

Radiation Safety Officer Training and Experience  
and Preceptor Attestation

(10 CFR 35.50)

NRC Form 313A (RSO)

On

Mary Hennings-Frank, BS, CNMT

DMS Imaging  
109 S. Petro Ave.  
Sioux Falls, SD 57105

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A member of the dms health group

<b>Operations office:</b>	<b>Corporate office:</b>
109 S. Petro Avenue	2101 N. University Drive
Sioux Falls, SD 57107	Fargo, ND 58102
Phone: 605-330-9060	Phone: 701-237-9073
800-333-0365	800-437-4628
Fax: 877-595-8108	Fax: 800-848-0990

[www.dmsimg.com](http://www.dmsimg.com)

November 12, 2007

Nuclear Regulatory Commission

To whom it My Concern:

My name is Mary Hennings-Frank and I work for DMS Health Group out of Fargo, North Dakota. I would like to apply to become the Radiation Safety Officer for DMS Health Group. I have over 18 years experience in the field of Nuclear Medicine. My last position was the Program Director for the Nuclear Medicine program at Southeast Technical Institute in Sioux Falls, South Dakota. I have taught Radiation Safety and Biology; Physics & Instrumentation; Invivo/Invitro Studies; Radiopharmacy; EKG; and Nuclear Medicine Math and Stats.

I have also practice and taught Nuclear Medicine under the jurisdiction of Dr. Fred Lovrien the Radiation Safety Officer for Sanford Medical Center in Sioux Falls, South Dakota.

Please find enclosed documentation which verifies my work experience and training education to become a Radiation Safety Officer.

Thank you for considering me qualified to be a Radiaiton Safety Officer.

Sincerely,



Mary Hennings-Frank

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### Radiation Safety Officer Training and Experience

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November 13, 2007

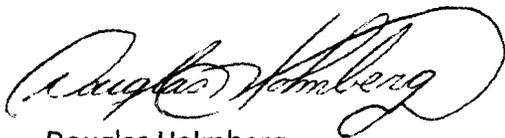
Nuclear Regulatory Commission  
Region IV  
611 Ryan Plaza Drive, Suite 400  
Arlington, Texas 76011-8064

To Whom It May Concern:

Please amend license condition 11 of NRC license number 40-32477-01. We wish to remove Michelle White as Radiation Safety Officer and name Mary Hennings-Frank as the replacement. Attached is the delegation of authority form and NRC form 313A Radiation Safety Training and Experience and Preceptor Attestation form for Mary Hennings-Frank.

If you have any questions or need additional information please contact me at (605) 357-2609.

Sincerely,



Douglas Holmberg  
Regional Vice President  
DMS Imaging, Inc.

No. 471590

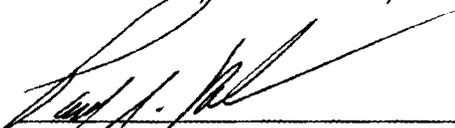


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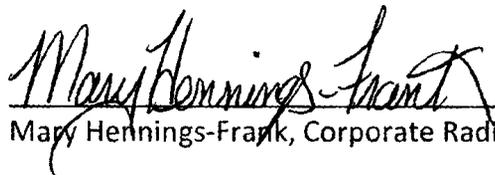
Radiation Safety Officer Delegation of Authority

Mary Hennings-Frank has been appointed Corporate Radiation Safety Officer and as such accepts the responsibility for ensuring the safe use of radioactive material. The Corporate Radiation Safety Officer is also responsible for managing the radiation safety program and ensuring compliance with regulations. Mary Hennings-Frank is hereby delegated the authority necessary to meet these responsibilities.

I also grant Ms. Hennings-Frank the authorization to be the main contact person for all radioactive material licensing and regulatory issues. She has the authority to make commitments, amendments, etc. on behalf of the DMS Health Group.

  
\_\_\_\_\_  
Paul Wilson, CEO

11/14/07  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Mary Hennings-Frank, Corporate Radiation Safety Officer

11/17/07  
\_\_\_\_\_  
Date

**RADIATION SAFETY OFFICER TRAINING AND EXPERIENCE  
AND PRECEPTOR ATTESTATION  
[10 CFR 35.50]**

APPROVED BY OMB: NO. 3150-01  
EXPIRES: 10/31/2008

Name of Proposed Radiation Safety Officer

Requested Authorization(s) *The license authorizes the following medical uses (check all that apply):*

- 35.100   
  35.200   
  35.300   
  35.400   
  35.500   
  35.600 (remote afterloader)  
 35.600 (teletherapy)   
  35.600 (gamma stereotactic radiosurgery)   
 ~~35.600~~ (Sealed Source Cs137 )  
 31.11 *Prepackaged kits*

**PART I -- TRAINING AND EXPERIENCE  
(Select one of the four methods below)**

\*Training and Experience, including board certification, must have been obtained within the 7 years preceding the date of application or the individual must have obtained related continuing education and experience since the required training and experience was completed. Provide dates, duration, and description of continuing education and experience related to the uses checked above.

**1. Board Certification**

- a. Provide a copy of the board certification.
- b. Use Table 3.c. to describe training in radiation safety, regulatory issues, and emergency procedures for all types of medical use on the license.
- c. Skip to and complete Part II Preceptor Attestation.

OR

**2. Current Radiation Safety Officer Seeking Authorization to Be Recognized as a Radiation Safety Officer for the Additional Medical Uses Checked Above**

- a. Use the table in section 3.c. to describe training in radiation safety, regulatory issues, and emergency procedures for the additional types of medical use for which recognition as RSO is sought.
- b. Skip to and complete Part II Preceptor Attestation.

OR

**3. Structured Educational Program for Proposed Radiation Safety Officer**

a. Classroom and Laboratory Training

Description of Training	Location of Training	Clock Hours	Dates of Training*
Radiation physics and instrumentation	Southeast Technical Institute 2320 N. Career Ave. Sioux Falls, SD 57105 (Section 3)	108 Hours 270 Hours	1992-1994 2002-2007
Radiation protection		108 Hours 270 Hours (Section 4)	1992-1994 2002-2007
Mathematics pertaining to the use and measurement of radioactivity	Southeast Technical Institute 2320 N. Career Ave. Sioux Falls, SD 57105 (Section 5)	108 Hours 270 Hours	1992-1994 2002-2007
Radiation biology	Southeast Technical Institute 2320 N. Career Ave. Sioux Falls, SD 57105 (Section 6)	108 Hours 270 Hours	1992-1994 2002-2007
Radiation dosimetry	Southeast Technical Institute 2320 N. Career Ave. Sioux Falls, SD 57105 (Section 7)	108 Hours 270 Hours	1992-1994 2002-2007

**Total Hours of Training: 1,890 Hours**

**RADIATION SAFETY OFFICER TRAINING AND EXPERIENCE AND PRECEPTOR ATTESTATION (continued)**

**3. Structured Educational Program for Proposed Radiation Safety Officer (continued)**

**b. Supervised Radiation Safety Experience**

*(If more than one supervising individual is necessary to document supervised work experience, provide multiple copies of this section.)*

Description of Experience	Location of Training/ License or Permit Number of Facility	Dates of Training*
Shipping, receiving, and performing related radiation surveys	Sanford USD Medical Center 1305 W. 18th Street Sioux Falls, SD 57105  NRC License #40-12378-01 (RSO)	2002-2007
Using and performing checks for proper operation of instruments used to determine the activity of dosages, survey meters, and instruments used to measure radionuclides	Sanford USD Medical Center 1305 W. 18th Street Sioux Falls, SD 57105  NRC License #40-12378-01 (RSO)	2002-2007
Securing and controlling byproduct material	Sanford USD Medical Center 1305 W. 18th Street Sioux Falls, SD 57105  NRC License #40-12378-01 (RSO)	2002-2007
Using administrative controls to avoid mistakes in administration of byproduct material	Sanford USD Medical Center 1305 W. 18th Street Sioux Falls, SD 57105  NRC License #40-12378-01 (RSO)	2002-2007
Using procedures to prevent or minimize radioactive contamination and using proper decontamination procedures	Sanford USD Medical Center 1305 W. 18th Street Sioux Falls, SD 57105  NRC License #40-12378-01 (RSO)	2002-2007
Using emergency procedures to control byproduct material	Sanford USD Medical Center 1305 W. 18th Street Sioux Falls, SD 57105  NRC License #40-12378-01 (RSO)	2002-2007
Disposing of byproduct material	Sanford USD Medical Center 1305 W. 18th Street Sioux Falls, SD 57105  NRC License #40-12378-01 (RSO)	2002-2007
Licensed Material Used (e.g., 35.100, 35.200, etc.)+ <hr/> 35.100 <hr/> 35.200 <hr/> 31.11 Cs-137 Technical Operations Sealed	Sanford USD Medical Center 1305 W. 18th Street Sioux Falls, SD 57105  NRC License #40-12378-01 (RSO)	2002-2007

\* Choose all applicable sections of 10 CFR Part 35 to describe radioisotopes and quantities used: 35.100, 35.200, 35.300, 35.400, 35.500, 35.600 remote afterloader units, 35.600 teletherapy units, 35.600 gamma stereotactic radiosurgery units, emerging technologies (provide list of devices).

**RADIATION SAFETY OFFICER TRAINING AND EXPERIENCE AND PRECEPTOR ATTESTATION (continued)**

**3. Structured Educational Program for Proposed Radiation Safety Officer (continued)**

b. Supervised Radiation Safety Experience (continued)

(If more than one supervising individual is necessary to document supervised work experience, provide multiple copies of this section.)

Supervising Individual Dr. Fred Lovrien	License/Permit Number listing supervising individual as a Radiation Safety Officer NRC License #40-12378-01
This license authorizes the following medical uses:	
<input checked="" type="checkbox"/> 35.100	<input checked="" type="checkbox"/> 35.200
<input type="checkbox"/> 35.300	<input type="checkbox"/> 35.400
<input type="checkbox"/> 35.500	<input type="checkbox"/> 35.600 (remote afterloader)
<input type="checkbox"/> 35.600 (gamma stereotactic radiosurgery)	<input checked="" type="checkbox"/> <del>35.600</del> (Cs-137 Technical)
<input checked="" type="checkbox"/> 31.11 Prepackaged Kits	Operations Sealed source

c. Describe training in radiation safety, regulatory issues, and emergency procedures for all types of medical use on the license.

Description of Training	Training Provided By	Dates of Training*
Radiation safety, regulatory issues, and emergency procedures for 35.100, 35.200, and 35.500 uses	Training under supervisin of Dr. Fred Lovrien	1994-2001 2002-2007
Radiation safety, regulatory issues, and emergency procedures for 35.300 uses	N/A	
Radiation safety, regulatory issues, and emergency procedures for 35.400 uses	N/A	
Radiation safety, regulatory issues, and emergency procedures for 35.600 - teletherapy uses	N/A	
Radiation safety, regulatory issues, and emergency procedures for 35.600 - remote afterloader uses	N/A	
Radiation safety, regulatory issues, and emergency procedures for 35.600 - gamma stereotactic radiosurgery uses	N/A	
Radiation safety, regulatory issues, and emergency procedures for 35.1000, specify use(s):	N/A	

**RADIATION SAFETY OFFICER TRAINING AND EXPERIENCE AND PRECEPTOR ATTESTATION (continued)**

**3. Structured Educational Program for Proposed Radiation Safety Officer (continued)**

c. Training in radiation safety, regulatory issues, and emergency procedures for all types of medical use on the license (continued)

Supervising Individual <i>If training was provided by supervising RSO, AU, AMP, or ANP. (If more than one supervising individual is necessary to document supervised training, provide multiple copies of this page.)</i>	License/Permit Number listing supervising individual
Dr. Fred Lovrien	NRC License #40-12378-01 (RSO)

License/Permit lists supervising individual as:

Radiation Safety Officer     Authorized User     Authorized Nuclear Pharmacist  
 Authorized Medical Physicist

Authorized as RSO, AU, ANP, or AMP for the following medical uses:

35.100     35.200     35.300     35.400  
 35.500     35.600 (remote afterloader)     35.600 (teletherapy)  
 35.600 (gamma stereotactic radiosurgery)     ~~35.100~~ (Cs-137 Sealed Source)  
 31.11 Prepackaged Kits

d. Skip to and complete Part II Preceptor Attestation.

OR

**4. Authorized User, Authorized Medical Physicist, or Authorized Nuclear Pharmacist identified on the licensee's license**

- a. Provide license number.
- b. Use the table in section 3.c. to describe training in radiation safety, regulatory issues, and emergency procedures for all types of medical use on the license.
- c. Skip to and complete Part II Preceptor Attestation.

**PART II – PRECEPTOR ATTESTATION**

Note: This part must be completed by the individual's preceptor. The preceptor does not have to be the supervising individual as long as the preceptor provides, directs, or verifies training and experience required. If more than one preceptor is necessary to document experience, obtain a separate preceptor statement from each.

**First Section**

Check one of the following:

**1. Board Certification**

I attest that \_\_\_\_\_ has satisfactorily completed the requirements in  
Name of Proposed Radiation Safety Officer

10 CFR 35.50(a)(1)(i) and (a)(1)(ii); or 35.50 (a)(2)(i) and (a)(2)(ii); or 35.50(c)(1).

OR

**2. Structured Educational Program for Proposed Radiation Safety Officers**

I attest that Mary Hennings-Frank has satisfactorily completed a structural educational  
Name of Proposed Radiation Safety Officer

program consisting of both 200 hours of classroom and laboratory training and one year of full-time radiation safety experience as required by 10 CFR 35.50(b)(1).

OR

**RADIATION SAFETY OFFICER TRAINING AND EXPERIENCE AND PRECEPTOR ATTESTATION (continued)**

**Preceptor Attestation (continued)**

**First Section (continued)**

Check one of the following:

**3. Additional Authorization as Radiation Safety Officer**

I attest that \_\_\_\_\_ is an  
Name of Proposed Radiation Safety Officer

Authorized User  Authorized Nuclear Pharmacist

Authorized Medical Physicist

identified on the Licensees license and has experience with the radiation safety aspects of similar type of use of byproduct material for which the individual has Radiation Safety Officer responsibilities

**AND**

**Second Section**

Complete for all (check all that apply):

I attest that Mary Hennings-Frank has training in the radiation safety, regulatory issues, and  
Name of Proposed Radiation Safety Officer

emergency procedures for the following types of use:

35.100

35.200

35.300 oral administration of less than or equal to 33 millicuries of sodium iodide I-131, for which a written directive is required

35.300 oral administration of greater than 33 millicuries of sodium iodide I-131

35.300 parenteral administration of any beta-emitter, or a photon-emitting radionuclide with a photon energy less than 150 keV for which a written directive is required

35.300 parenteral administration of any other radionuclide for which a written directive is required

35.400

35.500

35.600 remote afterloader units

35.600 teletherapy units

35.600 gamma stereotactic radiosurgery units

35.1000 emerging technologies, including:  
 31.11 Pre Packaged Kits

Cs-137 Technical Operations Sealed Sources

RADIATION SAFETY OFFICER TRAINING AND EXPERIENCE AND PRECEPTOR ATTESTATION (continued)

AND

Third Section  
Complete for ALL

I attest that Mary Hennings-Frank has achieved a level of radiation safety knowledge  
Name of Proposed Radiation Safety Officer  
sufficient to function independently as a Radiation Safety Officer for a medical use licensee.

