

THE INTERNATIONAL ASSOCIATION FOR RADIO,  
TELECOMMUNICATIONS & ELECTROMAGNETICS, INC.  
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**Study Reference Guide and  
Sample Questions  
For  
Telecommunication Engineers  
Credential Certification Exams**

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## STUDY REFERENCE GUIDE

### TELECOMMUNICATIONS MASTER ENGINEER EXAM

The Telecommunications Master Engineer examination encompasses the following areas of technology:

<b>Terminology</b>	21%
<b>Circuits</b>	19%
<b>Networks</b>	14%
<b>Modulation</b>	8%
<b>Propagation</b>	8%
<b>Transmission</b>	7%
<b>Transmission Lines</b>	7%
<b>Mathematics</b>	4%
<b>Physics</b>	4%
<b>Antennas</b>	2%
<b>Switching</b>	2%
<b>LAN</b>	1%
<b>Receivers</b>	1%
<b>Safety</b>	1%
<b>Telecommunications Standards</b>	<u>1%</u>
Total	100%

The iNARTE "Master Engineer" Exam is composed of 100 multiple-choice questions. Completion time for the Master examination is approximately 6 hours. Eight hours is the maximum time allowed to complete the exam.

This exam is "open book" thus any books or notes can be used. Calculators and "lap-top" computers (battery operated) are also allowed, but must not be used to communicate with another person. Power and internet service is not guaranteed.

Studying the following books would be a useful review for the Master exam:

#### **Electronic Communications Systems**

by Wayne Tomasi, Prentice Hall, 3<sup>rd</sup> Edition (or latest) ISBN 0137514395

#### **Telecommunications**

by Warren Hioki, Prentice Hall, 3<sup>rd</sup> Edition ISBN 0136320430

#### **Electronic Communications Techniques**

by Paul Young, Prentice Hall, Fourth Edition ISBN 0137799845

#### **Fiber Optic Communications**

by Joseph C. Palais, Prentice Hall, Fourth Edition ISBN 0138954429

**Basic Engineering Circuit Analysis**  
by David Erwin, Prentice Hall, Fifth Edition

**Digital Data Communications**  
by Jack Quinn, Prentice Hall ISBN 0023972408

**Introduction to Telephones & Telephone Systems**  
by A Michael Noll, Artech House, Sixth Edition

**Digital Fundamentals**  
by Thomas L. Floyd, Prentice Hall ISBN 0130808504

**Microelectronic Circuits and Devices**  
by Mark N. Horenstein, Prentice Hall, Second Edition ISBN 0137013353

Any equivalents (i.e. other books covering the same subjects) are, of course, just as good for studying purposes.

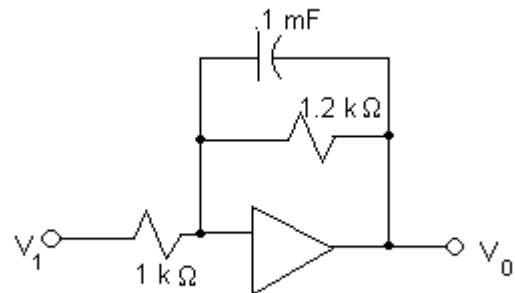
# MASTER ENGINEER - SAMPLE TEST

Answer key located on back page.

- The ability of a receiver to reject adjacent channel frequencies is described as its:
  - sensitivity.
  - suppression factor.
  - selectivity.
  - dissemination factor.
- Determine the characteristic impedance, of a quarter wave transformer used to match a line with a characteristic impedance of 50 ohms to a 200 ohm load.
  - 100 ohms.
  - 112 ohms.
  - 1235 ohms.
  - 150 ohms.
- What transmission medium is best suited for high-capacity and minimal interference?
  - Coaxial cable.
  - Twisted pair copper wire.
  - Microwave
  - Satellite
  - Optical Fiber

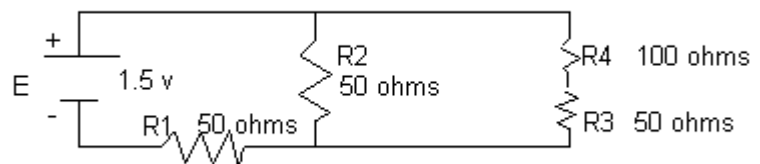
4. This diagram is:

- A unity gain buffer.
- A high gain amplifier with gain = 12
- A low pass filter with a cutoff frequency of .1326.3 Hz
- None of the above



