2024-2028 Extra Class - Preliminary
FCC Element 4 Question Pool Syllabus

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SUBELEMENT E1 - COMMISSION RULES [6 Exam Questions - 6 Groups] 68 Questions

E1A Frequency privileges; signal frequency range; automatic message forwarding; stations aboard ships or aircraft; power restriction on 630- and 2200-meter bands

E1A01 (D) [97.305, 97.307(b)]
Why is it not legal to transmit a 3 kHz bandwidth USB signal with a carrier frequency of 14.348 MHz?
A. USB is not used on 20-meter phone
B. The lower 1 kHz of the signal is outside the 20-meter band
C. 14.348 MHz is outside the 20-meter band
D. The upper 1 kHz of the signal is outside the 20-meter band
~~

E1A02 (D) [97.301, 97.305]
When using a transceiver that displays the carrier frequency of phone signals, which of the following displayed frequencies represents the lowest frequency at which a properly adjusted LSB emission will be totally within the band?
A. The exact lower band edge
B. 300 Hz above the lower band edge
C. 1 kHz above the lower band edge
D. 3 kHz above the lower band edge
~~

E1A03 (C) [97.305, 97.307(b)]
What is the highest legal carrier frequency on the 20-meter band for transmitting a 2.8 kHz wide USB data signal?
A. 14.0708 MHz
B. 14.1002 MHz
C. 14.1472 MHz
D. 14.3490 MHz
~~

E1A04 (C) [97.301, 97.305]
May an Extra class operator answer the CQ of a station on 3.601 MHz LSB phone?
A. Yes, the entire signal will be inside the SSB allocation for Extra class operators
B. Yes, the displayed frequency is within the 75-meter phone band segment
C. No, the sideband components will extend beyond the edge of the phone band segment
D. No, US stations are not permitted to use phone emissions below 3.610 MHz
~~

E1A05 (C) [97.5]
Who must be in physical control of the station apparatus of an amateur station aboard any vessel or craft that is documented or registered in the United States?
A. Only a person with an FCC Marine Radio license grant
B. Only a person named in an amateur station license grant
C. Any person holding an FCC issued amateur license or who is authorized for alien reciprocal operation
D. Any person named in an amateur station license grant or a person holding an unrestricted Radiotelephone Operator Permit
~~

E1A06 (B) [97.303(h)(1)]
What is the required transmit frequency of a CW signal for channelized 60 meter operation?
A. At the lowest frequency of the channel
B. At the center frequency of the channel
C. At the highest frequency of the channel
D. On any frequency where the signal’s sidebands are within the channel
~~

E1A07 (C) [97.313(k)]
What is the maximum power permitted on the 2200-meter band?
A. 50 watts PEP (peak envelope power)
B. 100 watts PEP (peak envelope power)
C. 1 watt EIRP (equivalent isotropic radiated power)
D. 5 watts EIRP (equivalent isotropic radiated power)
~~

E1A08 (B) [97.219]
If a station in a message forwarding system inadvertently forwards a message that is in violation of FCC rules, who is primarily accountable for the rules violation?
A. The control operator of the packet bulletin board station
B. The control operator of the originating station
C. The control operators of all the stations in the system
D. The control operators of all the stations in the system not authenticating the source from which they accept communications
~~

E1A09 (D) [97.313(l)]
Except in some parts of Alaska, what is the maximum power permitted on the 630-meter band?
A. 50 watts PEP (peak envelope power)
B. 100 watts PEP (peak envelope power)
C. 1 watt EIRP (equivalent isotropic radiated power)
D. 5 watts EIRP (equivalent isotropic radiated power)
~~

E1A10 (A) [97.11]
If an amateur station is installed aboard a ship or aircraft, what condition must be met before the station is operated?
A. Its operation must be approved by the master of the ship or the pilot in command of the aircraft
B. The amateur station operator must agree not to transmit when the main radio of the ship or aircraft is in use
C. The amateur station must have a power supply that is completely independent of the main ship or aircraft power supply
D. The amateur station must operate only in specific segments of the amateur service HF and VHF bands
~~

E1A11 (B) [97.5]
What licensing is required when operating an amateur station aboard a US-registered vessel in international waters?
A. Any amateur license with an FCC Marine or Aircraft endorsement
B. Any FCC-issued amateur license
C. Only General class or higher amateur licenses
D. An unrestricted Radiotelephone Operator Permit
~~

E1B Station restrictions and special operations: restrictions on station location; general operating restrictions; spurious emissions; antenna structure restrictions; RACES operations

E1B01 (D) [97.3]
Which of the following constitutes a spurious emission?
A. An amateur station transmission made without the proper call sign identification
B. A signal transmitted to prevent its detection by any station other than the intended recipient
C. Any transmitted signal that unintentionally interferes with another licensed radio station and whose levels exceed 40 dB below the fundamental power level
D. An emission outside the signal’s necessary bandwidth that can be reduced or eliminated without affecting the information transmitted
~~

E1B02 (A) [97.307(f)(2)]
Which of the following is an acceptable bandwidth for digital voice or slow-scan TV transmissions made on the HF amateur bands?
A. 3 kHz
B. 10 kHz
C. 15 kHz
D. 20 kHz
~~

E1B03 (A) [97.13]
Within what distance must an amateur station protect an FCC monitoring facility from harmful interference?
A. 1 mile
B. 3 miles
C. 10 miles
D. 30 miles
~~

E1B04 (C) [97.303(b)]
What must the control operator of a repeater operating in the 70-centimeter band do if a radiolocation system experiences interference from that repeater?
A. Reduce the repeater antenna HAAT (Height Above Average Terrain)
B. File an FAA NOTAM (Notice to Air Missions) with the repeater system's ERP, call sign, and six-character grid locator
C. Cease operation or make changes to the repeater that mitigate the interference
D. All these choices are correct
~~

E1B05 (C) [97.3]
What is the National Radio Quiet Zone?
A. An area surrounding the FCC monitoring station in Laurel, Maryland
B. An area in New Mexico surrounding the White Sands Test Area
C. An area surrounding the National Radio Astronomy Observatory
D. An area in Florida surrounding Cape Canaveral
~~

E1B06 (A) [97.15]
Which of the following additional rules apply if you are erecting an amateur station antenna structure at a site at or near a public use airport?
A. You may have to notify the Federal Aviation Administration and register it with the FCC as required by Part 17 of the FCC rules
B. You may have to enter the height above ground in meters, and the latitude and longitude in degrees, minutes, and seconds on the FAA website
C. You must file an Environmental Impact Statement with the EPA before construction begins
D. You must obtain a construction permit from the airport zoning authority per Part 119 of the FAA regulations
~~

E1B07 (C) [97.15]
To what type of regulations does PRB-1 apply?
A. Homeowners associations
B. FAA tower height limits
C. State and local zoning
D. Use of wireless devices in vehicles
~~

E1B08 (D) [97.121]
What limitations may the FCC place on an amateur station if its signal causes interference to domestic broadcast reception, assuming that the receivers involved are of good engineering design?
A. The amateur station must cease operation
B. The amateur station must cease operation on all frequencies below 30 MHz
C. The amateur station must cease operation on all frequencies above 30 MHz
D. The amateur station must avoid transmitting during certain hours on frequencies that cause the interference
~~

E1B09 (C) [97.407]
Which amateur stations may be operated under RACES rules?
A. Only those club stations licensed to Amateur Extra class operators
B. Any FCC-licensed amateur station except a Technician class
C. Any FCC-licensed amateur station certified by the responsible civil defense organization for the area served
D. Only stations meeting the FCC Part 97 technical standards for operation during an emergency
~~

E1B10 (A) [97.407]
What frequencies are authorized to an amateur station operating under RACES rules?
A. All amateur service frequencies authorized to the control operator
B. Specific segments in the amateur service MF, HF, VHF, and UHF bands
C. Specific local government channels
D. All these choices are correct
~~

E1B11 (B) [97.15]
What does PRB-1 require of state and local regulations affecting amateur radio antenna size and structures?
A. No limitations may be placed on antenna size or placement
B. Reasonable accommodations of amateur radio must be made
C. Such structures must be permitted when use for emergency communications can be demonstrated
D. Such structures must be permitted if certified by a registered professional engineer
~~

E1C Automatic and remote control; band-specific regulations; operating in and communicating with foreign countries; spurious emission standards; HF modulation index limit; band-specific rules

E1C01 (D) [97.303]
What is the maximum bandwidth for a data emission on 60 meters?
A. 60 Hz
B. 170 Hz
C. 1.5 kHz
D. 2.8 kHz
~~

E1C02 (C) [97.117]
Which of the following apply to communications transmitted to amateur stations in foreign countries?
A. Third party traffic must be limited to that intended for the exclusive use of government and non-Government Organization (NGOs) involved in emergency relief activities
B. All transmissions must be in English
C. Communications must be limited to those incidental to the purpose of the amateur service and remarks of a personal nature
D. All these choices are correct
~~

E1C03 (B) [97.303(g)]
How long must an operator wait after filing a notification with the Utilities Technology Council (UTC) before operating on the 2200-meter or 630-meter band?
A. Operators must not operate until approval is received
B. Operators may operate after 30 days, providing they have not been told that their station is within 1 kilometer of PLC systems using those frequencies
C. Operators may not operate until a test signal has been transmitted in coordination with the local power company
D. Operations may commence immediately, and may continue unless interference is reported by the UTC
~~

E1C04 (A)
What is an IARP?
A. A permit that allows US amateurs to operate in certain countries of the Americas
B. The internal amateur radio practices policy of the FCC
C. An indication of increased antenna reflected power
D. A forecast of intermittent aurora radio propagation
~~

E1C05 (B) [97.221(c)(1), 97.115(c)]
Under what situation may a station transmit third party communications while being automatically controlled?
A. Never
B. Only when transmitting RTTY or data emissions
C. Only when transmitting SSB or CW
D. On any mode approved by the National Telecommunication and Information Administration
~~

E1C06 (C)
Which of the following is required in order to operate in accordance with CEPT rules in foreign countries where permitted?
A. You must identify in the official language of the country in which you are operating
B. The US embassy must approve of your operation
C. You must have a copy of FCC Public Notice DA 16-1048
D. You must append "/CEPT" to your call sign
~~

E1C07 (D) [97.303(g)]
What notifications must be given before transmitting on the 630- or 2200-meter bands?
A. A special endorsement must be requested from the FCC
B. An environmental impact statement must be filed with the Department of the Interior
C. Operators must inform the FAA of their intent to operate, giving their call sign and distance to the nearest runway
D. Operators must inform the Utilities Technology Council (UTC) of their call sign and coordinates of the station
~~

E1C08 (B) [97.213]
What is the maximum permissible duration of a remotely controlled station’s transmissions if its control link malfunctions?
A. 30 seconds
B. 3 minutes
C. 5 minutes
D. 10 minutes
~~

E1C09 (B) [97.307]
What is the highest modulation index permitted at the highest modulation frequency for angle modulation below 29.0 MHz?
A. 0.5
B. 1.0
C. 2.0
D. 3.0
~~

E1C10 (A) [97.307]
What is the maximum mean power level for a spurious emission below 30 MHz with respect to the fundamental emission?
A. - 43 dB
B. - 53 dB
C. - 63 dB
D. - 73 dB
~~

E1C11 (A) [97.5]
Which of the following operating arrangements allows an FCC-licensed US citizen to operate in many European countries, and amateurs from many European countries to operate in the US?
A. CEPT
B. IARP
C. ITU reciprocal license
D. All these choices are correct
~~

E1C12 (D) [97.305(c)]
In what portion of the 630-meter band are phone emissions permitted?
A. None
B. Only the top 3 kHz
C. Only the bottom 3 kHz
D. The entire band
~~

E1D Amateur Space and Earth stations; telemetry and telecommand rules; identification of balloon transmissions; one-way communications

E1D01 (A) [97.3]
What is the definition of telemetry?
A. One-way transmission of measurements at a distance from the measuring instrument
B. Two-way transmissions in excess of 1000 feet
C. Two-way transmissions of data
D. One-way transmission that initiates, modifies, or terminates the functions of a device at a distance
~~

E1D02 (B) [97.211(b)]
Which of the following may transmit encrypted messages?
A. Telecommand signals to terrestrial repeaters
B. Telecommand signals from a space telecommand station
C. Auxiliary relay links carrying repeater audio
D. Mesh network backbone nodes
~~

E1D03 (B) [97.3(a)(45)]
What is a space telecommand station?
A. An amateur station located on the surface of the Earth for communication with other Earth stations by means of Earth satellites
B. An amateur station that transmits communications to initiate, modify, or terminate functions of a space station
C. An amateur station located in a satellite or a balloon more than 50 kilometers above the surface of the Earth
D. An amateur station that receives telemetry from a satellite or balloon more than 50 kilometers above the surface of the Earth
~~

E1D04 (A) [97.119(a)]
Which of the following is required in the identification transmissions from a balloon-borne telemetry station?
A. Call sign
B. The output power of the balloon transmitter
C. The station's six-character Maidenhead grid locator
D. All these choices are correct
~~

E1D05 (D) [97.213(d)]
What must be posted at the location of a station being operated by telecommand on or within 50 kilometers of the Earth’s surface?
A. A photocopy of the station license
B. A label with the name, address, and telephone number of the station licensee
C. A label with the name, address, and telephone number of the control operator
D. All these choices are correct
~~

E1D06 (A) [97.215(c)]
What is the maximum permitted transmitter output power when operating a model craft by telecommand?
A. 1 watt
B. 2 watts
C. 5 watts
D. 100 watts
~~

E1D07 (A) [97.207]
Which of the following HF amateur bands include allocations for space stations?
A. 40 meters, 20 meters, 15 meters, and 10 meters
B. 30 meters, 17 meters, and 10 meters
C. Only 10 meters
D. Satellite operation is permitted on all HF bands
~~

E1D08 (D) [97.207]
Which VHF amateur bands have frequencies authorized for space stations?
A. 6 meters and 2 meters
B. 6 meters, 2 meters, and 1.25 meters
C. 2 meters and 1.25 meters
D. 2 meters
~~

E1D09 (B) [97.207]
Which UHF amateur bands have frequencies authorized for space stations?
A. 70 centimeters only
B. 70 centimeters and 13 centimeters
C. 70 centimeters and 33 centimeters
D. 33 centimeters and 13 centimeters
~~

E1D10 (B) [97.211]
Which amateur stations are eligible to be telecommand stations of space stations, subject to the privileges of the class of operator license held by the control operator of the station?
A. Any amateur station approved by AMSAT
B. Any amateur station so designated by the space station licensee
C. Any amateur station so designated by the ITU
D. All these choices are correct
~~

E1D11 (D) [97.209]
Which amateur stations are eligible to operate as Earth stations?
A. Any amateur licensee who has successfully completed the AMSAT space communications course
B. Only those of General, Advanced or Amateur Extra class operators
C. Only those of Amateur Extra class operators
D. Any amateur station, subject to the privileges of the class of operator license held by the control operator
~~

E1D12 (A) [97.207(e), 97.203(g)]
Which of the following amateur stations may transmit one-way communications?
A. A space station, beacon station, or telecommand station
B. A local repeater or linked repeater station
C. A message forwarding station or automatically controlled digital station
D. All these choices are correct
~~

E1E Volunteer examiner program: definitions; qualifications; preparation and administration of exams; reimbursement; accreditation; question pools; documentation requirements

E1E01 (A) [97.527]
For which types of out-of-pocket expenses do the Part 97 rules state that VEs and VECs may be reimbursed?
A. Preparing, processing, administering, and coordinating an examination for an amateur radio operator license
B. Teaching an amateur operator license examination preparation course
C. No expenses are authorized for reimbursement
D. Providing amateur operator license examination preparation training materials
~~

E1E02 (C) [97.523]
Who is tasked by Part 97 with maintaining the pools of questions for all US amateur license examinations?
A. The Ves
B. The FCC
C. The VECs
D. The ARRL
~~

E1E03 (C) [97.521]
What is a Volunteer Examiner Coordinator?
A. A person who has volunteered to administer amateur operator license examinations
B. An organization paid by the volunteer examiner team to publicize and schedule examinations
C. An organization that has entered into an agreement with the FCC to coordinate, prepare, and administer amateur operator license examinations
D. The person who has entered into an agreement with the FCC to be the VE session manager
~~

E1E04 (D) [97.509, 97.525]
What is required to be accredited as a Volunteer Examiner?
A. Each General, Advanced and Amateur Extra class operator is automatically accredited as a VE when the license is granted
B. The amateur operator applying must pass a VE examination administered by the FCC Enforcement Bureau
C. The prospective VE must obtain accreditation from the FCC
D. A VEC must confirm that the VE applicant meets FCC requirements to serve as an examiner
~~

E1E05 (B) [97.509(j)]
What must the VE team do with the application form if the examinee does not pass the exam?
A. Maintain the application form with the VEC’s records
B. Return the application document to the examinee
C. Send the application form to the FCC and inform the FCC of the grade
D. Destroy the application form
~~

E1E06 (C) [97.509]
Who is responsible for the proper conduct and necessary supervision during an amateur operator license examination session?
A. The VEC coordinating the session
B. The designated monitoring VE
C. Each administering VE
D. Only the VE session manager
~~

E1E07 (B) [97.509, 97.511]
What should a VE do if a candidate fails to comply with the examiner’s instructions during an amateur operator license examination?
A. Warn the candidate that continued failure to comply will result in termination of the examination
B. Immediately terminate the candidate’s examination
C. Allow the candidate to complete the examination, but invalidate the results
D. Immediately terminate everyone’s examination and close the session
~~

E1E08 (C) [97.509]
To which of the following examinees may a VE not administer an examination?
A. Employees of the VE
B. Friends of the VE
C. Relatives of the VE as listed in the FCC rules
D. All these choices are correct
~~

E1E09 (A) [97.509]
What may be the penalty for a VE who fraudulently administers or certifies an examination?
A. Revocation of the VE’s amateur station license grant and the suspension of the VE’s amateur operator license grant
B. A fine of up to $1,000 per occurrence
C. A sentence of up to one year in prison
D. All these choices are correct
~~

E1E10 (C) [97.509(m)]
What must the administering VEs do after the administration of a successful examination for an amateur operator license?
A. They must collect and send the documents directly to the FCC
B. They must collect and submit the documents to the coordinating VEC for grading
C. They must submit the application document to the coordinating VEC according to the coordinating VEC instructions
D. They must return the documents to the applicant for submission to the FCC according to the FCC instructions
~~

E1E11 (B) [97.509(i)]
What must the VE team do if an examinee scores a passing grade on all examination elements needed for an upgrade or new license?
A. Photocopy all examination documents and forward them to the FCC for processing
B. Three VEs must certify that the examinee is qualified for the license grant and that they have complied with the administering VE requirements
C. Issue the examinee the new or upgrade license
D. All these choices are correct
~~

E1F Miscellaneous rules: external RF power amplifiers; prohibited communications; spread spectrum; auxiliary stations; Canadian amateurs operating in the US; special temporary authority

E1F01 (B) [97.305]
On what frequencies are spread spectrum transmissions permitted?
A. Only on amateur frequencies above 50 MHz
B. Only on amateur frequencies above 222 MHz
C. Only on amateur frequencies above 420 MHz
D. Only on amateur frequencies above 144 MHz
~~

E1F02 (C) [97.107]
What privileges are authorized in the US to persons holding an amateur service license granted by the government of Canada?
A. None, they must obtain a US license
B. Full privileges of the General class license on the 80-, 40-, 20-, 15-, and 10-meter bands
C. The operating terms and conditions of the Canadian amateur service license, not to exceed US Amateur Extra class license privileges
D. Full privileges, up to and including those of the Amateur Extra class license, on the 80-, 40-, 20-, 15-, and 10-meter bands
~~

E1F03 (D) [97.315]
Under what circumstances may a dealer sell an external RF power amplifier capable of operation below 144 MHz if it has not been granted FCC certification?
A. Gain is less than 23 dB when driven by power of 10 watts or less
B. The equipment dealer assembled it from a kit
C. It was manufactured and certificated in a country which has a reciprocal certification agreement with the FCC
D. The amplifier is constructed or modified by an amateur radio operator for use at an amateur station
~~

E1F04 (A) [97.3]
Which of the following geographic descriptions approximately describes "Line A"?
A. A line roughly parallel to and south of the border between the US and Canada
B. A line roughly parallel to and west of the US Atlantic coastline
C. A line roughly parallel to and north of the border between the US and Mexico
D. A line roughly parallel to and east of the US Pacific coastline
~~

E1F05 (D) [97.303]
Amateur stations may not transmit in which of the following frequency segments if they are located in the contiguous 48 states and north of Line A?
A. 440 MHz - 450 Mhz
B. 53 MHz - 54 Mhz
C. 222 MHz - 223 Mhz
D. 420 MHz - 430 MHz
~~

E1F06 (A) [1.931]
Under what circumstances might the FCC issue a Special Temporary Authority (STA) to an amateur station?
A. To provide for experimental amateur communications
B. To allow use of a special event call sign
C. To allow a VE group with less than three VEs to administer examinations in a remote, sparsely populated area
D. To allow a licensee who has passed an upgrade exam to operate with upgraded privileges while waiting for posting on the FCC database
~~