Fourth Section  
Complete the following for Preceptor Attestation and signature

I am the Radiation Safety Officer for Sanford USD Medical Center  
Name of Facility

License/Permit Number: NRC License #40-12378-01

*Fred Lovrien MD.*

Name of Preceptor  
Lovrien, Fred C. MD

Signature

Telephone Number  
605-328-2170

Date  
11/20/07

1600 W. 26<sup>th</sup> Street  
Sioux Falls, SD 57105

605-357-8201  
mary.hennings-frank@southeasttech.com

# Mary Hennings-Frank

## Objective

To use my knowledge, experience, dedication, and skills to work for a highly progressively growing company.

## Experience

2001 - Present Southeast Technical Institute Sioux Falls, SD

### **Nuclear Medicine Program Director**

- Responsible for the organization, administration, periodic review, planning, development, and general effectiveness of the program.
- Input into budget preparation.
- Provide supervision and coordination to the clinical coordinator(s).
- Effective in instruction, curriculum design, program planning, evaluation and counseling.

1994-2001 DMS Imaging Sioux Falls, SD

### **Nuclear Medicine Manager**

- Supervised 35 Nuclear Medicine Technologist in a 5 state region.
- Managed 24 mobile Nuclear Medicine trucks.
- Performed the hiring and dismissal of Nuclear Medicine Technologist.

1992-1994 Sioux Valley Hospital Sioux Falls, SD

### **Staff Nuclear Medicine Technologist**

- Carried out Nuclear Medicine procedures.
- Performed patient care daily.
- Handled Radiation with care.

1989-1992 Avera McKennan Sioux Falls, SD

### **Staff Nuclear Medicine Technologist**

- Carried out Nuclear Medicine procedures daily.
- Performed patient care daily.
- Radiation Safety.

## Education

1982 - 1989 University of Iowa Iowa City, IA

- B.S., Nuclear Medicine

## Interests

Traveling, watching sporting events, laughing.

## References

Available upon request.

# The University of Iowa

ON THE RECOMMENDATION OF THE FACULTY OF THE  
*College of Medicine*  
AND UNDER THE AUTHORITY OF THE BOARD OF REGENTS  
THE UNIVERSITY OF IOWA HAS CONFERRED THE DEGREE OF  
*Bachelor of Science*

UPON

*Mary B. Hemmings-Frank*

WHO HAS HONORABLY FULFILLED ALL OF THE REQUIREMENTS  
PRESCRIBED BY THE UNIVERSITY FOR THIS DEGREE  
AWARDED AT THE UNIVERSITY AT IOWA CITY IN THE STATE OF IOWA  
THIS FOURTH DAY OF AUGUST, NINETEEN HUNDRED AND EIGHTY-NINE.

*Merrill A. Pomeroy*  
.....  
PRESIDENT OF THE STATE BOARD OF REGENTS



*Heuter R. Rawling*  
.....  
PRESIDENT OF THE UNIVERSITY  
*John Eckstein*  
.....  
DEAN OF THE COLLEGE

# The University of Iowa

## COLLEGE OF MEDICINE

THIS IS TO CERTIFY THAT

*Mary Hennings-Frank*

HAS HONORABLY COMPLETED THE CLINICAL COURSE IN

*Nuclear Medicine Technology*

AND IN WITNESS WHEREOF, IS AWARDED THIS

*Certificate in Nuclear Medicine Technology*

AT IOWA CITY, IN THE STATE OF IOWA

AUGUST 11, 1989

*Hunter R. Rawling*

PRESIDENT OF THE UNIVERSITY

*John Eckstein*



*Kenneth B. Holmes*

DIRECTOR OF NUCLEAR MEDICINE TECHNOLOGY

*P. 1 1*

# Nuclear Medicine Technology Certification Board

SPONSORED BY

THE BOARD OF REGISTRY OF THE AMERICAN SOCIETY OF CLINICAL PATHOLOGISTS

THE SOCIETY OF NUCLEAR MEDICINE

AND

TECHNOLOGIST SECTION OF THE SOCIETY OF NUCLEAR MEDICINE

HEREBY CERTIFIES THAT

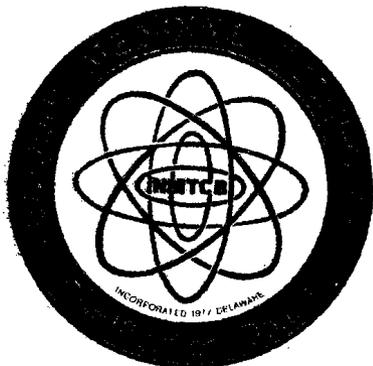
**Mary B. Hennings-Frank**

HAS MET THE REQUIREMENTS THROUGH EXAMINATION BY THIS BOARD

AND IS HEREBY QUALIFIED TO PRACTICE THE SPECIALTY OF

**NUCLEAR MEDICINE TECHNOLOGY**

June 22, 1990

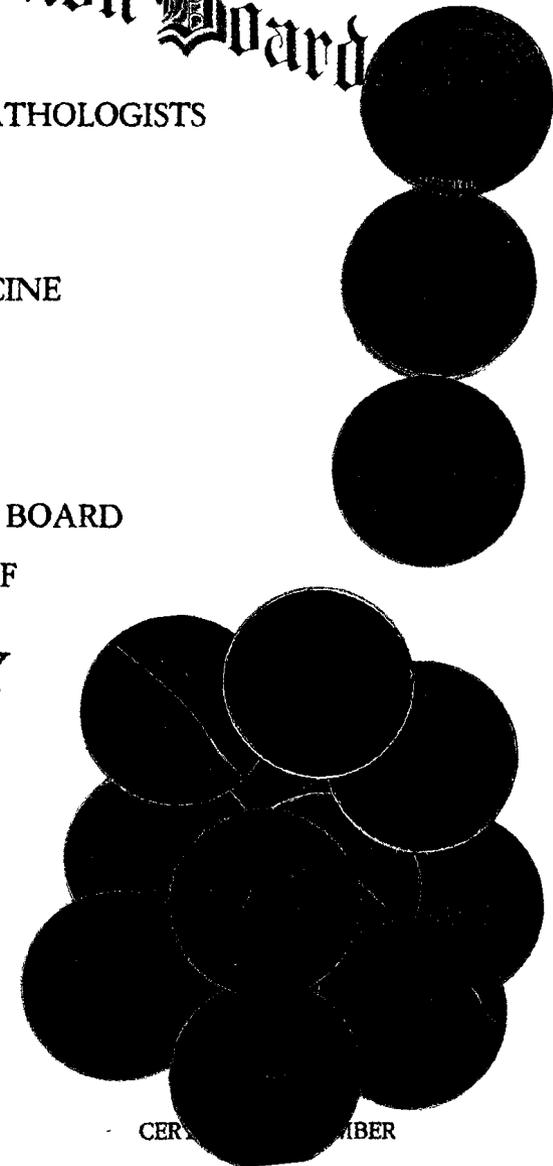


*Jacqueline A. Bridge, CMPT*

CHAIRMAN

*Judy B. Patterson, CMPT*

SECRETARY



CERTIFICATION MEMBER

**The Society of Nuclear Medicine Technologist Section  
Attendance Verification Form**

**Program Title:** Building on the Past, Bridging the Future  
**Program Date:** October 13-15, 2006  
**Program Sponsor:** Missouri Valley Chapter Society of Nuclear Medicine  
**Program Location:** Marriott Coralville Hotel & Conference Center, Coralville, Iowa  
**SNM RHB Number:** 0001  
**Participant's Name:** Mary Hennings-Frank (Please Print clearly)  
**Street Address:** 1600 W. 26<sup>th</sup> Street  
**City:** SIOUX FALLS **State:** SD **Zip:** 57105  
**SNM Member ID #** 287561 (Must enter for properly recorded credit, or specify Non-Member)

In Verification	Time	Session Title	Reference #	CEH	Out Verification
		<b>Saturday, October 14, 2006</b>			
	8:00am-9:00am	From Catalytic RNA to the Howard Hughes Institute	025255	1.0	
	9:00am-10:00am	Advances in Molecular Imaging of Cancer	025256	1.0	
	10:30am-11:30am	Nuclear Medicine and Neuroendocrine Tumors	025257	1.0	
	11:30am-12:30pm	Adverse Effects of Radiopharmaceuticals	025258	1.0	
	1:30pm-2:30pm	Coronary CT Angiography - What's New? OR	025260	1.0	
	1:30pm-2:30pm	Pancreatic Cancer and the Impact of PET Imaging	025263	1.0	
	2:30pm-3:30pm	SPECT/CT and Attenuation Correction OR X	025261	1.0	
	2:30pm-3:30pm	Pharmacologic Stress Agents	025264	1.0	
	4:00pm-5:00pm	Recent Advances in SPECT Imaging OR	025262	1.0	
	4:00pm-5:00pm	Tales from the Road - Common Technical Errors Encountered X	025265	1.0	
		<b>Sunday, October 15, 2006</b>			
	8:00am-9:00pm	The Avoidance of PET/CT Image Interpretation Errors in Nuclear Medicine	025266	1.0	
	9:00am-10:00am	General Nuclear Medicine - Read With The Experts	025267	1.0	
	10:15am-11:15am	Functional Imaging of Lymphomas	025268	1.0	
	11:15am-12:15pm	The Future of the Profession	025269	1.0	
		<b>Total Credits you are claiming</b>		<b>8</b>	



**Society of Nuclear Medicine Technologist Section**

**Continuing Education Credit Certificate**

**Missouri Valley Chapter Society of Nuclear Medicine**

**Certifies**

*Mary Jennings-Frank*  
Participant

has satisfactorily completed

Building on the Past, Bridging the Future  
on October 13-15, 2006  
at Marriott Coralville Hotel & Conference Center  
in Coralville, Iowa

and has earned 8 # of credits CEH(s)

SNMITS VOICE Reference Number(s) 025255-025269

*October 15, 2006*

Date Completed

*Yanni C. Gruchell*

Signature of Authorized Representative or Sponsor

SNM Member ID #

287561

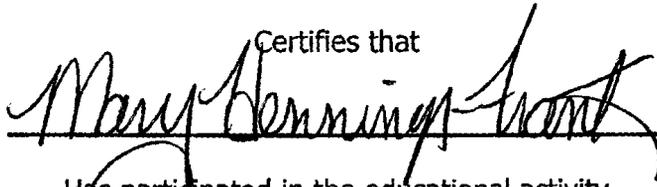
# SNMITS

Advancing Molecular Imaging and Therapy

VOICE CE Credit Certificate

Missouri Valley Chapter Society of Nuclear Medicine

Certifies that



Has participated in the educational activity

**Spanning the Continuum – Nuclear to Molecular Imaging**

St. Louis, MO

and has earned 10 CEH(s)

**SNMITS VOICE Reference #(s):**

- |  |  |
|--|--|
| <input checked="" type="checkbox"/> 026593 – Advances in Instrumentation – 1.0 CEH(s) [CA Scope: NI]   | <input checked="" type="checkbox"/> 026600 – Track B – Technologist Role in Emergencies involving RAM – 1.0 CEH(s) [CA Scope: R and/or Radiation Safety] |
| <input checked="" type="checkbox"/> 026594 – Radiation Shielding for PET Centers – 1.0 CEH(s) [CA Scope: R and/or Radiation Safety]          | <input type="checkbox"/> 026601- Track C – Maintenance of Competency – 1.0 CEH(s) [CA Scope: NI]   |
| <input checked="" type="checkbox"/> 026595 – Operating Errors and Imaging Artifacts – 1.0 CEH(s) [CA Scope: I]                               | <input checked="" type="checkbox"/> 026602 – Are you smarter than a Nuclear Medicine Student – 1.0 CEH(s) [CA Scope: I]                                  |
| <input checked="" type="checkbox"/> 026596 – Contemporary Issues in Myocardial Perfusion Imaging – 1.0 CEH(s) [CA Scope: I]                  | <input checked="" type="checkbox"/> 026603 – Read with the Experts: Hematology, Oncology and Neurology – 2.0 CEH(s) [CA Scope: I]                        |
| <input type="checkbox"/> 026597 – Track A – Student Session – 2.0 CEH(s) [CA Scope: NI]  | <input checked="" type="checkbox"/> 026604 – Fundamentals of CT Anatomy – 1.0 CEH(s) [CA Scope: I]   |
| <input checked="" type="checkbox"/> 026598 – Track B – Terrorism in Radioactive Materials – 1.0 CEH(s) [CA Scope: R and/or Radiation Safety] | <input type="checkbox"/> 026605 – Laboratory Accreditation – New Directives and New Directions – 1.0 CEH(s) [CA Scope: I]                                |
| <input type="checkbox"/> 026599 – Track C – The Next Chapter in Nuclear Cardiology – 1.0 CEH(s) [CA Scope: I]                                |  |

October 14, 2007

Date Completed

Nanci A. Burchell – MVC SNM Program Coordinator

Signature of Authorized Representative or Sponsor

SNM/SNMITS ID#: 2 8 7 5 6 1



Advancing Molecular Imaging and Therapy

1850 Samuel Morse Drive  
 Reston, VA 20190-5316  
 Tel: 703.708.9000  
 Fax: 703.708.9015  
 www.snm.org

November 13, 2007

Mary Hennings-Frank  
 Southeast Technical Institute  
 2320 N Career Ave.  
 Sioux Falls, SD 57107

**VOICE TRANSCRIPT**

The Society of Nuclear Medicine confirms you have participated in the following continuing education activities between the dates of November 13, 2004 and November 14, 2007. The total of **13.50 VOICE credits** has been earned.

N. Lynn Barnes, MEd  
 Director of Education

If you have any questions regarding this transcript, please call the SNM Education Department at (703) 708-9000 or email [education@snm.org](mailto:education@snm.org).

**Accreditation Statement**

VOICE-approved credit is recognized by most licensure states and by the ARRT (as Category A credit). Participants should report only those sessions at which they were present a minimum of 80% of the presentation or for which a score of 80% was earned via exam.

