



# Pulse Radiology Education

Pulse Radiology

Online MRI Program *plus* Clinical Training

**INSTRUCTOR'S NAME**

**Neil Huber MBA | RT (R)(MR)**

**OFFICE HOURS**

**Monday - Friday**

10:00 am - 8:00 pm EST

**Saturday & Sunday**

Accessible only via e-mail

**PERSONAL PHONE**

**347-231-2963**

**E-MAIL ADDRESS**

**info@PulseRadiology.com**

## (I) **DESCRIPTION OF COURSE**

This course is an ARRT-Approved, Structured Education Online Program. This course is also an approved RCEEM by the American Society of Radiologic Technologists (ASRT). The structured education online portion is comprised of 14 online, weekly modules which includes: 11 video lectures followed by 11 weekly tests, one (1) 100-question midterm, one (1) 220-question Mock MRI Registry and one (1) week dedicated to Clinical Requirements and Registry Preparation.

### *Part A: Online MRI Structured Education*

The goal of this online structured education course is to provide ARRT radiologic technologists, ARDMS sonographers, NMTCB technologists and radiation therapists the fundamental principles and comprehensive knowledge to be fully prepared to sit confidently for the MRI certification exam administered by the American Registry of Radiologic Technologists (ARRT). Pulse Radiology MR Trainees will learn to apply formulas to calculate precessional frequency through the Larmor Equation and analyze positive and negative linear variations from gradient pulse applications. The ability to understand the formation process of a diagnostic MR image is vital and will be discussed with in-depth analysis of pulse sequence design and k-Space raw data generation. The skills to be able to identify the causes and appearances of MR artifacts will be taught which is important knowledge for the MRI Registry and also daily MR practice.

## Part B: Clinical Training

MR Trainees will be assigned access to Pulse Radiology Affiliate MR centers to develop their practical skills through observation and advanced learning from registered MR technologists in the field. All MR Trainees *are required to pass an MRI Safety Clearance* before entering an affiliate center and must adhere to the company policy of the designated clinical affiliate. Clinical appointments are appointed in a first come, first serve format.

### *What to expect before, during and at the conclusion of clinical training?*

Clinical training is a very important step in your development as an MR Technologist and unprofessional behavior *will not be tolerated*. Our clinical affiliates share a similar interest in developing the future of our labor force. To ensure a positive outcome, clinical affiliates have the ability to remove a trainee from site, pause training or approach for employment. Treat this training as a *live interview* as many of our alumni have been retained at their clinical site for employment.

### *Clinical Coordination*

Each Pulse Radiology MR Trainee will be assign a personal clinical coordinator to help communication, coordinate and management schedules. Each trainee is allowed a maximum of 2 days of call out time from their training. This must be approved by your clinical coordinator and site manager 2 days in advance to ensure proper communication.

### *Uniform Policy & Identification*

Please wear business casual attire or scrubs (baby blue or navy). Sneakers and hospital clogs are acceptable. Sandals, jeans and sweatpants are not allowed. Each Pulse Radiology MR Trainee will be provided an ID with picture which should be worn at chest level while on affiliate premises.

If you are currently pregnant or become pregnant during your enrollment, please notify your clinical coordinator to ensure communication.

## **(II) PREREQUISITES OF COURSE**

- Imaging professionals registered with the American Registry of Radiologic Technologists (ARRT) this includes:
  1. ARRT Radiologic Technologists
  2. ARRT Radiation Therapists
  3. ARDMS Sonographers
  4. NMTCB Nuclear Medicine Technologists

- Bachelor, Associate or High-School + ARRT registration is required.
- MRI Clearance via Pulse Radiology MRI Safety Questionnaire

### (III) **INTERNET CAPABILITIES**

Pulse Radiology operates from a external, web-based student portal. For best performance, connecting to Wi-Fi would provide best speed. The Pulse Radiology Student Portal is accessible via desktop, laptop, tablet or smartphone. We recommend downloading the Teachable app to access your student portal from your smartphone or tablet.