5. What is the total resistance of the circuit below?

- 85.7 ohms
- 78.5 ohms.
- 80.7 ohms.
- 87.5 ohms





## STUDY REFERENCE GUIDE

### TELECOMMUNICATIONS SENIOR ENGINEER EXAM

The Telecommunications Senior Engineer examination is the second level of Telecommunications examinations and is intended for Telecommunications Engineers who have 2 to 4 years of practical experience following graduation from a 4 year BSEE or similar curriculum with a telecommunications specialty. The Senior Engineer examination encompasses the following areas of technology:

<b>Terminology</b>	17%
<b>Circuits</b>	17%
<b>Networks</b>	15%
<b>Modulation</b>	8%
<b>Propagation</b>	10%
<b>Transmission</b>	7%
<b>Transmission Lines</b>	10%
<b>Mathematics</b>	4%
<b>Physics</b>	4%
<b>Antennas</b>	2%
<b>Switching</b>	2%
<b>LAN</b>	1%
<b>Receivers</b>	1%
<b>Safety</b>	1%
<b>Telecommunications Standards</b>	<u>1%</u>
<b>Total</b>	100%

The iNARTE "Senior Engineer" Exam is composed of 100 multiple-choice questions. Completion time for the Senior examination is approximately 6 hours. Eight hours is the maximum time allowed to complete the exam.

This exam is "open book" thus any books or notes can be used. Calculators and "lap-top" computers (battery operated) are also allowed, but must not be used to communicate with another person. Power and internet service is not guaranteed.

Studying the following books would be a useful review for the Senior Engineer exam:

**Electronic Communications Systems**

by Wayne Tomasi, Prentice Hall, 3<sup>rd</sup> Edition (or latest) ISBN 0137514395

**Telecommunications**

by Warren Hioki, Prentice Hall, 3<sup>rd</sup> Edition ISBN 0136320430

**Electronic Communications Techniques**

by Paul Young, Prentice Hall, Fourth Edition ISBN 0137799845

**Fiber Optic Communications**

by Joseph C. Palais, Prentice Hall, Fourth Edition ISBN 0138954429

**Basic Engineering Circuit Analysis**

by David Erwin, Prentice Hall, Fifth Edition

**Digital Data Communications**

by Jack Quinn, Prentice Hall ISBN 0023972408

**Introduction to Telephones & Telephone Systems**

by A Michael Noll, Artech House, Sixth Edition

**Digital Fundamentals**

by Thomas L. Floyd, Prentice Hall ISBN 0130808504

**Microelectronic Circuits and Devices**

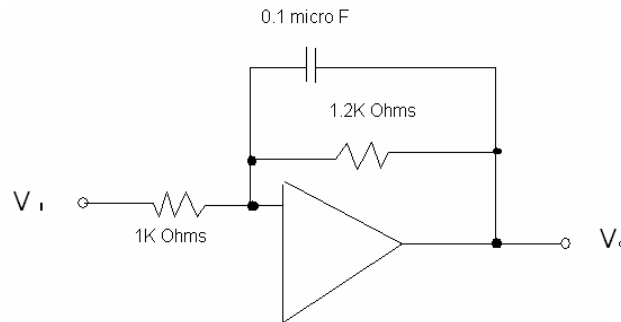
by Mark N. Horenstein, Prentice Hall, Second Edition ISBN 0137013353

Any equivalents (i.e. other books covering the same subjects) are, of course, just as good for studying purposes.

# SENIOR ENGINEER - SAMPLE TEST

Answer key located on back page.

1. The below is:



- (A). A unity gain buffer
- (B). A high gain amplifier with gain = 12
- (C). A low pass filter with a cutoff frequency of .1326.6 Hz
- (D). None of the above

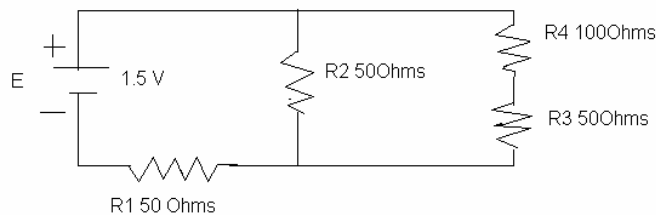
2. The range of frequencies of significant amplitude centered around a resonant frequency is called the\_\_\_\_\_?

- (A). Signal-to-noise ratio
- (B). Bandwidth
- (C). Quality factor
- (D). Carrier frequency

3. What is the basic rate for ISDN?

- (A). 2B+2D
- (B). 2B+D
- (C). B+2D
- (D). B-D

4. What is the current through R3 below?



- (A). 4 amps
- (B). .04 amps
- (C). .004 amps
- (D). .0004 amps

5. What are the steps followed to achieve Pulse Code Modulation?

- (A). Sampling, quantizing, modulation
- (B). Detecting, sampling, quantizing.
- (C). Sampling, quantizing, coding.
- (D). Coding, modulating, packetizing



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## STUDY REFERENCE GUIDE

### TELECOMMUNICATIONS JUNIOR ENGINEER EXAM

The iNARTE "Junior Engineer" exam is the first of three Telecommunications exams and is primarily intended for students who are graduating from a 4-year university program with a telecommunication specialty, however, differential equations are not needed for this exam.