**VOICE Participation Detail**

ID: 287561

Activity/Session Title	Date	Credit Code	Credits
Read w/ the Experts: Hematology, Oncology & Nuerology (CA Scope: I)	10/14/2007	026603	2.00
Advances in Instrumentation (CA Scope: NI)	10/13/2007	026593	1.00
Radiation Shielding for PET Centers (CA Scope: R and/or Radiation Safety)	10/13/2007	026594	1.00
Operating Errors and Imaging Artifacts (CA Scope: I)	10/13/2007	026595	1.00
Contemporary Issues in Myocardial Perfusion (CA Scope: I)	10/13/2007	026596	1.00
Track B - Terrorism in Radioactive Materials (CA Scope: R and/or Radiation Safety)	10/13/2007	026598	1.00
Track B - Technologist Role in Emergencies involving RAM (CA Scope: R and/or Radiation Safety)	10/13/2007	026600	1.00
Are You Smarter than a Nuclear Medicine Student? (CA Scope: I)	10/13/2007	026602	1.00
Receptor Binding Kinetics for Diagnosis and Therapy- Part I: Basic Science (CA Scope: 1.5 R)	6/5/2006	024748	1.50
MIRD CME: Bystander and Low-Dose Rate Effects - Are These Relevant to Radionuclide Therapy: Part I (CA Scope: 1.5 NI)	6/4/2006	024724	1.50
General Nuclear Medicine - Part I (CA Scope: 1.5 I)	6/4/2006	024861	1.50
<b>Total Credits:</b>			<b>13.50</b>

**Course #NM-227    Computers & Instrumentation**  
**Southeast Technical Institute Syllabus**

**3 Credits**  
**Fall 2007**

<u>Instructor:</u>	Mary Hennings-Frank	<u>Class Time:</u>	M/W/F 2:00pm – 2:50pm
<u>Office:</u>	HC 213	<u>Course Location:</u>	HC 255
<u>Telephone:</u>	(605) 367-4632	<u>FAX:</u>	(605) 367-5724
<u>E-mail:</u>	<a href="mailto:mary.hennings-frank@southeasttech.com">mary.hennings-frank@southeasttech.com</a>	<u>Office Hours:</u>	Monday 1-2pm Tuesday 11am-Noon Wednesday 8-9am Thursday 3-4pm Friday 1-2pm

**I.    Catalog Description**

Exposes students to the practical approach of using computers in Nuclear Medicine as well the fundamentals of Instrumentation. Students will also acquire experience with the function of equipment used in the daily practice of nuclear medicine.

**II.    Course Prerequisites**

HC 111, NM 101, NM 120, NM 123, NM124, NM220,

**III.    Description of Instructional Methods**

Southeast Technical Institute values a student-centered learning environment, which nurtures intellectual and social development. Southeast instructors have designed their general education courses to utilize a variety of instructional methods.

This course includes the following:

- Course readings
- Collaborative learning groups
- Lecture
- Discussion
- In class presentations
- Modeling of learning activities
- Demonstrations

**IV.    Course Requirements**

**a.    Required textbook(s) and other materials**

Essential: Nuclear Medicine Physics  
Rachel A. Powsner & Edward R. Powsner  
Second Edition

**b.    Supplementary materials**

Daily Assignments  
Nuclear Medicine and PET; Mosby  
Practical Mathematics in Nuclear Medicine; Patricia Wells, MAE, CNMT

**c. Class attendance policy**

It is the students' responsibility to call or e-mail the instructor if they are sick or tardy. If the student fails to call or e-mail the instructor of their absent, a written document will be typed up and put in the student file. If the student is tardy three times during the semester course, both the student and the instructor will meet and corrective action will be taken.

Southeast General Catalog describes the institute's standard attendance policy: One absence per credit hour is allowed in a course before absences can reduce grades. For this course which is a 3 credit course, if the student is absent the fourth time, not only will the student's final grade be reduced by one-half the letter grade, the student will also be put on corrective action.

All records of absenteeism and tardiness will be kept in the students file and are open for discussion with potential clinical site and employers.

In all cases of absence, it is necessary for students to make up work that is missed. It is the responsibility of the student to make arrangements with the instructor(s) to make up missed work.

**d. Cheating and plagiarism policy**

Students attending Southeast Technical Institute are expected to comply with all pertinent state laws and take personal responsibility for their conduct.

Southeast policies authorize suspension or termination of any student from school for misconduct as outlined in the rules of this policy. The following student misconduct shall constitute grounds for student discipline, suspension, or termination when such activity occurs on school grounds or during an educational function under the auspices of the school board: acts of dishonesty, including cheating and plagiarism or other forms of dishonesty relating to academic achievement.

**e. Make-up policy**

**Assignments:** Students are expected to turn in assignments on the day indicated in the course schedule. Late assignments are defined as any assignment turned in after they were collected by the instructor. Late assignments will be docked 10% for each day late.

**Quizzes:**      Quizzes may be given at anytime without warning over any material, which has been presented via; lecture, video, assigned reading, or guest speaker. The purpose of quizzes is to assess the students understanding or retention of information presented, at a given place and time. There is a specified time limit for each quiz, and the papers will be collected after that time period. Any student entering late into class will only have the remaining time allowed to complete. If you are absent on the day of a quiz, the quiz will be zero. No quizzes are to be made up.

**Test:** If you are absent the day of a test, you must notify your instructor and make arrangements to make up the test before the next lecture (at the soonest make-up time available). The following criteria will be made concerning make-up testing:

- **1<sup>st</sup> test made up = no grading penalty**
- **2<sup>nd</sup> test made up = -7% to the test grade**
- **3<sup>rd</sup> test (and any subsequent test) = -14% to the test grade**
- **ANT TEST NOT MADE UP WITHIN ONE WEEK WILL BE SCORED AS A ZERO**

Make up test schedule will be posted at the beginning of the semester. To make up the test, you must know the name of your instructor, the course number of the class you are making up a test for, and have a photo ID>

**Course #NM-227    Computers & Instrumentation**  
**Southeast Technical Institute Syllabus**

**3 Credits**  
**Fall 2007**

**Classroom Expectation:**

1. Class days are Monday, Wednesday, and Friday from 2:00pm – 2:50pm.
2. Any requests for absences or schedule changes are to be made prior to the beginning of the course whenever possible. Granting requests will be at the discretion of the course instructor.
3. Attendance at all classes is mandatory. Students are expected to notify the instructor for all absences by leaving a message on their voice mail or e-mail.
4. The student is responsible for any missed classroom content. There may be make-up activities as determined by the instructor.
5. If the student becomes ill during the day, they are to notify the instructor prior to leaving directly or by voicemail.
6. Tardiness to class is an unacceptable behavior. Tardiness up to 10 minutes will be counted as 1/3 absent, late three times is the equivalent to one absence.
7. There will be no makeup of quizzes due to tardiness.
8. Assignments in the syllabus are to be completed before class unless stated otherwise.
9. All school policies and conduct are to be followed as stated in the student handbook.
10. Class schedules are subject to change at the discretion of the instructor. Students will be informed as early as possible of the changes.
11. All course requirements must be met in order to successfully complete the course.
12. An overall grade of 80% (C) or above must be attained in order to pass this course.
13. Cell phones are to be turned off or placed on a silent mode during class.
14. Lap top computers are allowed for note taking in the class. They should not be used for e-mailing, instant messaging, or surfing the website during class.
15. Violations of safety to self or others, or violation to safe operating practices of equipment may result in reduction or loss of your daily grade, removal from class, and/or other disciplinary action.
16. Students are required to follow nuclear medicine dress code (as listed below).

**Dress Code:**

- No open toe shoes (example: Scandals)
- No Jeans
- No caps of any kind
- No ripped clothing
- No Shorts/Tank tops of any kind
- Scrubs (no sweatshirts over scrub top. May wear long or short sleeve white T-shirt under scrubs, and or add lab coat if cold)
- Nice dress pants and shirts if not wearing scrubs
- No revealing clothing
- Limited and conservative jewelry and cosmetics
- Limited exposed body piercing and tattoos
- Personal hygiene should limit body odor, including perfumes and colognes
- Smoke odor should not be detectable

**Students in violation of dress code will be asked to correct their transgression in prior to joining the classroom.**

**V. Course Goals**

<b>Objectives</b>	
<ol style="list-style-type: none"> <li>1. Explain the structure of the Periodic Table, discussing the various symbols and abbreviations used in the table.</li> <li>2. Explain the structure of the trilinear chart of the nuclides, discussing the various symbols and abbreviations used in the chart.</li> <li>3. Describe the process of ionization.</li> <li>4. From a decay scheme, name the parent radionuclide, daughter, half-lives of parent and daughters, types of emissions, energy of emissions, and abundance and origin of the emissions.</li> </ol>	<ol style="list-style-type: none"> <li>17. State the characteristics of the parallel-hole, diverging, converging, pinhole, slant-hole, and fan-beam collimators as they relate to the Anger scintillation camera.</li> <li>18. Describe the components of a scintillation camera and the function of each.</li> <li>19. Describe the physical and chemical properties of gamma camera crystals. Discuss the effects of crystal thickness on resolution and efficiency.</li> <li>20. Describe the types and number of photomultiplier tubes used in gamma cameras, explaining the rationale for various types and configurations.</li> </ol>

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| <ol style="list-style-type: none"><li>5. Define and calculate the decay constant of a radionuclide.</li><li>6. Determine the decay factor, given half-life, time, and required decay chart or calculator with <math>\ln</math> and <math>e^x</math> functions.</li><li>7. Discuss the principles of operation of the pocket dosimeter, Cutie-pie, and dose calibrator.</li><li>8. Describe pulse-size characteristic for an ion chamber when operated in the ion chamber region, the proportional region, and the G-M region; describe the gas-detector response as a function of voltage; and state the basic principles of operation of gas detectors.</li><li>9. Describe the following QC procedures for dose calibrator, stating frequency and allowable variances for each procedure: geometry, linearity, accuracy, precision, and constancy.</li><li>10. Describe the components and applications of G-M tubes, including voltage plateau, effects of background, and quenching.</li><li>11. List and describe the function of each component of a NaI (TI) scintillation detector.</li><li>12. Describe the characteristics of scintillation detector crystals.</li><li>13. Describe the basic physical concepts involved with scintillation spectrometry, the practical operation of the scintillation detector, and the practical operation of the pulse-height analyzer portion of the spectrometer.</li></ol> | <ol style="list-style-type: none"><li>21. Explain the function of the x, y, and z signals used in a gamma camera system, discussing the significance of the signals in the production of an accurate image on the display system.</li><li>22. Describe the effect on an image when the following situations occur:<ol style="list-style-type: none"><li>a. Cracked or fractured crystal</li><li>b. Improper PM tube calibration</li><li>c. Improper PHA calibration</li><li>d. Improperly focused CRT</li><li>e. Unclean CRT</li></ol></li><li>23. Compare acquisition parameters of SPECT imaging with those of planar imaging.</li><li>24. Compare acquisition parameters of PET, SPECT, and PCD imaging.</li><li>25. Define terms such as ramp filter, cutoffs, and Fourier reconstruction and filtering.</li><li>26. Outline the steps in a comprehensive quality control program for a scintillation camera.</li><li>27. Identify special problems that occur when SPECT quality control procedures are performed, addressing specifically uniformity, linearity, and COR.</li><li>28. Discuss buffers and zoom as they relate to nuclear medicine computers.</li><li>29. Compare list mode acquisition to histogram and frame acquisition, explaining the advantages and disadvantages of each approach.</li><li>30. Diagram and/or describe how the computer performs a mitigated acquisition study.</li><li>31. Discuss matrix types and sized for work and byte mode, and give examples of each.</li></ol> |
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<p>14. Operate a solid scintillation counter and demonstrate this ability by obtaining a gamma ray spectrum using a single-channel analyzer.</p> <p>15. Determine pulse height analyzer (PHA) setting to include a desired energy range. Determine the energies to be included by a specific PHA setting.</p> <p>16. Outline specific QC procedures for scintillation counter to include the following window calibration, sensitivity, energy resolution, volumetric evaluation, and chi-square determination.</p>	<p>32. Compare and contrast the various types of display systems used on nuclear medicine computers.</p> <p>33. List data processing operations that are essentially cosmetic treatments of the image, and explain briefly how each is accomplished.</p> <p>34. Describe the relationship between a ROI and a histogram generated from a dynamic study.</p>
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#### VI. Student Learning Outcomes

Student success is important to STI faculty, and all faculty are involved in assessing student learning. Upon completion of an Associate in Applied Science degree, Southeast graduates will have competence in the following four broad student outcomes:

1. Science & Technology: Technical competence including knowledge of technology and/or scientific principles as these apply to programs.
2. Problem Solving & Critical Thinking: The ability to select and use various approaches to solve a wide variety of problems – scientific, mathematical, social and personal. Graduates will also be able to evaluate information from a variety of perspectives, analyze data and make appropriate judgments.
3. Communication: The ability to communicate effectively in several forms – oral, written, nonverbal and interpersonal. Graduates will also demonstrate knowledge of how to manage and access information.
4. Professionalism: Strong work ethic, including responsible attendance; skill in teamwork and collaboration, as well as an ability to work with others, respecting diversity; ability to adapt to change; commitment to lifelong learning; adherence to professional standards; and positive self-esteem and integrity.

**VII. Evaluation Procedures**

**a. Assessments**

The methods of evaluation and criteria for this course are: 4 exams with quizzes and assignments to monitor the overall learning criteria. A comprehensive final will be given to monitor how much the students have retained.

**Grading procedure:**

4 Unit exams:	70%
Quizzes/Assignments	15%
Final Exam:	15%

**b. Grading policy**

<b>Letter Grade</b>	<b>Percent</b>
A	94% - 100%
B	87% - 93%
C	80% - 86%
D	74% - 79%
F	<= 73%

A grade of C (80%) or greater is required to successfully pass this course.

Grades in this course are only rounded to the second place following the decimal. Grades will not be rounded to the nearest whole number.

**VIII. ADA Statement**

The instructor in this course will act with integrity and strive to engage in equitable verbal and nonverbal behavior with respect to differences from age, gender, race, handicapping conditions, and religion. If you have special needs as addressed by the Americans with Disabilities Act and need course materials in alternative formats, notify your instructor immediately. Reasonable efforts will be made to accommodate your special needs.

Violation of safety to self and others and/or violations of safe operating practices of equipment may result in: the reduction or loss of your daily grade; removal from class and/or other disciplinary action.