E1F07 (D) [97.113]
When may an amateur station send a message to a business?
A. When the pecuniary interest of the amateur or his or her employer is less than $25
B. When the pecuniary interest of the amateur or his or her employer is less than $50
C. At no time
D. When neither the amateur nor their employer has a pecuniary interest in the communications
~~

E1F08 (A) [97.113(c)]
Which of the following types of amateur station communications are prohibited?
A. Communications transmitted for hire or material compensation, except as otherwise provided in the rules
B. Communications that have political content, except as allowed by the Fairness Doctrine
C. Communications that have religious content
D. Communications in a language other than English
~~

E1F09 (C) [FCC Part 97.113(a)(4)]
Which of the following cannot be transmitted over an amateur radio mesh network?
A. Third party traffic
B. Email
C. Messages encoded to obscure their meaning
D. All these choices are correct
~~

E1F10 (B) [97.201]
Who may be the control operator of an auxiliary station?
A. Any licensed amateur operator
B. Only Technician, General, Advanced, or Amateur Extra class operators
C. Only General, Advanced, or Amateur Extra class operators
D. Only Amateur Extra class operators
~~

E1F11 (D) [97.317]
Which of the following best describes one of the standards that must be met by an external RF power amplifier if it is to qualify for a grant of FCC certification?
A. It must produce full legal output when driven by not more than 5 watts of mean RF input power
B. It must have received an Underwriters Laboratory certification for electrical safety as well as having met IEEE standard 14.101(B)
C. It must exhibit a gain of less than 23 dB when driven by 10 watts or less
D. It must satisfy the FCC's spurious emission standards when operated at the lesser of 1500 watts or its full output power
~~

SUBELEMENT E2 - OPERATING PROCEDURES [5 Exam Questions - 5 Groups]

E2A Amateur radio in space: amateur satellites; orbital mechanics; frequencies and modes; satellite hardware; satellite operations

E2A01 (C)
What is the direction of an ascending pass for an amateur satellite?
A. From west to east
B. From east to west
C. From south to north
D. From north to south
~~

E2A02 (D)
Which of the following is characteristic of an inverting linear transponder?
A. Doppler shift is reduced because the uplink and downlink shifts are in opposite directions
B. Signal position in the band is reversed
C. Upper sideband on the uplink becomes lower sideband on the downlink, and vice versa
D. All these choices are correct
~~

E2A03 (D)
How is an upload signal processed by an inverting linear transponder?
A. The signal is detected and remodulated on the reverse sideband
B. The signal is passed through a nonlinear filter
C. The signal is reduced to I and Q components, and the Q component is filtered out
D. The signal is mixed with a local oscillator signal and the difference product is transmitted
~~

E2A04 (B)
What is meant by the "mode" of an amateur radio satellite?
A. Whether the satellite is in a low earth or geostationary orbit
B. The satellite's uplink and downlink frequency bands
C. The satellite's orientation with respect to the Earth
D. Whether the satellite is in a polar or equatorial orbit
~~

E2A05 (D)
What do the letters in a satellite’s mode designator specify?
A. Power limits for uplink and downlink transmissions
B. The location of the ground control station
C. The polarization of uplink and downlink signals
D. The uplink and downlink frequency ranges
~~

E2A06 (A)
What are Keplerian elements?
A. Parameters that define the orbit of a satellite
B. Phase reversing elements in a Yagi antenna
C. High-emission heater filaments used in magnetron tubes
D. Encrypting codes used for spread spectrum modulation
~~

E2A07 (D)
Which of the following types of signals can be relayed through a linear transponder?
A. FM and CW
B. SSB and SSTV
C. PSK and packet
D. All these choices are correct
~~

E2A08 (B)
Why should effective radiated power (ERP) be limited to a satellite that uses a linear transponder?
A. To prevent creating errors in the satellite telemetry
B. To avoid reducing the downlink power to all other users
C. To prevent the satellite from emitting out-of-band signals
D. To avoid interfering with terrestrial QSOs
~~

E2A09 (A)
What do the terms “L band” and “S band” specify?
A. The 23- and 13-centimeter bands
B. The 2-meter and 70-centimeter bands
C. FM and digital store-and-forward systems
D. Which sideband to use
~~

E2A10 (B)
What type of satellite appears to stay in one position in the sky?
A. HEO
B. Geostationary
C. Geomagnetic
D. LEO
~~

E2A11 (B)
What type of antenna can be used to minimize the effects of spin modulation and Faraday rotation?
A. A linearly polarized antenna
B. A circularly polarized antenna
C. An isotropic antenna
D. A log-periodic dipole array
~~

E2A12 (C)
What is the purpose of digital store-and-forward functions on an amateur radio satellite?
A. To upload operational software for the transponder
B. To delay download of telemetry between satellites
C. To hold digital messages in the satellite for later download
D. To relay messages between satellites
~~

E2A13 (B)
Which of the following techniques is used by digital satellites to relay messages?
A. Digipeating
B. Store-and-forward
C. Multisatellite relaying
D. Node hopping
~~

E2B Television practices: fast-scan television standards and techniques; slow scan television standards and techniques

E2B01 (A)
In digital television, what does a coding rate of 3/4 mean?
A. 25% of the data sent is forward error correction data
B. Data compression reduces data rate by ¾
C. 1/4 of the time interval is used as a guard interval
D. Three, four-bit words are used to transmit each pixel
~~

E2B02 (C)
How many horizontal lines make up a fast-scan (NTSC) television frame?
A. 30
B. 60
C. 525
D. 1080
~~

E2B03 (D)
How is an interlaced scanning pattern generated in a fast-scan (NTSC) television system?
A. By scanning two fields simultaneously
B. By scanning each field from bottom-to-top
C. By scanning lines from left-to-right in one field and right-to-left in the next
D. By scanning odd-numbered lines in one field and even-numbered lines in the next
~~

E2B04 (A)
How is color information sent in analog SSTV?
A. Color lines are sent sequentially
B. Color information is sent on a 2.8 kHz subcarrier
C. Color is sent in a color burst at the end of each line
D. Color is amplitude modulated on the frequency modulated intensity signal
~~

E2B05 ©
Which of the following describes the use of vestigial sideband in analog fast-scan TV transmissions?
A. The vestigial sideband carries the audio information
B. The vestigial sideband contains chroma information
C. Vestigial sideband reduces the bandwidth while increasing the fidelity of low frequency video components
D. Vestigial sideband provides high frequency emphasis to sharpen the picture
~~

E2B06 (A)
What is vestigial sideband modulation?
A. Amplitude modulation in which one complete sideband and a portion of the other are transmitted
B. A type of modulation in which one sideband is inverted
C. Narrow-band FM modulation achieved by filtering one sideband from the audio before frequency modulating the carrier
D. Spread spectrum modulation achieved by applying FM modulation following single sideband amplitude modulation
~~

E2B07 (B)
Which types of modulation are used for amateur television DVB-T signals?
A. FM and FSK
B. QAM and QPSK
C. AM and OOK
D. All these choices are correct
~~

E2B08 (A)
What technique allows commercial analog TV receivers to be used for fast-scan TV operations on the 70-centimeter band?
A. Transmitting on channels shared with cable TV
B. Using converted satellite TV dishes
C. Transmitting on the abandoned TV channel 2
D. Using USB and demodulating the signal with a computer sound card
~~

E2B09 (D)
What kind of receiver can be used to receive and decode SSTV using the Digital Radio Mondiale (DRM) protocol?
A. CDMA
B. AREDN
C. AM
D. SSB
~~

E2B10 (A)
What aspect of an analog slow-scan television signal encodes the brightness of the picture?
A. Tone frequency
B. Tone amplitude
C. Sync amplitude
D. Sync frequency
~~

E2B11 (B)
What is the function of the vertical interval signaling (VIS) code sent as part of an SSTV transmission?
A. To lock the color burst oscillator in color SSTV images
B. To identify the SSTV mode being used
C. To provide vertical synchronization
D. To identify the call sign of the station transmitting
~~

E2B12 (A)
What signals SSTV receiving software to begin a new picture line?
A. Specific tone frequencies
B. Elapsed time
C. Specific tone amplitudes
D. A two-tone signal
~~

E2C Contest and DX operating; remote operation techniques; log data format; contact confirmation; RF network systems

E2C01 (D)
What indicator is required to be used by US-licensed operators when operating a station via remote control and the remote transmitter is located in the US?
A. / followed by the USPS two-letter abbreviation for the state in which the remote station is located
B. /R# where # is the district of the remote station
C. / followed by the ARRL Section of the remote station
D. No additional indicator is required
~~

E2C02 (C)
Which of the following file formats is used for exchanging amateur radio log data?
A. NEC
B. ARLD
C. ADIF
D. OCF
~~

E2C03 (A)
From which of the following bands is amateur radio contesting generally excluded?
A. 30 meters
B. 6 meters
C. 70 centimeters
D. 33 centimeters
~~

E2C04 (B)
Which of the following frequencies can be used for amateur radio mesh networks?
A. HF frequencies where digital communications are permitted
B. Frequencies shared with various unlicensed wireless data services
C. Cable TV channels 41-43
D. The 60-meter band channel centered on 5373 kHz
~~

E2C05 (B)
What is the function of a DX QSL Manager?
A. Allocate frequencies for Dxpeditions
B. Handle the receiving and sending of confirmations for a DX station
C. Run a net to allow many stations to contact a rare DX station
D. Communicate to a DXpedition about propagation, band openings, pileup conditions, etc.
~~

E2C06 (C)
During a VHF/UHF contest, in which band segment would you expect to find the highest level of SSB or CW activity?
A. At the top of each band, usually in a segment reserved for contests
B. In the middle of each band, usually on the national calling frequency
C. In the weak signal segment of the band, with most of the activity near the calling frequency
D. In the middle of the band, usually 25 kHz above the national calling frequency
~~

E2C07 (A)
What is the Cabrillo format?
A. A standard for submission of electronic contest logs
B. A method of exchanging information during a contest QSO
C. The most common set of contest rules
D. A digital protocol specifically designed for rapid contest exchanges
~~

E2C08 (D)
Which of the following contacts may be confirmed through the Logbook of The World (LoTW)?
A. Special event contacts between stations in the US
B. Contacts between a US station and a non-US station
C. Contacts for Worked All States credit
D. All these choices are correct
~~

E2C09 (C)
What type of equipment is commonly used to implement an amateur radio mesh network?
A. A 2-meter VHF transceiver with a 1,200-baud modem
B. A computer running EchoLink to provide interface from the radio to the internet
C. A wireless router running custom firmware
D. A 440 MHz transceiver with a 9,600-baud modem
~~

E2C10 (D)
Why do DX stations often transmit and receive on different frequencies?
A. Because the DX station may be transmitting on a frequency that is prohibited to some responding stations
B. To separate the calling stations from the DX station
C. To improve operating efficiency by reducing interference
D. All these choices are correct
~~

E2C11 (A)
How should you generally identify your station when attempting to contact a DX station during a contest or in a pileup?
A. Send your full call sign once or twice
B. Send only the last two letters of your call sign until you make contact
C. Send your full call sign and grid square
D. Send the call sign of the DX station three times, the words “this is,” then your call sign three times
~~

E2C12 (C)
What indicates the delay between a control operator action and the corresponding change in the transmitted signal?
A. Jitter
B. Hang time
C. Latency
D. Anti-VOX
~~

E2D Operating methods: digital modes and procedures for VHF and UHF; APRS; EME procedures; meteor scatter procedures

E2D01 (B)
Which of the following digital modes is designed for meteor scatter communications?
A. WSPR
B. MSK144
C. Hellschreiber
D. APRS
~~

E2D02 (D)
What information replaces signal-to-noise ratio when using the FT8 or FT4 modes in a VHF contest?
A. RST report
B. State abbreviation
C. Serial number
D. Grid square
~~

E2D03 (D)
Which of the following digital modes is designed for EME communications?
A. MSK144
B. PACTOR III
C. WSPR
D. Q65
~~

E2D04 (C)
What technology is used for real-time tracking of balloons carrying amateur radio transmitters?
A. FT8
B. Bandwidth compressed LORAN
C. APRS
D. PACTOR III
~~

E2D05 (B)
What is the characteristic of the JT65 mode?
A. Uses only a 65 Hz bandwidth
B. Decodes signals with a very low signal-to-noise ratio
C. Symbol rate is 65 baud
D. Permits fast-scan TV transmissions over narrow bandwidth
~~

E2D06 (A)
Which of the following is a method for establishing EME contacts?
A. Time-synchronous transmissions alternating between stations
B. Storing and forwarding digital messages
C. Judging optimum transmission times by monitoring beacons reflected from the moon
D. High-speed CW identification to avoid fading
~~

E2D07 (C)
What digital protocol is used by APRS?
A. PACTOR
B. QAM
C. AX.25
D. AMTOR
~~

E2D08 (C)
What type of packet frame is used to transmit APRS beacon data?
A. Acknowledgement
B. Burst
C. Unnumbered Information
D. Connect
~~

E2D09 (A)
What type of modulation is used by JT65?
A. Multitone AFSK
B. PSK
C. RTTY
D. QAM
~~

E2D10 (C)
What does the packet path WIDE3-1 designate?
A. Three stations are allowed on frequency, one transmitting at a time
B. Three subcarriers are permitted, subcarrier one is being used
C. Three digipeater hops are requested with one remaining
D. Three internet gateway stations may receive one transmission
~~

E2D11 (D)
How do APRS stations relay data?
A. By packet ACK/NAK relay
B. By C4FM repeaters
C. By DMR repeaters
D. By packet digipeaters
~~

E2E Operating methods: digital modes and procedures for HF

E2E01 (B)
Which of the following types of modulation is used for data emissions below 30 MHz?
A. DTMF tones modulating an FM signal
B. FSK
C. Pulse modulation
D. Spread spectrum
~~

E2E02 (B)
Which of the following synchronizes WSJT-X digital mode transmit/receive timing?
A. Alignment of frequency shifts
B. Synchronization of computer clocks
C. Sync-field transmission
D. Sync-pulse timing
~~

E2E03 (B)
To what does the "4" in FT4 refer?
A. Multiples of 4 bits of user information
B. Four-tone continuous-phase frequency shift keying
C. Four transmit/receive cycles per minute
D. All these choices are correct
~~

E2E04 (D)
Which of the following is characteristic of the FST4 mode?
A. Four-tone Gaussian frequency shift keying
B. Variable transmit/receive periods
C. Seven different tone spacings
D. All these choices are correct
~~

E2E05 (A)
Which of these digital modes does not support keyboard-to-keyboard operation?
A. WSPR
B. RTTY
C. PSK31
D. MFSK16
~~

E2E06 (C)
What is the length of an FT8 transmission cycle?
A. It varies with the amount of data
B. 8 seconds
C. 15 seconds
D. 30 seconds
~~

E2E07 (C)
How does Q65 differ from JT65?
A. Keyboard-to keyboard operation is supported
B. Quadrature modulation is used
C. Multiple receive cycles are averaged
D. All these choices are correct
~~

E2E08 (B)
Which of the following HF digital modes can be used to transfer binary files?
A. PSK31
B. PACTOR
C. RTTY
D. AMTOR
~~

E2E09 (D)
Which of the following HF digital modes uses variable-length character coding?
A. RTTY
B. PACTOR
C. MT63
D. PSK31
~~

E2E10 (C)
Which of these digital modes has the narrowest bandwidth?
A. MFSK16
B. 170 Hz shift, 45-baud RTTY
C. FT8
D. PACTOR IV
~~

E2E11 (A)
What is the difference between direct FSK and audio FSK?
A. Direct FSK modulates the transmitter VFO
B. Direct FSK occupies less bandwidth
C. Direct FSK can transmit higher baud rates
D. All these choices are correct
~~

E2E12 (A)
How do ALE stations establish contact?
A. ALE constantly scans a list of frequencies, activating the radio when the designated call sign is received
B. ALE radios monitor an internet site for the frequency they are being paged on
C. ALE radios send a constant tone code to establish a frequency for future use
D. ALE radios activate when they hear their signal echoed by back scatter
~~

E2E13 (D)
Which of these digital modes has the highest data throughput under clear communication conditions?
A. MFSK16
B. 170 Hz shift, 45 baud RTTY
C. FT8
D. PACTOR IV
~~

SUBELEMENT E3 - RADIO WAVE PROPAGATION [3 Exam Questions - 3 Groups]

E3A Electromagnetic Waves and Specialized Propagation: Earth-Moon-Earth (EME) communications; meteor scatter; microwave tropospheric and scatter propagation; auroral propagation; daily variation of ionospheric propagation; circular polarization

E3A01 (D)
What is the approximate maximum separation measured along the surface of the Earth between two stations communicating by EME?
A. 2,000 miles, if the moon is at perigee
B. 2,000 miles, if the moon is at apogee
C. 5,000 miles, if the moon is at perigee
D. 12,000 miles, if the moon is “visible” by both stations
~~

E3A02 (B)
What characterizes libration fading of an EME signal?
A. A slow change in the pitch of the CW signal
B. A fluttery, irregular fading
C. A gradual loss of signal as the sun rises
D. The returning echo is several hertz lower in frequency than the transmitted signal
~~

E3A03 (A)
When scheduling EME contacts, which of these conditions will generally result in the least path loss?
A. When the Moon is at perigee
B. When the Moon is full
C. When the Moon is at apogee
D. When the MUF is above 30 MHz
~~

E3A04 (D)
In what direction does an electromagnetic wave travel?
A. It depends on the phase angle of the magnetic field
B. It travels parallel to the electric and magnetic fields
C. It depends on the phase angle of the electric field
D. It travels at a right angle to the electric and magnetic fields
~~

E3A05 (C)
How are the component fields of an electromagnetic wave oriented?
A. They are parallel
B. They are tangential
C. They are at right angles
D. They are 90 degrees out of phase
~~

E3A06 (B)
What should be done to continue a long-distance contact when the MUF for that path decreases due to darkness?
A. Switch to a higher frequency HF band
B. Switch to a lower frequency HF band
C. Change to an antenna with a higher takeoff angle
D. Change to an antenna with greater beam width
~~

E3A07 (C)
Atmospheric ducts capable of propagating microwave signals often form over what geographic feature?
A. Mountain ranges
B. Stratocumulus clouds
C. Large bodies of water
D. Nimbus clouds
~~

E3A08 (A)
When a meteor strikes the Earth’s atmosphere, a linear ionized region is formed at what region of the ionosphere?
A. The E region
B. The F1 region
C. The F2 region
D. The D region
~~

E3A09 (C)
Which of the following frequency ranges is most suited for meteor-scatter communications?
A. 1.8 MHz - 1.9 Mhz
B. 10 MHz - 14 Mhz
C. 28 MHz - 148 Mhz
D. 220 MHz - 450 MHz
~~

E3A10 (D)
What determines the speed of electromagnetic waves through a medium?
A. Resistance and reactance
B. Evanescence
C. Birefringence
D. The index of refraction
~~

E3A11 (B)
What is a typical range for tropospheric duct propagation of microwave signals?
A. 10 miles to 50 miles
B. 100 miles to 300 miles
C. 1,200 miles
D. 2,500 miles
~~

E3A12 (C)
What is most likely to result in auroral propagation?
A. Meteor showers
B. Quiet geomagnetic conditions
C. Severe geomagnetic storms
D. Extreme low-pressure areas in polar regions
~~

E3A13 (A)
Which of these emission modes is best for auroral propagation?
A. CW
B. SSB
C. FM
D. RTTY
~~

E3A14 (B)
What are circularly polarized electromagnetic waves?
A. Waves with an electric field bent into a circular shape
B. Waves with rotating electric and magnetic fields
C. Waves that circle Earth
D. Waves produced by a loop antenna
~~

E3B Transequatorial propagation; long-path propagation; ordinary and extraordinary waves; chordal hop; sporadic-E mechanisms; ground-wave propagation

E3B01 (A)
Where is transequatorial propagation (TEP) most likely to occur?
A. Between points separated by 2,000 miles to 3,000 miles over a path perpendicular to the geomagnetic equator
B. Between points located 1,500 miles to 2,000 miles apart on the geomagnetic equator
C. Between points located at each other's antipode
D. Through the region where the terminator crosses the geographic equator
~~

E3B02 (C)
What is the approximate maximum range for signals using transequatorial propagation?
A. 1,000 miles
B. 2,500 miles
C. 5,000 miles
D. 7,500 miles
~~

E3B03 (C)
At what time of day is transequatorial propagation most likely to occur?
A. Morning
B. Noon
C. Afternoon or early evening
D. Late at night
~~

E3B04 (B)
What are "extraordinary" and "ordinary" waves?
A. Extraordinary waves exhibit rare long-skip propagation, compared to ordinary waves, which travel shorter distances
B. Independently propagating, elliptically polarized waves created in the ionosphere
C. Long-path and short-path waves
D. Refracted rays and reflected waves
~~

E3B05 (D)
Which of the following paths is most likely to support long-distance propagation on 160 meters?
A. A path entirely in sunlight
B. Paths at high latitudes
C. A direct north-south path
D. A path entirely in darkness
~~

