# EAST AFRICAN SCHOOL OF AVIATION
# FLIGHT DISPATCH 26/EWAC 02

# FINAL EXAM RADIO NAVIGATION

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**SECTION A 40 QUESTIONS**

**1) An aircraft is "homing" to a radio beacon whilst maintaining a relative bearing of zero. If the magnetic heading decreases, the aircraft is experiencing :**

***A*** left drift

***B*** zero drift

***C*** a wind from the west

***D*** right drift

**2) Which of the following coordinate systems is used by the GPS receiver to determine position (Latitude, longitude and altitude)?**

***A*** ED 87

***B*** ED 50

***C*** EUREF 92

***D*** WGS 84

**3) A frequency of 10 GHz is considered to be the optimum for use in an airborne weather radar system because:**

***A*** static interference is minimised

***B*** less power output is required in the mapping mode

***C*** the larger water droplets will give good echoes and the antenna can be kept relatively small

***D*** greater detail can be obtained at the more distant ranges of the smaller water droplets

**4) An aircraft on a heading of 280°(M) is on a bearing of 090°(M) from a VOR. The bearing you should select on the OMNI bearing selector to centralise the VOR/ILS left/right deviation needle with a 'TO' indication is:**

***A*** 280°

***B*** 270°

***C*** 090°

***D*** 100°

**5) In general the operation of airborne weather radar equipment on the ground is:**

***A*** only permitted with certain precautions, to safeguard health of personnel and to protect equipment

***B*** permitted anywhere

***C*** totally prohibited

***D*** unrestrictedly permitted in aerodrome maintenance areas

**6) A Primary radar operates on the principle of:**

***A*** phase comparison

***B*** continuous wave transmission

***C*** pulse technique

***D*** transponder interrogation

**7) Signal reception is required from a minimum number of satellites that have adequate elevation and suitable geometry in order for a Satellite-Assisted Navigation System (GNSS/GPS) to carry out independent three dimensional operation, Receiver Autonomous Integrity Monitoring (RAIM) and to isolate any faulty satellite and remove it from contributing to the navigation solution. The number of satellites is:**

***A*** 5 ***B*** 6 ***C*** 7 ***D*** 4

**8) An aircraft carrying out an ILS approach is receiving more 90 Hz than 150 Hz modulation notes from both the localiser and glidepath transmitters. The ILS indication will show:**

***A*** Fly left and fly up

***B*** Fly right and fly down

***C*** Fly left and fly down

***D*** Fly right and fly up

**9) The two main design functions of Secondary Surveillance Radar (SSR) Mode S are:**

***A*** air to ground and ground to air data link communications and improved ATC aircraft surveillance capability

***B*** collision avoidance using TCAS II and improved long range (HF) communication capability.

***C*** continuous automatic position reporting using Global Positioning System (GPS) satellites and collision avoidance using TCAS II

***D*** the elimination of ground to air communications and the introduction of automatic separation between aircraft using TCAS II

**10) A ground radar transmitting at a PRF of 1200 pulses/second will have a maximum unambiguous range of approximately:**

***A*** 67 NM

***B*** 135 NM

***C*** 270 NM

***D*** 27 NM

**11) The azimuth transmitter of a Microwave Landing System (MLS) provides a fan-shaped horizontal approach zone which is usually:**

***A*** + or - 30° of the runway centre-line

***B*** + or - 40° of the runway centre-line

***C*** + or - 50° of the runway centre-line

***D*** + or - 60° of the runway centre-line

**12) MLS installations notified for operation, unless otherwise stated, provide azimuth coverage of:**

***A*** + or - 20° about the nominal courseline out to a range of 20NM

***B*** + or - 40° about the nominal courseline out to a range of 30NM

***C*** + or - 20° about the nominal courseline out to a range of 10NM

***D*** + or - 40° about the nominal courseline out to a range of 20NM

**13) One of the tasks of the space segment of the satellite navigation system NAVSTAR/GPS is to:**

***A*** compute the user position from the received user messages and to transmit the computed position back to the user segment

***B*** monitor the satellites' orbits and status

***C*** transmit signals which can be used, by suitable receivers, to determine time, position and velocity

***D*** transmit signals to suitable receivers and to monitor the orbital planes autonomously

**14) Which one of the following methods is used by a Microwave Landing System (MLS) to indicate distance from the runway threshold?**