**IX. Tentative Course Outline/Schedule**

**UNIT 1 (August 20<sup>th</sup> through September 14<sup>th</sup>)**

Chapter 1: Basic Nuclear Medicine Physics (Page 1 – 19)  
Chapter 2: Interaction of Radiation with Matter (Page 20 – 28)  
Chapter 3: Formation of Radionuclides (Page 29 – 36)  
**September 3<sup>rd</sup> (No Class)**  
**September 14<sup>th</sup> Unit Test #1**

**UNIT 2 (September 17<sup>th</sup> through October 12<sup>th</sup>)**

Chapter 4: Nonscintillation Detectors (Page 37 – 51)  
Chapter 5: Non-imaging Scintillation Detectors (Page 52 – 64)  
Chapter 6: Imaging Instrumentation (Page 65 – 84)  
**October 10<sup>th</sup> Unit Test #2**  
**October 12<sup>th</sup> Missouri Valley Chapter Meeting**

**UNIT 3 (October 15<sup>th</sup> through November 9<sup>th</sup>)**

Chapter 7: Single-Photon Emission Computed Tomography (SPECT) (Page 85 – 113)  
**November 9<sup>th</sup> Unit Test #3**

**UNIT 4 (November 12<sup>th</sup> through December 12<sup>th</sup>)**

Chapter 10: Quality Control  
**November 12<sup>th</sup> (No Class)**  
**November 23<sup>rd</sup> (No Class)**  
**December 12<sup>th</sup> Unit Test #4**

**Review and Final**

December 14<sup>th</sup> Review for final  
**December 19<sup>th</sup> Comprehensive Final**

**Course #NM-220      Radiation Safety & Biology      3 Credits**  
**Southeast Technical Institute Syllabus      Summer 2007**

<u>Instructor:</u>	Mary Hennings-Frank	<u>Class Time:</u>	W/F 9:00am – 12:00pm
<u>Office:</u>	HC 213	<u>Course Location:</u>	HC 255
<u>Telephone:</u>	(605) 367-4632	<u>FAX:</u>	(605) 367-5724
<u>E-mail:</u>	<a href="mailto:mary.hennings-frank@southeasttech.com">mary.hennings-frank@southeasttech.com</a>	<u>Office Hours:</u>	Monday 9-10am Tuesday 3-4pm Wednesday 1-2pm Thursday 12pm-1pm Friday 2-3pm

**I. Catalog Description**

Students will enhance their knowledge in the safe use of radionuclides and their handling. This will also encompass the legal requirements set for by the NRC and other governing agencies to benefit the patient, the technologist, and the public in the clinical environment.

**II. Course Prerequisites**

HC 111, NM 101, NM 120, NM 123, NM124

**III. Description of Instructional Methods**

Southeast Technical Institute values a student-centered learning environment, which nurtures intellectual and social development. Southeast instructors have designed their general education courses to utilize a variety of instructional methods.

This course includes the following:

- Course readings
- Collaborative learning groups
- Lecture
- Discussion
- In class presentations
- Modeling of learning activities
- Demonstrations

**IV. Course Requirements**

- a. **Required textbook(s) and other materials**  
Radiation Protection in Medical Radiography; Statkiewicz-Sherer, Visconti, Ritenour; Mosby; 5<sup>th</sup> Edition
- b. **Supplementary materials**  
Daily Assignments

**c. Class attendance policy**

It is the students' responsibility to call or e-mail the instructor if they are sick or tardy. If the student fails to call or e-mail the instructor of their absent, a written document will be typed up and put in the student file. If the student is tardy three times during the semester course, both the student and the instructor will meet and corrective action will be taken.

Southeast General Catalog describes the institute's standard attendance policy: One absence per credit hour is allowed in a course before absences can reduce grades. For this course which is a 3 credit course, if the student is absent the fourth time, not only will the student's final grade be reduced by one-half the letter grade, the student will also be put on corrective action.

All records of absenteeism and tardiness will be kept in the students file and are open for discussion with potential clinical site and employers.

In all cases of absence, it is necessary for students to make up work that is missed. It is the responsibility of the student to make arrangements with the instructor(s) to make up missed work.

**d. Cheating and plagiarism policy**

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**e. Make-up policy**

**Assignments:** Students are expected to turn in assignments on the day indicated in the course schedule. Late assignments are defined as any assignment turned in after they were collected by the instructor. Late assignments will be docked 10% for each day late.

**Quizzes:** Quizzes may be given at anytime without warning over any material, which has been presented via; lecture, video, assigned reading, or guest speaker. The purpose of quizzes is to assess the students understanding or retention of information presented, at a given place and time. There is a specified time limit for each quiz, and the papers will be collected after that time period. Any student entering late into class will only have the remaining time allowed to complete. If you are absent on the day of a quiz, the quiz will be zero. No quizzes are to be made up.

**Test:** If you are absent the day of a test, you must notify your instructor and make arrangements to make up the test before the next lecture (at the soonest make-up time available). The following criteria will be made concerning make-up testing:

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- **3<sup>rd</sup> test (and any subsequent test) = -14% to the test grade**
- **ANT TEST NOT MADE UP WITHIN ONE WEEK WILL BE SCORED AS A ZERO**

Make up test schedule will be posted at the beginning of the semester. To make up the test, you must know the name of your instructor, the course number of the class you are making up a test for, and have a photo ID>

**Classroom Expectation:**

1. Class days are Wednesday and Friday from 0900 – 1200
2. Any requests for absences or schedule changes are to be made prior to the beginning of the course whenever possible. Granting requests will be at the discretion of the course instructor.
3. Attendance at all classes is mandatory. Students are expected to notify the instructor for all absences by leaving a message on their voice mail or e-mail.
4. The student is responsible for any missed classroom content. There may be make-up activities as determined by the instructor.
5. If the student becomes ill during the day, they are to notify the instructor prior to leaving directly or by voicemail.
6. Tardiness to class is an unacceptable behavior. Tardiness up to 10 minutes will be counted as 1/3 absent, late three times is the equivalent to one absence.
7. There will be no makeup of quizzes due to tardiness.
8. Assignments in the syllabus are to be completed before class unless stated otherwise.
9. All school policies and conduct are to be followed as stated in the student handbook.
10. Class schedules are subject to change at the discretion of the instructor. Students will be informed as early as possible of the changes.
11. All course requirements must be met in order to successfully complete the course.
12. An overall grade of 80% (C) or above must be attained in order to pass this course.
13. Cell phones are to be turned off or placed on a silent mode during class.
14. Lap top computers are allowed for note taking in the class. They should not be used for e-mailing, instant messaging, or surfing the website during class.
15. Violations of safety to self and others, or violation of safe operating practices of equipment may result in reduction or loss of your daily grade, removal from class, and/or other disciplinary action.
16. Students are required to follow nuclear medicine dress code (as listed below).

**Dress Code:**

- No open toe shoes (example: Scandals)
- NO JEANS
- No caps of any kind
- No ripped clothing
- NO SHORTS OR TANK TOPS
- Scrubs (no sweatshirts over scrub top. May wear long or short sleeve white T-shirt under scrubs, and or add lab coat if cold)
- Nice dress pants and shirts if not wearing scrubs
- No revealing clothing
- Limited and conservative jewelry and cosmetics
- Limited exposed body piercing and tattoos
- Personal hygiene should limit body odor, including perfumes and colognes
- Smoke odor should not be detectable

**Students in violation of dress code will be asked to correct their transgression in prior to joining the classroom.**

**V. Course Goals**

<b>Objectives</b>	
1. Identify the syndromes associated with radiation exposure	6. Define various radiation limits and procedure to measure
2. Calculate units of measurements used in Nuclear Medicine	7. Identify, measure and account for radiation under safe exposure conditions
3. Explain the effects and responses of ionizing radiation on cells and tissues	8. Describe Code of Federal Regulations title 10 part 19, 20, 30, and 35
4. Recognize factors affecting cell responses to radiation	9. Perform radiation surveys using various meters
5. Identify the regulatory agencies and licensing regulations	10. Recognize regulations by DOT, etc.

**VI. Student Learning Outcomes**

Student success is important to STI faculty, and all faculty are involved in assessing student learning. Upon completion of an Associate in Applied Science degree, Southeast graduates will have competence in the following four broad student outcomes:

1. Science & Technology: Technical competence including knowledge of technology and/or scientific principles as these apply to programs.
2. Problem Solving & Critical Thinking: The ability to select and use various approaches to solve a wide variety of problems – scientific, mathematical, social and personal. Graduates will also be able to evaluate information from a variety of perspectives, analyze data and make appropriate judgments.
3. Communication: The ability to communicate effectively in several forms -- oral, written, nonverbal and interpersonal. Graduates will also demonstrate knowledge of how to manage and access information.
4. Professionalism: Strong work ethic, including responsible attendance; skill in teamwork and collaboration, as well as an ability to work with others, respecting diversity; ability to adapt to change; commitment to lifelong learning; adherence to professional standards; and positive self-esteem and integrity.

As a result of taking this course, the following student outcomes will be sought by helping the student develop:

**VII. Evaluation Procedures**

**a. Assessments**

The methods of evaluation and criteria for this course are: 5 exams with quizzes and assignments to monitor the overall learning criteria. A comprehensive final will be given to monitor how much the students have retained.

**Grading procedure:**

5 Unit exams:	65%
Quizzes/Assignments	20%
Final Exam:	15%

## b. Grading policy

Letter Grade	Percent
A	94% - 100%
B	87% - 93%
C	80% - 86%
D	74% - 79%
F	$\leq 73\%$

A grade of C (80%) or greater is required to successfully pass this course.

Grades in this course are only rounded to the second place following the decimal. Grades will not be rounded to the nearest whole number.

**VIII. ADA Statement**

The instructor in this course will act with integrity and strive to engage in equitable verbal and nonverbal behavior with respect to differences from age, gender, race, handicapping conditions, and religion. If you have special needs as addressed by the Americans with Disabilities Act and need course materials in alternative formats, notify your instructor immediately. Reasonable efforts will be made to accommodate your special needs.

Violation of safety to self and others and/or violations of safe operating practices of equipment may result in: the reduction or loss of your daily grade; removal from class and/or other disciplinary action.

**IX.    Tentative Course Outline/Schedule**

- June 6:**            Welcome/Syllabus/Expectations/Rules/Questions  
Chapter 4 "Overview of Cell Biology" (Page 63-82)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- June 8:**            Chapter 3 "Radiation Quantities and Units" (Page 45-62)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- June 13:**          **Unit Exam #1** (Chapter 3 & 4)  
Chapter 5 "Molecular and Cellular Radiation" (Page 83-109)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- June 15:**          Chapter 6 "Radiation Effects on Organs Systems" (Page 110-140)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- June 20:**          **Unit Exam #2** (Chapter 5 & 6)  
Chernobyl Movie
- June 22:**          Chapter 1 "Introduction to Radiation Protection" (Page 1-24)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- June 27:**          Chapter 2 "Interaction of X-radiation with Matter" (Page 25-44)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- June 29:**          **Unit Exam #3** (Chapter 1 & 2)  
Chapter 7 "Dose Limits for Exposure to Ionizing Radiation"  
(Page 141-162) Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)

**X.    Tentative Course Outline/Schedule**

- July 6:**            NRC CFR Licensing (Handout)
- July 11:**          **Unit Exam #4** (Chapter 7 and NRC licensing)  
Handout reading
- July 13:**          Chapter 10 "Radiation Monitoring" (Page 249-268)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- July 18:**          Chapter 11 "Radioisotopes and Radiation" (Page 269-286)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- July 20:**          **Unit Exam #5** (Handout reading, Chapter 10 & 11)  
Patient Care and Quality Improvement (Chapter 8 Mosby)  
Review for Final
- July 25:**          **Comprehensive Final**
- July 27:**          **Clinical picks selection**

**Class Content****June 6<sup>th</sup> Class orientation/Syllabus/Lecture Chapter 4 “Overview of Cell Biology”**

Upon completion of this session, the student will:

1. Describe the expectations of the course
2. Discuss the objectives of the course
3. Explain the focus of the course
4. Discuss the grading policy for this course
5. State the purpose for acquiring a basic knowledge of cell structure, composition, and function as a foundation for radiation biology.
6. List the essential functions of water in the human body.
7. Describe the molecular structure of deoxyribonucleic acid and explain the way it functions in the cell.
8. List the various cellular components and identify their physical characteristics and functions.
9. Distinguish between the two types of cell division, mitosis and meiosis, and describe each process.

**Assignments:**

- Read Chapter 4 page 63-82 (Mosby)
- Crossword puzzle and Cell labeling

**June 8<sup>th</sup> Lecture Chapter 3 “Radiation Quantities and Units”**

Upon completion of this session, the student will:

1. Explain the concept of skin erythema dose, tolerance dose, and threshold dose.
2. Differentiate between somatic and genetic effects
3. Differentiate between the following radiation quantities: *exposure, absorbed dose, equivalent dose, and effective dose*, and identify the appropriate symbol for each quantity.
4. List and explain the International System (SI) and traditional units for radiation exposure, absorbed dose, equivalent dose, and effective dose.
5. Given the numeric value for an absorbed dose of radiation stated in gray (rad), the radiation weighting factor for the type and energy of radiation in question, and the tissue weighting factor, determine the effective dose.

**Assignment:**

- Read Chapter 3 page 45 – 62 (Mosby)
- Math problems
- General Discussion Questions Page 61 (1-10)

**June 13<sup>th</sup> Test #1 Lecture Chapter 5 “Molecular and Cellular Radiation”**

Upon completion of this session, the student will:

1. List the three radiation energy transfer determinates and explain their individual concepts.
2. Differentiate between the three levels of biologic damage that may occur in living systems as a result of exposure to ionizing radiation and describe how the process of direct and indirect action of ionizing radiation on the molecular structure of living systems occurs.
3. Describe target theory.
4. Explain the purpose for and function of survival curves.
5. List the factors that affect cell radiosensitivity.

Assignments:

- Read Chapter 5 page 83 -109 (Mosby)
- Crossword Puzzle

**June 15<sup>th</sup> Lecture Chapter 6 “Radiation Effects on Organ Systems”**

Upon completion of this session, the student will:

1. Explain the purpose of a radiation dose-response curve.
2. Differentiate between threshold and nonthreshold relationships.
3. List and describe the various early nonstochastic somatic effects, late nonstochastic somatic effects, and late stochastic somatic effects of ionizing radiation on living systems.
4. Describe acute radiation syndrome and identify the stages.
5. LD 50/30 and the meaning.
6. Describe the concept of risk for radiation-induced malignancies.
7. Explain how spontaneous mutations occur.
8. Differentiate between dominant and recessive gene mutations.

Assignments:

- Read Chapter 6 page 110 – 140 (Mosby)
- General Discussion Questions page 138 (1-5)

**June 20<sup>th</sup> Test #2 Chernobyl Movie**

Upon completion of this session, the student will:

1. Identify radiation effects from the atomic bomb survivors of Hiroshima and Nagasaki.

Assignments:

- A handout will be giving during the movie.