E3B06 (B)
On which of the following amateur bands is long-path propagation most frequent?
A. 160 meters and 80 meters
B. 40 meters and 20 meters
C. 10 meters and 6 meters
D. 6 meters and 2 meters
~~

E3B07 (C)
What effect does lowering a signal’s transmitted elevation angle have on ionospheric HF skip propagation?
A. Faraday rotation becomes stronger
B. The MUF decreases
C. The distance covered by each hop increases
D. The critical frequency increases
~~

E3B08 (C)
How does the maximum range of ground-wave propagation change when the signal frequency is increased?
A. It stays the same
B. It increases
C. It decreases
D. It peaks at roughly 8 MHz
~~

E3B09 (A)
At what time of year is sporadic-E propagation most likely to occur?
A. Around the solstices, especially the summer solstice
B. Around the solstices, especially the winter solstice
C. Around the equinoxes, especially the spring equinox
D. Around the equinoxes, especially the fall equinox
~~

E3B10 (A)
What is the effect of chordal-hop propagation?
A. The signal experiences less loss compared to multi-hop propagation, which uses Earth as a reflector
B. The MUF for chordal-hop propagation is much lower than for normal skip propagation
C. Atmospheric noise is reduced in the direction of chordal-hop propagation
D. Signals travel faster along ionospheric chords
~~

E3B11 (D)
At what time of day is sporadic-E propagation most likely to occur?
A. Between midnight and sunrise
B. Between sunset and midnight
C. Between sunset and sunrise
D. Between sunrise and sunset
~~

E3B12 (B)
What is chordal-hop propagation?
A. Propagation away from the great circle bearing between stations
B. Successive ionospheric refractions without an intermediate reflection from the ground
C. Propagation across the geomagnetic equator
D. Signals reflected back toward the transmitting station
~~

E3B13 (A)
What type of polarization is supported by ground-wave propagation?
A. Vertical
B. Horizontal
C. Circular
D. Elliptical
~~

E3C Propagation prediction and reporting: radio horizon; effects of space-weather phenomena

E3C01 (D)
What is the cause of short-term radio blackouts?
A. Coronal mass ejections
B. Sunspots on the solar equator
C. North-oriented interplanetary magnetic field
D. Solar flares
~~

E3C02 (A)
What is indicated by a rising A-index or K-index?
A. Increasing disturbance of the geomagnetic field
B. Decreasing disturbance of the geomagnetic field
C. Higher levels of solar UV radiation
D. An increase in the critical frequency
~~

E3C03 (B)
Which of the following signal paths is most likely to experience high levels of absorption when the A-index or K-index is elevated?
A. Transequatorial
B. Through the auroral oval
C. Sporadic-E
D. NVIS
~~

E3C04 (C)
What does the value of Bz (B sub z) represent?
A. Geomagnetic field stability
B. Critical frequency for vertical transmissions
C. North-south strength of the interplanetary magnetic field
D. Duration of long-delayed echoes
~~

E3C05 (A)
What orientation of Bz (B sub z) increases the likelihood that charged particles from the Sun will cause disturbed conditions?
A. Southward
B. Northward
C. Eastward
D. Westward
~~

E3C06 (A)
How does the VHF/UHF radio horizon compare to the geographic horizon?
A. It is approximately 15 percent farther
B. It is approximately 20 percent nearer
C. It is approximately 50 percent farther
D. They are approximately the same
~~

E3C07 (D)
Which of the following indicates the greatest solar flare intensity?
A. Class A
B. Class Z
C. Class M
D. Class X
~~

E3C08 (D)
Which of the following is the space-weather term for an extreme geomagnetic storm?
A. B9
B. X5
C. M9
D. G5
~~

E3C09 (D)
What type of data is reported by amateur radio propagation reporting networks?
A. Solar flux
B. Electric field intensity
C. Magnetic declination
D. Digital-mode and CW signals
~~

E3C10 (B)
What does the 304A solar parameter measure?
A. The ratio of X-ray flux to radio flux, correlated to sunspot number
B. UV emissions at 304 angstroms, correlated to the solar flux index
C. The solar wind velocity at an angle of 304 degrees from the solar equator, correlated to geomagnetic storms
D. The solar emission at 304 GHz, correlated to X-ray flare levels
~~

E3C11 (C)
What does VOACAP software model?
A. AC voltage and impedance
B. VHF radio propagation
C. HF propagation
D. AC current and impedance
~~

E3C12 (B)
Which of the following is indicated by a sudden rise in radio background noise across a large portion of the HF spectrum?
A. A temperature inversion has occurred
B. A coronal mass ejection impact or a solar flare has occurred
C. Transequatorial propagation on 6 meters is likely
D. Long-path propagation on the higher HF bands is likely
~~

SUBELEMENT E4 - AMATEUR PRACTICES [5 Exam Questions - 5 Groups]

E4A Test equipment: analog and digital instruments; spectrum analyzers; antenna analyzers; oscilloscopes; RF measurements

E4A01 (A)
Which of the following limits the highest frequency signal that can be accurately displayed on a digital oscilloscope?
A. Sampling rate of the analog-to-digital converter
B. Analog-to-digital converter reference frequency
C. Q of the circuit
D. All these choices are correct
~~

E4A02 (B)
Which of the following parameters does a spectrum analyzer display on the vertical and horizontal axes?
A. Signal amplitude and time
B. Signal amplitude and frequency
C. SWR and frequency
D. SWR and time
~~

E4A03 (B)
Which of the following test instruments is used to display spurious signals and/or intermodulation distortion products generated by an SSB transmitter?
A. Differential resolver
B. Spectrum analyzer
C. Logic analyzer
D. Network analyzer
~~

E4A04 (A)
How is compensation of an oscilloscope probe performed?
A. A square wave is displayed, and the probe is adjusted until the horizontal portions of the displayed wave are as nearly flat as possible
B. A high frequency sine wave is displayed, and the probe is adjusted for maximum amplitude
C. A frequency standard is displayed, and the probe is adjusted until the deflection time is accurate
D. A DC voltage standard is displayed, and the probe is adjusted until the displayed voltage is accurate
~~

E4A05 (D)
What is the purpose of using a prescaler with a frequency counter?
A. Amplify low-level signals for more accurate counting
B. Multiply a higher frequency signal so a low-frequency counter can display the operating frequency
C. Prevent oscillation in a low-frequency counter circuit
D. Reduce the signal frequency to within the counter's operating range
~~

E4A06 (A)
What is the effect of aliasing on a digital oscilloscope when displaying a waveform?
A. A false, jittery low-frequency version of the waveform is displayed
B. The waveform DC offset will be inaccurate
C. Calibration of the vertical scale is no longer valid
D. Excessive blanking occurs, which prevents display of the waveform
~~

E4A07 (B)
Which of the following is an advantage of using an antenna analyzer compared to an SWR bridge?
A. Antenna analyzers automatically tune your antenna for resonance
B. Antenna analyzers compute SWR and impedance automatically
C. Antenna analyzers display a time-varying representation of the modulation envelope
D. All these choices are correct
~~

E4A08 (D)
Which of the following is used to measure SWR?
A. Directional wattmeter
B. Vector network analyzer
C. Antenna analyzer
D. All these choices are correct
~~

E4A09 (A)
Which of the following is good practice when using an oscilloscope probe?
A. Minimize the length of the probe's ground connection
B. Never use a high-impedance probe to measure a low-impedance circuit
C. Never use a DC-coupled probe to measure an AC circuit
D. All these choices are correct
~~

E4A10 (D)
Which trigger mode is most effective when using an oscilloscope to measure a linear power supply’s output ripple?
A. Single-shot
B. Edge
C. Level
D. Line
~~

E4A11 (D)
Which of the following can be measured with an antenna analyzer?
A. Velocity factor
B. Cable length
C. Resonant frequency of a tuned circuit
D. All these choices are correct
~~

E4B Measurement technique and limitations: instrument accuracy and performance limitations; probes; techniques to minimize errors; measurement of Q; instrument calibration; S parameters; vector network analyzers; RF signals

E4B01 (B)
Which of the following factors most affects the accuracy of a frequency counter?
A. Input attenuator accuracy
B. Time base accuracy
C. Decade divider accuracy
D. Temperature coefficient of the logic
~~

E4B02 (A)
What is the significance of voltmeter sensitivity expressed in ohms per volt?
A. The full scale reading of the voltmeter multiplied by its ohms per volt rating is the input impedance of the voltmeter
B. The reading in volts multiplied by the ohms per volt rating will determine the power drawn by the device under test
C. The reading in ohms divided by the ohms per volt rating will determine the voltage applied to the circuit
D. The full scale reading in amps divided by ohms per volt rating will determine the size of shunt needed
~~

E4B03 (C)
Which S parameter is equivalent to forward gain?
A. S11
B. S12
C. S21
D. S22
~~

E4B04 (A)
Which S parameter represents input port return loss or reflection coefficient (equivalent to VSWR)?
A. S11
B. S12
C. S21
D. S22
~~

E4B05 (B)
What three test loads are used to calibrate an RF vector network analyzer?
A. 50 ohms, 75 ohms, and 90 ohms
B. Short circuit, open circuit, and 50 ohms
C. Short circuit, open circuit, and resonant circuit
D. 50 ohms through 1/8 wavelength, 1/4 wavelength, and 1/2 wavelength of coaxial cable
~~

E4B06 (D)
How much power is being absorbed by the load when a directional power meter connected between a transmitter and a terminating load reads 100 watts forward power and 25 watts reflected power?
A. 100 watts
B. 125 watts
C. 112.5 watts
D. 75 watts
~~

E4B07 (A)
What do the subscripts of S parameters represent?
A. The port or ports at which measurements are made
B. The relative time between measurements
C. Relative quality of the data
D. Frequency order of the measurements
~~

E4B08 (C)
Which of the following can be used to determine the Q of a series-tuned circuit?
A. The ratio of inductive reactance to capacitive reactance
B. The frequency shift
C. The bandwidth of the circuit's frequency response
D. The resonant frequency of the circuit
~~

E4B09 (B)
Which of the following can be measured by a two-port vector network analyzer?
A. Phase noise
B. Filter frequency response
C. Pulse rise time
D. Forward power
~~

E4B10 (B)
Which of the following methods measures intermodulation distortion in an SSB transmitter?
A. Modulate the transmitter using two RF signals having non-harmonically related frequencies and observe the RF output with a spectrum analyzer
B. Modulate the transmitter using two AF signals having non-harmonically related frequencies and observe the RF output with a spectrum analyzer
C. Modulate the transmitter using two AF signals having harmonically related frequencies and observe the RF output with a peak reading wattmeter
D. Modulate the transmitter using two RF signals having harmonically related frequencies and observe the RF output with a logic analyzer
~~

E4B11 (D)
Which of the following can be measured with a vector network analyzer?
A. Input impedance
B. Output impedance
C. Reflection coefficient
D. All these choices are correct
~~

E4C Receiver performance: phase noise, noise floor, image rejection, minimum detectable signal (MDS), increasing signal-to-noise ratio and dynamic range, noise figure, reciprocal mixing; selectivity; SDR non-linearity; use of attenuators at low frequencies

E4C01 (D)
What is an effect of excessive phase noise in an SDR receiver's master clock oscillator?
A. It limits the receiver's ability to receive strong signals
B. It can affect the receiver's frequency calibration
C. It decreases the receiver's third-order intercept point
D. It can combine with strong signals on nearby frequencies to generate interference
~~

E4C02 (A)
Which of the following receiver circuits can be effective in eliminating interference from strong out-of-band signals?
A. A front-end filter or preselector
B. A narrow IF filter
C. A notch filter
D. A properly adjusted product detector
~~

E4C03 (C)
What is the term for the suppression in an FM receiver of one signal by another stronger signal on the same frequency?
A. Desensitization
B. Cross-modulation interference
C. Capture effect
D. Frequency discrimination
~~

E4C04 (D)
What is the noise figure of a receiver?
A. The ratio of atmospheric noise to phase noise
B. The ratio of the noise bandwidth in hertz to the theoretical bandwidth of a resistive network
C. The ratio in dB of the noise generated in the receiver to atmospheric noise
D. The ratio in dB of the noise generated by the receiver to the theoretical minimum noise
~~

E4C05 (B)
What does a receiver noise floor of -174 dBm represent?
A. The receiver noise is 6 dB above the theoretical minimum
B. The theoretical noise in a 1 Hz bandwidth at the input of a perfect receiver at room temperature
C. The noise figure of a 1 Hz bandwidth receiver
D. The receiver noise is 3 dB above theoretical minimum
~~

E4C06 (D)
How much does increasing a receiver’s bandwidth from 50 Hz to 1,000 Hz increase the receiver’s noise floor?
A. 3 dB
B. 5 dB
C. 10 dB
D. 13 dB
~~

E4C07 (B)
What does the MDS of a receiver represent?
A. The meter display sensitivity
B. The minimum discernible signal
C. The modulation distortion specification
D. The maximum detectable spectrum
~~

E4C08 (D)
An SDR receiver is overloaded when input signals exceed what level?
A. One-half of the maximum sample rate
B. One-half of the maximum sampling buffer size
C. The maximum count value of the analog-to-digital converter
D. The reference voltage of the analog-to-digital converter
~~

E4C09 (C)
Which of the following choices is a good reason for selecting a high IF for a superheterodyne HF or VHF communications receiver?
A. Fewer components in the receiver
B. Reduced drift
C. Easier for front-end circuitry to eliminate image responses
D. Improved receiver noise figure
~~

E4C10 (C)
What is an advantage of having a variety of receiver bandwidths from which to select?
A. The noise figure of the RF amplifier can be adjusted to match the modulation type, thus increasing receiver sensitivity
B. Receiver power consumption can be reduced when wider bandwidth is not required
C. Receive bandwidth can be set to match the modulation bandwidth, maximizing signal-to-noise ratio and minimizing interference
D. Multiple frequencies can be received simultaneously if desired
~~

E4C11 (D)
Why does input attenuation reduce receiver overload on the lower frequency HF bands with little or no impact on signal-to-noise ratio?
A. The attenuator has a low-pass filter to increase the strength of lower frequency signals
B. The attenuator has a noise filter to suppress interference
C. Signals are attenuated separately from the noise
D. Atmospheric noise is generally greater than internally generated noise even after attenuation
~~

E4C12 (C)
How does a narrow-band roofing filter affect receiver performance?
A. It improves sensitivity by reducing front-end noise
B. It improves intelligibility by using low Q circuitry to reduce ringing
C. It improves blocking dynamic range by attenuating strong signals near the receive frequency
D. All these choices are correct
~~

E4C13 (D)
What is reciprocal mixing?
A. Two out-of-band signals mixing to generate an in-band spurious signal
B. In-phase signals cancelling in a mixer resulting in loss of receiver sensitivity
C. Two digital signals combining from alternate time slots
D. Local oscillator phase noise mixing with adjacent strong signals to create interference to desired signals
~~

E4C14 (C)
What is the purpose of the receiver IF Shift control?
A. To permit listening on a different frequency from the transmitting frequency
B. To change frequency rapidly
C. To reduce interference from stations transmitting on adjacent frequencies
D. To tune in stations slightly off frequency without changing the transmit frequency
~~

E4D Receiver performance characteristics: dynamic range; intermodulation and cross-modulation interference; third-order intercept; desensitization; preselector; sensitivity; link margin

E4D01 (A)
What is meant by the blocking dynamic range of a receiver?
A. The difference in dB between the noise floor and the level of an incoming signal that will cause 1 dB of gain compression
B. The minimum difference in dB between the levels of two FM signals that will cause one signal to block the other
C. The difference in dB between the noise floor and the third-order intercept point
D. The minimum difference in dB between two signals which produce third-order intermodulation products greater than the noise floor
~~

E4D02 (A)
Which of the following describes problems caused by poor dynamic range in a receiver?
A. Spurious signals caused by cross modulation and desensitization from strong adjacent signals
B. Oscillator instability requiring frequent retuning and loss of ability to recover the opposite sideband
C. Poor weak signal reception caused by insufficient local oscillator injection
D. Oscillator instability and severe audio distortion of all but the strongest received signals
~~

E4D03 (B)
What creates intermodulation interference between two repeaters in close proximity?
A. The output signals cause feedback in the final amplifier of one or both transmitters
B. The output signals mix in the final amplifier of one or both transmitters
C. The input frequencies are harmonically related
D. The output frequencies are harmonically related
~~

E4D04 (B)
Which of the following is used to reduce or eliminate intermodulation interference in a repeater caused by a nearby transmitter?
A. A band-pass filter in the feed line between the transmitter and receiver
B. A properly terminated circulator at the output of the repeater’s transmitter
C. Utilizing a Class C final amplifier
D. Utilizing a Class D final amplifier
~~

E4D05 (A)
What transmitter frequencies would create an intermodulation-product signal in a receiver tuned to 146.70 MHz when a nearby station transmits on 146.52 MHz?
A. 146.34 MHz and 146.61 MHz
B. 146.88 MHz and 146.34 MHz
C. 146.10 MHz and 147.30 MHz
D. 146.30 MHz and 146.90 MHz
~~

E4D06 (C)
What is the term for the reduction in receiver sensitivity caused by a strong signal near the received frequency?
A. Reciprocal mixing
B. Quieting
C. Desensitization
D. Cross modulation interference
~~

E4D07 (A)
Which of the following reduces the likelihood of receiver desensitization?
A. Insert attenuation before the first RF stage
B. Raise the receiver’s IF frequency
C. Increase the receiver’s front-end gain
D. Switch from fast AGC to slow AGC
~~

E4D08 (C)
What causes intermodulation in an electronic circuit?
A. Negative feedback
B. Lack of neutralization
C. Nonlinear circuits or devices
D. Positive feedback
~~

E4D09 (C)
What is the purpose of the preselector in a communications receiver?
A. To store frequencies that are often used
B. To provide broadband attenuation before the first RF stage to prevent intermodulation
C. To increase the rejection of signals outside the band being received
D. To allow selection of the optimum RF amplifier device
~~

E4D10 (C)
What does a third-order intercept level of 40 dBm mean with respect to receiver performance?
A. Signals less than 40 dBm will not generate audible third-order intermodulation products
B. The receiver can tolerate signals up to 40 dB above the noise floor without producing third-order intermodulation products
C. A pair of 40 dBm input signals will theoretically generate a third-order intermodulation product that has the same output amplitude as either of the input signals
D. A pair of 1 mW input signals will produce a third-order intermodulation product that is 40 dB stronger than the input signal
~~

E4D11 (A)
Why are odd-order intermodulation products, created within a receiver, of particular interest compared to other products?
A. Odd-order products of two signals in the band being received are also likely to be within the band
B. Odd-order products are more likely to overload the IF filters
C. Odd-order products are an indication of poor image rejection
D. Odd-order intermodulation produces three products for every input signal within the band of interest
~~

E4D12 (C)
What is the link margin in a system with a transmit power level of 10 W (+40 dBm), a system antenna gain of 10 dBi, a cable loss of 3 dB, a path loss of 136 dB, a receiver minimum discernable signal of -103 dBm, and a required signal-to-noise ratio of 6 dB?
A. -8dB
B. -14dB
C. +8dB
D. +14dB
~~

E4D13 (A)
What is the received signal level with a transmit power of 10 W (+40 dBm), a transmit antenna gain of 6 dBi, a receive antenna gain of 3 dBi, and a path loss of 100 dB?
A. -51 dBm
B. -54 dBm
C. -57 dBm
D. -60 dBm
~~

E4D14 (D)
What power level does a receiver minimum discernible signal of -100 dBm represent?
A. 100 microwatts
B. 0.1 microwatt
C. 0.001 microwatts
D. 0.1 picowatts
~~

E4E Noise and interference: external RF interference; electrical and computer noise; line noise; DSP filtering and noise reduction; common-mode current; surge protectors; single point ground panel

E4E01 (A)
What problem can occur when using an automatic notch filter (ANF) to remove interfering carriers while receiving CW signals?
A. Removal of the CW signal as well as the interfering carrier
B. Any nearby signal passing through the DSP system will overwhelm the desired signal
C. Excessive ringing
D. All these choices are correct
~~

E4E02 (D)
Which of the following types of noise can often be reduced by a digital noise reduction?
A. Broadband white noise
B. Ignition noise
C. Power line noise
D. All these choices are correct
~~

E4E03 (B)
Which of the following types of noise are removed by a noise blanker?
A. Broadband white noise
B. Impulse noise
C. Hum and buzz
D. All these choices are correct
~~

E4E04 (D)
How can conducted noise from an automobile battery charging system be suppressed?
A. By installing filter capacitors in series with the alternator leads
B. By installing a noise suppression resistor and a blocking capacitor at the battery
C. By installing a high-pass filter in series with the radio’s power lead and a low-pass filter in parallel with the antenna feed line
D. By installing ferrite chokes on the charging system leads
~~

E4E05 (B)
What is used to suppress radio frequency interference from a line-driven AC motor?
A. A high-pass filter in series with the motor’s power leads
B. A brute-force AC-line filter in series with the motor’s power leads
C. A bypass capacitor in series with the motor’s field winding
D. A bypass choke in parallel with the motor’s field winding
~~