This Telecommunications exam is oriented much more toward "systems" than "circuits" so as to reflect the special needs of the telecommunications users.

The Junior Engineer exam is composed of 70 multiple-choice questions which are divided into two parts, each lasting four hours. The questions are divided among the following categories:

**- TELECOM PRINCIPLES (20%):**

Applications. Definitions. Transmission media. Units. Communication theory (Nyquist, Shannon etc.). Noise. Analog modulations (AM, SSB, FM, PM). Digital modulations (ASK, FSK, PSK, QAM ...)

**- TRANSMITTER AND RECEIVER CIRCUITS (15%):**

Analysis of circuit diagrams. Calculation of voltages and currents in a circuit. Transistors and power tubes.

**- DIGITAL COMMUNICATIONS (10%):**

PAM, PCM, ADPCM, TDM, line codes (NRZ, RTZ, polar, bipolar, pseudo-ternary ...), channel codes (BnZS, ZBTSI...)

**- DATA COMMUNICATIONS (10%):**

Codes (Baudot, ASCII...). Serial communication. SDLC. HDLC. Error correcting codes. Modems. Packet switching. X.25. OSI. LAN.

**- OPTO-ELECTRONICS (10%):**

Optical fibers. Laser diodes. LED. Photo-detectors...

**- MICROWAVE LINKS (10%):**

Antennas. Propagation. Power budgets (link calculations).  
FDM. Basic FCC rules.

**- SATELLITE LINKS (10%):**

Antennas. Power budgets. Multiple-access  
methods (FDMA, TDMA).

**- TRANSMISSION-LINES PRINCIPLES (5%):**

Impedances. Matching. SWR. Return Loss...

**- HF AND VHF LINKS (5%):**

Antennas. Propagation. Receivers and  
Transmitters (from a block diagram point of  
view).

**- ENGINEERING ECONOMY (5%):**

Present worth. PWAC. Benefit/cost ratio.

This exam is "open book" thus any books or notes can be used. Calculators and "lap-top" computers are also allowed (battery operated), but must not be used to communicate with another person. Power and internet service is not guaranteed.

Studying the following books would be a useful review for the Junior Engineer exam.

**Radio System Design for  
Telecommunications**

by R.L. Freeman, Wiley & Sons, NY, NY, 1987, ISBN  
0471162604

**Digital Telephony and Network Integration**

by B.E. Keiser & E. Strange, Van Nostrand Reinhold, NY,  
NY, 1985,  
ISBN 0442009011

**Electronic Communication Techniques**

by P.H. Young, Merril Publishing, Columbus, OH, 1985

**Data and Computer Communications**

by W. Stallings, MacMillan Publishing, NY, Third Edition,  
1990

All four books have sample problems with answers.

Any equivalents (i.e. other books covering the same subjects) are, of course, just as good for studying purposes.



# JUNIOR ENGINEER - SAMPLE TEST

Answer key located on back page.

1. What is the upper bandwidth, in percent, for a 230 MHz center frequency antenna that has 3 dB points at 190 MHz and 240 MHz?
  - (a) 96.5%
  - (b) 4.34%
  - (c) 16%
  - (d) 18%
  
2. Measuring the response of a filter circuit versus input frequency is known as:
  - (a) Peak to Average Ratio
  - (b) Gain Slope
  - (c) Envelope Display
  - (d) Frequency Response
  
3. In Quadrature Amplitude Modulation, (QAM), the carrier is modulated by:
  - (a) Amplitude
  - (b) Phase
  - (c) Frequency
  - (d) Both (a) & (b)
  - (e) Both (b) & (c)
  
4. The device in a Vacuum Tube that allows a smaller signal to control a larger one is a:
  - (a) Filament
  - (b) Plate
  - (c) Grid
  - (d) Triode
  
5. The number of codes that an eight element ternary code can represent is:
  - (a) 256
  - (b) 6561
  - (c) 128
  - (d) 2187
  - (e) 65536



# KEY TO INARTE ENGINEER SAMPLE TEST

## MASTER

- 1 - C
- 2 - A
- 3 - E
- 4 - C
- 5 - D

## SENIOR

- 1 - C
- 2 - B
- 3 - B
- 4 - B
- 5 - C

## JUNIOR

- 1 - B
- 2 - D
- 3 - D
- 4 - C
- 5 - B