**June 22<sup>nd</sup> Lecture Chapter 1 "Introduction to Radiation Protection"**

Upon completion of this session, the student will:

1. Discuss the concept of effective radiation protection.
2. Explain the justification and responsibility for nuclear medicine procedures.
3. Explain how imaging professionals can help ensure that both occupational and nonoccupational dose limits remain well below maximum allowable levels.
4. State the ALARA principle and discuss its significance in diagnostic imaging.
5. List and describe three sources of natural background ionizing radiation and six sources of manmade, or artificial, ionizing radiation.
6. Describe the potential for ionizing radiation to cause biologic damage.
7. List the different forms of electromagnetic and particulate radiation and identify those forms that are classified as ionizing radiation.
8. Explain the concept of equivalent dose and effective dose.
9. Discuss the significance of the sievert as a unit of measure for equivalent dose.

Assignments:

- Read Chapter 1 page 1 – 24 (Mosby)
- Matching worksheet

**June 27<sup>th</sup> Lecture Chapter 2 "Interaction of X-radiation with Matter"**

Upon completion of this session, the student will:

1. Describe the process of absorption and explain the reason why absorbed dose is atoms of biologic matter should be kept as small as possible.
2. List the events that occur when x-radiation passes through matter.
3. Discuss the probability of photon interaction with matter.
4. List and explain the five processes of interaction with matter: Compton scattering, photoelectric absorption, pair production, coherent scattering, and photodisintegration.

Assignments:

- Read Chapter 2 page 25 – 44 (Mosby)
- Crossword puzzle
- General Discussion Questions page 42 – 43 (1, 5, 7, 9)

**June 29<sup>th</sup> Test #3 Lecture Chapter 7 "Dose Limits for Exposure to Ionizing Radiation"**

Upon completion of this session, the student will:

1. List and describe the function of the four major organizations that share the responsibility for evaluation the relationship between radiation equivalent doses and induced biologic effects and five U.S. regulatory agencies responsible for enforcing established radiation effective dose limiting standards.
2. Describe effective dose limit and the effective dose limiting system.
3. Describe current radiation protection philosophy and state the goal and objective of radiation protection.
4. Explain the concept of risk as it relates to the medical imaging industry.
5. Identify the risk from exposure to ionizing radiation at low absorbed doses.
6. State the following in terms of International System (SI) units and traditional units:
  - a. Annual occupational dose limits
  - b. Annual effective dose limits
  - c. Annual equivalent dose limits
  - d. Annual effective dose limit for a minor
  - e. Annual occupational dose limits for pregnant worker

**Assignments:**

- Read Chapter 7 page 141 – 162 (Mosby)
- Fill in the blank worksheet

**July 6<sup>th</sup> Lecture on NRC CFR Licensing**

Upon completion of this session, the student will:

1. Post appropriate signs in designated areas.
2. Package radioactive materials according to regulations.
3. Maintain accurate, written radiation safety/protection records.
4. Use radiation monitoring devices.
5. Review monthly personnel exposure records with regard to maximum permissible radiation dose limits.
6. Reducing radiation exposure.
7. Notifying the appropriate authority of excessive radiation exposure.
8. Notifying the appropriate authority of a medical event.
9. Proper methods of storage of radiopharmaceuticals
10. Instructions in radiation safety precautions to patient, family or staff.
11. Maintain appropriate quality control records.

**Assignments:**

- Read handout

**July 11<sup>th</sup> Test #4 Lecture "Radiation Protection in Nuclear Medicine"**

Upon completion of this session, the student will:

1. State the annual occupational effective dose limit for whole body exposure of diagnostic imaging personnel routine operations and explain the significance of the ALARA concept for these individuals.
2. Identify the type of x-radiation that poses the greatest occupational hazard in diagnostic nuclear medicine and explain the various ways this hazard can be reduced or eliminated.
3. Explain the way various methods and techniques that reduce patient exposure during a diagnostic examination also reduce exposure for the nuclear medicine technologist.
4. List and explain the three basic principles of radiation protection that can be used for personnel exposure reduction.
5. State and explain the inverse square law.
6. Describe the construction of protective structural shielding, and list the factors that govern the selection of appropriate construction materials.

Assignments:

- Read Hand out
- Radiation Protection Math Problems

**July 13<sup>th</sup> Lecture Chapter 10 "Radiation Monitoring"**

Upon completion of this session, the student will:

1. State the reason why a radiation worker should wear a personnel dosimeter and explain the function and characteristic of such devices.
2. Describe the various components of the film badge, pocket ionization chamber, and TLD and explain the use of each of these devices as personnel monitors.
3. Explain the function of radiation survey instruments.
4. List three gas-filler radiation survey instruments.
5. Explain the purpose of the following instruments: ionization chamber (cutie pie), proportional counter, Geiger-Muller (GM) detector.

Assignments:

- Read Chapter 10 page 249 – 268 (Mosby)
- General Discussion Questions page 267 (1 – 10)

**July 18<sup>th</sup> Lecture Chapter 11 "Radioisotopes and Radiation"**

Upon completion of this session, the student will:

1. Describe how therapeutic isotopes may be characterized.
2. Describe the process of electron capture.
3. Identify the two best radiation safety practices to follow for patients having therapeutic prostate seed implants.
4. Explain the process of beta decay.
5. Discuss the radiation hazards that may be encountered by personnel caring for a patient who is receiving iodine-131 therapy treatment for thyroid cancer.
6. Explain how radioisotopes are used as radioactive tracers in nuclear medicine work.
7. Identify and describe the type of radiation events that are used in positron emission tomography.
8. Describe the procedure for external decontamination from radioactive materials.

Assignments:

- Read Chapter 11 page 269 – 286 (Mosby)
- Crossword puzzle

**July 20<sup>th</sup> Test Unit #5 Lecture Patient Care and Quality Improvement**

Upon completion of this session, the student will:

1. Identify steps that must be taken prior to patient arrival for a nuclear medicine procedure.
2. Describe appropriate techniques for interacting with various age groups.
3. Describe and demonstrate proper viniculture techniques.
4. Describe and demonstrate the proper monitoring and care of intravenous lines.
5. Describe and demonstrate the standard precaution guidelines.
6. Demonstrate proper aseptic and sterile techniques.
7. Describe quality-improvement programs and their relationship to nuclear medicine services.

Assignments:

- Read Nuclear Medicine and PET (Christian) Chapter 8 page 221 – 235

**July 25<sup>th</sup> Comprehensive Final****July 27<sup>th</sup> Clinical picks selection**

**Course #NM-124 Nuclear Medicine Math and Stats**  
**Southeast Technical Institute Syllabus**

**3 Credits**  
**Spring 2007**

<u>Instructor:</u>	Mary Hennings-Frank	<u>Class Time:</u>	M/W 2:00pm – 3:15pm
<u>Office:</u>	HC 213	<u>Course Location:</u>	HC 255
<u>Telephone:</u>	(605) 367-4632	<u>FAX:</u>	(605) 367-5724
<u>E-mail:</u>	<a href="mailto:mary.hennings-frank@southeasttech.com">mary.hennings-frank@southeasttech.com</a>	<u>Office Hours:</u>	Monday 9-10am Tuesday 3-4pm Wednesday 1-2pm Thursday 10-11am Friday 2-3pm

**I. Catalog Description**

A practical working knowledge of fundamental mathematics is developed for a thorough understanding of nuclear medicine applications. Topics include statistics, radiation safety, instrumentation, radiopharmacy, clinical procedures, with decay charts and universal decay table

**II. Course Prerequisites**

Math 101, Physics 100, and NM 101

**III. Description of Instructional Methods**

Southeast Technical Institute values a student-centered learning environment, which nurtures intellectual and social development. Southeast instructors have designed their general education courses to utilize a variety of instructional methods.

This course includes the following:

- Course readings
- Collaborative learning groups
- Lecture
- Discussion
- In class presentations
- Modeling of learning activities
- Demonstrations

**IV. Course Requirements**

- a. Required textbook(s) and other materials**  
Practical Mathematics in Nuclear Medicine Technology, Patricia Wells, MAE, CNMT
- b. Supplementary materials**  
Daily Assignments

c. **Class attendance policy**

Southeast General Catalog describes the institute's standard attendance policy: One absence per credit hour is allowed in a course before absences can reduce grades. Instructors may reduce a student's final grade by one-half letter for each additional absence.

In all cases of absence, it is necessary for students to make up work that is missed. It is the responsibility of the student to make arrangements with the instructor(s) to make up missed work.

d. **Cheating and plagiarism policy**

Students attending Southeast Technical Institute are expected to comply with all pertinent state laws and take personal responsibility for their conduct.

Southeast policies authorize suspension or termination of any student from school for misconduct as outlined in the rules of this policy. The following student misconduct shall constitute grounds for student discipline, suspension, or termination when such activity occurs on school grounds or during an educational function under the auspices of the school board: acts of dishonesty, including cheating and plagiarism or other forms of dishonesty relating to academic achievement.

e. **Make-up policy**

Students are expected to turn in assignments on the day indicated in the course schedule. It will be subject to instructor's discretion as to whether the assignment will be accepted late. The instructor will issue a grade of incomplete only for extenuating circumstances. No assignment will be accepted for grade after the final day of the course.

All assignments **must** be turned in at the time specified. Late assignments will be deducted 20% for each class day that it is late. *Any missed exam must be made up according to the Health Team policy.* **Students have one week from the day of the test to make up the exam. It is the responsibility of the student to inform the instructor of when they are going to be taking the makeup exam. The first make-up test is "free" meaning no points will be taken off; 7 points will automatically be taken off for the second missed exam; 14 points will automatically be taken off for the third, fourth, etc. missed exam.** The student may be required to take an alternative exam. *Quizzes may not be made up.* It is the responsibility of the student for all assigned work, notes, handouts, readings etc. . **A minimum of 80% is required to successfully pass this course according to Southeast Heath grading policy.**

**V. Course Goals**

<b>Objectives</b>	
1. Practice rounding of numbers, mathematical operations, powers, exponents, and roots.	8. Discuss mean, median, mode and standard deviation of values.
2. Compare inverse and direct proportions.	9. Radiation safety with time, distance, shielding, half-life calculations.
3. Demonstrate the ability to multiple conversions.	10. Calculating percent error for different instruments, geometry, constancy, efficiency.
4. Analyze logs, natural logs, and antilog.	11. Performing window calculations, camera sensitivity, pixel calculations, pipetting and centrifuge use.
5. Graph results on linear & semi-log paper and slope calculations.	12. Demonstrate decay calculations, dose volumes, pediatric dose calculations, Mo-99 generators, elations, and chromatography.
6. Demonstrate use of statistics: percents error or difference.	13. Practice clinical procedures for calculating ejection fractions, plotting curves for gastric emptying studies.
7. Comparing effects of background on counts and counting rates.	14. Performing calculations for quantitative studies, uptakes, in-vitro procedures.

**VI. Student Learning Outcomes**

Student success is important to STI faculty, and all faculty are involved in assessing student learning. Upon completion of an Associate in Applied Science degree, Southeast graduates will have competence in the following four broad student outcomes:

1. Science & Technology: Technical competence including knowledge of technology and/or scientific principles as these apply to programs.
2. Problem Solving & Critical Thinking: The ability to select and use various approaches to solve a wide variety of problems – scientific, mathematical, social and personal. Graduates will also be able to evaluate information from a variety of perspectives, analyze data and make appropriate judgments.

3. Communication: The ability to communicate effectively in several forms – oral, written, nonverbal and interpersonal. Graduates will also demonstrate knowledge of how to manage and access information.
4. Professionalism: Strong work ethic, including responsible attendance; skill in teamwork and collaboration, as well as an ability to work with others, respecting diversity; ability to adapt to change; commitment to lifelong learning; adherence to professional standards; and positive self-esteem and integrity.

As a result of taking this course, the following student outcomes will be sought by helping the student develop:

### **VII. Evaluation Procedures**

#### **a. Assessments**

The methods of evaluation and criteria for this course are: Each student will be given a pre-exam before the beginning of the course, at mid-term, and then again at the end of the course to assess their math skills that they have learned throughout the this course.

#### **b. Grading policy**

<b>Letter Grade</b>	<b>Percent</b>
A	94% - 100%
B	87% - 93%
C	80% - 86%
D	74% - 79%
F	<= 73%

### **VIII. ADA Statement**

The instructor in this course will act with integrity and strive to engage in equitable verbal and nonverbal behavior with respect to differences from age, gender, race, handicapping conditions, and religion. If you have special needs as addressed by the Americans with Disabilities Act and need course materials in alternative formats, notify your instructor immediately. Reasonable efforts will be made to accommodate your special needs.

Violation of safety to self and others and/or violations of safe operating practices of equipment may result in: the reduction or loss of your daily grade; removal from class and/or other disciplinary action.