E4E06 (C)
What type of electrical interference can be caused by computer network equipment?
A. A loud AC hum in the audio output of your station’s receiver
B. A clicking noise at intervals of a few seconds
C. The appearance of unstable modulated or unmodulated signals at specific frequencies
D. A whining-type noise that continually pulses off and on
~~

E4E07 (B)
Which of the following can cause shielded cables to radiate or receive interference?
A. Low inductance ground connections at both ends of the shield
B. Common-mode currents on the shield and conductors
C. Use of braided shielding material
D. Tying all ground connections to a common point resulting in differential-mode currents in the shield
~~

E4E08 (B)
What current flows equally on all conductors of an unshielded multiconductor cable?
A. Differential-mode current
B. Common-mode current
C. Reactive current only
D. Magnetically-coupled current only
~~

E4E09 (C)
What undesirable effect can occur when using a noise blanker?
A. Received audio in the speech range might have an echo effect
B. The audio frequency bandwidth of the received signal might be compressed
C. Strong signals may be distorted and appear to cause spurious emissions
D. FM signals can no longer be demodulated
~~

E4E10 (D)
Which of the following can create intermittent loud roaring or buzzing AC line interference?
A. Arcing contacts in a thermostatically controlled device
B. A defective doorbell or doorbell transformer inside a nearby residence
C. A malfunctioning illuminated advertising display
D. All these choices are correct
~~

E4E11 (B)
What could be the cause of local AM broadcast band signals combining to generate spurious signals on the MF or HF bands?
A. One or more of the broadcast stations is transmitting an over-modulated signal
B. Nearby corroded metal connections are mixing and reradiating the broadcast signals
C. You are receiving skywave signals from a distant station
D. Your station receiver IF amplifier stage is overloaded
~~

E4E12 (A)
What causes interference received as a series of carriers at regular intervals across a wide frequency range?
A. Switch-mode power supplies
B. Radar transmitters
C. Wireless security camera transmitters
D. Electric fences
~~

E4E13 (C)
Where should a station AC surge protector be installed?
A. At the AC service panel
B. At an AC outlet
C. On the single point ground panel
D. On a ground rod outside the station
~~

E4E14 (D)
What is the purpose of a single point ground panel?
A. Remove AC power in case of a short-circuit
B. Prevent common-mode transients in multi-wire systems
C. Eliminate air gaps between protected and non-protected circuits
D. Ensure all lightning protectors activate at the same time
~~

SUBELEMENT E5 - ELECTRICAL PRINCIPLES [4 Exam Questions - 4 Groups]

E5A Resonance and Q: characteristics of resonant circuits; series and parallel resonance; definitions and effects of Q; half-power bandwidth

E5A01 (A)
What can cause the voltage across reactances in a series RLC circuit to be higher than the voltage applied to the entire circuit?
A. Resonance
B. Capacitance
C. Low quality factor (Q)
D. Resistance
~~

E5A02 (C)
What is the resonant frequency of an RLC circuit if R is 22 ohms, L is 50 microhenries, and C is 40 picofarads?
A. 44.72 MHz
B. 22.36 MHz
C. 3.56 MHz
D. 1.78 MHz
~~

E5A03 (D)
What is the magnitude of the impedance of a series RLC circuit at resonance?
A. High, compared to the circuit resistance
B. Approximately equal to capacitive reactance
C. Approximately equal to inductive reactance
D. Approximately equal to circuit resistance
~~

E5A04 (A)
What is the magnitude of the impedance of a parallel RLC circuit at resonance?
A. Approximately equal to circuit resistance
B. Approximately equal to inductive reactance
C. Low compared to the circuit resistance
D. High compared to the circuit resistance
~~

E5A05 (A)
What is the result of increasing the Q of an impedance-matching circuit?
A. Matching bandwidth is decreased
B. Matching bandwidth is increased
C. Losses increase
D. Harmonics increase
~~

E5A06 (B)
What is the magnitude of the circulating current within the components of a parallel LC circuit at resonance?
A. It is at a minimum
B. It is at a maximum
C. It equals 1 divided by the quantity 2 times pi, times the square root of (inductance L multiplied by capacitance C)
D. It equals 2 times pi, times the square root of (inductance L multiplied by capacitance C)
~~

E5A07 (A)
What is the magnitude of the current at the input of a parallel RLC circuit at resonance?
A. Minimum
B. Maximum
C. R/L
D. L/R
~~

E5A08 (C)
What is the phase relationship between the current through and the voltage across a series resonant circuit at resonance?
A. The voltage leads the current by 90 degrees
B. The current leads the voltage by 90 degrees
C. The voltage and current are in phase
D. The voltage and current are 180 degrees out of phase
~~

E5A09 (C)
How is the Q of an RLC parallel resonant circuit calculated?
A. Reactance of either the inductance or capacitance divided by the resistance
B. Reactance of either the inductance or capacitance multiplied by the resistance
C. Resistance divided by the reactance of either the inductance or capacitance
D. Reactance of the inductance multiplied by the reactance of the capacitance
~~

E5A10 (A)
What is the resonant frequency of an RLC circuit if R is 33 ohms, L is 50 microhenries, and C is 10 picofarads?
A. 7.12 MHz
B. 23.5 kHz
C. 7.12 kHz
D. 23.5 MHz
~~

E5A11 (C)
What is the half-power bandwidth of a resonant circuit that has a resonant frequency of 7.1 MHz and a Q of 150?
A. 157.8 Hz
B. 315.6 Hz
C. 47.3 kHz
D. 23.67 kHz
~~

E5A12 (C)
What is the half-power bandwidth of a resonant circuit that has a resonant frequency of 3.7 MHz and a Q of 118?
A. 436.6 kHz
B. 218.3 kHz
C. 31.4 kHz
D. 15.7 kHz
~~

E5A13 (C)
What is an effect of increasing Q in a series resonant circuit?
A. Fewer components are needed for the same performance
B. Parasitic effects are minimized
C. Internal voltages increase
D. Phase shift can become uncontrolled
~~

E5B Time constants and phase relationships: RL and RC time constants; phase angle in reactive circuits and components; admittance and susceptance

E5B01 (B)
What is the term for the time required for the capacitor in an RC circuit to be charged to 63.2% of the applied voltage or to discharge to 36.8% of its initial voltage?
A. An exponential rate of one
B. One time constant
C. One exponential period
D. A time factor of one
~~

E5B02 (D)
What letter is commonly used to represent susceptance?
A. G
B. X
C. Y
D. B
~~

E5B03 (B)
How is impedance in polar form converted to an equivalent admittance?
A. Take the reciprocal of the angle and change the sign of the magnitude
B. Take the reciprocal of the magnitude and change the sign of the angle
C. Take the square root of the magnitude and add 180 degrees to the angle
D. Square the magnitude and subtract 90 degrees from the angle
~~

E5B04 (D)
What is the time constant of a circuit having two 220-microfarad capacitors and two 1-megohm resistors, all in parallel?
A. 55 seconds
B. 110 seconds
C. 440 seconds
D. 220 seconds
~~

E5B05 (D)
What is the effect on the magnitude of pure reactance when it is converted to susceptance?
A. It is unchanged
B. The sign is reversed
C. It is shifted by 90 degrees
D. It is replaced by its reciprocal
~~

E5B06 (C)
What is susceptance?
A. The magnetic impedance of a circuit
B. The ratio of magnetic field to electric field
C. The imaginary part of admittance
D. A measure of the efficiency of a transformer
~~

E5B07 (C)
What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 500 ohms, R is 1 kilohm, and XL is 250 ohms?
A. 68.2 degrees with the voltage leading the current
B. 14.0 degrees with the voltage leading the current
C. 14.0 degrees with the voltage lagging the current
D. 68.2 degrees with the voltage lagging the current
~~

E5B08 (A)
What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 300 ohms, R is 100 ohms, and XL is 100 ohms?
A. 63 degrees with the voltage lagging the current
B. 63 degrees with the voltage leading the current
C. 27 degrees with the voltage leading the current
D. 27 degrees with the voltage lagging the current
~~

E5B09 (D)
What is the relationship between the AC current through a capacitor and the voltage across a capacitor?
A. Voltage and current are in phase
B. Voltage and current are 180 degrees out of phase
C. Voltage leads current by 90 degrees
D. Current leads voltage by 90 degrees
~~

E5B10 (A)
What is the relationship between the AC current through an inductor and the voltage across an inductor?
A. Voltage leads current by 90 degrees
B. Current leads voltage by 90 degrees
C. Voltage and current are 180 degrees out of phase
D. Voltage and current are in phase
~~

E5B11 (B)
What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 25 ohms, R is 100 ohms, and XL is 75 ohms?
A. 27 degrees with the voltage lagging the current
B. 27 degrees with the voltage leading the current
C. 63 degrees with the voltage lagging the current
D. 63 degrees with the voltage leading the current
~~

E5B12 (A)
What is admittance?
A. The inverse of impedance
B. The term for the gain of a field effect transistor
C. The inverse of reactance
D. The term for the on-impedance of a field effect transistor
~~

E5C Coordinate systems and phasors in electronics: rectangular coordinates; polar coordinates; phasors; logarithmic axes

E5C01 (A)
Which of the following represents pure capacitive reactance of 100 ohms in rectangular notation?
A. 0 - j100
B. 0 + j100
C. 100 - j0
D. 100 + j0
~~

E5C02 (C)
How are impedances described in polar coordinates?
A. By X and R values
B. By real and imaginary parts
C. By magnitude and phase angle
D. By Y and G values
~~

E5C03 (C)
Which of the following represents a pure inductive reactance in polar coordinates?
A. A positive 45 degree phase angle
B. A negative 45 degree phase angle
C. A positive 90 degree phase angle
D. A negative 90 degree phase angle
~~

E5C04 (D)
What type of Y-axis scale is most often used for graphs of circuit frequency response?
A. Linear
B. Scatter
C. Random
D. Logarithmic
~~

E5C05 (C)
What kind of diagram is used to show the phase relationship between impedances at a given frequency?
A. Venn diagram
B. Near field diagram
C. Phasor diagram
D. Far field diagram
~~

E5C06 (B)
What does the impedance 50 - j25 ohms represent?
A. 50 ohms resistance in series with 25 ohms inductive reactance
B. 50 ohms resistance in series with 25 ohms capacitive reactance
C. 25 ohms resistance in series with 50 ohms inductive reactance
D. 25 ohms resistance in series with 50 ohms capacitive reactance
~~

E5C07 (D)
Where is the impedance of a pure resistance plotted on rectangular coordinates?
A. On the vertical axis
B. On a line through the origin, slanted at 45 degrees
C. On a horizontal line, offset vertically above the horizontal axis
D. On the horizontal axis
~~

E5C08 (D)
What coordinate system is often used to display the phase angle of a circuit containing resistance, inductive, and/or capacitive reactance?
A. Maidenhead grid
B. Faraday grid
C. Elliptical coordinates
D. Polar coordinates
~~

E5C09 (A)
When using rectangular coordinates to graph the impedance of a circuit, what do the axes represent?
A. The X axis represents the resistive component, and the Y axis represents the reactive component
B. The X axis represents the reactive component, and the Y axis represents the resistive component
C. The X axis represents the phase angle, and the Y axis represents the magnitude
D. The X axis represents the magnitude, and the Y axis represents the phase angle
~~

E5C10 (B)
Which point on Figure E5-1 best represents the impedance of a series circuit consisting of a 400-ohm resistor and a 38-picofarad capacitor at 14 MHz?
A. Point 2
B. Point 4
C. Point 5
D. Point 6
~~

E5C11 (B)
Which point in Figure E5-1 best represents the impedance of a series circuit consisting of a 300-ohm resistor and an 18-microhenry inductor at 3.505 MHz?
A. Point 1
B. Point 3
C. Point 7
D. Point 8
~~

E5C12 (A)
Which point on Figure E5-1 best represents the impedance of a series circuit consisting of a 300-ohm resistor and a 19-picofarad capacitor at 21.200 MHz?
A. Point 1
B. Point 3
C. Point 7
D. Point 8
~~

E5D RF effects in components and circuits: skin effect; real and reactive power; electrical length of conductors

E5D01 (A)
What is the result of conductor skin effect?
A. Resistance increases as frequency increases because RF current flows closer to the surface
B. Resistance decreases as frequency increases because electron mobility increases
C. Resistance increases as temperature increases because of the change in thermal coefficient
D. Resistance decreases as temperature increases because of the change in thermal coefficient
~~

E5D02 (B)
Why is it important to keep lead lengths short for components used in circuits for VHF and above?
A. To increase the thermal time constant
B. To minimize inductive reactance
C. To maintain component lifetime
D. All these choices are correct
~~

E5D03 (C)
What is the phase relationship between current and voltage for reactive power?
A. They are out of phase
B. They are in phase
C. They are 90 degrees out of phase
D. They are 45 degrees out of phase
~~

E5D04 (B)
Why are short connections used at microwave frequencies?
A. To increase neutralizing resistance
B. To reduce phase shift along the connection
C. To increase compensating capacitance
D. To reduce noise figure
~~

E5D05 (C)
What parasitic characteristic causes electrolytic capacitors to be unsuitable for use at RF?
A. Skin effect
B. Shunt capacitance
C. Inductance
D. Dielectric leakage
~~

E5D06 (D)
What parasitic characteristic creates an inductor’s self-resonance?
A. Skin effect
B. Dielectric loss
C. Coupling
D. Inter-turn capacitance
~~

E5D07 (B)
What combines to create the self-resonance of a component?
A. The component’s resistance and reactance
B. The component’s nominal and parasitic reactance
C. The component’s inductance and capacitance
D. The component’s electrical length and impedance
~~

E5D08 (D)
What is the primary cause of loss in film capacitors at RF?
A. Inductance
B. Dielectric loss
C. Self-discharge
D. Skin effect
~~

E5D09 (B)
What happens to reactive power in ideal inductors and capacitors?
A. It is dissipated as heat in the circuit
B. Energy is stored in magnetic or electric fields, but power is not dissipated
C. It is canceled by Coulomb forces in the capacitor and inductor
D. It is dissipated in the formation of inductive and capacitive fields
~~

E5D10 (D)
As a conductor’s diameter increases, what is the effect on its electrical length?
A. Thickness has no effect on electrical length
B. It varies randomly
C. It decreases
D. It increases
~~

E5D11 (B)
How much real power is consumed in a circuit consisting of a 100-ohm resistor in series with a 100-ohm inductive reactance drawing 1 ampere?
A. 70.7 watts
B. 100 watts
C. 141.4 watts
D. 200 watts
~~

E5D12 (D)
What is reactive power?
A. Power consumed in circuit Q
B. Power consumed by an inductor’s wire resistance
C. The power consumed in inductors and capacitors
D. Wattless, nonproductive power
~~

SUBELEMENT E6 - CIRCUIT COMPONENTS [6 Exam Questions - 6 Groups]

E6A Semiconductor materials and devices: semiconductor materials; bipolar junction transistors; operation and types of field-effect transistors

E6A01 (C)
In what application is gallium arsenide used as a semiconductor material?
A. In high-current rectifier circuits
B. In high-power audio circuits
C. In microwave circuits
D. In very low-frequency RF circuits
~~

E6A02 (A)
Which of the following semiconductor materials contains excess free electrons?
A. N-type
B. P-type
C. Bipolar
D. Insulated gate
~~

E6A03 (C)
Why does a PN-junction diode not conduct current when reverse biased?
A. Only P-type semiconductor material can conduct current
B. Only N-type semiconductor material can conduct current
C. Holes in P-type material and electrons in the N-type material are separated by the applied voltage, widening the depletion region
D. Excess holes in P-type material combine with the electrons in N-type material, converting the entire diode into an insulator
~~

E6A04 (C)
What is the name given to an impurity atom that adds holes to a semiconductor crystal structure?
A. Insulator impurity
B. N-type impurity
C. Acceptor impurity
D. Donor impurity
~~

E6A05 (C)
How does DC input impedance at the gate of a field-effect transistor (FET) compare with that of a bipolar transistor?
A. They are both low impedance
B. An FET has lower input impedance
C. An FET has higher input impedance
D. They are both high impedance
~~

E6A06 (B)
What is the beta of a bipolar junction transistor?
A. The frequency at which the current gain is reduced to 0.707
B. The change in collector current with respect to the change in base current
C. The breakdown voltage of the base-to-collector junction
D. The switching speed
~~

E6A07 (D)
Which of the following indicates that a silicon NPN junction transistor is biased on?
A. Base-to-emitter resistance of approximately 6 ohms to 7 ohms
B. Base-to-emitter resistance of approximately 0.6 ohms to 0.7 ohms
C. Base-to-emitter voltage of approximately 6 volts to 7 volts
D. Base-to-emitter voltage of approximately 0.6 volts to 0.7 volts
~~

E6A08 (D)
What is the term for the frequency at which the grounded-base current gain of a bipolar junction transistor has decreased to 0.7 of the gain obtainable at 1 kHz?
A. Corner frequency
B. Alpha rejection frequency
C. Beta cutoff frequency
D. Alpha cutoff frequency
~~

E6A09 (A)
What is a depletion-mode field-effect transistor (FET)?
A. An FET that exhibits a current flow between source and drain when no gate voltage is applied
B. An FET that has no current flow between source and drain when no gate voltage is applied
C. An FET that exhibits very high electron mobility due to a lack of holes in the N-type material
D. An FET for which holes are the majority carriers
~~

E6A10 (B)
In Figure E6-1, which is the schematic symbol for an N-channel dual-gate MOSFET?
A. 2
B. 4
C. 5
D. 6
~~

E6A11 (A)
In Figure E6-1, which is the schematic symbol for a P-channel junction FET?
A. 1
B. 2
C. 3
D. 6
~~

E6A12 (D)
What is the purpose of connecting Zener diodes between a MOSFET gate and its source or drain?
A. To provide a voltage reference for the correct amount of reverse-bias gate voltage
B. To protect the substrate from excessive voltages
C. To keep the gate voltage within specifications and prevent the device from overheating
D. To protect the gate from static damage
~~

E6B Diodes

E6B01 (B)
What is the most useful characteristic of a Zener diode?
A. A constant current drop under conditions of varying voltage
B. A constant voltage drop under conditions of varying current
C. A negative resistance region
D. An internal capacitance that varies with the applied voltage
~~

E6B02 (D)
Which characteristic of a Schottky diode makes it a better choice than a silicon junction diode for use as a power supply rectifier?
A. Much higher reverse voltage breakdown
B. More constant reverse avalanche voltage
C. Longer carrier retention time
D. Lower forward voltage drop
~~

E6B03 (B)
What property of an LED's semiconductor material determines its forward voltage drop?
A. Intrinsic resistance
B. Band gap
C. Junction capacitance
D. Junction depth
~~

E6B04 (A)
What type of semiconductor device is designed for use as a voltage-controlled capacitor?
A. Varactor diode
B. Tunnel diode
C. Silicon-controlled rectifier
D. Zener diode
~~

E6B05 (D)
What characteristic of a PIN diode makes it useful as an RF switch?
A. Extremely high reverse breakdown voltage
B. Ability to dissipate large amounts of power
C. Reverse bias controls its forward voltage drop
D. Low junction capacitance
~~

E6B06 (D)
Which of the following is a common use of a Schottky diode?
A. In oscillator circuits as the negative resistance element
B. As a variable capacitance in an automatic frequency control circuit
C. In power supplies as a constant voltage reference
D. As a VHF/UHF mixer or detector
~~

E6B07 (B)
What causes a junction diode to fail from excessive current?
A. Excessive inverse voltage
B. Excessive junction temperature
C. Insufficient forward voltage
D. Charge carrier depletion
~~

E6B08 (A)
Which of the following is a Schottky barrier diode?
A. Metal-semiconductor junction
B. Electrolytic rectifier
C. PIN junction
D. Thermionic emission diode
~~

E6B09 (C)
What is a common use for point-contact diodes?
A. As a constant current source
B. As a constant voltage source
C. As an RF detector
D. As a high-voltage rectifier
~~

E6B10 (B)
In Figure E6-2, which is the schematic symbol for a Schottky diode?
A. 1
B. 6
C. 2
D. 3
~~

E6B11 (A)
What is used to control the attenuation of RF signals by a PIN diode?
A. Forward DC bias current
B. A variable RF reference voltage
C. Reverse voltage larger than the RF signal
D. Capacitance of an RF coupling capacitor
~~

E6C Digital ICs: families of digital ICs; gates; programmable logic devices

E6C01 (A)
What is the function of hysteresis in a comparator?
A. To prevent input noise from causing unstable output signals
B. To allow the comparator to be used with AC input signals
C. To cause the output to continually change states
D. To increase the sensitivity
~~

E6C02 (B)
What happens when the level of a comparator’s input signal crosses the threshold voltage?
A. The IC input can be damaged
B. The comparator changes its output state
C. The reference level appears at the output
D. The feedback loop becomes unstable
~~

E6C03 (A)
What is tri-state logic?
A. Logic devices with 0, 1, and high-impedance output states
B. Logic devices that utilize ternary math
C. Logic with three output impedances which can be selected to better match the load impedance
D. A counter with eight states
~~