(Search: **Teachable Online Courses**)



#### **Teachable Online Courses**

An offline reader for learning

Teachable

★★★★★ 4.7, 1.1K Ratings

Free

### (IV) **READING SOURCES**

Pulse Radiology does not require any additional reading sources. We do support additional external reading sources such as:

- MRI Quiz (Link: <https://www.mriquiz.com/>)
- MRI In Practice, 4th Edition (Link: <https://www.amazon.com/MRI-Practice-Catherine-Westbrook/dp/1444337432>)
- Sectional Anatomy for Imaging Professionals, 3rd Edition (Link: [https://www.amazon.com/Sectional-Anatomy-Imaging-Professionals-3e/dp/0323082602/ref=pb\\_xgy\\_14\\_img\\_2/143-7008851-5117257?\\_encoding=UTF8&pd\\_rd\\_i=0323082602&pd\\_rd\\_r=752K2TC3NPWFS-MAZK6CX&pd\\_rd\\_w=EaI4H&pd\\_rd\\_wg=JT8hE&psc=1&refRID=752K2TC3NPWFMAZK6CX](https://www.amazon.com/Sectional-Anatomy-Imaging-Professionals-3e/dp/0323082602/ref=pb_xgy_14_img_2/143-7008851-5117257?_encoding=UTF8&pd_rd_i=0323082602&pd_rd_r=752K2TC3NPWFS-MAZK6CX&pd_rd_w=EaI4H&pd_rd_wg=JT8hE&psc=1&refRID=752K2TC3NPWFMAZK6CX))
- MRI Master (Link: <https://mrimaster.com/>)
- MRI Safety by Dr. Frank Shellock, Ph.D. (Link: <http://www.mrisafety.com/>)

### (V) **POLICY ON ACADEMIC HONESTY**

Academic dishonesty is a serious ethical and professional infraction. This course places high value upon educating fellow technologists, as passing a certification exam is the

goal for this course. Remember that cheating and dishonesty only effects you and degrades the quality of preparation offered to you by Pulse Radiology. This course is created to be completed as a consecutive, progressive format. Each week builds fundamental content that is advanced in the following weekly modules. For best results to minimize confusion, complete this course in the consecutive format outlined.

Pulse Radiology trusts that students do not infringe on the copyright law by sharing materialized information or using course information for future teaching and publishing without Pulse Radiology's written and/or verbal consent.

## **(VI) METHODS OF EVALUATING STUDENTS**

- MR Trainees are required to complete each module to its full entirety to receive continuing education credits which are approved by the American Society of Radiologic Technologists (ASRT).
- At the conclusion of each weekly test, MR trainees will receive a copy of test results directly to e-mail provided during test login. You have 3 attempts to pass the weekly test.
- Evaluation of each trainee will be monitored via weekly lecture completion, weekly tests, midterm and final mock registry 220.

## **COURSE CALENDAR**

<b>Week</b>	<b>Topic</b>	<b>Exam</b> <b>(All exams to be completed</b> <b>AFTER lecture time)</b>
1	<b><u>Week 1: MRI Syllabus</u></b> <ul style="list-style-type: none"> <li>• ARRT MRI Content Specifications (permitted to use by ARRT 2019)</li> <li>• ARRT MRI Clinical Requirements (permitted to use by ARRT 2019)</li> <li>• Pulse Radiology Clinical Notes</li> </ul> <b>**We suggest printing multiple copies and dedicating one page to each body part</b> <b>For example: 1 Pulse Radiology Clinical Note for MRI Knee, etc.</b>	No exam