IX. Tentative Course Outline/Schedule

**Chapter I: Basics Math Skills for Nuclear Medicine  
Technology**

Jan 8<sup>th</sup>: Syllabus & pages 3-5; Pre-Exam

Jan 10<sup>th</sup>: Significant figures and rounding, page 1-4; Powers and exponents, page 9 & 10; Scientific notation, page 13-16; (Assignment Page 5, problems 6-20: Page 15-16 Odd number problems only); Due 1/17)

Jan 17<sup>th</sup>: Direct and inverse proportions, page 20-25; Converting within the metric system, page 26-31; Converting Curie and Becquerel page 32-34; Converting Rad and Gray page 35-36; Converting Rem and Sieverts page 37-38; Converting pound and kilogram page 39-40. (Assignment page 23-24 Odd number problems only; Page 31 Odd number problems only; problems on page 34, 11-20; problems page 40 Even number only Due 1/22)

Jan 22<sup>nd</sup>: Logs, natural logs page 43-45; Solving equations page 46-47; Graphing on linear papers page 48-51; (Assignment problems page 44-45 Even only; problems page 47 Even only; problems page 51, 1-12 Odd only Due 1/24)/REVIEW

**Jan 24<sup>th</sup>: UNIT 1 EXAM OVER CHAPTER I**

**Chapter III: Radiation Protection**

Jan 29<sup>th</sup>: Conversion of counts per minute to disintegrations per minute page 93-95; Exposure rate constants page 96-97; Radiation dose vs. time page 98-100; Radiation dose vs. distance page 101-104; (Assignment problems page 94-95, 1-10; problems page 97 Odd only; problems page 99, 1-5; problems page 102-104 Even only Due 1/31)

Jan 31<sup>st</sup>: Radiation dose vs. shielding page 105-109; Effective half-life calculations page 110-112; REVIEW (Assignment problem page 108-109 All; problems page 111-112 All Due 2/5)

**Feb 5<sup>th</sup>: UNIT 2 EXAM OVER CHAPTER III**

**Chapter IV: Instrumentation**

Feb 7<sup>th</sup>: Calibrator accuracy and constancy page 113-115; Percent error page 116-118; Geometry and percent error page 119-121; Geometry and percent error page 122-123; (Assignment problems page 114, 1-4 and page 115, 9, 11, 13; problem page 117, 1-6; problems page 120, 1-4; problems page 123, 1-5 Due 2/12)

Feb 12<sup>th</sup>: Dose calibrator linearity page 124-126; Correction factors page 127-128; Energy Resolution page 129-132; Chi Square page 133-137; (Assignment problems page 125, 1-5; problems page 128, 1-8; problems page 130-132, 1-6; problems page 136-137, 1-5 Due 2/14)

**Feb 14<sup>th</sup>:** Well counter efficiency page 138-139; Window calculation page 140-141; Window calculation page 142-146; Camera sensitivity page 147-148; (Assignment problems page 139 Odd number only; problem page 140-141 Odd number only; problem page 144-146 Odd number only; problem page 148 Even only Due 2/21)

**Feb 21<sup>st</sup>:** Acquisition time page 149-151; Flood or phantom fill page 152-153; Total pixels page 154-155; Centrifuge: relative centrifugal force vs. time page 166-167; (Assignment problems page 151 Even only; problems page 153, 1-5; problems page 155, 1-6; problems page 167, Even only Due 2/26)

**Feb 26<sup>th</sup>: UNIT 3 EXAM OVER CHAPTER IV**

**Feb 28<sup>th</sup>:** Mid-Term Review

**March 5<sup>th</sup>: Mid-Term EXAM over Chapter I, III, IV**

**March 7<sup>th</sup>:** Mid-Term (Pre-Exam)

**Chapter V: Radiopharmacy**

**March 12<sup>th</sup>:** Decay half-life page 169-171; Decay charts page 172-174; Universal decay table page 175-178; Pre-calibration calculations page 179-182; (Assignment problems page 171, 1-9; problems page 173-174, 1-10; problems page 177-178, Odd number only; problems page 181-182, 1-10 Due 3/14)

**March 14<sup>th</sup>:** Specific concentration page 183-184; Dose volume calculation page 185-188; Total activity page 189-191; Total volume page 192-194; (Problem Handout due (3/19))

**March 19<sup>th</sup>:** Activity per unit weight page 195-196; Unit dose page 197-199; Pediatric doses page 200-201; (Assignment problems page 195-196, 1-7; problems page 198-199, Odd number only; problems page 200-201, Odd number only; 3/21)

**March 21<sup>st</sup>:** Minimum and maximum doses page 210-212; Lung particle calculations page 213-215; Capsule calculations page 216-217; Generator yield page 218-219; (Assignment problems page 211-212, Even number only; problems page 214-215, Even number only; problems page 217, 1-9; problems page 219, 1-9 Due 3/26)

**March 26<sup>th</sup>:** Mo99/Tc99m yield page 220-223; Allowable Mo99 page 224-227; Chromatography calculation page 230-233; (Assignment problems page 222-223, Odd number only; problems page 226, 1-10; problems page 231-233, 1-10 Due 3/28)

**March 28<sup>th</sup>: UNIT 4 EXAM OVER RADIOPHARMAY**

## Chapter VI: Clinical Procedures

April 2<sup>nd</sup>: Left ventricle EF page 235-237; Gallbladder EF page 238-240; Gastro esophageal reflux page 241-242; Gastric emptying page 243-247; (Assignment problems page 236-237, Odd number only; problems page 239-240, Odd number only; problems page 241-242, 1-6; problems page 245-247, 1-5 Due 4/4)

April 4<sup>th</sup>: Lung quantization page 253-255; Thyroid uptake page 256-259; Schilling calculation page 260-263; Concentrations page 264-265; (Assignment problems page 254-255, 1-5; problems page 257-259, Odd number only; problems page 262-263, Odd number only; problems page 265, Odd number only Due 4/9)

April 9<sup>th</sup>: Plasma volume page 269-272; Red cell mass page 273-276; Whole blood volume page 277-278; (Assignment problems page 270-272, Odd number only; problems page 275-276, Odd number only; problems page 278, 1-3 Due 4/11)

## April 11th: UNIT 5 EXAM OVER CLINICAL PROCEDURES

## Chapter II: Statistics

April 16<sup>th</sup>: Standard deviation page 67-71; Coefficient of variation page 76-78; Error inherent page 79-80 (Assignment problems page 70, 1-5; problems page 77, 1-7; problems page 80 Even only Due 4/18)

April 18<sup>th</sup>: Statistical significance page 81-82; Standard deviation page 83-85; Levy Jennings plot page 88-91; (Assignment problems page 82, Even number only; problems page 84-85, Odd number only; problems page 90-91, 1-5 Due 4/23)

## April 23<sup>rd</sup>: UNIT 6 EXAM OVER STATISTIC

April 25th: Final Pre-Exam

April 30<sup>th</sup> : Review for final

May 2<sup>nd</sup> Final Exam over Chapter II, V, VI

**Course #NM-220      Radiation Safety & Biology      3 Credits**  
**Southeast Technical Institute Syllabus      Summer 2007**

<u>Instructor:</u>	Mary Hennings-Frank	<u>Class Time:</u>	W/F 9:00am – 12:00pm
<u>Office:</u>	HC 213	<u>Course Location:</u>	HC 255
<u>Telephone:</u>	(605) 367-4632	<u>FAX:</u>	(605) 367-5724
<u>E-mail:</u>	<a href="mailto:mary.hennings-frank@southeasttech.com">mary.hennings-frank@southeasttech.com</a>	<u>Office Hours:</u>	Monday 9-10am Tuesday 3-4pm Wednesday 1-2pm Thursday 12pm-1pm Friday 2-3pm

**I. Catalog Description**

Students will enhance their knowledge in the safe use of radionuclides and their handling. This will also encompass the legal requirements set for by the NRC and other governing agencies to benefit the patient, the technologist, and the public in the clinical environment.

**II. Course Prerequisites**

HC 111, NM 101, NM 120, NM 123, NM124

**III. Description of Instructional Methods**

Southeast Technical Institute values a student-centered learning environment, which nurtures intellectual and social development. Southeast instructors have designed their general education courses to utilize a variety of instructional methods.

This course includes the following:

- Course readings
- Collaborative learning groups
- Lecture
- Discussion
- In class presentations
- Modeling of learning activities
- Demonstrations

**IV. Course Requirements**

- a. **Required textbook(s) and other materials**  
Radiation Protection in Medical Radiography; Statkiewicz-Sherer, Visconti, Ritenour; Mosby; 5<sup>th</sup> Edition
- b. **Supplementary materials**  
Daily Assignments

**c. Class attendance policy**

It is the students' responsibility to call or e-mail the instructor if they are sick or tardy. If the student fails to call or e-mail the instructor of their absent, a written document will be typed up and put in the student file. If the student is tardy three times during the semester course, both the student and the instructor will meet and corrective action will be taken.

Southeast General Catalog describes the institute's standard attendance policy: One absence per credit hour is allowed in a course before absences can reduce grades. For this course which is a 3 credit course, if the student is absent the fourth time, not only will the student's final grade be reduced by one-half the letter grade, the student will also be put on corrective action.

All records of absenteeism and tardiness will be kept in the students file and are open for discussion with potential clinical site and employers.

In all cases of absence, it is necessary for students to make up work that is missed. It is the responsibility of the student to make arrangements with the instructor(s) to make up missed work.

**d. Cheating and plagiarism policy**

Students attending Southeast Technical Institute are expected to comply with all pertinent state laws and take personal responsibility for their conduct.

Southeast policies authorize suspension or termination of any student from school for misconduct as outlined in the rules of this policy. The following student misconduct shall constitute grounds for student discipline, suspension, or termination when such activity occurs on school grounds or during an educational function under the auspices of the school board: acts of dishonesty, including cheating and plagiarism or other forms of dishonesty relating to academic achievement.

**e. Make-up policy**

**Assignments:** Students are expected to turn in assignments on the day indicated in the course schedule. Late assignments are defined as any assignment turned in after they were collected by the instructor. Late assignments will be docked 10% for each day late.

**Quizzes:** Quizzes may be given at anytime without warning over any material, which has been presented via; lecture, video, assigned reading, or guest speaker. The purpose of quizzes is to assess the students understanding or retention of information presented, at a given place and time. There is a specified time limit for each quiz, and the papers will be collected after that time period. Any student entering late into class will only have the remaining time allowed to complete. If you are absent on the day of a quiz, the quiz will be zero. No quizzes are to be made up.

**Test:** If you are absent the day of a test, you must notify your instructor and make arrangements to make up the test before the next lecture (at the soonest make-up time available). The following criteria will be made concerning make-up testing:

- **1<sup>st</sup> test made up = no grading penalty**
- **2<sup>nd</sup> test made up = -7% to the test grade**
- **3<sup>rd</sup> test (and any subsequent test) = -14% to the test grade**
- **ANT TEST NOT MADE UP WITHIN ONE WEEK WILL BE SCORED AS A ZERO**

Make up test schedule will be posted at the beginning of the semester. To make up the test, you must know the name of your instructor, the course number of the class you are making up a test for, and have a photo ID>

**Classroom Expectation:**

1. Class days are Wednesday and Friday from 0900 – 1200
2. Any requests for absences or schedule changes are to be made prior to the beginning of the course whenever possible. Granting requests will be at the discretion of the course instructor.
3. Attendance at all classes is mandatory. Students are expected to notify the instructor for all absences by leaving a message on their voice mail or e-mail.
4. The student is responsible for any missed classroom content. There may be make-up activities as determined by the instructor.
5. If the student becomes ill during the day, they are to notify the instructor prior to leaving directly or by voicemail.
6. Tardiness to class is an unacceptable behavior. Tardiness up to 10 minutes will be counted as 1/3 absent, late three times is the equivalent to one absence.
7. There will be no makeup of quizzes due to tardiness.
8. Assignments in the syllabus are to be completed before class unless stated otherwise.
9. All school policies and conduct are to be followed as stated in the student handbook.
10. Class schedules are subject to change at the discretion of the instructor. Students will be informed as early as possible of the changes.
11. All course requirements must be met in order to successfully complete the course.
12. An overall grade of 80% (C) or above must be attained in order to pass this course.
13. Cell phones are to be turned off or placed on a silent mode during class.
14. Lap top computers are allowed for note taking in the class. They should not be used for e-mailing, instant messaging, or surfing the website during class.
15. Violations of safety to self and others, or violation to safe operating practices of equipment may result in reduction or loss of your daily grade, removal from class, and/or other disciplinary action.
16. Students are required to follow nuclear medicine dress code (as listed below).

**Dress Code:**

- No open toe shoes (example: Scandals)
- NO JEANS
- No caps of any kind
- No ripped clothing
- NO SHORTS OR TANK TOPS
- Scrubs (no sweatshirts over scrub top. May wear long or short sleeve white T-shirt under scrubs, and or add lab coat if cold)
- Nice dress pants and shirts if not wearing scrubs
- No revealing clothing
- Limited and conservative jewelry and cosmetics
- Limited exposed body piercing and tattoos
- Personal hygiene should limit body odor, including perfumes and colognes
- Smoke odor should not be detectable

**Students in violation of dress code will be asked to correct their transgression in prior to joining the classroom.**

**V. Course Goals**

<b>Objectives</b>	
1. Identify the syndromes associated with radiation exposure	6. Define various radiation limits and procedure to measure
2. Calculate units of measurements used in Nuclear Medicine	7. Identify, measure and account for radiation under safe exposure conditions
3. Explain the effects and responses of ionizing radiation on cells and tissues	8. Describe Code of Federal Regulations title 10 part 19, 20, 30, and 35
4. Recognize factors affecting cell responses to radiation	9. Perform radiation surveys using various meters
5. Identify the regulatory agencies and licensing regulations	10. Recognize regulations by DOT, etc.

## VI. Student Learning Outcomes

Student success is important to STI faculty, and all faculty are involved in assessing student learning. Upon completion of an Associate in Applied Science degree, Southeast graduates will have competence in the following four broad student outcomes:

1. Science & Technology: Technical competence including knowledge of technology and/or scientific principles as these apply to programs.
2. Problem Solving & Critical Thinking: The ability to select and use various approaches to solve a wide variety of problems – scientific, mathematical, social and personal. Graduates will also be able to evaluate information from a variety of perspectives, analyze data and make appropriate judgments.
3. Communication: The ability to communicate effectively in several forms – oral, written, nonverbal and interpersonal. Graduates will also demonstrate knowledge of how to manage and access information.
4. Professionalism: Strong work ethic, including responsible attendance; skill in teamwork and collaboration, as well as an ability to work with others, respecting diversity; ability to adapt to change; commitment to lifelong learning; adherence to professional standards; and positive self-esteem and integrity.

As a result of taking this course, the following student outcomes will be sought by helping the student develop:

## VII. Evaluation Procedures

### a. Assessments

The methods of evaluation and criteria for this course are: 5 exams with quizzes and assignments to monitor the overall learning criteria. A comprehensive final will be given to monitor how much the students have retained.

### Grading procedure:

5 Unit exams:	65%
Quizzes/Assignments	20%
Final Exam:	15%

## b. Grading policy

Letter Grade	Percent
A	94% - 100%
B	87% - 93%
C	80% - 86%
D	74% - 79%
F	$\leq 73\%$

A grade of C (80%) or greater is required to successfully pass this course.

Grades in this course are only rounded to the second place following the decimal. Grades will not be rounded to the nearest whole number.

**VIII. ADA Statement**

The instructor in this course will act with integrity and strive to engage in equitable verbal and nonverbal behavior with respect to differences from age, gender, race, handicapping conditions, and religion. If you have special needs as addressed by the Americans with Disabilities Act and need course materials in alternative formats, notify your instructor immediately. Reasonable efforts will be made to accommodate your special needs.

Violation of safety to self and others and/or violations of safe operating practices of equipment may result in: the reduction or loss of your daily grade; removal from class and/or other disciplinary action.