E6C04 (C)
Which of the following is an advantage of BiCMOS logic?
A. Its simplicity results in much less expensive devices than standard CMOS
B. It is immune to electrostatic damage
C. It has the high input impedance of CMOS and the low output impedance of bipolar transistors
D. All these choices are correct
~~

E6C05 (D)
Which of the following digital logic families has the lowest power consumption?
A. Schottky TTL
B. ECL
C. NMOS
D. CMOS
~~

E6C06 (C)
Why do CMOS digital integrated circuits have high immunity to noise on the input signal or power supply?
A. Large bypass capacitance is inherent
B. The input switching threshold is about twice the power supply voltage
C. The input switching threshold is about half the power supply voltage
D. Bandwidth is very limited
~~

E6C07 (B)
What best describes a pull-up or pull-down resistor?
A. A resistor in a keying circuit used to reduce key clicks
B. A resistor connected to the positive or negative supply used to establish a voltage when an input or output is an open circuit
C. A resistor that ensures that an oscillator frequency does not drift
D. A resistor connected to an op-amp output that prevents signals from exceeding the power supply voltage
~~

E6C08 (B)
In Figure E6-3, which is the schematic symbol for a NAND gate?
A. 1
B. 2
C. 3
D. 4
~~

E6C09 (B)
What is used to design the configuration of a field-programmable gate array (FPGA)?
A. Karnaugh maps
B. Hardware description language (HDL)
C. An auto-router
D. Machine and assembly language
~~

E6C10 (D)
In Figure E6-3, which is the schematic symbol for a NOR gate?
A. 1
B. 2
C. 3
D. 4
~~

E6C11 (C)
In Figure E6-3, which is the schematic symbol for the NOT operation (inversion)?
A. 2
B. 4
C. 5
D. 6
~~

E6D Inductors and piezoelectricity: permeability, core material and configuration; transformers; piezoelectric devices

E6D01 (C)
What is piezoelectricity?
A. The ability of materials to generate electromagnetic waves of a certain frequency when voltage is applied
B. A characteristic of materials that have an index of refraction which depends on the polarization of the electromagnetic wave passing through it
C. A characteristic of materials that generate a voltage when stressed and that flex when a voltage is applied
D. The ability of materials to generate voltage when an electromagnetic wave of a certain frequency is applied
~~

E6D02 (A)
What is the equivalent circuit of a quartz crystal?
A. Series RLC in parallel with a shunt C representing electrode and stray capacitance
B. Parallel RLC, where C is the parallel combination of resonance capacitance of the crystal and electrode and stray capacitance
C. Series RLC, where C is the parallel combination of resonance capacitance of the crystal and electrode and stray capacitance
D. Parallel RLC, where C is the series combination of resonance capacitance of the crystal and electrode and stray capacitance
~~

E6D03 (A)
Which of the following is an aspect of the piezoelectric effect?
A. Mechanical deformation of material due to the application of a voltage
B. Mechanical deformation of material due to the application of a magnetic field
C. Generation of electrical energy in the presence of light
D. Increased conductivity in the presence of light
~~

E6D04 (B)
Why are cores of inductors and transformers sometimes constructed of thin layers?
A. To simplify assembly during manufacturing
B. To reduce power loss from eddy currents in the core
C. To increase the cutoff frequency by reducing capacitance
D. To save cost by reducing the amount of magnetic material
~~

E6D05 (C)
How do ferrite and powdered iron compare for use in an inductor core?
A. Ferrite cores generally have lower initial permeability
B. Ferrite cores generally have better temperature stability
C. Ferrite cores generally require fewer turns to produce a given inductance value
D. Ferrite cores are easier to use with surface-mount technology
~~

E6D06 (D)
What core material property determines the inductance of an inductor?
A. Permittivity
B. Resistance
C. Reactivity
D. Permeability
~~

E6D07 (D)
What is the current that flows in the primary winding of a transformer when there is no load on the secondary winding?
A. Stabilizing current
B. Direct current
C. Excitation current
D. Magnetizing current
~~

E6D08 (B)
Which of the following materials has the highest temperature stability of its magnetic characteristics?
A. Brass
B. Powdered iron
C. Ferrite
D. Aluminum
~~

E6D09 (C)
What devices are commonly used as VHF and UHF parasitic suppressors at the input and output terminals of a transistor HF amplifier?
A. Electrolytic capacitors
B. Butterworth filters
C. Ferrite beads
D. Steel-core toroids
~~

E6D10 (A)
What is a primary advantage of using a toroidal core instead of a solenoidal core in an inductor?
A. Toroidal cores confine most of the magnetic field within the core material
B. Toroidal cores make it easier to couple the magnetic energy into other components
C. Toroidal cores exhibit greater hysteresis
D. Toroidal cores have lower Q characteristics
~~

E6D11 (B)
Which type of core material decreases inductance when inserted into a coil?
A. Ceramic
B. Brass
C. Ferrite
D. Aluminum
~~

E6D12 (C)
What causes inductor saturation?
A. Operation at too high a frequency
B. Selecting a core with low permeability
C. Operation at excessive magnetic flux
D. Selecting a core with excessive permittivity
~~

E6E Semiconductor materials and packages for RF use

E6E01 (B)
Why is gallium arsenide (GaAs) useful for semiconductor devices operating at UHF and higher frequencies?
A. Higher noise figures
B. Higher electron mobility
C. Lower junction voltage drop
D. Lower transconductance
~~

E6E02 (A)
Which of the following device packages is a through-hole type?
A. DIP
B. PLCC
C. BGA
D. SOT
~~

E6E03 (D)
Which of the following materials supports the highest frequency of operation when used in MMICs?
A. Silicon
B. Silicon nitride
C. Silicon dioxide
D. Gallium nitride
~~

E6E04 (A)
Which is the most common input and output impedance of MMICs?
A. 50 ohms
B. 300 ohms
C. 450 ohms
D. 75 ohms
~~

E6E05 (A)
Which of the following noise figure values is typical of a low-noise UHF preamplifier?
A. 0.5 dB
B. -10 dB
C. 44 dBm
D. -20 dBm
~~

E6E06 (D)
What characteristics of MMICs make them a popular choice for VHF through microwave circuits?
A. The ability to retrieve information from a single signal, even in the presence of other strong signals
B. Extremely high Q factor and high stability over a wide temperature range
C. Nearly infinite gain, very high input impedance, and very low output impedance
D. Controlled gain, low noise figure, and constant input and output impedance over the specified frequency range
~~

E6E07 (D)
What type of transmission line is often used for connections to MMICs?
A. Miniature coax
B. Circular waveguide
C. Parallel wire
D. Microstrip
~~

E6E08 (C)
How is power supplied to the most common type of MMIC?
A. Through a capacitor and RF choke connected to the amplifier input lead
B. MMICs require no operating bias
C. Through a resistor and/or RF choke connected to the amplifier output lead
D. Directly to the bias voltage (Vcc) lead
~~

E6E09 (D)
Which of the following component package types have the least parasitic effects at frequencies above the HF range?
A. TO-220
B. Axial lead
C. Radial lead
D. Surface mount
~~

E6E10 (D)
What advantage does surface-mount technology offer at RF compared to using through-hole components?
A. Smaller circuit area
B. Shorter circuit board traces
C. Components have less parasitic inductance and capacitance
D. All these choices are correct
~~

E6E11 (D)
What is a characteristic of DIP packaging used for integrated circuits?
A. Extremely low stray capacitance (dielectrically isolated package)
B. Extremely high resistance between pins (doubly insulated package)
C. Two chips in each package (dual in package)
D. Two rows of connecting pins on opposite sides of package (dual in-line package)
~~

E6E12 (C)
Why are DIP through-hole package ICs not typically used at UHF and higher frequencies?
A. Excessive dielectric loss
B. Epoxy coating is conductive above 300 MHz
C. Excessive lead length
D. Unsuitable for combining analog and digital signals
~~

E6F Electro-optical technology: photoconductivity; photovoltaic devices; optical sensors and encoders; optically isolated switching

E6F01 (C)
What absorbs the energy from light falling on a photovoltaic cell?
A. Protons
B. Photons
C. Electrons
D. Holes
~~

E6F02 (A)
What happens to photoconductive material when light shines on it?
A. Resistance decreases
B. Resistance increases
C. Reflectivity increases
D. Reflectivity decreases
~~

E6F03 (D)
What is the most common configuration of an optoisolator or optocoupler?
A. A lens and a photomultiplier
B. A frequency-modulated helium-neon laser
C. An amplitude-modulated helium-neon laser
D. An LED and a phototransistor
~~

E6F04 (B)
What is the photovoltaic effect?
A. The conversion of voltage to current when exposed to light
B. The conversion of light to electrical energy
C. The effect that causes a photodiode to emit light when a voltage is applied
D. The effect that causes a phototransistor’s beta to decrease when exposed to light
~~

E6F05 (A)
Which of the following describes an optical shaft encoder?
A. A device that detects rotation by interrupting a light source with a patterned wheel
B. A device that measures the strength of a beam of light using analog-to-digital conversion
C. An optical computing device in which light is coupled between devices by fiber optics
D. A device for generating RTTY signals by means of a rotating light source
~~

E6F06 (C)
Which of these materials is most commonly used to create photoconductive devices?
A. Polyphenol acetate
B. Argon
C. Crystalline semiconductor
D. All these choices are correct
~~

E6F07 (B)
What is a solid-state relay?
A. A relay that uses transistors to drive the relay coil
B. A device that uses semiconductors to implement the functions of an electromechanical relay
C. A mechanical relay that latches in the on or off state each time it is pulsed
D. A semiconductor switch that uses a monostable multivibrator circuit
~~

E6F08 (C)
Why are optoisolators often used in conjunction with solid-state circuits that control 120 VAC circuits?
A. Optoisolators provide a low-impedance link between a control circuit and a power circuit
B. Optoisolators provide impedance matching between the control circuit and power circuit
C. Optoisolators provide an electrical isolation between a control circuit and the circuit being switched
D. Optoisolators eliminate the effects of reflected light in the control circuit
~~

E6F09 (D)
What is the efficiency of a photovoltaic cell?
A. The output RF power divided by the input DC power
B. The output in lumens divided by the input power in watts
C. The open-circuit voltage divided by the short-circuit current under full illumination
D. The relative fraction of light that is converted to current
~~

E6F10 (B)
What is the most common material used in power-generating photovoltaic cells?
A. Selenium
B. Silicon
C. Cadmium sulfide
D. Indium arsenide
~~

E6F11 (A)
What is the approximate open-circuit voltage produced by a fully illuminated silicon photovoltaic cell?
A. 0.5 volts
B. 0.7 volts
C. 1.1 volts
D. 1.5 volts
~~

SUBELEMENT E7 - PRACTICAL CIRCUITS [8 Exam Questions - 8 Groups]

E7A Digital circuits: digital circuit principles and logic circuits; classes of logic elements; positive and negative logic; frequency dividers; truth tables

E7A01 (C)
Which circuit is bistable?
A. An AND gate
B. An OR gate
C. A flip-flop
D. A bipolar amplifier
~~

E7A02 (A)
What is the function of a decade counter?
A. It produces one output pulse for every 10 input pulses
B. It decodes a decimal number for display on a seven-segment LED display
C. It produces 10 output pulses for every input pulse
D. It decodes a binary number for display on a seven-segment LED display
~~

E7A03 (B)
Which of the following can divide the frequency of a pulse train by 2?
A. An XOR gate
B. A flip-flop
C. An OR gate
D. A multiplexer
~~

E7A04 (A)
How many flip-flops are required to divide a signal frequency by 16?
A. 4
B. 6
C. 8
D. 16
~~

E7A05 (D)
Which of the following circuits continuously alternates between two states without an external clock signal?
A. Monostable multivibrator
B. J-K flip-flop
C. T flip-flop
D. Astable multivibrator
~~

E7A06 (A)
What is a characteristic of a monostable multivibrator?
A. It switches temporarily to an alternate state for a set time
B. It produces a continuous square wave
C. It stores one bit of data
D. It maintains a constant output voltage, regardless of variations in the input voltage
~~

E7A07 (D)
What logical operation does a NAND gate perform?
A. It produces a 0 at its output only if all inputs are 0
B. It produces a 1 at its output only if all inputs are 1
C. It produces a 0 at its output if some but not all inputs are 1
D. It produces a 0 at its output only if all inputs are 1
~~

E7A08 (A)
What logical operation does an OR gate perform?
A. It produces a 1 at its output if any input is 1
B. It produces a 0 at its output if all inputs are 1
C. It produces a 0 at its output if some but not all inputs are 1
D. It produces a 1 at its output if all inputs are 0
~~

E7A09 (C)
What logical operation is performed by a two-input exclusive NOR gate?
A. It produces a 0 at its output only if all inputs are 0
B. It produces a 1 at its output only if all inputs are 1
C. It produces a 0 at its output if one and only one of its inputs is 1
D. It produces a 1 at its output if one and only one input is 1
~~

E7A10 (B)
What is a truth table?
A. A list of inputs and corresponding outputs for an op-amp
B. A list of inputs and corresponding outputs for a digital device
C. A diagram showing logic states when the digital gate output is true
D. A table of logic symbols that indicate the logic states of an op-amp
~~

E7A11 (B)
What does “positive logic” mean in reference to logic devices?
A. The logic devices have high noise immunity
B. High voltage represents a 1, low voltage a 0
C. The logic circuit is in the “true” condition
D. 1s and 0s are defined as different positive voltage levels
~~

E7B Amplifiers: class of operation; vacuum tube and solid-state circuits; distortion and intermodulation; spurious and parasitic suppression; switching-type amplifiers

E7B01 (A)
For what portion of the signal cycle does each active element in a push-pull, Class AB amplifier conduct?
A. More than 180 degrees but less than 360 degrees
B. Exactly 180 degrees
C. The entire cycle
D. Less than 180 degrees
~~

E7B02 (A)
What is a Class D amplifier?
A. An amplifier that uses switching technology to achieve high efficiency
B. A low power amplifier that uses a differential amplifier for improved linearity
C. An amplifier that uses drift-mode FETs for high efficiency
D. An amplifier biased to be relatively free from distortion
~~

E7B03 (A)
What circuit is required at the output of an RF switching amplifier?
A. A filter to remove harmonic content
B. A high-pass filter to compensate for low gain at low frequencies
C. A matched load resistor to prevent damage by switching transients
D. A temperature compensating load resistor to improve linearity
~~

E7B04 (A)
What is the operating point of a Class A common emitter amplifier?
A. Approximately halfway between saturation and cutoff
B. Approximately halfway between the emitter voltage and the base voltage
C. At a point where the bias resistor equals the load resistor
D. At a point where the load line intersects the zero bias current curve
~~

E7B05 (C)
What can be done to prevent unwanted oscillations in an RF power amplifier?
A. Tune the stage for minimum loading
B. Tune both the input and output for maximum power
C. Install parasitic suppressors and/or neutralize the stage
D. Use a phase inverter in the output filter
~~

E7B06 (B)
What is a characteristic of a grounded-grid amplifier?
A. High power gain
B. Low input impedance
C. High electrostatic damage protection
D. Low bandwidth
~~

E7B07 (D)
Which of the following is the likely result of using a Class C amplifier to amplify a single-sideband phone signal?
A. Reduced intermodulation products
B. Increased overall intelligibility
C. Reduced third-order intermodulation
D. Signal distortion and excessive bandwidth
~~

E7B08 (B)
Why are switching amplifiers more efficient than linear amplifiers?
A. Switching amplifiers operate at higher voltages
B. The switching device is at saturation or cutoff most of the time
C. Linear amplifiers have high gain resulting in higher harmonic content
D. Switching amplifiers use push-pull circuits
~~

E7B09 (D)
What is characteristic of an emitter follower (or common collector) amplifier?
A. Low input impedance and phase inversion from input to output
B. Differential inputs and single output
C. Acts as an OR circuit if one input is grounded
D. Input and output signals in-phase
~~

E7B10 (B)
In Figure E7-1, what is the purpose of R1 and R2?
A. Load resistors
B. Voltage divider bias
C. Self bias
D. Feedback
~~

E7B11 (D)
In Figure E7-1, what is the purpose of R3?
A. Fixed bias
B. Emitter bypass
C. Output load resistor
D. Self bias
~~

E7B12 (C)
What type of amplifier circuit is shown in Figure E7-1?
A. Common base
B. Common collector
C. Common emitter
D. Emitter follower
~~

E7C Filters and matching networks: types of networks; types of filters; filter applications; filter characteristics; impedance matching

E7C01 (D)
How are the capacitors and inductors of a low-pass filter Pi-network arranged between the network's input and output?
A. Two inductors are in series between the input and output, and a capacitor is connected between the two inductors and ground
B. Two capacitors are in series between the input and output, and an inductor is connected between the two capacitors and ground
C. An inductor is connected between the input and ground, another inductor is connected between the output and ground, and a capacitor is connected between the input and output
D. A capacitor is connected between the input and ground, another capacitor is connected between the output and ground, and an inductor is connected between the input and output
~~

E7C02 (B)
What is the frequency response of a T-network with series capacitors and a shunt inductor?
A. Low-pass
B. High-pass
C. Band-pass
D. Notch
~~

E7C03 (A)
What is the purpose of adding an inductor to a Pi-network to create a Pi-L-network?
A. Greater harmonic suppression
B. Higher efficiency
C. To eliminate one capacitor
D. Greater transformation range
~~

E7C04 (C)
How does an impedance-matching circuit transform a complex impedance to a resistive impedance?
A. It introduces negative resistance to cancel the resistive part of impedance
B. It introduces transconductance to cancel the reactive part of impedance
C. It cancels the reactive part of the impedance and changes the resistive part to the desired value
D. Reactive currents are dissipated in matched resistances
~~

E7C05 (D)
Which filter type has ripple in the passband and a sharp cutoff?
A. A Butterworth filter
B. An active LC filter
C. A passive op-amp filter
D. A Chebyshev filter
~~

E7C06 (C)
What are the characteristics of an elliptical filter?
A. Gradual passband rolloff with minimal stop-band ripple
B. Extremely flat response over its pass band with gradually rounded stop-band corners
C. Extremely sharp cutoff with one or more notches in the stop band
D. Gradual passband rolloff with extreme stop-band ripple
~~

E7C07 (B)
Which describes a Pi-L network?
A. A Phase Inverter Load network
B. A Pi-network with an additional output series inductor
C. A network with only three discrete parts
D. A matching network in which all components are isolated from ground
~~

E7C08 (B)
Which of the following is most frequently used as a band-pass or notch filter in VHF and UHF transceivers?
A. A Sallen-Key filter
B. A helical filter
C. A swinging choke filter
D. A finite impulse response filter
~~

E7C09 (D)
What is a crystal lattice filter?
A. A power supply filter made with interlaced quartz crystals
B. An audio filter made with four quartz crystals that resonate at 1 kHz intervals
C. A filter using lattice-shaped quartz crystals for high-Q performance
D. A filter for low-level signals made using quartz crystals
~~

E7C10 (B)
Which of the following filters is used in a 2-meter band repeater duplexer?
A. A crystal filter
B. A cavity filter
C. A DSP filter
D. An L-C filter
~~

E7C11 (C)
Which of the following measures a filter’s ability to reject signals in adjacent channels?
A. Passband ripple
B. Phase response
C. Shape factor
D. Noise factor
~~

E7D Power supplies and voltage regulators; solar array charge controllers

E7D01 (D)
How does a linear electronic voltage regulator work?
A. It has a ramp voltage as its output
B. It eliminates the need for a pass transistor
C. The control element duty cycle is proportional to the line or load conditions
D. The conduction of a control element is varied to maintain a constant output voltage
~~

E7D02 (B)
How does a switchmode voltage regulator work?
A. By alternating the output between positive and negative voltages
B. By varying the duty cycle of pulses input to a filter
C. By varying the conductivity of a pass element
D. By switching between two Zener diode reference voltages
~~

E7D03 (A)
What device is used as a stable voltage reference?
A. A Zener diode
B. A digital-to-analog converter
C. An SCR
D. An analog-to-digital converter
~~

E7D04 (B)
Which of the following describes a three-terminal voltage regulator?
A. A series current source
B. A series regulator
C. A shunt regulator
D. A shunt current source
~~

E7D05 (D)
Which of the following types of linear voltage regulator operates by loading the unregulated voltage source?
A. A constant current source
B. A series regulator
C. A shunt current source
D. A shunt regulator
~~

E7D06 (C)
What is the purpose of Q1 in the circuit shown in Figure E7-2?
A. It provides negative feedback to improve regulation
B. It provides a constant load for the voltage source
C. It controls the current to keep the output voltage constant
D. It provides regulation by switching or “chopping” the input DC voltage
~~

E7D07 (A)
What is the purpose of C2 in the circuit shown in Figure E7-2?
A. It bypasses rectifier output ripple around D1
B. It is a brute force filter for the output
C. To prevent self-oscillation
D. To provide fixed DC bias for Q1
~~

E7D08 (C)
What type of circuit is shown in Figure E7-2?
A. Switching voltage regulator
B. Common emitter amplifier
C. Linear voltage regulator
D. Common base amplifier
~~

