety.

9.5.4.3 Identification of hazardous attitudes (error proneness)

- Name those hazardous mental attitudes, which, if prevalent in a crew member, might represent a hazard to flight safety.
- Describe the signs of mental attitudes and behavior patterns in a flight crew member, which might be hazardous to flight safety.
- Describe the mental attitude and behavior patterns of an ideal crew member.
- Summarize how a person's basic attitude influences his work in the cockpit.

9.5.5 Human overload and underload

9.5.5.1 Arousal

- Explain the term 'arousal.'
- Describe the relationship between arousal and performance.
- Understand the graphical representation of the above relationship.

9.5.5.2 Stress

- Explain the term 'homeostasis.'
- Explain the term 'stress'. Why is stress a natural human reaction.
- State that the physiological response to stress is generated by the 'fight or flight' response.
- Describe the function of the autonomic nervous system (ANS) in stress response.
- Explain the biological reaction to stress by means of the 'general adaptation syndrome' (GAS).
- Explain the relationship between arousal and stress by referring to the effects of "good" and "bad" stress.
- State the relationship between stress and performance.
- Explain the differences between stress factors and stress reactions.
- State the basic categories of stress factors.
- Name major stress factors.
- List the major environmental sources of stress in the cockpit.
- State the acceptable amount of workload with regard to crew resources available, before it becomes an unacceptable stress factor.
- Name the principal causes of domestic stress.
- State that the stress experienced as a result of particular demands varies

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

between individuals.

- Explain the process which is responsible for the individual differences in experiencing stress.
- Explain the difference between stress factors and risk factors.
- List factors influencing the tolerance of stressors.
- Create and explain a simple model of stress.
- Explain the relationship between stress and anxiety.
- Describe the effects of anxiety on human performance.
- State the general effect of acute stress on the human system.
- Name the symptoms of stress relating to the different phases of the GAS.
- Describe the relationship between stress, attention, and vigilance.
- State the general effect of chronic stress on the human system.
- Explain the differences between psychological, psychosomatic and somatic stress reactions.
- Name typical common physiological and psychological symptoms of human overload.
- Describe effects of stress on the personality.
- Explain how stress is cumulative and how stress from one situation can be transferred to a different situation.
- Explain how successful completion of a stressful task will reduce the amount of stress experienced when a similar situation arises in the future.
- List sources and symptoms of human underload.
- Describe the effect of human under/overload on effectiveness in the cockpit.

9.5.5.3 **Fatigue**

- Explain the term 'fatigue' and differentiate between the two types of fatigue.
- Name causes for both types.
- Identify symptoms and describe effects of fatigue.

9.5.5.4 **Body rhythms and sleep**

- Name some internal body rhythms.
- Explain the term 'circadian rhythm.'
- State the approximate duration of a 'free-running' circadian rhythm.
- Explain the significance of 'Zeitgebers' in regulating the normal circadian rhythm.
- State the effect of the circadian rhythm of body temperature on an individual's performance standard and the effect on an individual's sleep patterns.
- List and describe the stages of a sleep cycle.
- Differentiate between REM and non-REM sleep.
- Explain the function of sleep and describe the effects of insufficient sleep on performance.
- Explain the simple calculations for the sleep/wake credit/debit situation.
- Explain how sleep debt can become cumulative.
- State the time formula for the adjustment of body rhythms to the new local time scale after crossing time zones.
- State the problems caused by circadian dysrhythmia (jet-lag) on an individual's performance and sleep sequence.
- Differentiate between the effects of westbound and eastbound travel.
- Explain the interactive effects of circadian rhythm and vigilance on a pilot's performance during flight as the duty-day elapses.
- Describe the main effects of lack of sleep on an individual's performance.
- List possible coping strategies for jet-lag.

AP 1.3.006B	 <small>רשות התעופה האזרחית Civil Aviation Authority</small>	PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

9.5.5.5 **Fatigue and stress management**

- List strategies which prevent or delay the onset of fatigue and hypovigilance.
- List and describe coping strategies for dealing with stress factors and stress reactions.
- Distinguish between short-term and long-term methods of stress management.
- Give examples of short term methods of stress management.
- Give examples of long-term methods of coping with stress.

9.5.6 **Advanced cockpit automation**

- Define and explain the basic concepts of automation.

9.5.6.1 **Advantages and disadvantages ("criticalities")**

- List the advantages/disadvantages of automation in the cockpit in respect of level of vigilance, attention, workload, situational awareness, and crew coordination.
- State the advantages and disadvantages of the two components of the man-machine system with regard to information input and processing, decision making, and output activities.
- Explain the "ironies of automation."
- Give examples of methods to overcome the disadvantages of automation.
- Interpret the present philosophy on automation with regard to the usage of automated systems by available man-machine interfaces and pilots' duties.

9.5.6.2 **Automation complacency**

- State the main weaknesses in the monitoring of automatic systems.
- Explain the following terms in connection with automation:
 - Passive monitoring.
 - Blinkered concentration.
 - Confusion.
- Give examples of actions which may be taken to counteract ineffective monitoring of automatic systems.
- Define 'complacency.'

9.5.6.2 **Working concepts**

- Analyze the influence of automation on crew communication and describe the potential disadvantages.
- Summarize how the negative effects of automation on pilots may be alleviated.
- Interpret the role of automation with respect to flight safety

10. **WRITTEN EXAMS.**

- 10.1 The subjects on which the ALTP applicant will be examined, are detailed hereafter. by chapters and subchapters as appropriate, according to the syllabus. (It includes 7 written exams).

Applicants not holding an Instrument rating are required in addition to the 7 subjects, to be examined on Radio Aids to Navigation.

AP 1.3.006B		PEL Handbook
ATPL Knowledge Test Standards		Revision 1
		21 AUG 12

- 10.1.1 **AIR LAW:** 2.1.1 ; 2.2. ; 2.3.
- 10.1.2 **GENERAL TECHNICAL KNOWLEDGE:** 1.1 ; 1.2.1. ; 1.2.3. ; 3.1. ; 3.2. ; 3.3 ; 3.4. ; 3.5.4. ; 3.6.1.; 3.6.2. ; 3.6.3. ; 3.6.4. ; 7.7. ; 8.1. ; 8.2. ; 8.3. ; 8.4. ; 8.5.1. ; 8.5.2. ; 8.6.
- 10.1.3 **METEOROLOGY:** 1.2.2. ; 6.1. ; 6.2. ; 6.3. ; 6.4. ; 6.5. ; 6.6. ; 6.7. ; 6.8. ; 6.9. ; 6.10. ; 6.11. ; 7.7.3.
- 10.1.4 **NAVIGATION :** 1.1. ; 1.3. ; 7.1. ; 7.3. ; 7.4.
- 10.1.5 **MAGNETISM and AICRAFT INSTRUMENTS :** 1.2.3. ; 3.5.1. ; 3.5.2. ; 3.5.3. ; 3.5.5. ; 7.2. ; 7.5. ; 7.6. ; 7.8.
- 10.1.6 **FLIGHT PLANNING:** 3.6.5.1. ; 3.6.5.2. ; 3.6.5.3. ; 3.6.5.4. ; 3.6.6.1. ; 4.1. ; 4.2.
- 10.1.7 **AIRCRAFT TYPE TECHNICAL:** On the type of airplane the applicant will take the practical flight test; limitations; normal procedures; emergency procedures; system's operation in normal and in emergency-closed manual.
- 10.1.8 **RADIO AIDS TO NAVIGATION :** According to the IFR Syllabus .
- 10.1.9 **HUMAN PERFORMANCE**

ב ה צ ל ח ה