**Course #NM-220      Radiation Safety & Biology**  
**Southeast Technical Institute Syllabus**

**3 Credits**  
**Summer 2007**

**IX.      Tentative Course Outline/Schedule**

- June 6:**            Welcome/Syllabus/Expectations/Rules/Questions  
Chapter 4 "Overview of Cell Biology" (Page 63-82)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- June 8:**            Chapter 3 "Radiation Quantities and Units" (Page 45-62)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- June 13:**          **Unit Exam #1** (Chapter 3 & 4)  
Chapter 5 "Molecular and Cellular Radiation" (Page 83-109)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- June 15:**          Chapter 6 "Radiation Effects on Organs Systems" (Page 110-140)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- June 20:**          **Unit Exam #2** (Chapter 5 & 6)  
Chernobyl Movie
- June 22:**          Chapter 1 "Introduction to Radiation Protection" (Page 1-24)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- June 27:**          Chapter 2 "Interaction of X-radiation with Matter" (Page 25-44)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- June 29:**          **Unit Exam #3** (Chapter 1 & 2)  
Chapter 7 "Dose Limits for Exposure to Ionizing Radiation"  
(Page 141-162) Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)

**X.      Tentative Course Outline/Schedule**

- July 6:**            NRC CFR Licensing (Handout)
- July 11:**          **Unit Exam #4** (Chapter 7 and NRC licensing)  
Handout reading
- July 13:**          Chapter 10 "Radiation Monitoring" (Page 249-268)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- July 18:**          Chapter 11 "Radioisotopes and Radiation" (Page 269-286)  
Statkiewicz Sherer (Mosby 5<sup>th</sup> Edition)
- July 20:**          **Unit Exam #5** (Handout reading, Chapter 10 & 11)  
Patient Care and Quality Improvement (Chapter 8 Mosby)  
Review for Final
- July 25:**          **Comprehensive Final**
- July 27:**          **Clinical picks selection**

**Class Content****June 6<sup>th</sup> Class orientation/Syllabus/Lecture Chapter 4 “Overview of Cell Biology”**

Upon completion of this session, the student will:

1. Describe the expectations of the course
2. Discuss the objectives of the course
3. Explain the focus of the course
4. Discuss the grading policy for this course
5. State the purpose for acquiring a basic knowledge of cell structure, composition, and function as a foundation for radiation biology.
6. List the essential functions of water in the human body.
7. Describe the molecular structure of deoxyribonucleic acid and explain the way it functions in the cell.
8. List the various cellular components and identify their physical characteristics and functions.
9. Distinguish between the two types of cell division, mitosis and meiosis, and describe each process.

**Assignments:**

- Read Chapter 4 page 63-82 (Mosby)
- Crossword puzzle and Cell labeling

**June 8<sup>th</sup> Lecture Chapter 3 “Radiation Quantities and Units”**

Upon completion of this session, the student will:

1. Explain the concept of skin erythema dose, tolerance dose, and threshold dose.
2. Differentiate between somatic and genetic effects
3. Differentiate between the following radiation quantities: *exposure, absorbed dose, equivalent dose, and effective dose*, and identify the appropriate symbol for each quantity.
4. List and explain the International System (SI) and traditional units for radiation exposure, absorbed dose, equivalent dose, and effective dose.
5. Given the numeric value for an absorbed dose of radiation stated in gray (rad), the radiation weighting factor for the type and energy of radiation in question, and the tissue weighting factor, determine the effective dose.

**Assignment:**

- Read Chapter 3 page 45 – 62 (Mosby)
- Math problems
- General Discussion Questions Page 61 (1-10)

**June 13<sup>th</sup> Test #1 Lecture Chapter 5 “Molecular and Cellular Radiation”**

Upon completion of this session, the student will:

1. List the three radiation energy transfer determinates and explain their individual concepts.
2. Differentiate between the three levels of biologic damage that may occur in living systems as a result of exposure to ionizing radiation and describe how the process of direct and indirect action of ionizing radiation on the molecular structure of living systems occurs.
3. Describe target theory.
4. Explain the purpose for and function of survival curves.
5. List the factors that affect cell radiosensitivity.

Assignments:

- Read Chapter 5 page 83 -109 (Mosby)
- Crossword Puzzle

**June 15<sup>th</sup> Lecture Chapter 6 “Radiation Effects on Organ Systems”**

Upon completion of this session, the student will:

1. Explain the purpose of a radiation dose-response curve.
2. Differentiate between threshold and nonthreshold relationships.
3. List and describe the various early nonstochastic somatic effects, late nonstochastic somatic effects, and late stochastic somatic effects of ionizing radiation on living systems.
4. Describe acute radiation syndrome and identify the stages.
5. LD 50/30 and the meaning.
6. Describe the concept of risk for radiation-induced malignancies.
7. Explain how spontaneous mutations occur.
8. Differentiate between dominant and recessive gene mutations.

Assignments:

- Read Chapter 6 page 110 – 140 (Mosby)
- General Discussion Questions page 138 (1-5)

**June 20<sup>th</sup> Test #2 Chernobyl Movie**

Upon completion of this session, the student will:

1. Identify radiation effects from the atomic bomb survivors of Hiroshima and Nagasaki.

Assignments:

- A handout will be giving during the movie.

**June 22<sup>nd</sup> Lecture Chapter 1 “Introduction to Radiation Protection”**

Upon completion of this session, the student will:

1. Discuss the concept of effective radiation protection.
2. Explain the justification and responsibility for nuclear medicine procedures.
3. Explain how imaging professionals can help ensure that both occupational and nonoccupational dose limits remain well below maximum allowable levels.
4. State the ALARA principle and discuss its significance in diagnostic imaging.
5. List and describe three sources of natural background ionizing radiation and six sources of manmade, or artificial, ionizing radiation.
6. Describe the potential for ionizing radiation to cause biologic damage.
7. List the different forms of electromagnetic and particulate radiation and identify those forms that are classified as ionizing radiation.
8. Explain the concept of equivalent dose and effective dose.
9. Discuss the significance of the sievert as a unit of measure for equivalent dose.

Assignments:

- Read Chapter 1 page 1 – 24 (Mosby)
- Matching worksheet

**June 27<sup>th</sup> Lecture Chapter 2 “Interaction of X-radiation with Matter”**

Upon completion of this session, the student will:

1. Describe the process of absorption and explain the reason why absorbed dose is atoms of biologic matter should be kept as small as possible.
2. List the events that occur when x-radiation passes through matter.
3. Discuss the probability of photon interaction with matter.
4. List and explain the five processes of interaction with matter: Compton scattering, photoelectric absorption, pair production, coherent scattering, and photodisintegration.

Assignments:

- Read Chapter 2 page 25 – 44 (Mosby)
- Crossword puzzle
- General Discussion Questions page 42 – 43 (1, 5, 7, 9)

**June 29<sup>th</sup> Test #3 Lecture Chapter 7 "Dose Limits for Exposure to Ionizing Radiation"**

Upon completion of this session, the student will:

1. List and describe the function of the four major organizations that share the responsibility for evaluation the relationship between radiation equivalent doses and induced biologic effects and five U.S. regulatory agencies responsible for enforcing established radiation effective dose limiting standards.
2. Describe effective dose limit and the effective dose limiting system.
3. Describe current radiation protection philosophy and state the goal and objective of radiation protection.
4. Explain the concept of risk as it relates to the medical imaging industry.
5. Identify the risk from exposure to ionizing radiation at low absorbed doses.
6. State the following in terms of International System (SI) units and traditional units:
  - a. Annual occupational dose limits
  - b. Annual effective dose limits
  - c. Annual equivalent dose limits
  - d. Annual effective dose limit for a minor
  - e. Annual occupational dose limits for pregnant worker

**Assignments:**

- Read Chapter 7 page 141 – 162 (Mosby)
- Fill in the blank worksheet

**July 6<sup>th</sup> Lecture on NRC CFR Licensing**

Upon completion of this session, the student will:

1. Post appropriate signs in designated areas.
2. Package radioactive materials according to regulations.
3. Maintain accurate, written radiation safety/protection records.
4. Use radiation monitoring devices.
5. Review monthly personnel exposure records with regard to maximum permissible radiation dose limits.
6. Reducing radiation exposure.
7. Notifying the appropriate authority of excessive radiation exposure.
8. Notifying the appropriate authority of a medical event.
9. Proper methods of storage of radiopharmaceuticals
10. Instructions in radiation safety precautions to patient, family or staff.
11. Maintain appropriate quality control records.

**Assignments:**

- Read handout

**July 11<sup>th</sup> Test #4 Lecture “Radiation Protection in Nuclear Medicine”**

Upon completion of this session, the student will:

1. State the annual occupational effective dose limit for whole body exposure of diagnostic imaging personnel routine operations and explain the significance of the ALARA concept for these individuals.
2. Identify the type of x-radiation that poses the greatest occupational hazard in diagnostic nuclear medicine and explain the various ways this hazard can be reduced or eliminated.
3. Explain the way various methods and techniques that reduce patient exposure during a diagnostic examination also reduce exposure for the nuclear medicine technologist.
4. List and explain the three basic principles of radiation protection that can be used for personnel exposure reduction.
5. State and explain the inverse square law.
6. Describe the construction of protective structural shielding, and list the factors that govern the selection of appropriate construction materials.

**Assignments:**

- Read Hand out
- Radiation Protection Math Problems

**July 13<sup>th</sup> Lecture Chapter 10 “Radiation Monitoring”**

Upon completion of this session, the student will:

1. State the reason why a radiation worker should wear a personnel dosimeter and explain the function and characteristic of such devices.
2. Describe the various components of the film badge, pocket ionization chamber, and TLD and explain the use of each of these devices as personnel monitors.
3. Explain the function of radiation survey instruments.
4. List three gas-filler radiation survey instruments.
5. Explain the purpose of the following instruments: ionization chamber (cutie pie), proportional counter, Geiger-Muller (GM) detector.

**Assignments:**

- Read Chapter 10 page 249 – 268 (Mosby)
- General Discussion Questions page 267 (1 – 10)

**July 18<sup>th</sup> Lecture Chapter 11 "Radioisotopes and Radiation"**

Upon completion of this session, the student will:

1. Describe how therapeutic isotopes may be characterized.
2. Describe the process of electron capture.
3. Identify the two best radiation safety practices to follow for patients having therapeutic prostate seed implants.
4. Explain the process of beta decay.
5. Discuss the radiation hazards that may be encountered by personnel caring for a patient who is receiving iodine-131 therapy treatment for thyroid cancer.
6. Explain how radioisotopes are used as radioactive tracers in nuclear medicine work.
7. Identify and describe the type of radiation events that are used in positron emission tomography.
8. Describe the procedure for external decontamination from radioactive materials.

**Assignments:**

- Read Chapter 11 page 269 – 286 (Mosby)
- Crossword puzzle

**July 20<sup>th</sup> Test Unit #5 Lecture Patient Care and Quality Improvement**

Upon completion of this session, the student will:

1. Identify steps that must be taken prior to patient arrival for a nuclear medicine procedure.
2. Describe appropriate techniques for interacting with various age groups.
3. Describe and demonstrate proper viniculture techniques.
4. Describe and demonstrate the proper monitoring and care of intravenous lines.
5. Describe and demonstrate the standard precaution guidelines.
6. Demonstrate proper aseptic and sterile techniques.
7. Describe quality-improvement programs and their relationship to nuclear medicine services.

**Assignments:**

- Read Nuclear Medicine and PET (Christian) Chapter 8 page 221 – 235

**July 25<sup>th</sup> Comprehensive Final****July 27<sup>th</sup> Clinical picks selection**

## Nuclear Regulatory Commission Regulation of Nuclear Medicine

Radiation Safety  
2007

## Diagnostic Nuclear Medicine

- More than 50 years ago
- 12 – 14 million procedures
- Determine the cause of a medical problem



## Diagnostic Nuclear Medicine Facility

- Reception area
- File room
- Waiting room
- Hot lab
- Imaging room
- Thyroid uptake room
- Physician office
- Chief technologist office
- Hallways
- bathroom

## Devices and Materials NRC Regulates

- Dose calibrator
- Fume hood
- Shielding material
- Protective clothing
- Radioactive waste storage containers
- Sealed calibration sources
- Survey meters
- Well counters
- Whole-body/ring dosimeter
- Individual room exhaust systems

## NRC divided into 4 regions



## NRC Licenses for Medical Use 10 CFR Part 30

- Three types
  - General in vitro license
  - Specific license of limited scope
  - Specific license of broad scope

### Elements of Radiation Protection Program (NRC)

- Post Appropriate Signs in Designated Areas
- Package radioactive materials according to regulations
- Maintain Accurate, Written Radiation Safety/Protection Records
- Personnel Exposure Limits
- Medical Event
- Quality Control Records

### Post Appropriate Signs in Designated Areas

- Areas Designations
- Posting Requirements
- Radiation Surveys
- Radiation Wipe Tests
- Records Required

### Area Designations

- Unrestricted Area
  - Less than 2.0 mrem/hr
- Restricted Area
  - Greater than 2.0 mrem/hr
- Controlled Area
  - Radioactive materials is controlled

### Posting Requirements

- Caution: Radioactive Materials
- Radioactive materials are used or stored



### Posting Requirements

- Caution: Radiation Area
- Greater than 5.0 but less than 100 mrem in 1 hour at 30 cm.