E7D09 (C)
How is battery operating time calculated?
A. Average current divided by capacity in amp-hours
B. Average current divided by internal resistance
C. Capacity in amp-hours divided by average current
D. Internal resistance divided by average current
~~

E7D10 (C)
Why is a switching type power supply less expensive and lighter than an equivalent linear power supply?
A. The inverter design does not require an output filter circuit
B. The control circuitry uses less current, therefore smaller heat sinks are required
C. The high frequency inverter design uses much smaller transformers and filter components for an equivalent power output
D. It recovers power from the unused portion of the AC cycle, thus using fewer components
~~

E7D11 (D)
What is the purpose of an inverter connected to a solar panel output?
A. Reduce AC ripple on the output
B. Maintain voltage with varying illumination levels
C. Prevent discharge when panel is not illuminated
D. Convert the panel’s output from DC to AC
~~

E7D12 (C)
What is the dropout voltage of a linear voltage regulator?
A. Minimum input voltage for rated power dissipation
B. Maximum output voltage drop when the input voltage is varied over its specified range
C. Minimum input-to-output voltage required to maintain regulation
D. Maximum that the output voltage may decrease at rated load
~~

E7D13 (C)
Which of the following calculates power dissipated by a series linear voltage regulator?
A. Input voltage multiplied by input current
B. Input voltage divided by output current
C. Voltage difference from input to output multiplied by output current
D. Output voltage multiplied by output current
~~

E7D14 (D)
What is the purpose of connecting equal-value resistors across power supply filter capacitors connected in series?
A. Equalize the voltage across each capacitor
B. Discharge the capacitors when voltage is removed
C. Provide a minimum load on the supply
D. All these choices are correct
~~

E7D15 (D)
What is the purpose of a step-start circuit in a high-voltage power supply?
A. To provide a dual-voltage output for reduced power applications
B. To compensate for variations of the incoming line voltage
C. To prevent arcing across the input power switch or relay contacts
D. To allow the filter capacitors to charge gradually
~~

E7E Modulation and demodulation: reactance, phase, and balanced modulators; detectors; mixers

E7E01 (B)
Which of the following can be used to generate FM phone signals?
A. Balanced modulation of the audio amplifier
B. Reactance modulation of a local oscillator
C. Reactance modulation of the final amplifier
D. Balanced modulation of a local oscillator
~~

E7E02 (D)
What is the function of a reactance modulator?
A. Produce PM or FM signals by varying a resistance
B. Produce AM signals by varying an inductance
C. Produce AM signals by varying a resistance
D. Produce PM or FM signals by varying a capacitance
~~

E7E03 (D)
What is a frequency discriminator?
A. An FM generator circuit
B. A circuit for filtering closely adjacent signals
C. An automatic band-switching circuit
D. A circuit for detecting FM signals
~~

E7E04 (A)
What is one way to produce a single-sideband phone signal?
A. Use a balanced modulator followed by a filter
B. Use a reactance modulator followed by a mixer
C. Use a loop modulator followed by a mixer
D. Use a product detector with a DSB signal
~~

E7E05 (D)
What is added to an FM speech channel to boost the higher audio frequencies?
A. A de-emphasis network
B. A harmonic enhancer
C. A heterodyne enhancer
D. A pre-emphasis network
~~

E7E06 (A)
Why is de-emphasis used in FM communications receivers?
A. For compatibility with transmitters using phase modulation
B. To reduce impulse noise reception
C. For higher efficiency
D. To remove third-order distortion products
~~

E7E07 (B)
What is meant by the term “baseband” in radio communications?
A. The lowest frequency band that the transmitter or receiver covers
B. The frequency range occupied by a message signal prior to modulation
C. The unmodulated bandwidth of the transmitted signal
D. The basic oscillator frequency in an FM transmitter that is multiplied to increase the deviation and carrier frequency
~~

E7E08 (C)
What are the principal frequencies that appear at the output of a mixer?
A. Two and four times the input frequency
B. The square root of the product of input frequencies
C. The two input frequencies along with their sum and difference frequencies
D. 1.414 and 0.707 times the input frequency
~~

E7E09 (A)
What occurs when the input signal levels to a mixer are too high?
A. Spurious mixer products are generated
B. Mixer blanking occurs
C. Automatic limiting occurs
D. Excessive AGC voltage levels are generated
~~

E7E10 (A)
How does a diode envelope detector function?
A. By rectification and filtering of RF signals
B. By breakdown of the Zener voltage
C. By mixing signals with noise in the transition region of the diode
D. By sensing the change of reactance in the diode with respect to frequency
~~

E7E11 (C)
Which type of detector is used for demodulating SSB signals?
A. Discriminator
B. Phase detector
C. Product detector
D. Phase comparator
~~

E7F Software defined radio fundamentals: digital signal processing (DSP) filtering, modulation, and demodulation; analog-digital conversion; digital filters

E7F01 (C)
What is meant by “direct sampling” in software defined radios?
A. Software is converted from source code to object code during operation of the receiver
B. I and Q signals are generated by digital processing without the use of RF amplification
C. Incoming RF is digitized by an analog-to-digital converter without being mixed with a local oscillator signal
D. A switching mixer is used to generate I and Q signals directly from the RF input
~~

E7F02 (A)
What kind of digital signal processing audio filter is used to remove unwanted noise from a received SSB signal?
A. An adaptive filter
B. A crystal-lattice filter
C. A Hilbert-transform filter
D. A phase-inverting filter
~~

E7F03 (C)
What type of digital signal processing filter is used to generate an SSB signal?
A. An adaptive filter
B. A notch filter
C. A Hilbert-transform filter
D. An elliptical filter
~~

E7F04 (D)
Which method generates an SSB signal using digital signal processing?
A. Mixing products are converted to voltages and subtracted by adder circuits
B. A frequency synthesizer removes unwanted sidebands
C. Varying quartz crystal characteristics are emulated in digital form
D. Signals are combined in quadrature phase relationship
~~

E7F05 (B)
How frequently must an analog signal be sampled to be accurately reproduced?
A. At least half the rate of the highest frequency component of the signal
B. At least twice the rate of the highest frequency component of the signal
C. At the same rate as the highest frequency component of the signal
D. At four times the rate of the highest frequency component of the signal
~~

E7F06 (D)
What is the minimum number of bits required to sample a signal with a range of 1 volt at a resolution of 1 millivolt?
A. 4 bits
B. 6 bits
C. 8 bits
D. 10 bits
~~

E7F07 (C)
What function is performed by a Fast Fourier Transform?
A. Converting analog signals to digital form
B. Converting digital signals to analog form
C. Converting signals from the time domain to the frequency domain
D. Converting signals from the frequency domain to the time domain
~~

E7F08 (B)
What is the function of decimation?
A. Converting data to binary-coded decimal form
B. Reducing the effective sample rate by removing samples
C. Attenuating the signal
D. Removing unnecessary significant digits
~~

E7F09 (A)
Why is an anti-aliasing filter required in a decimator?
A. It removes high-frequency signal components that would otherwise be reproduced as lower frequency components
B. It peaks the response of the decimator, improving bandwidth
C. It removes low-frequency signal components to eliminate the need for DC restoration
D. It notches out the sampling frequency to avoid sampling errors
~~

E7F10 (A)
What aspect of receiver analog-to-digital conversion determines the maximum receive bandwidth of a direct-sampling software defined radio (SDR)?
A. Sample rate
B. Sample width in bits
C. Integral non-linearity
D. Differential non-linearity
~~

E7F11 (B)
What sets the minimum detectable signal level for a direct-sampling software defined receiver in the absence of atmospheric or thermal noise?
A. Sample clock phase noise
B. Reference voltage level and sample width in bits
C. Data storage transfer rate
D. Missing codes and jitter
~~

E7F12 (A)
Which of the following is generally true of Finite Impulse Response (FIR) filters?
A. FIR filters can delay all frequency components of the signal by the same amount
B. FIR filters are easier to implement for a given set of passband rolloff requirements
C. FIR filters can respond faster to impulses
D. All these choices are correct
~~

E7F13 (D)
What is the function of taps in a digital signal processing filter?
A. To reduce excess signal pressure levels
B. Provide access for debugging software
C. Select the point at which baseband signals are generated
D. Provide incremental signal delays for filter algorithms
~~

E7F14 (B)
Which of the following would allow a digital signal processing filter to create a sharper filter response?
A. Higher data rate
B. More taps
C. Lower Q
D. Double-precision math routines
~~

E7G Operational amplifiers: characteristics and applications

E7G01 (A)
What is the typical output impedance of an op-amp?
A. Very low
B. Very high
C. 100 ohms
D. 10,000 ohms
~~

E7G02 (B)
What is the frequency response of the circuit in E7-3 if a capacitor is added across the feedback resistor?
A. High-pass filter
B. Low-pass filter
C. Band-pass filter
D. Notch filter
~~

E7G03 (D)
What is the typical input impedance of an op-amp?
A. 100 ohms
B. 10,000 ohms
C. Very low
D. Very high
~~

E7G04 (C)
What is meant by the term “op-amp input offset voltage”?
A. The output voltage of the op-amp minus its input voltage
B. The difference between the output voltage of the op-amp and the input voltage required in the immediately following stage
C. The differential input voltage needed to bring the open loop output voltage to zero
D. The potential between the amplifier input terminals of the op-amp in an open loop condition
~~

E7G05 (A)
How can unwanted ringing and audio instability be prevented in an op-amp audio filter?
A. Restrict both gain and Q
B. Restrict gain but increase Q
C. Restrict Q but increase gain
D. Increase both gain and Q
~~

E7G06 (B)
What is the gain-bandwidth of an operational amplifier?
A. The maximum frequency for a filter circuit using that type of amplifier
B. The frequency at which the open-loop gain of the amplifier equals one
C. The gain of the amplifier at a filter’s cutoff frequency
D. The frequency at which the amplifier’s offset voltage is zero
~~

E7G07 (C)
What voltage gain can be expected from the circuit in Figure E7-3 when R1 is 10 ohms and RF is 470 ohms?
A. 0.21
B. 4700
C. 47
D. 24
~~

E7G08 (D)
How does the gain of an ideal operational amplifier vary with frequency?
A. It increases linearly with increasing frequency
B. It decreases linearly with increasing frequency
C. It decreases logarithmically with increasing frequency
D. It does not vary with frequency
~~

E7G09 (D)
What will be the output voltage of the circuit shown in Figure E7-3 if R1 is 1,000 ohms, RF is 10,000 ohms, and 0.23 volts DC is applied to the input?
A. 0.23 volts
B. 2.3 volts
C. -0.23 volts
D. -2.3 volts
~~

E7G10 (C)
What absolute voltage gain can be expected from the circuit in Figure E7-3 when R1 is 1,800 ohms and RF is 68 kilohms?
A. 1
B. 0.03
C. 38
D. 76
~~

E7G11 (B)
What absolute voltage gain can be expected from the circuit in Figure E7-3 when R1 is 3,300 ohms and RF is 47 kilohms?
A. 28
B. 14
C. 7
D. 0.07
~~

E7G12 (A)
What is an operational amplifier?
A. A high-gain, direct-coupled differential amplifier with very high input impedance and very low output impedance
B. A digital audio amplifier whose characteristics are determined by components external to the amplifier
C. An amplifier used to increase the average output of frequency modulated amateur signals to the legal limit
D. A RF amplifier used in the UHF and microwave regions
~~

E7H Oscillators and signal sources: types of oscillators; synthesizers and phase-locked loops; direct digital synthesizers; stabilizing thermal drift; microphonics; high-accuracy oscillators

E7H01 (D)
What are three common oscillator circuits?
A. Taft, Pierce, and negative feedback
B. Pierce, Fenner, and Beane
C. Taft, Hartley, and Pierce
D. Colpitts, Hartley, and Pierce
~~

E7H02 (C)
What is a microphonic?
A. An IC used for amplifying microphone signals
B. Distortion caused by RF pickup on the microphone cable
C. Changes in oscillator frequency caused by mechanical vibration
D. Excess loading of the microphone by an oscillator
~~

E7H03 (C)
What is a phase-locked loop?
A. An electronic servo loop consisting of a ratio detector, reactance modulator, and voltage-controlled oscillator
B. An electronic circuit also known as a monostable multivibrator
C. An electronic servo loop consisting of a phase detector, a low-pass filter, a voltage-controlled oscillator, and a stable reference oscillator
D. An electronic circuit consisting of a precision push-pull amplifier with a differential phase input
~~

E7H04 (C)
How is positive feedback supplied in a Colpitts oscillator?
A. Through a tapped coil
B. Through link coupling
C. Through a capacitive divider
D. Through a neutralizing capacitor
~~

E7H05 (D)
How is positive feedback supplied in a Pierce oscillator?
A. Through a tapped coil
B. Through link coupling
C. Through a neutralizing capacitor
D. Through a quartz crystal
~~

E7H06 (B)
Which of these functions can be performed by a phase-locked loop?
A. Wide-band AF and RF power amplification
B. Frequency synthesis and FM demodulation
C. Photovoltaic conversion and optical coupling
D. Comparison of two digital input signals and digital pulse counting
~~

E7H07 (D)
How can an oscillator’s microphonic responses be reduced?
A. Use NP0 capacitors
B. Reduce noise on the oscillator’s power supply
C. Increase the gain
D. Mechanically isolate the oscillator circuitry from its enclosure
~~

E7H08 (A)
Which of the following components can be used to reduce thermal drift in crystal oscillators?
A. NP0 capacitors
B. Toroidal inductors
C. Wirewound resistors
D. Non-inductive resistors
~~

E7H09 (A)
What type of frequency synthesizer circuit uses a phase accumulator, lookup table, digital-to-analog converter, and a low-pass anti-alias filter?
A. A direct digital synthesizer
B. A hybrid synthesizer
C. A phase-locked loop synthesizer
D. A direct conversion synthesizer
~~

E7H10 (B)
What information is contained in the lookup table of a direct digital synthesizer (DDS)?
A. The phase relationship between a reference oscillator and the output waveform
B. Amplitude values that represent the desired waveform
C. The phase relationship between a voltage-controlled oscillator and the output waveform
D. Frequently used receiver and transmitter frequencies
~~

E7H11 (C)
What are the major spectral impurity components of direct digital synthesizers?
A. Broadband noise
B. Digital conversion noise
C. Spurious signals at discrete frequencies
D. Harmonics of the local oscillator
~~

E7H12 (B)
Which of the following ensures that a crystal oscillator operates on the frequency specified by the crystal manufacturer?
A. Provide the crystal with a specified parallel inductance
B. Provide the crystal with a specified parallel capacitance
C. Bias the crystal at a specified voltage
D. Bias the crystal at a specified current
~~

E7H13 (D)
Which of the following is a technique for providing highly accurate and stable oscillators needed for microwave transmission and reception?
A. Use a GPS signal reference
B. Use a rubidium stabilized reference oscillator
C. Use a temperature-controlled high Q dielectric resonator
D. All these choices are correct
~~

SUBELEMENT E8 - SIGNALS AND EMISSIONS [4 Exam Questions - 4 Groups]

E8A Fourier analysis; RMS measurements; average RF power and peak envelope power (PEP); analog/digital conversion

E8A01 (A)
What technique shows that a square wave is made up of a sine wave and its odd harmonics?
A. Fourier analysis
B. Vector analysis
C. Numerical analysis
D. Differential analysis
~~

E8A02 (A)
Which of the following is a type of analog-to-digital conversion?
A. Successive approximation
B. Harmonic regeneration
C. Level shifting
D. Phase reversal
~~

E8A03(B)
Which of the following describes a signal in the time domain?
A. Power at intervals of phase
B. Amplitude at different times
C. Frequency at different times
D. Discrete impulses in time order
~~

E8A04 (B)
What is “dither” with respect to analog-to-digital converters?
A. An abnormal condition where the converter cannot settle on a value to represent the signal
B. A small amount of noise added to the input signal to reduce quantization noise
C. An error caused by irregular quantization step size
D. A method of decimation by randomly skipping samples
~~

E8A05 (D)
What is the benefit of making voltage measurements with a true-RMS calculating meter?
A. An inverse Fourier transform can be used
B. The signal’s RMS noise factor is also calculated
C. The calculated RMS value can be converted directly into phasor form
D. RMS is measured for both sinusoidal and non-sinusoidal signals
~~

E8A06 (A)
What is the approximate ratio of PEP-to-average power in an unprocessed single-sideband phone signal?
A. 2.5 to 1
B. 25 to 1
C. 1 to 1
D. 13 to 1
~~

E8A07 (B)
What determines the PEP-to-average power ratio of an unprocessed single-sideband phone signal?
A. The frequency of the modulating signal
B. Speech characteristics
C. The degree of carrier suppression
D. Amplifier gain
~~

E8A08 (C)
Why are direct or flash conversion analog-to-digital converters used for a software defined radio?
A. Very low power consumption decreases frequency drift
B. Immunity to out-of-sequence coding reduces spurious responses
C. Very high speed allows digitizing high frequencies
D. All these choices are correct
~~

E8A09 (D)
How many different input levels can be encoded by an analog-to-digital converter with 8-bit resolution?
A. 8
B. 8 multiplied by the gain of the input amplifier
C. 256 divided by the gain of the input amplifier
D. 256
~~

E8A10 (C)
What is the purpose of a low-pass filter used at the output of a digital-to-analog converter?
A. Lower the input bandwidth to increase the effective resolution
B. Improve accuracy by removing out-of-sequence codes from the input
C. Remove spurious sampling artifacts from the output signal
D. All these choices are correct
~~

E8A11 (A)
Which of the following is a measure of the quality of an analog-to-digital converter?
A. Total harmonic distortion
B. Peak envelope power
C. Reciprocal mixing
D. Power factor
~~

E8B Modulation and demodulation: modulation methods; modulation index and deviation ratio; frequency- and time-division multiplexing; orthogonal frequency-division multiplexing (OFDM)

E8B01 (A)
What is the modulation index of an FM signal?
A. The ratio of frequency deviation to modulating signal frequency
B. The ratio of modulating signal amplitude to frequency deviation
C. The modulating signal frequency divided by the bandwidth of the transmitted signal
D. The bandwidth of the transmitted signal divided by the modulating signal frequency
~~
E8B02 (D)
How does the modulation index of a phase-modulated emission vary with RF carrier frequency?
A. It increases as the RF carrier frequency increases
B. It decreases as the RF carrier frequency increases
C. It varies with the square root of the RF carrier frequency
D. It does not depend on the RF carrier frequency
~~

E8B03 (A)
What is the modulation index of an FM phone signal having a maximum frequency deviation of 3000 Hz either side of the carrier frequency if the highest modulating frequency is 1000 Hz?
A. 3
B. 0.3
C. 6
D. 0.6
~~

E8B04 (B)
What is the modulation index of an FM phone signal having a maximum carrier deviation of plus or minus 6 kHz if the highest modulating frequency is 2 kHz?
A. 0.3
B. 3
C. 0.6
D. 6
~~

E8B05 (D)
What is the deviation ratio of an FM phone signal having a maximum frequency swing of plus or minus 5 kHz if the highest modulation frequency is 3 kHz?
A. 6
B. 0.167
C. 0.6
D. 1.67
~~

E8B06 (A)
What is the deviation ratio of an FM phone signal having a maximum frequency swing of plus or minus 7.5 kHz if the highest modulation frequency is 3.5 kHz?
A. 2.14
B. 0.214
C. 0.47
D. 47
~~

E8B07 (A)
Orthogonal frequency-division multiplexing (OFDM) is a technique used for which types of amateur communication?
A. Digital modes
B. Extremely low-power contacts
C. EME
D. OFDM signals are not allowed on amateur bands
~~

E8B08 (D)
What describes orthogonal frequency-division multiplexing (OFDM)?
A. A frequency modulation technique that uses non-harmonically related frequencies
B. A bandwidth compression technique using Fourier transforms
C. A digital mode for narrow-band, slow-speed transmissions
D. A digital modulation technique using subcarriers at frequencies chosen to avoid intersymbol interference
~~

E8B09 (B)
What is deviation ratio?
A. The ratio of the audio modulating frequency to the center carrier frequency
B. The ratio of the maximum carrier frequency deviation to the highest audio modulating frequency
C. The ratio of the carrier center frequency to the audio modulating frequency
D. The ratio of the highest audio modulating frequency to the average audio modulating frequency
~~

E8B10 (B)
What is frequency division multiplexing (FDM)?
A. The transmitted signal jumps from band to band at a predetermined rate
B. Dividing the transmitted signal into separate frequency bands that each carry a different data stream
C. The transmitted signal is divided into packets of information
D. Two or more information streams are merged into a digital combiner, which then pulse position modulates the transmitter
~~

E8B11 (B)
What is digital time division multiplexing?
A. Two or more data streams are assigned to discrete sub-carriers on an FM transmitter
B. Two or more signals are arranged to share discrete time slots of a data transmission
C. Two or more data streams share the same channel by transmitting time of transmission as the sub-carrier
D. Two or more signals are quadrature modulated to increase bandwidth efficiency
~~