2	<p><b><u>Week 2: Patient Care</u></b></p> <p><b>Legal and Ethical Principles</b></p> <ul style="list-style-type: none"> <li>• Confirmation of Exam Requisition</li> <li>• Legal Issues</li> <li>• Patient Bill of Rights</li> </ul> <p><b>MRI Screening and Safety</b></p> <ul style="list-style-type: none"> <li>• Screening and Education</li> <li>• Equipment Safety</li> <li>• MRI Environment</li> <li>• Biological Considerations</li> </ul> <p><b>Patient Assessment, Monitoring and Management</b></p> <ul style="list-style-type: none"> <li>• Routine Monitoring</li> <li>• Emergency Response</li> <li>• Patient Transfer and Body Mechanics</li> <li>• Assisting Patients with Medical Equipment</li> </ul> <p><b>Interpersonal Communications</b></p> <ul style="list-style-type: none"> <li>• Modes of Communication</li> <li>• Challenges of Communication</li> <li>• Patient Education</li> </ul> <p><b>Infection Control</b></p> <ul style="list-style-type: none"> <li>• Terminology and Basic Concepts</li> <li>• Cycle of Infection</li> <li>• Standard Precautions</li> <li>• Additional or Transmission-Based Precautions</li> <li>• Safe Cleaning of Equipment</li> <li>• Proper Disposal of Contaminated Materials</li> </ul>	Patient Care (40)
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3	<p><b><u>Week 3: Fundamentals of MRI Physics</u></b></p> <p><b>Nuclear Magnetism</b></p> <ul style="list-style-type: none"> <li>• Definitions</li> <li>• Study of Hydrogen</li> <li>• Net Magnetization and B0</li> <li>• Hydrogen and Magnetic Fields</li> <li>• Precessional, Resonant and Larmor frequency</li> <li>• Larmor Equation</li> <li>• Frequency of Hydrogen</li> <li>• Mock Registry Question</li> </ul> <p><b>Tissue Characteristics</b></p> <ul style="list-style-type: none"> <li>• Definitions</li> <li>• Tissue Differentiation</li> <li>• Process of Excitation and Relaxation</li> <li>• Flip Angle</li> <li>• T1 Relaxation (spin-lattice)</li> <li>• T2 Relaxation (spin-spin)</li> <li>• Tissue Categories</li> <li>• Relaxation Rates</li> </ul> <p><b>Spatial Localization</b></p> <ul style="list-style-type: none"> <li>• Definitions</li> <li>• Coordinating Planes</li> <li>• Gradients</li> <li>• x, y, z Gradients</li> <li>• How do gradients work?</li> <li>• Gradient Field Variations</li> <li>• Gradient Field formula</li> <li>• Mock registry Question</li> </ul>	MRI Physics (20)
4	<p><b><u>Week 4: Instrumentation of MRI</u></b></p> <p><b>Electromagnetism</b></p> <ul style="list-style-type: none"> <li>• Faraday's Law</li> <li>• Types of Magnets</li> <li>• Study of the Magnetic Field</li> </ul> <p><b>Radio Frequency System</b></p> <ul style="list-style-type: none"> <li>• RF Coil Configuration</li> <li>• Transmit and Receive Coils</li> <li>• Phase Array Coil</li> <li>• Radio Frequency Tuning</li> </ul> <p><b>Gradient System</b></p> <ul style="list-style-type: none"> <li>• Gradient Coil Configuration</li> <li>• Slew Rate</li> <li>• Rise and Fall Time</li> <li>• Duty Cycle</li> </ul>	Instrumentation (20)