***A*** Timing the interval between the reception of sequential secondary radar pulses from the MLS station to the aircraft

***B*** A DME co-located with the MLS transmitters

***C*** Timing the interval between the transmission and reception of primary radar pulses from the aircraft to MLS station

***D*** Measurement of the frequency shift between the MLS azimuth and elevation transmissions

**15) One of the tasks of the control segment of the satellite navigation system NAVSTAR/GPS is to:**

***A*** grant and monitor user authorisations

***B*** monitor the status of the satellites

***C*** manufacture and launch the satellites

***D*** manipulate the signals of selected satellites to reduce the precision of the position fix

**16) 'Night Effect' which causes loss of signal and fading, resulting in bearing errors from NDB transmissions, is due to:**

***A*** static activity increasing at night particularly in the lower frequency band

***B*** the effect of the Aurora Borealis

***C*** skywave distortion of the null position and is maximum at dawn and dusk

***D*** interference from other transmissions and is maximum at dusk when east of the NDB

**17) In which mode of operation does the aircraft weather radar use a cosecant radiation pattern.**

***A*** MANUAL

***B*** MAPPING

***C*** CONTOUR

***D*** WEATHER

**18) In the NAVSTAR/GPS satellite navigation system, 'Selective Availability' (SA) gives the option to artificially degrade the accuracy by :**

***A*** shutting off selected satellites

***B*** using a less accurate atomic clock in a satellite for signal processing

***C*** offsetting satellite atomic clocks by a predetermined constant amount

***D*** dithering the satellite clock

**19) What is the approximate maximum theoretical range at which an aircraft at FL130 could receive information from a VDF facility which is sited 1024 FT above MSL?**

***A*** 150 NM ***B*** 180 NM ***C*** 220 NM ***D*** 120 NM

**20) The maximum pulse repetition frequency (PRF) that can be used by a primary radar facility in order to detect targets unambiguously at a range of 50 NM is: (pps = pulses per second)**

***A*** 610 pps

***B*** 713 pps

***C*** 1620 pps

***D*** 3240 pps

**21) An aircraft is required to approach a VOR via the 104° radial. Which of the following settings should be made on the VOR/ILS deviation indicator?**

***A*** 284° with the FROM flag showing

***B*** 104° with the TO flag showing

***C*** 104° with the FROM flag showing

***D*** 284° with the TO flag showing

**22) ICAO specifications are that range errors indicated by Distance Measuring Equipment (DME) should not exceed:**

***A*** + or - 0.5 NM or 3% of the distance measured whichever is the greater

***B*** + or - 1.25 NM plus 0.25% of the distance measured

***C*** + or - 0.25 NM plus 3% of the distance measured up to a maximum of 5 NM

***D*** + or - 0.25 NM plus 1.25% of the distance measured

**23) Given: VOR station position N61° E025°, variation 13°E; Estimated position of an aircraft N59° E025°, variation 20°E. What VOR radial is the aircraft on?**

***A*** 160°

***B*** 193°

***C*** 167°

***D*** 347°

**24) Which of the following equipments uses primary radar principles?**

***A*** Global Positioning System (GPS)

***B*** Airborne weather radar (AWR)

***C*** Secondary Surveillance Radar (SSR)

***D*** Distance Measuring Equipment (DME)

**25) In order to indicate an emergency situation, the aircraft Secondary Surveillance Radar (SSR) transponder should be set to:**

***A*** 7500

***B*** 7000

***C*** 7700

***D*** 7600

**26) In the NAVSTAR/GPS satellite navigation system, receiver clock error:**

***A*** is negligible small because of the great accuracy the atomic clocks installed in the satellites

***B*** is corrected by using signals from four satellites

***C*** is the biggest part of the total error; it cannot be corrected

***D*** can be minimised by synchronisation of the receiver clock with the satellite clocks

**27) What is the maximum theoretical range that an aircraft at FL150 can receive signals from a VOR situated 609 feet above MSL?**

***A*** 156 NM

***B*** 184 NM

***C*** 220 NM

***D*** 147 NM

**28) The code transmitted by a SSR transponder consists of:**

***A*** phase differences

***B*** frequency differences

***C*** amplitude differences

***D*** pulses

**29) ADF bearings by an aeroplane by day within the published protection range should be accurate to within a maximum error of:**