E8C Digital signals: digital communication modes; information rate vs. bandwidth; error correction; constellation diagrams

E8C01 (B)
What is Quadrature Amplitude Modulation or QAM?
A. A technique for digital data compression used in digital television which removes redundancy in the data by comparing bit amplitudes
B. Transmission of data by modulating the amplitude of two carriers of the same frequency but 90 degrees out of phase
C. A method of performing single sideband modulation by shifting the phase of the carrier and modulation components of the signal
D. A technique for analog modulation of television video signals using phase modulation and compression
~~

E8C02 (C)
What is the definition of symbol rate in a digital transmission?
A. The number of control characters in a message packet
B. The maximum rate at which the forward error correction code can make corrections
C. The rate at which the waveform changes to convey information
D. The number of characters carried per second by the station-to-station link
~~

E8C03 (A)
Why should the phase of a PSK signal be changed at the zero crossing of the RF signal?
A. To minimize bandwidth
B. To simplify modulation
C. To improve carrier suppression
D. All these choices are correct
~~

E8C04 (C)
What technique minimizes the bandwidth of a PSK31 signal?
A. Zero-sum character encoding
B. Reed-Solomon character encoding
C. Use of sinusoidal data pulses
D. Use of linear data pulses
~~

E8C05 (C)
What is the approximate bandwidth of a 13-WPM International Morse Code transmission?
A. 13 Hz
B. 26 Hz
C. 52 Hz
D. 104 Hz
~~

E8C06 (B)
What is the bandwidth of an FT8 signal?
A. 10 Hz
B. 50 Hz
C. 600 Hz
D. 2.4 kHz
~~

E8C07 (A)
What is the bandwidth of a 4,800-Hz frequency shift, 9,600-baud ASCII FM transmission?
A. 15.36 kHz
B. 9.6 kHz
C. 4.8 kHz
D. 5.76 kHz
~~

E8C08 (D)
How does ARQ accomplish error correction?
A. Special binary codes provide automatic correction
B. Special polynomial codes provide automatic correction
C. If errors are detected, redundant data is substituted
D. If errors are detected, a retransmission is requested
~~
E8C09 (D)
Which digital code allows only one bit to change between sequential code values?
A. Binary Coded Decimal Code
B. Extended Binary Coded Decimal Interchange Code
C. Extended ASCII
D. Gray code
~~

E8C10 (C)
How can data rate be increased without increasing bandwidth?
A. It is impossible
B. Increasing analog-to-digital conversion resolution
C. Using a more efficient digital code
D. Using forward error correction
~~

E8C11 (A)
What is the relationship between symbol rate and baud?
A. They are the same
B. Baud is twice the symbol rate
C. Baud rate is half the symbol rate
D. The relationship depends on the specific code used
~~

E8C12 (C)
What factors affect the bandwidth of a transmitted CW signal?
A. IF bandwidth and Q
B. Modulation index and output power
C. Keying speed and shape factor (rise and fall time)
D. All these choices are correct
~~

E8C13 (B)
What is described by the constellation diagram of a QAM or QPSK signal?
A. How many carriers may be present at the same time
B. The possible phase and amplitude states for each symbol
C. Frequency response of the signal stream
D. The number of bits used for error correction in the protocol
~~

E8C14 (C)
What type of addresses do nodes have in a mesh network?
A. Email
B. Trust server
C. Internet Protocol (IP)
D. Talk group
~~

E8C15 (C)
What technique do individual nodes use to form a mesh network?
A. Forward error correction and Viterbi codes
B. Acting as store-and-forward digipeaters
C. Discovery and link establishment protocols
D. Custom code plugs for the local trunking systems
~~

E8D Keying defects and overmodulation of digital signals; digital codes; spread spectrum

E8D01 (A)
Why are received spread spectrum signals resistant to interference?
A. Signals not using the spread spectrum algorithm are suppressed in the receiver
B. The high power used by a spread spectrum transmitter keeps its signal from being easily overpowered
C. Built-in error correction codes minimize interference
D. If the receiver detects interference, it will signal the transmitter to change frequencies
~~

E8D02 (B)
What spread spectrum communications technique uses a high-speed binary bit stream to shift the phase of an RF carrier?
A. Frequency hopping
B. Direct sequence
C. Binary phase-shift keying
D. Phase compandored spread spectrum
~~

E8D03 (D)
Which describes spread spectrum frequency hopping?
A. If interference is detected by the receiver, it will signal the transmitter to change frequencies
B. RF signals are clipped to generate a wide band of harmonics which provides redundancy to correct errors
C. A binary bit stream is used to shift the phase of an RF carrier very rapidly in a pseudorandom sequence
D. Rapidly varying the frequency of a transmitted signal according to a pseudorandom sequence
~~

E8D04 (C)
What is the primary effect of extremely short rise or fall time on a CW signal?
A. More difficult to copy
B. The generation of RF harmonics
C. The generation of key clicks
D. More difficult to tune
~~

E8D05 (A)
What is the most common method of reducing key clicks?
A. Increase keying waveform rise and fall times
B. Insert low-pass filters at the transmitter output
C. Reduce keying waveform rise and fall times
D. Insert high-pass filters at the transmitter output
~~

E8D06 (D)
What is the advantage of including parity bits in ASCII characters?
A. Faster transmission rate
B. Signal-to-noise ratio is improved
C. A larger character set is available
D. Some types of errors can be detected
~~

E8D07 (D)
What is a common cause of overmodulation of AFSK signals?
A. Excessive numbers of retries
B. Excessive frequency deviation
C. Bit errors in the modem
D. Excessive transmit audio levels
~~

E8D08 (D)
What parameter evaluates distortion of an AFSK signal caused by excessive input audio levels?
A. Signal-to-noise ratio
B. Baud error rate
C. Repeat Request Rate (RRR)
D. Intermodulation Distortion (IMD)
~~

E8D09 (D)
What is considered an acceptable maximum IMD level for an idling PSK signal?
A. +5 dB
B. +10 dB
C. +15 dB
D. -30 dB
~~

E8D10 (B)
What are some of the differences between the Baudot digital code and ASCII?
A. Baudot uses 4 data bits per character, ASCII uses 7 or 8; Baudot uses 1 character as a letters/figures shift code, ASCII has no letters/figures code
B. Baudot uses 5 data bits per character, ASCII uses 7 or 8; Baudot uses 2 characters as letters/figures shift codes, ASCII has no letters/figures shift code
C. Baudot uses 6 data bits per character, ASCII uses 7 or 8; Baudot has no letters/figures shift code, ASCII uses 2 letters/figures shift codes
D. Baudot uses 7 data bits per character, ASCII uses 8; Baudot has no letters/figures shift code, ASCII uses 2 letters/figures shift codes
~~

E8D11 (C)
What is one advantage of using ASCII code for data communications?
A. It includes built-in error correction features
B. It contains fewer information bits per character than any other code
C. It is possible to transmit both uppercase and lowercase text
D. It uses one character as a shift code to send numeric and special characters
~~

SUBELEMENT E9 - ANTENNAS AND TRANSMISSION LINES [8 Exam Questions - 8 Groups]

E9A Basic antenna parameters: radiation resistance, gain, beamwidth, efficiency; effective radiated power (ERP) and effective isotropic radiated power (EIRP)

E9A01 (C)
What is an isotropic radiator?
A. A calibrated, unidirectional antenna used to make precise antenna gain measurements
B. An omnidirectional, horizontally polarized, precisely calibrated antenna used to make field measurements of antenna gain
C. A hypothetical, lossless antenna having equal radiation intensity in all directions used as a reference for antenna gain
D. A spacecraft antenna used to direct signals toward Earth
~~

E9A02 (D)
What is the effective radiated power (ERP) of a repeater station with 150 watts transmitter power output, 2 dB feed line loss, 2.2 dB duplexer loss, and 7 dBd antenna gain?
A. 469 watts
B. 78.7 watts
C. 420 watts
D. 286 watts
~~

E9A03 (C)
What term describing total radiated power takes into account all gains and losses?
A. Power factor
B. Half-power bandwidth
C. Effective radiated power
D. Apparent power
~~

E9A04 (B)
Which of the following factors affect the feed point impedance of an antenna?
A. Transmission line length
B. Antenna height
C. The settings of an antenna tuner at the transmitter
D. The input power level
~~

E9A05 (D)
What does the term “ground gain” mean?
A. The change in signal strength caused by grounding the antenna
B. The gain of the antenna with respect to a dipole at ground level
C. To force net gain to 0 dB by grounding part of the antenna
D. An increase in signal strength from ground reflections in the environment of the antenna
~~

E9A06 (A)
What is the effective radiated power (ERP) of a repeater station with 200 watts transmitter power output, 4 dB feed line loss, 3.2 dB duplexer loss, 0.8 dB circulator loss, and 10 dBd antenna gain?
A. 317 watts
B. 2,000 watts
C. 126 watts
D. 300 watts
~~

E9A07 (B)
What is the effective isotropic radiated power (EIRP) of a repeater station with 200 watts transmitter power output, 2 dB feed line loss, 2.8 dB duplexer loss, 1.2 dB circulator loss, and 7 dBi antenna gain?
A. 159 watts
B. 252 watts
C. 632 watts
D. 63.2 watts
~~

E9A08 (A)
Which frequency band has the smallest first Fresnel zone?
A. 5.8 GHz
B. 3.4 GHz
C. 2.4 GHz
D. 900 MHz
~~

E9A09 (B)
What is antenna efficiency?
A. Radiation resistance divided by transmission resistance
B. Radiation resistance divided by total resistance
C. Total resistance divided by radiation resistance
D. Effective radiated power divided by transmitter output
~~

E9A10 (A)
Which of the following improves the efficiency of a ground-mounted quarter-wave vertical antenna?
A. Installing a ground radial system
B. Isolating the coax shield from ground
C. Shortening the radiating element
D. All these choices are correct
~~

E9A11 (C)
Which of the following determines ground losses for a ground-mounted vertical antenna operating on HF?
A. The standing wave ratio
B. Distance from the transmitter
C. Soil conductivity
D. Take-off angle
~~

E9A12 (A)
How much gain does an antenna have compared to a half-wavelength dipole if it has 6 dB gain over an isotropic radiator?
A. 3.85 dB
B. 6.0 dB
C. 8.15 dB
D. 2.79 dB
~~

E9B Antenna patterns and designs: azimuth and elevation patterns; gain as a function of pattern; antenna modeling

E9B01 (B)
What is the 3 dB beamwidth of the antenna radiation pattern shown in Figure E9-1?
A. 75 degrees
B. 50 degrees
C. 25 degrees
D. 30 degrees
~~

E9B02 (D)
What is the front-to-back ratio of the antenna radiation pattern shown in Figure E9-1?
A. 36 dB
B. 14 dB
C. 24 dB
D. 18 dB
~~

E9B03 (D)
What is the front-to-side ratio of the antenna radiation pattern shown in Figure E9-1?
A. 12 dB
B. 24 dB
C. 18 dB
D. 14 dB
~~

E9B04 (B)
What is the front-to-back ratio of the radiation pattern shown in Figure E9-2?
A. 15 dB
B. 28 dB
C. 3 dB
D. 38 dB
~~

E9B05 (A)
What type of antenna pattern is shown in Figure E9-2?
A. Elevation
B. Azimuth
C. Near field
D. Polarization
~~

E9B06 (C)
What is the elevation angle of peak response in the antenna radiation pattern shown in Figure E9-2?
A. 45 degrees
B. 75 degrees
C. 7.5 degrees
D. 25 degrees
~~

E9B07 (C)
What is the difference in radiated power between a lossless antenna with gain and an isotropic radiator driven by the same power?
A. The power radiated from the directional antenna is increased by the gain of the antenna
B. The power radiated from the directional antenna is stronger by its front-to-back ratio
C. They are the same
D. The power radiated from the isotropic radiator is 2.15 dB greater than that from the directional antenna
~~

E9B08 (D)
What is the far field of an antenna?
A. The region of the ionosphere where radiated power is not refracted
B. The region where radiated power dissipates over a specified time period
C. The region where radiated field strengths are constant
D. The region where the shape of the radiation pattern no longer varies with distance
~~

E9B09 (B)
What type of analysis is commonly used for modeling antennas?
A. Graphical analysis
B. Method of Moments
C. Mutual impedance analysis
D. Calculus differentiation with respect to physical properties
~~

E9B10 (A)
What is the principle of a Method of Moments analysis?
A. A wire is modeled as a series of segments, each having a uniform value of current
B. A wire is modeled as a single sine-wave current generator
C. A wire is modeled as a single sine-wave voltage source
D. A wire is modeled as a series of segments, each having a distinct value of voltage across it
~~

E9B11 (C)
What is a disadvantage of decreasing the number of wire segments in an antenna model below 10 segments per half-wavelength?
A. Ground conductivity will not be accurately modeled
B. The resulting design will favor radiation of harmonic energy
C. The computed feed point impedance may be incorrect
D. The antenna will become mechanically unstable
~~

E9C Practical wire antennas; folded dipoles; phased arrays; effects of ground near antennas

E9C01 (D)
What type of radiation pattern is created by two 1/4-wavelength vertical antennas spaced 1/2-wavelength apart and fed 180 degrees out of phase?
A. Cardioid
B. Omni-directional
C. A figure-eight broadside to the axis of the array
D. A figure-eight oriented along the axis of the array
~~

E9C02 (A)
What type of radiation pattern is created by two 1/4-wavelength vertical antennas spaced 1/4-wavelength apart and fed 90 degrees out of phase?
A. Cardioid
B. A figure-eight end-fire along the axis of the array
C. A figure-eight broadside to the axis of the array
D. Omni-directional
~~

E9C03 (C)
What type of radiation pattern is created by two 1/4-wavelength vertical antennas spaced 1/2-wavelength apart and fed in phase?
A. Omni-directional
B. Cardioid
C. A figure-eight broadside to the axis of the array
D. A figure-eight end-fire along the axis of the array
~~

E9C04 (B)
What happens to the radiation pattern of an unterminated long wire antenna as the wire length is increased?
A. Fewer lobes form with the major lobes increasing closer to broadside to the wire
B. Additional lobes form with major lobes increasingly aligned with the axis of the antenna
C. The elevation angle increases, and the front-to-rear ratio decreases
D. The elevation angle increases, while the front-to-rear ratio is unaffected
~~

E9C05 (A)
What is the purpose of feeding an off-center-fed dipole (OCFD) between the center and one end instead of at the midpoint?
A. To create a similar feed point impedance on multiple bands
B. To suppress off-center lobes at higher frequencies
C. To resonate the antenna across a wider range of frequencies
D. To reduce common-mode current coupling on the feed line shield
~~

E9C06 (B)
What is the effect of adding a terminating resistor to a rhombic or long-wire antenna?
A. It reflects the standing waves on the antenna elements back to the transmitter
B. It changes the radiation pattern from bidirectional to unidirectional
C. It changes the radiation pattern from horizontal to vertical polarization
D. It decreases the ground loss
~~

E9C07 (A)
What is the approximate feed point impedance at the center of a two-wire half-wave folded dipole antenna?
A. 300 ohms
B. 72 ohms
C. 50 ohms
D. 450 ohms
~~

E9C08 (C)
What is a folded dipole antenna?
A. A dipole one-quarter wavelength long
B. A center-fed dipole with the ends folded down 90 degrees at the midpoint of each side
C. A half-wave dipole with an additional parallel wire connecting its two ends
D. A dipole configured to provide forward gain
~~

E9C09 (A)
Which of the following describes a G5RV antenna?
A. A wire antenna center-fed through a specific length of open-wire line connected to a balun and coaxial feed line
B. A multi-band trap antenna
C. A phased array antenna consisting of multiple loops
D. A wide band dipole using shorted coaxial cable for the radiating elements and fed with a 4:1 balun
~~

E9C10 (B)
Which of the following describes a Zepp antenna?
A. A horizontal array capable of quickly changing the direction of maximum radiation by changing phasing lines
B. An end-fed half-wavelength dipole
C. An omni-directional antenna commonly used for satellite communications
D. A vertical array capable of quickly changing the direction of maximum radiation by changing phasing lines
~~

E9C11 (D)
How is the far-field elevation pattern of a vertically polarized antenna affected by being mounted over seawater versus soil?
A. Radiation at low angles decreases
B. Additional lobes appear at higher elevation angles
C. Separate elevation lobes will combine into a single lobe
D. Radiation at low angles increases
~~

E9C12 (C)
Which of the following describes an extended double Zepp antenna?
A. An end-fed full-wave dipole antenna
B. A center-fed 1.5-wavelength dipole antenna
C. A center-fed 1.25-wavelength dipole antenna
D. An end-fed 2-wavelength dipole antenna
~~

E9C13 (B)
How does the radiation pattern of a horizontally polarized antenna vary with increasing height above ground?
A. The takeoff angle of the lowest elevation lobe increases
B. The takeoff angle of the lowest elevation lobe decreases
C. The horizontal beamwidth increases
D. The horizontal beamwidth decreases
~~

E9C14 (B)
How does the radiation pattern of a horizontally-polarized antenna mounted above a long slope compare with the same antenna mounted above flat ground?
A. The main lobe takeoff angle increases in the downhill direction
B. The main lobe takeoff angle decreases in the downhill direction
C. The horizontal beamwidth decreases in the downhill direction
D. The horizontal beamwidth increases in the uphill direction
~~

E9D Yagi antennas; parabolic reflectors; feed point impedance and loading of electrically short antennas; antenna Q; RF grounding

E9D01 (D)
How much does the gain of an ideal parabolic reflector antenna increase when the operating frequency is doubled?
A. 2 dB
B. 3 dB
C. 4 dB
D. 6 dB
~~

E9D02 (C)
How can two linearly polarized Yagi antennas be used to produce circular polarization?
A. Stack two Yagis to form an array with the respective elements in parallel planes fed 90 degrees out of phase
B. Stack two Yagis to form an array with the respective elements in parallel planes fed in phase
C. Arrange two Yagis on the same axis and perpendicular to each other with the driven elements at the same point on the boom and fed 90 degrees out of phase
D. Arrange two Yagis collinear to each other with the driven elements fed 180 degrees out of phase
~~

E9D03 (A)
What is the most efficient location for a loading coil on an electrically short whip?
A. Near the center of the vertical radiator
B. As low as possible on the vertical radiator
C. At a voltage maximum
D. At a voltage null
~~

E9D04 (C)
Why should antenna loading coils have a high ratio of reactance to resistance?
A. To swamp out harmonics
B. To lower the radiation angle
C. To maximize efficiency
D. To minimize the Q
~~

E9D05 (D)
Approximately how long is a Yagi’s driven element?
A. 234 divided by frequency in MHz
B. 1005 divided by frequency in MHz
C. 1/4 wavelength
D. 1/2 wavelength
~~

E9D06 (B)
What happens to SWR bandwidth when one or more loading coils are used to resonate an electrically short antenna?
A. It is increased
B. It is decreased
C. It is unchanged if the loading coil is located at the feed point
D. It is unchanged if the loading coil is located at a voltage maximum point
~~

E9D07 (D)
What is an advantage of top loading an electrically short HF vertical antenna?
A. Lower Q
B. Greater structural strength
C. Higher losses
D. Improved radiation efficiency
~~

E9D08 (B)
What happens as the Q of an antenna increases?
A. SWR bandwidth increases
B. SWR bandwidth decreases
C. Gain is reduced
D. More common-mode current is present on the feed line
~~

E9D09 (D)
What is the function of a loading coil in an electrically short antenna?
A. To increase the SWR bandwidth by increasing net reactance
B. To lower the losses
C. To lower the Q
D. To resonate the antenna by cancelling the capacitive reactance
~~

E9D10 (B)
How does radiation resistance of a base-fed whip antenna change below its resonant frequency?
A. Radiation resistance increases
B. Radiation resistance decreases
C. Radiation resistance becomes imaginary
D. Radiation resistance does not depend on frequency
~~

E9D11 (D)
Why do most two-element Yagis with normal spacing have a reflector instead of a director?
A. Lower SWR
B. Higher receiving directivity factor
C. Greater front-to-side
D. Higher gain
~~

E9D12 (C)
What is the purpose of making a Yagi's parasitic elements either longer or shorter than resonance?
A. Wind torque cancellation
B. Mechanical balance
C. Control of phase shift
D. Minimize losses
~~

E9E Impedance matching: matching antennas to feed lines; phasing lines; power dividers

E9E01 (B)
Which matching system for Yagi antennas requires the driven element to be insulated from the boom?
A. Gamma
B. Beta or hairpin
C. Shunt-fed
D. T-match
~~

E9E02 (A)
What antenna matching system matches coaxial cable to an antenna by connecting the shield to the center of the antenna and the conductor a fraction of a wavelength to one side?
A. Gamma match
B. Delta match
C. T-match
D. Stub match
~~

E9E03 (D)
What matching system uses a short length of transmission line connected in parallel with the feed line at or near the feed point?
A. Gamma match
B. Delta match
C. T-match
D. Stub match
~~

E9E04 (B)
What is the purpose of the series capacitor in a gamma match?
A. To provide DC isolation between the feed line and the antenna
B. To cancel unwanted inductive reactance
C. To provide a rejection notch that prevents the radiation of harmonics
D. To transform the antenna impedance to a higher value
~~