### Posting Requirements

- Caution: High Radiation Area
- Greater than or equal to 100 mrem in 1 hour at 30 cm but less than 500 rad in 1 hour at one meter



## Radiation Surveys

- Instruments
- GM meters
  - 0.1 mrem/hr to 100 mrem/hr
  - 100 mrem/hr to 1000 mrem/hr
- Calibration
- Proper operation



## Radiation Surveys

- Instruments
  - Cutie Pie
  - 0.1 mrem per hour
- Calibration
- Proper Operation



## Radiation Surveys

- Instruments
- Frequency
  - Daily = prepared, administered
  - Weekly = waste stored

## Radiation Wipe Tests

- Instruments Required
  - 2000 DPM
- Frequency
  - Weekly



## Records required

- Date of survey
- Plan of area
- Expressed
  - Mrem/hr
  - Dpm/100 cm<sup>2</sup>
- Instrument used
- Initials

## Package radioactive materials according to regulations

- DOT
- Preparing a Package for Shipment
- Transport Groups
- Required on Labels
- Surface contamination
- Types of Packaging

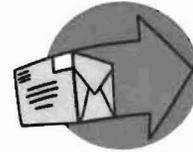
## DOT

- Must adhered whenever radioactive materials are shipped



## Preparing a Package for Shipment

- Survey package and record
- Verify surface contamination
- Radioactive label
- Transport Index
- Prepare shipping papers



## Transport Groups

- White I
- Surface less than equal to 0.5 mrem/hr
- TI = 0.05 mrem/hr (0)



## Transport Groups

- Yellow II
- Surface = 0.5 – 50 mrem/hr
- TI = less than or equal to 1.0 mrem/hr



## Transport Groups

- Yellow III
- Surface = >50.0 – 200 mrem/hr
- TI = >1.0 – 10 mrem/hr



## Information Required on Labels

- Contents
- Activity
- TI

### Check for Surface Contamination

- 300 cm<sup>2</sup>
- Any radioactive package
- 22 dpm/cm<sup>2</sup> or 6,600 dpm area 300 cm<sup>2</sup>
- Conversion
  - Net cpm
  - Dpm = -----
  - Efficiency

### Types of Packaging

- Type A
  - Most Radiopharmaceuticals
  - Prescribed exposure during transportation
  - <20 Ci Mo<sup>99</sup>, <100 Ci Tc<sup>99m</sup>
- Type B
  - Radioactivity exceed limit
  - NRC approval

### Maintain Accurate, Written Radiation Safety/Protection Records

- Personnel Exposure Documents
- Bioassay Documents
- Wipe Tests
- Survey Instrument
  - Calibration
  - Reference Check
- Radiation Receipt Log

### Maintain Accurate, Written Radiation Safety/Protection Records

- Radiopharmaceutical dispensing records
- Radiation Disposal Records
  - Decay in Storage
  - Transfer
  - Release into sewer system

### Maintain Accurate, Written Radiation Safety/Protection Records

- Sealed Source
  - Leak Tests
  - Sealed Source Inventory
- Dose Calibrator
  - Accuracy
  - Constancy
  - Linearity
  - Geometry

### Maintain Accurate, Written Radiation Safety/Protection Records

- Negative Pressure Check
- Safety Instructions
- Radiation Protection Programs
- Generator Eluate Checks
  - Mo99 breakthrough
  - Aluminum

### Personnel Exposure Records

- Maximum Permissible Dose (MPD)
  - Occupational
  - TEDE = 5 rem/year
  - TODE = 50 rem/year
  - Lens of eye = 15 rem/year
  - Extremities = 50 rem/year
  - Cumulative exposure

### Personnel Exposure Records

- Members of the public
  - 2 mrem/hr
  - 100 mrem/year (TEDE)
  - No organ limit
- Embryo/Fetus of Declared Pregnant Worker
  - 500 mrem

### Occupational Dose Limits 10 CFR 20.1201

- 5 rem (0.05 Sv)---total effective dose equivalent (TEDE)
- 15 rem (0.15 Sv)---lens dose equivalent (LDE)
- 50 rem (0.5 Sv)---shallow-dose equivalent (SDE) to skin or any extremity

### Medical Event

- Error and Excess exposure
- Chief Technologist
- RSO
- NRC notified next calendar day

### All Diagnostic Rx ( $< 30$ uCi $I^{125}$ or $I^{131}$ )

- Recordable Event
  - None
- Medical Event
  - Wrong pt. rx., route, or dose AND
  - $> 5$  rem EDE
  - 50 rem organ dose
  - 50 rem skin

### Sodium Iodide Rx ( $> 30$ uCi $I^{125}$ or $I^{131}$ )

- Recordable Event
  - $> 20\%$  prescribed AND  $> 15$  uCi
  - No written directive
  - No record
- Medical Event
  - Wrong pt.
  - Wrong Rx
  - $> 20\%$  AND 30 uCi

### Other Therapeutic Rx ( $P^{32}$ , $Sr^{89}$ , $Y^{90}$ )

- Recordable Event
  - >10%
  - No written directive
  - Not record
- Medical Event
  - Wrong pt., rx., route
- > 20%

### Maintain Appropriate Quality Control Records

- Scintillation Camera
  - Linearity
  - Resolution – weekly
  - Sensitivity
  - Uniformity – daily, each day of use

### Maintain Appropriate Quality Control Records

- Dose Calibrator
  - Accuracy (plus or minus 10%) NRS
  - Constancy (plus or minus 10%) NRS
  - Geometry (plus or minus 10%) NRS
  - Linearity (plus or minus 10%) NRS

### Maintain Appropriate Quality Control Records

- Survey Meter
  - Calibration – annual
  - Battery check/Reference Check – each day of use

### Maintain Appropriate Quality Control Records

- Sealed Sources
  - Inventory – every 3 months
  - Leak Test = every 6 months



### Maintain Appropriate Quality Control Records

- Aerosol and Gas  
Control Tests
  - Negative pressure = every 6 months
  - Collection/decay devices = every month



12-17-07

DATE

This is to acknowledge the receipt of your letter/application dated 11-12-07, and to inform you that the initial processing, which includes an administrative review, has been performed.

There were no administrative omissions. Your application will be assigned to a technical reviewer. Please note that the technical review may identify additional omissions or require additional information.

Please provide to this office within 30 days of your receipt of this card:

---

The action you requested is normally processed within 90 days.

A copy of your action has been forwarded to our License Fee & Accounts Receivable Branch, who will contact you separately if there is a fee issue involved.

Your action has been assigned **Mail Control Number** 471590.  
When calling to inquire about this action, please refer to this mail control number.  
You may call me at 817-860-8103.

Sincerely,

*Colleen Munnahan*

Licensing Assistant

## ACCEPTANCE REVIEW MEMO (ARM)

**Licensee:** DMS Imaging

**License No.:** 40-32477-01

**Docket No.:** 030-36404

**Mail Control No.:** 471590

**Type of Action:** Amend

**Date of Requested Action:** 11-12-07

**Reviewer Assigned:**

**ARM reviewer(s):** Torres

Response	Deficiencies Noted During Acceptance Review
	<input type="checkbox"/> Open ended possession limits. Submit inventory. Limit possession. <input type="checkbox"/> Submit copies of latest leak test results. <input type="checkbox"/> Add IC L.C., split cover letter from license, add SUNSI markings to license. <input type="checkbox"/> Confirm with licensee if they have NARM material.

**Reviewer's Initials:** \_\_\_\_\_

**Date:** \_\_\_\_\_

- Yes  No Request for unrestricted release Group 2 or >. Consult with Bravo Branch.  
 Yes  No Termination request < 90 days from date of expiration  
 Yes  No Expedite (medical emergency, no RSO, location of use/storage not on license, RAM in possession not on license, other) *Δ of RSO*  
 Yes  No TAR needed to complete action.

**Branch Chief's and/or HP's Initials:** *RJC* **Date:** *12-13-07*

### SUNSI Screening according to RIS 2005-31

Yes  No **Sensitive and Non-Publicly Available** if any item below is checked

General guidance:

- \_\_\_\_\_ RAM = or > than Category 3 (Table 1, RIS 2005-31), use Unity Rule
- \_\_\_\_\_ Exact location of RAM (whether = or > than Category 3 or not)
- \_\_\_\_\_ Design of structure and/or equipment (site specific)
- \_\_\_\_\_ Information on nearby facilities
- \_\_\_\_\_ Detailed design drawings and/or performance information
- \_\_\_\_\_ Emergency planning and/or fire protection systems

Specific guidance for medical, industrial and academic (above Category 3):

- \_\_\_\_\_ RAM quantities and inventory
- \_\_\_\_\_ Manufacturer's name and model number of sealed sources & devices
- \_\_\_\_\_ Site drawings with exact location of RAM, description of facility
- \_\_\_\_\_ RAM security program information (locks, alarms, etc.)
- \_\_\_\_\_ Emergency Plan specifics (routes to/from RAM, response to security events)
- \_\_\_\_\_ Vulnerability/security assessment/accident-safety analysis/risk assess
- \_\_\_\_\_ Mailing lists related to security response

**Branch Chief's and/or HP's Initials:** *RJC* **Date:** *12-13-07*

## Checklist to Ensure That Radioactive Material Will Be Used as Intended

### Applicant Information:

Control No. 471590

Name: DMS Imaging	Type of Request: Amend Program Code(s):	
Location: SD	License No.: 40-32477-01	Docket No.: 030-36404

### STEP 1, ITEM A - INITIAL SCREENING

<p><b>Instructions for Step 1:</b> Complete Step 1 for all applications. If Step 1, Items A and B, are "YES" then do not complete Step 2. Sign and date the completed form and add it to ADAMS as Non-Sensitive and Non-Publicly Available. If a "NO" response is indicated for Item A or Item B, add the completed form to ADAMS as Sensitive and Non-Publicly Available, and complete Step 2 (Additional Screening). If the type of use is subject to a Security Order, complete Step 3, Item A, without delay. If the additional requirements for increased controls will be applied or voided, complete Step 3, Item B, without delay.</p>	YES or NO
A. The applicant is a known entity or a licensee transferring control to a known entity. This determination has been made using the screening criteria in Worksheet A below.	Yes

### Worksheet A

<p><b>Instructions for Worksheet A:</b> Answer each of the 6 questions below by placing a "Yes", "No", or "NA" response in the column on the right. Best practices for a reviewer are provided after each of the questions. If the answer to any of the 6 questions is "Yes" then indicate "Yes" in Step 1, Item A, above. If the answers to all of the 6 questions is "No" then indicate "No" in Step 1, Item A, above. <b>NOTE</b> - If the reviewer has personal knowledge of the applicant's veracity, this can be taken into account in responding to any questions. For example, if the applicant's management and/or RSO have been associated with a current or previous NRC or Agreement State license, then the applicant may be considered as a known entity.</p>	YES, NO, or NA
1. <b>Does the applicant have a current Agreement State or NRC license?</b> The reviewer should 1) confirm that a valid license/registration/authorization exists for the applicant; and 2) compare the current license to the application to verify that the application represents a reasonable expansion of the licensee's operation (i.e., medical facility adding a gamma knife or an Agreement State licensee obtaining an NRC license in order to work in NRC jurisdiction without filing reciprocity).	Yes
2. <b>Does the applicant have a current Agreement State or NRC license at another location and the new application represents the addition of a new facility within the scope of the licensee's core business?</b> The reviewer should contact the appropriate licensing authority to confirm that a valid license/registration/authorization exists for the applicant and the corporate office of the licensee to verify that it has knowledge of and approves of the new application.	NA
3. <b>Does the applicant have a current State or Federal government license, registration, authorization, etc., for other operations within the scope of its proposed license activities?</b> (e.g., a company authorized by a State for mining that is now requesting authorization to use fixed gauges). The reviewer should contact the appropriate government office to confirm that the license, registration, authorization, etc., is valid; and the applicant's corporate office to confirm that it has knowledge of and approves of the new application to possess radioactive materials.	NA
4. <b>Is the applicant a local, State or Federal government agency?</b> The reviewer should contact the local, State or Federal government office to confirm that the applicant is a government entity.	NA
5. <b>Does the application only involve the relocation of an existing licensee, or its mailing address, to another State?</b> This includes new licenses created from existing licenses listing locations in multiple States, in preparation for transfer of licenses to States that will shortly sign an Agreement with the NRC.	NA
6. <b>Is the application only the result of a licensee failing to submit a renewal application in a timely manner?</b>	NA

**STEP 1, ITEM B - INITIAL SCREENING CONTINUED**

<p>B. The applicant is requesting certain radionuclides and quantities that are less than the Risk Significant Quantity (TBq) values in Worksheet B, below, as "highlighted" by the reviewer, or is currently subject to a security order or additional requirements for increased controls. If "Yes", there is no need to proceed further.</p>	<p>NA</p>
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**Worksheet B - Risk Significant Quantities**

(Category 2 Quantities, IAEA Safety Guide No. RS-G-1.9, Categorization of Radioactive Sources, August 2005)

Radionuclide	Risk Significant Quantity (TBq <sup>1</sup> )	Risk Significant Quantity (Ci <sup>1</sup> )	Radionuclide	Risk Significant Quantity (TBq <sup>1</sup> )	Risk Significant Quantity (Ci <sup>1</sup> )
Am-241	0.6	16	Pm-147	400	11,000
Am-241/Be	0.6	16	Pu-238	0.6	16
Cf-252	0.2	5.4	Pu-239/Be	0.6	16
Cm-244	0.5	14	Ra-226 <sup>2</sup>	0.4	11
Co-60	0.3	8.1	Se-75	2	54
Cs-137	1	27	Sr-90 (Y-90)	10	270
Gd-153	10	270	Tm-170	200	5,400
Ir-192	0.8	22	Yb-169	3	81

<sup>1</sup> The primary values are TBq. The curie (Ci) values are for informational purposes only.  
<sup>2</sup> The Atomic Energy Act, as amended by the Energy Policy Act of 2005, authorizes NRC to regulate Ra-226 and NRC is in the process of amending its regulations for discrete sources of Ra-226.

<p>Calculations of the Total Activity or the Unity Rule were completed.  <b>NOTE—If an amendment of an existing license is being requested, the calculations will include the previously authorized quantities for the radionuclide(s).</b></p>	<p>Yes, No, or Not Applicable (NA)</p>
<p>Total Activity—multiple activities are requested for a single radionuclide and the sum of the activities is less than the Risk Significant Quantity (TBq) for the radionuclide.</p>	<p>—</p>
<p>Unity Rule—multiple radionuclides are requested and the sum of the ratios is less than 1.0, e.g., [(total activity for radionuclide A) ÷ (risk significant quantity for radionuclide A)] + [(total activity for radionuclide B) ÷ (risk significant quantity for radionuclide B)] &lt; 1.0.</p>	<p>—</p>

**Signature and Date for Step 1:**

 12-13-07  
 License Reviewer and Date

(FOR LFMS USE)  
INFORMATION FROM LTS  
-----

BETWEEN:  
License Fee Management Branch, ARM  
and  
Regional Licensing Sections

: Program Code: 02220  
: Status Code: 0  
: Fee Category: 3P 7C  
: Exp. Date: 20111231  
: Fee Comments:  
: Decom Fin Assur Reqd: N  
: .....

LICENSE FEE TRANSMITTAL

A. REGION

1. APPLICATION ATTACHED

Applicant/Licensee: DMS IMAGING, INC.  
Received Date: 20071112  
Docket No: 3036404  
Control No.: 471590  
License No.: 40-32477-01  
Action Type: Amendment

2. FEE ATTACHED

Amount: \_\_\_\_\_  
Check No.: \_\_\_\_\_

3. COMMENTS

Signed *Colleen Murnahan*  
Date 12-13-07

B. LICENSE FEE MANAGEMENT BRANCH (Check when milestone 03 is entered /\_/\_/)

1. Fee Category and Amount: \_\_\_\_\_

2. Correct Fee Paid. Application may be processed for:

Amendment \_\_\_\_\_  
Renewal \_\_\_\_\_  
License \_\_\_\_\_

3. OTHER \_\_\_\_\_  
\_\_\_\_\_

Signed \_\_\_\_\_  
Date \_\_\_\_\_

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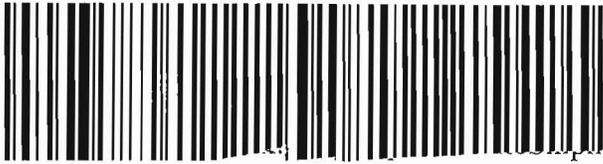
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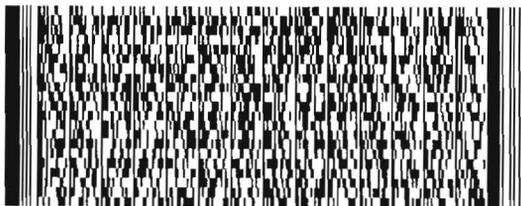
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