***A*** +/-5°

***B*** +/-10°

***C*** +/-2.5°

***D*** +/-2°

**30) The maximum theoretical range at which an aircraft at FL210 may receive signals from a VOR facility sited 340 feet above mean sea level is approximately:**

***A*** 204 NM ***B*** 245 NM ***C*** 163 NM ***D*** 183 NM

**31) There are two NDBs, one 20 NM inland, and the other 50 NM inland from the coast. Assuming that the error caused by coastal refraction is the same for both propagations, the extent of the error in a position line plotted by an aircraft that is over water will be:**

***A*** the same from both beacons when the aircraft is on a relative bearing of 090° and 270°

***B*** greater from the beacon that is 50 NM inland

***C*** the same from both beacons when the aircraft is on a relative bearing of 180° and 360°

***D*** greater from the beacon that is 20 NM inland

**32) In a Satellite-Assisted Navigation system (GNSS/GPS) a position line is obtained by:**

***A*** the aircraft's receiver measuring the phase angle of the signal received from a satellite in a known position

***B*** timing the period that is taken for a transmission from the aircraft's transmitter/receiver to reach and return from a satellite in a known position

***C*** the aircraft's receiver measuring the time difference between signals received from a minimum number of satellites

***D*** timing the period that is taken for a satellite's transmission to reach the aircraft's receiver

**33) At what approximate height above the WGS-84 ellipsoid are NAVSTAR/GPS satellites circling the earth?**

***A*** 20200 km

***B*** 10900 km

***C*** 36000 km

***D*** 19500 km

**34) How long does it take a NAVSTAR/GPS satellite to orbit the earth?**

***A*** 12 days

***B*** 365 days because the satellites are located in a geostationary orbit

***C*** Approximately 12 hours (1/2 of a sidereal day)

***D*** Approximately 24 hours (one sidereal day)

**35) What is the colour sequence when passing over an Outer, Middle and Inner Marker beacon?**

***A*** blue - amber - white

***B*** amber - white - green

***C*** white - amber - blue

***D*** blue - green - white

**36) Which one of the following correctly lists the major ground based components of a Microwave Landing System (MLS)?**

***A*** Separate azimuth and elevation transmitters, DME facility

***B*** Separate azimuth and elevation transmitters, outer and middle marker beacons

***C*** Combined azimuth and elevation transmitter, DME facility

***D*** Combined azimuth and elevation transmitter, outer and inner marker beacons

**37) Which one of the following is an advantage of a Microwave Landing System (MLS) compared with an Instrument Landing System (ILS)?**

***A*** The installation does not require to have a separate method (marker beacons or DME) to determine range

***B*** There is no restriction on the number of ground installations that can be operated because there is an unlimited number of frequency channels available

***C*** It is insensitive to geographical site and can be installed at sites where it is not possible to use an ILS

***D*** It does not require a separate azimuth (localiser) and elevation (azimuth) transmitter

**38) Quadrantal errors associated with aircraft Automatic Direction Finding (ADF) equipment are caused by:**

***A*** misalignment of the loop aerial

***B*** skywave/groundwave contamination

***C*** signal bending by the aircraft metallic surfaces

***D*** signal bending caused by electrical interference from aircraft wiring

**39) A DME is located at MSL. An aircraft passing vertically above the station at flight level FL 360 will obtain a DME range of approximately:**

***A*** 7 NM ***B*** 11 NM ***C*** 8 NM ***D*** 6 NM

**40) GPS system satellites transmit their signals on two carrier waves 1575 MHz and 1227 MHz and supply two possible codes accessible acording to user (civil or military). Commercial aviation uses:**

***A*** only the 1 227 MHz carrier wave and one code

***B*** the two carrier waves and one public code

***C*** only the 1 575 MHz carrier wave and one code

***D*** only the 1 575 MHz carrier wave and two codes

**SECTION B (20 MARKS)**

**41. State and explain five factors that affect propagation of radio signals (5 marks).**

**42. A transmitter is moving towards a receiver at 800kph. The transmission frequency is 3 GHZ, calculate the Doppler frequency in KHZ (5 marks).**

**43. State 5 advantages of MLS over ILS (5 marks).**

**44. determine the altitude of the cloud top given range of 45nm, tilt angle of 3.5 degrees, beamwidth of 5 degrees and aircraft at FL350 ( 5 marks)**