E9E05 (A)
What Yagi driven element feed point impedance is required to use a beta or hairpin matching system?
A. Capacitive (driven element electrically shorter than 1/2 wavelength)
B. Inductive (driven element electrically longer than 1/2 wavelength)
C. Purely resistive
D. Purely reactive
~~

E9E06 (C)
Which of these transmission line impedances would be suitable for constructing a quarter-wave Q-section for matching a 100-ohm feed point impedance to a 50-ohm transmission line?
A. 50 ohms
B. 62 ohms
C. 75 ohms
D. 90 ohms
~~

E9E07 (B)
What parameter describes the interaction of a load and transmission line?
A. Characteristic impedance
B. Reflection coefficient
C. Velocity factor
D. Dielectric constant
~~

E9E08 (C)
What is a use for a Wilkinson divider?
A. To divide the operating frequency of a transmitter signal so it can be used on a lower frequency band
B. To feed high-impedance antennas from a low-impedance source
C. To divide power equally between two 50-ohm loads while maintaining 50-ohm input impedance
D. To divide the frequency of the input to a counter to increase its frequency range
~~

E9E09 (C)
Which of the following is used to shunt feed a grounded tower at its base?
A. Double-bazooka match
B. Beta or hairpin match
C. Gamma match
D. All these choices are correct
~~

E9E10 Question Deleted (section not renumbered)
~~

E9E11 (A)
What is the purpose of using multiple driven elements connected through phasing lines?
A. To control the antenna’s radiation pattern
B. To prevent harmonic radiation from the transmitter
C. To allow single-band antennas to operate on other bands
D. To create a low-angle radiation pattern
~~

E9F Transmission lines: characteristics of open and shorted feed lines; coax versus open wire; velocity factor; electrical length; coaxial cable dielectrics; microstrip

E9F01 (D)
What is the velocity factor of a transmission line?
A. The ratio of its characteristic impedance to its termination impedance
B. The ratio of its termination impedance to its characteristic impedance
C. The velocity of a wave in the transmission line multiplied by the velocity of light in a vacuum
D. The velocity of a wave in the transmission line divided by the velocity of light in a vacuum
~~

E9F02 (C)
Which of the following has the biggest effect on the velocity factor of a transmission line?
A. The characteristic impedance
B. The transmission line length
C. The insulating dielectric material
D. The center conductor resistivity
~~

E9F03 (D)
Why is the electrical length of a coaxial cable longer than its physical length?
A. Skin effect is less pronounced in the coaxial cable
B. Skin effect is more pronounced in the coaxial cable
C. Electromagnetic waves move faster in coaxial cable than in air
D. Electromagnetic waves move more slowly in a coaxial cable than in air
~~

E9F04 (B)
What impedance does a 1/2-wavelength transmission line present to an RF generator when the line is shorted at the far end?
A. Very high impedance
B. Very low impedance
C. The same as the characteristic impedance of the line
D. The same as the output impedance of the RF generator
~~

E9F05 (D)
What is microstrip?
A. Special shielding material designed for microwave frequencies
B. Miniature coax used for low power applications
C. Short lengths of coax mounted on printed circuit boards to minimize time delay between microwave circuits
D. Precision printed circuit conductors above a ground plane that provide constant impedance interconnects at microwave frequencies
~~

E9F06 (C)
What is the approximate physical length of an air-insulated, parallel conductor transmission line that is electrically 1/2 wavelength long at 14.10 MHz?
A. 7.0 meters
B. 8.5 meters
C. 10.6 meters
D. 13.3 meters
~~

E9F07 (A)
How does parallel conductor transmission line compare to coaxial cable with a plastic dielectric?
A. Lower loss
B. Higher SWR
C. Smaller reflection coefficient
D. Lower velocity factor
~~

E9F08 (D)
Which of the following is a significant difference between foam dielectric coaxial cable and solid dielectric coaxial cable, assuming all other parameters are the same?
A. Foam dielectric coaxial cable has lower safe maximum operating voltage
B. Foam dielectric coaxial cable has lower loss per unit of length
C. Foam dielectric coaxial cable has higher velocity factor
D. All these choices are correct
~~

E9F09 (A)
What impedance does a 1/4-wavelength transmission line present to an RF generator when the line is shorted at the far end?
A. Very high impedance
B. Very low impedance
C. The same as the characteristic impedance of the transmission line
D. The same as the generator output impedance
~~

E9F10 (C)
What impedance does a 1/8-wavelength transmission line present to an RF generator when the line is shorted at the far end?
A. A capacitive reactance
B. The same as the characteristic impedance of the line
C. An inductive reactance
D. Zero
~~

E9F11 (C)
What impedance does a 1/8-wavelength transmission line present to an RF generator when the line is open at the far end?
A. The same as the characteristic impedance of the line
B. An inductive reactance
C. A capacitive reactance
D. Infinite
~~

E9F12 (D)
What impedance does a 1/4-wavelength transmission line present to an RF generator when the line is open at the far end?
A. The same as the characteristic impedance of the line
B. The same as the input impedance to the generator
C. Very high impedance
D. Very low impedance
~~

E9G The Smith chart

E9G01 (A)
Which of the following can be calculated using a Smith chart?
A. Impedance along transmission lines
B. Radiation resistance
C. Antenna radiation pattern
D. Radio propagation
~~

E9G02 (B)
What type of coordinate system is used in a Smith chart?
A. Voltage circles and current arcs
B. Resistance circles and reactance arcs
C. Voltage chords and current chords
D. Resistance lines and reactance chords
~~

E9G03 (C)
Which of the following is often determined using a Smith chart?
A. Beam headings and radiation patterns
B. Satellite azimuth and elevation bearings
C. Impedance and SWR values in transmission lines
D. Point-to-point propagation reliability as a function of frequency
~~

E9G04 (C)
What are the two families of circles and arcs that make up a Smith chart?
A. Inductance and capacitance
B. Reactance and voltage
C. Resistance and reactance
D. Voltage and impedance
~~

E9G05 (A)
Which of the following is a common use for a Smith chart?
A. Determine the length and position of an impedance matching stub
B. Determine the impedance of a transmission line, given the physical dimensions
C. Determine the gain of an antenna given the physical and electrical parameters
D. Determine the loss/100 feet of a transmission line, given the velocity factor and conductor materials
~~

E9G06 (B)
On the Smith chart shown in Figure E9-3, what is the name for the large outer circle on which the reactance arcs terminate?
A. Prime axis
B. Reactance axis
C. Impedance axis
D. Polar axis
~~

E9G07 (D)
On the Smith chart shown in Figure E9-3, what is the only straight line shown?
A. The reactance axis
B. The current axis
C. The voltage axis
D. The resistance axis
~~

E9G08 (C)
How is a Smith chart normalized?
A. Reassign the reactance axis with resistance values
B. Reassign the resistance axis with reactance values
C. Reassign the prime center’s impedance value
D. Reassign the prime center to the reactance axis
~~

E9G09 (A)
What third family of circles is often added to a Smith chart during the process of designing impedance matching networks?
A. Constant-SWR circles
B. Transmission line length circles
C. Coaxial-length circles
D. Radiation-pattern circles
~~

E9G10 (D)
What do the arcs on a Smith chart represent?
A. Frequency
B. SWR
C. Points with constant resistance
D. Points with constant reactance
~~

E9G11 (B)
In what units are the wavelength scales on a Smith chart calibrated?
A. In fractions of transmission line electrical frequency
B. In fractions of transmission line electrical wavelength
C. In fractions of antenna electrical wavelength
D. In fractions of antenna electrical frequency
~~

E9H Receiving antennas: radio direction finding (RDF) techniques; Beverage antennas; single- and multiple-turn loops

E9H01 (D)
When constructing a Beverage antenna, which of the following factors should be included in the design to achieve good performance at the desired frequency?
A. Its overall length must not exceed 1/4 wavelength
B. It must be mounted more than 1 wavelength above ground
C. It should be configured as a four-sided loop
D. It should be at least one wavelength long
~~

E9H02 (A)
Which is generally true for 160- and 80-meter receiving antennas?
A. Atmospheric noise is so high that directivity is much more important than losses
B. They must be erected at least 1/2 wavelength above the ground to attain good directivity
C. Low loss coax transmission line is essential for good performance
D. All these choices are correct
~~

E9H03 (D)
What is receiving directivity factor (RDF)?
A. Forward gain compared to the gain in the reverse direction
B. Relative directivity compared to isotropic
C. Relative directivity compared to a dipole
D. Peak antenna gain compared to average gain over the hemisphere around and above the antenna
~~

E9H04 (B)
What is the purpose of placing an electrostatic shield around a small-loop direction-finding antenna?
A. It adds capacitive loading, increasing the bandwidth of the antenna
B. It eliminates unbalanced capacitive coupling to the antenna’s surroundings, improving the depth of its nulls
C. It eliminates tracking errors caused by strong out-of-band signals
D. It increases signal strength by providing a better match to the feed line
~~

E9H05 (A)
What challenge is presented by a small wire-loop antenna for direction finding?
A. It has a bidirectional null pattern
B. It does not have a clearly defined null
C. It is practical for use only on VHF and higher bands
D. All these choices are correct
~~

E9H06 (D)
What indicates the correct value of terminating resistance for a Beverage antenna?
A. Maximum feed point DC resistance at the center of the desired frequency range
B. Minimum low-angle front-to-back ratio at the design frequency
C. Maximum DC current in the terminating resistor
D. Minimum variation in SWR over the desired frequency range
~~

E9H07 (B)
What is the function of a Beverage antenna’s termination resistor?
A. Increase the front-to-side ratio
B. Absorb signals from the reverse direction
C. Decrease SWR bandwidth
D. Eliminate harmonic reception
~~

E9H08 (A)
What is the function of a sense antenna?
A. It modifies the pattern of a DF antenna to provide a null in only one direction
B. It increases the sensitivity of a DF antenna array
C. It allows DF antennas to receive signals at different vertical angles
D. It provides diversity reception that cancels multipath signals
~~

E9H09 (A)
What type of radiation pattern is created by a single-turn, terminated loop such as a pennant antenna?
A. Cardioid
B. Bidirectional
C. Omnidirectional
D. Hyperbolic
~~

E9H10 (C)
How can the output voltage of a multiple-turn receiving loop antenna be increased?
A. By reducing the permeability of the loop shield
B. By utilizing high impedance wire for the coupling loop
C. By increasing the number of turns and/or the area enclosed by the loop
D. All these choices are correct
~~

E9H11 (B)
What feature of a cardioid pattern antenna makes it useful for direction-finding antennas?
A. A very sharp peak
B. A single null
C. Broadband response
D. High radiation angle
~~

SUBELEMENT E0 - SAFETY - [1 exam question - 1 group]

E0A Safety: RF radiation hazards; hazardous materials; grounding

E0A01 (B)
What is the primary function of an external earth connection or ground rod?
A. Prevent static build up on power lines
B. Lightning charge dissipation
C. Reduce RF current flow between pieces of equipment
D. Protect breaker panel from power surges
~~

E0A02 (B)
When evaluating RF exposure levels from your station at a neighbor’s home, what must you do?
A. Ensure signals from your station are less than the controlled maximum permissible exposure (MPE) limits
B. Ensure signals from your station are less than the uncontrolled maximum permissible exposure (MPE) limits
C. Ensure signals from your station are less than the controlled maximum permissible emission (MPE) limits
D. Ensure signals from your station are less than the uncontrolled maximum permissible emission (MPE) limits
~~

E0A03 (C)
Over what range of frequencies are the FCC human body RF exposure limits most restrictive?
A. 300 kHz - 3 MHz
B. 3 - 30 MHz
C. 30 - 300 MHz
D. 300 - 3000 MHz
~~

E0A04 (C)
When evaluating a site with multiple transmitters operating at the same time, the operators and licensees of which transmitters are responsible for mitigating over-exposure situations?
A. Each transmitter that produces 20 percent or more of its MPE limit in areas where the total MPE limit is exceeded
B. Each transmitter operating with a duty cycle greater than 25 percent
C. Each transmitter that produces 5 percent or more of its MPE limit in areas where the total MPE limit is exceeded
D. Each transmitter operating with a duty cycle greater than 50 percent
~~

E0A05 (B)
What hazard is created by operating at microwave frequencies?
A. Microwaves are ionizing radiation
B. The high gain antennas commonly used can result in high exposure levels
C. Microwaves are in the frequency range where wave velocity is higher
D. The extremely high frequency energy can damage the joints of antenna structures
~~

E0A06 (D)
Why are there separate electric (E) and magnetic (H) MPE limits at frequencies below 300 MHz?
A. The body reacts to electromagnetic radiation from both the E and H fields
B. Ground reflections and scattering cause the field strength to vary with location
C. E field and H field radiation intensity peaks can occur at different locations
D. All these choices are correct
~~

E0A07 (B)
What is meant by “100% tie-off” regarding tower safety?
A. All loose ropes and guys secured to a fixed structure
B. At least one lanyard attached to the tower at all times
C. All tools secured to the climber’s harness
D. All circuit breakers feeding power to the tower must be tied closed with tape, cable, or ties
~~

E0A08 (C)
What does SAR measure?
A. Signal attenuation ratio
B. Signal amplification rating
C. The rate at which RF energy is absorbed by the body
D. The rate of RF energy reflected from stationary terrain
~~

E0A09 (C)
Which of the following types of equipment are exempt from RF exposure evaluations?
A. Transceivers with less than 7 watts of RF output
B. Antennas that radiate only in the near field
C. Hand-held transceivers sold before May 3, 2021
D. Dish antennas less than one meter in diameter
~~

E0A10 (A)
When must an RF exposure evaluation be performed on an amateur station operating on 80 meters?
A. An evaluation must always be performed
B. When the ERP of the station is less than 10 watts
C. When the station’s operating mode is CW
D. When the output power from the transmitter is less than 100 watts
~~

E0A11 (D)
To what should lanyards be attached while climbing?
A. Antenna mast
B. Guy brackets
C. Tower rungs
D. Tower legs
~~

E0A12 (A)
Where should a shock-absorbing lanyard be attached to a tower when working above ground?
A. Above the climber’s head level
B. To the belt of the fall-arrest harness
C. Even with the climber's waist
D. To the next lowest set of guys
~~

End of Questions

NOTE: The graphics required for certain questions in sections E5, E6, E7, and E9 are included on the following pages.

Figure E5-1

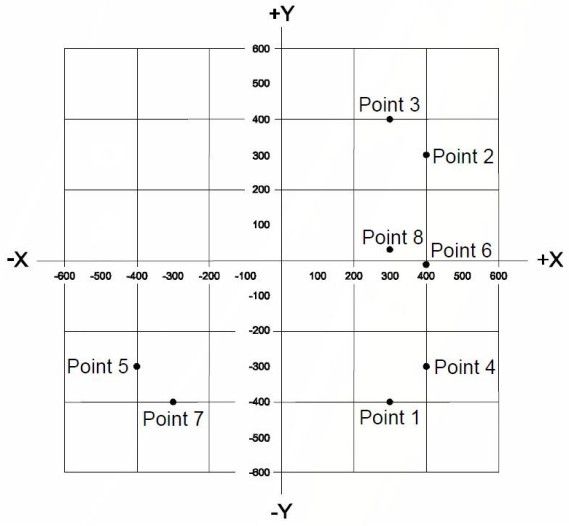

Figure E6-1

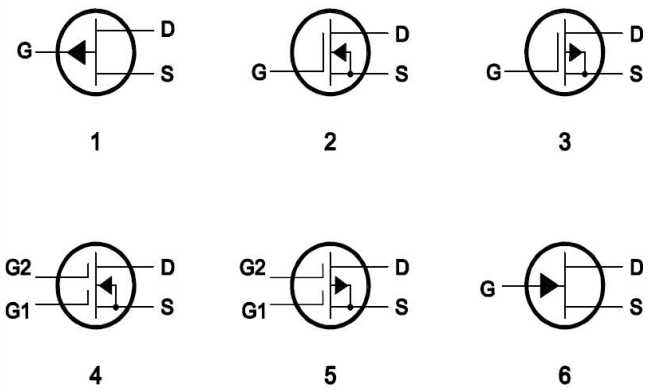

Figure E6-2

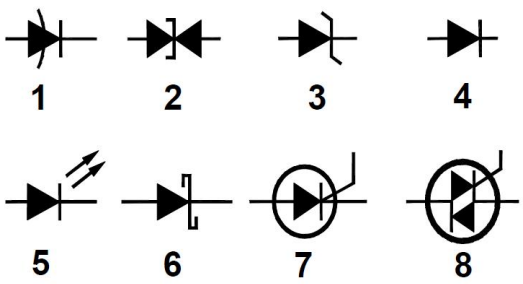

Figure E6-3

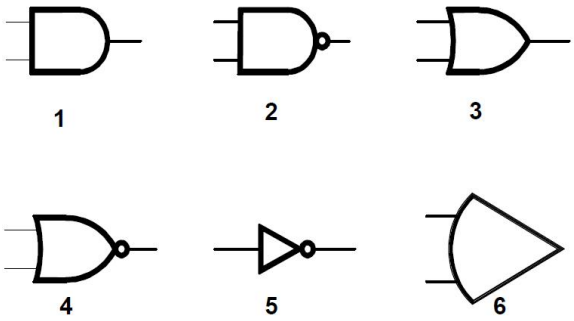

Figure E7-1

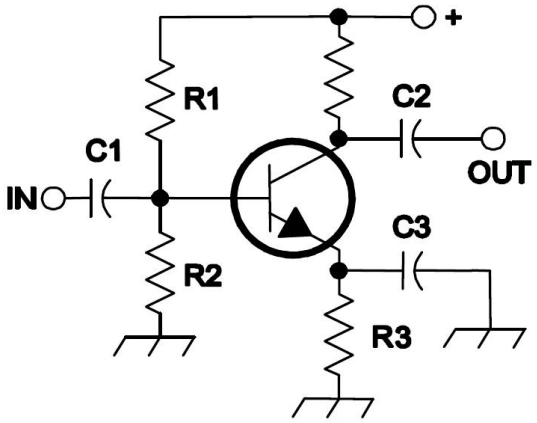

Figure E7-2

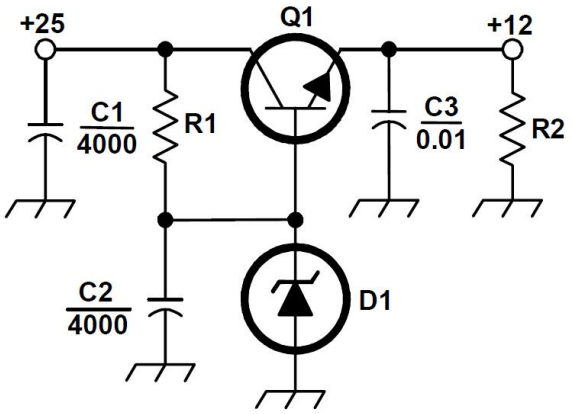

Figure E7-3

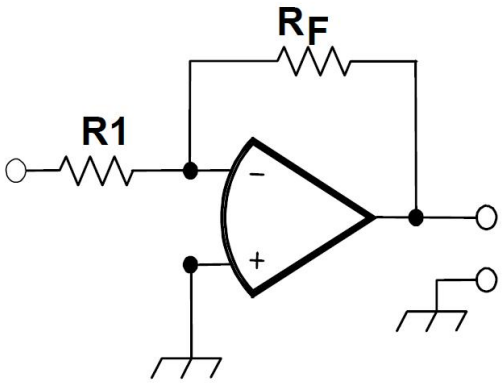

Figure E9-1

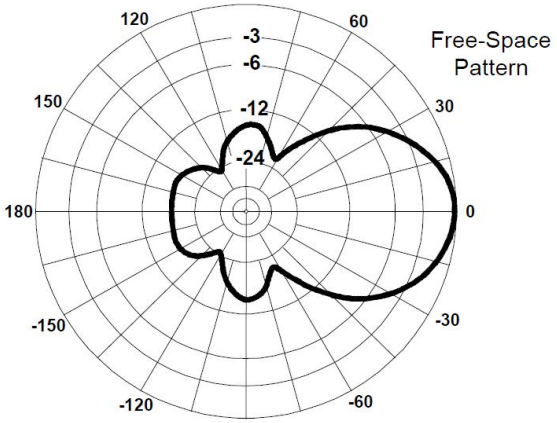

Figure E9-2

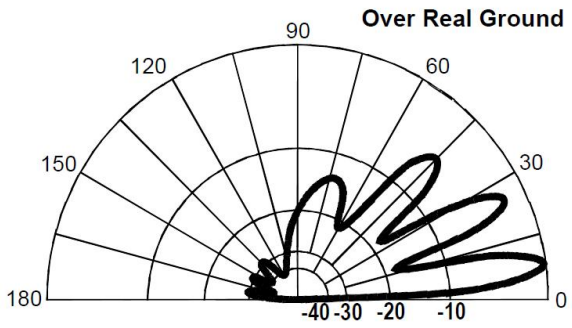

Figure E9-3