5	<p><b><u>Week 5: Pulse Sequence Design</u></b></p> <p><b>Pulse Sequence</b></p> <ul style="list-style-type: none"> <li>• Pulse Sequence Timing Diagram</li> <li>• Simple Explanation</li> <li>• Technical Explanation</li> <li>• Step-by-Step Approach to Timing Diagrams</li> </ul> <p><b>Spin Echo</b></p> <ul style="list-style-type: none"> <li>• Conventional Spin Echo</li> <li>• Fast Spin Echo</li> </ul> <p><b>Inversion Recovery</b></p> <ul style="list-style-type: none"> <li>• What is TI?</li> <li>• Why do we need a 180° pulse?</li> <li>• STIR</li> <li>• FLAIR</li> </ul> <p><b>Gradient Recall Echo</b></p> <ul style="list-style-type: none"> <li>• Conventional GRE</li> <li>• Spoiled GRE</li> <li>• Steady State GRE</li> <li>• Fast GRE</li> </ul> <p><b>Echo Planar Imaging</b></p> <ul style="list-style-type: none"> <li>• EPI</li> </ul>	Pulse Sequences (20)
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6	<p><b><u>Week 6: Parameters and Options</u></b></p> <p><b>Four Impacts of MRI Parameters</b></p> <ul style="list-style-type: none"> <li>• SNR</li> <li>• CNR</li> <li>• Spatial Resolution</li> <li>• Acquisition Time</li> <li>• Formulas for 2D / 3D Scan Times</li> <li>• Mock Registry Question</li> </ul> <p><b>MRI Parameters</b></p> <ul style="list-style-type: none"> <li>• TR</li> <li>• TE</li> <li>• TR/TE combinations</li> <li>• TI</li> <li>• FOV</li> <li>• Slice Thickness/ Gap/ Number of Slices</li> <li>• Matrix</li> <li>• Flip Angle</li> <li>• NEX/ NSA</li> <li>• ETL</li> <li>• Bandwidth</li> <li>• Phase</li> <li>• Frequency</li> <li>• Relationships of Parameters</li> </ul> <p><b>Imaging Options</b></p> <ul style="list-style-type: none"> <li>• 2D/3D Imaging</li> <li>• Slice Order</li> <li>• Saturation Pulse</li> <li>• Gradient Moment Nulling/ Flow Compensation</li> <li>• Suppression techniques</li> <li>• Gating and Triggering</li> <li>• Rectangular FOV</li> <li>• No Phase Wrap/ Anti-aliasing</li> <li>• Parallel Imaging</li> <li>• Motion in Phase direction</li> <li>• Motion Correction Techniques</li> <li>• Filtering</li> </ul>	Parameters (20)
7	<b><u>Week 7: Midterm 100</u></b>	Midterm (100)



8	<p><b><u>Week 8: Data Manipulation / Special Procedures</u></b></p> <p><b>K-space Mapping and Filling</b></p> <ul style="list-style-type: none"> <li>• k-space</li> <li>• k-space filling</li> <li>• Types of k-space</li> </ul> <p><b>Fourier Transformation</b></p> <ul style="list-style-type: none"> <li>• Fourier Transform explained</li> </ul> <p><b>Post-Processing</b></p> <ul style="list-style-type: none"> <li>• MIP</li> <li>• MPR</li> <li>• Isotropic vs. Anisotropic</li> <li>• Mock Registry Question</li> <li>• Subtraction</li> <li>• ADC Mapping</li> </ul> <p><b>Special Procedures</b></p> <ul style="list-style-type: none"> <li>• MRA/MRV</li> <li>• Types of MRA</li> <li>• Functional MRI Techniques</li> <li>• Perfusion</li> <li>• Spectroscopy</li> </ul> <p><b>Dynamic Imaging</b></p> <ul style="list-style-type: none"> <li>• Explanation of Dynamic Studies</li> </ul> <p><b>Contrast Bolus Detection</b></p> <ul style="list-style-type: none"> <li>• Fluoroscopic Triggering</li> <li>• Timing Bolus</li> <li>• Automatic Triggering</li> </ul>	Data (20)
9	<p><b><u>Week 9: Anatomy of Brain and Spine</u></b></p> <p>■ <b>Positioning, Set-up, Protocol &amp; Anatomy</b></p> <ul style="list-style-type: none"> <li>• Brain</li> <li>• IAC's</li> <li>• Pituitary</li> <li>• Orbits</li> <li>• Soft Tissue Neck</li> </ul> <p>■ <b>Positioning, Set-up, Protocol &amp; Anatomy</b></p> <ul style="list-style-type: none"> <li>• Cervical Spine</li> <li>• Thoracic Spine</li> <li>• Lumbar Spine</li> <li>• Sacrum</li> <li>• Coccyx</li> <li>• Sacroiliac Joints</li> </ul>	Head/Spine (20)

10	<p><b><u>Week 10: Anatomy of Chest and Abdomen</u></b></p> <ul style="list-style-type: none"> <li>■ <b>Positioning, Set-up, Protocol &amp; Anatomy</b> <ul style="list-style-type: none"> <li>• Brachial Plexus</li> <li>• Cardiac</li> <li>• MRA Aortic Arch</li> <li>• Breasts</li> </ul> </li> <li>■ <b>Positioning, Set-up, Protocol &amp; Anatomy</b> <ul style="list-style-type: none"> <li>• General Abdomen</li> <li>• MRCP</li> <li>• MRA Renal Artery</li> <li>• Soft Tissue Pelvis</li> <li>• Male Pelvis</li> <li>• Female Pelvis</li> </ul> </li> </ul>	Chest/Abdomen (20)
11	<p><b><u>Week 11: Anatomy of Upper and Lower Extremities</u></b></p> <ul style="list-style-type: none"> <li>■ <b>Positioning, Set-up, Protocol &amp; Anatomy</b> <ul style="list-style-type: none"> <li>• TMJ's</li> <li>• Shoulder</li> <li>• Elbow</li> <li>• Wrist</li> <li>• Hand</li> <li>• Finger</li> </ul> </li> <li>■ <b>Positioning, Set-up, Protocol &amp; Anatomy</b> <ul style="list-style-type: none"> <li>• MRA Runoff</li> <li>• Hip</li> <li>• Knee</li> <li>• Ankle</li> <li>• Mid Foot</li> <li>• Forefoot</li> </ul> </li> </ul>	Extremities (20)
12	<p><b><u>Week 12: MRI Artifacts</u></b></p> <ul style="list-style-type: none"> <li>• Aliasing/ Phase Wrap</li> <li>• Truncation/ Ringing</li> <li>• Gibbs Artifact</li> <li>• Chemical Shift</li> <li>• Metallic Susceptibility</li> <li>• RF/ Zipper Artifact</li> <li>• Flow/ Motion Artifact</li> <li>• Partial Volume Averaging</li> <li>• Crosstalk</li> <li>• Moire Pattern</li> <li>• Annefact</li> <li>• IDEAL Artifact</li> <li>• Imperfect Fat Saturation</li> <li>• Courdoroy Artifact</li> </ul>	Artifacts (20)

13	<p><b><u>Week 13: Clinical &amp; Registry Instructions</u></b></p> <p>The Week 13 Clinical &amp; Registry Instructions module is available for all Pulse Radiology students to help instruct on how to submit your Structured Education Certificate and log clinical cases into their ARRT Account.</p> <ul style="list-style-type: none"> <li>• ARRT Registry Preparation &amp; Instructions</li> <li>• ARRT MRI Primary Discipline Handbook (permitted to use by ARRT 2019)</li> <li>• ARRT MRI Task Inventory (permitted to use by ARRT 2019)</li> </ul>	No Exam
14	<p><b><u>Week 12: Mock Registry 220</u></b></p> <ul style="list-style-type: none"> <li>• This mock registry is very similar to the registry provided by PearsonVUE. We provide 3 hours to complete so we recommend you find a quiet place and treat this as a REAL registry to provide the best accurate registry score.</li> <li>• Statistics have shown that Pulse Radiology Mock Registry score results in a +5/-5 forecast for the real registry in 86% of test takers. For example, 85% forecasts you to be in a range of 80-90% on the registry</li> </ul>	Mock Registry (220)

## MRI Credit Distribution Approval Worksheet (Approved by: ARRT)



The American Registry of Radiologic Technologists®

### Credit Distribution Worksheet

#### Magnetic Resonance Imaging

PART A - ACTIVITY INFORMATION	
Provider Organization Name	Pulse Radiology Education
Activity Title (exactly as on RCEEM approval letter)	Pulse Radiology MRI Registry Program
RCEEM-Approved Credit-Hours	25.50

PART B - CREDIT DISTRIBUTION	
ARRT Content Category	Instructional Hours (increments of 0.25 only)
<b>Patient Care</b>	
Legal and Ethical Principles	1.00
Infection Control	1.00
Patient Assessment, Monitoring and Management	1.00
Interpersonal Communications	1.00
Contrast Administration	0.50
<b>Safety</b>	
MRI Screening and Safety	3.00
<b>Image Production</b>	
Physical Principles of Image Formation	2.00
Sequence Parameters and Options	5.00
Data Acquisition and Processing	5.00
<b>Procedures</b>	
Neuro (head, neck, spine)	2.00
Body (thorax, abdomen, pelvis)	2.00
Musculoskeletal	2.00
Topics Not Included in ARRT's Structured Education Requirements	0.00

this number  
declines as  
you enter hours  
above