Quiz: Electrotherapy - High Frequency (Ultrasound Therapy)

This quiz assesses the understanding of Ultrasound Therapy for Bachelor of Physiotherapy students, aligned with the course objectives from the *Electrotherapy - II* syllabus (Page 64). It includes 5 multiple-choice questions (MCQs) on biophysics and production, and 5 short-answer questions on technique or method of application in different inflammatory conditions, with one design-thinking (DT) question. The quiz is designed to evaluate the ability to list indications/contraindications, demonstrate techniques, and describe effects of electrotherapy modalities.

1. Multiple-Choice Questions (Biophysics and Production)

1. **What is the primary biophysical property of ultrasound that determines how much energy is absorbed by tissues?**
   a) Reflection
   b) Transmission
   c) Absorption
   d) Refraction

2. **In the production of therapeutic ultrasound, which effect is utilized to generate sound waves?**
   a) Photoelectric effect
   b) Piezoelectric effect
   c) Thermionic effect
   d) Electromagnetic effect

3. **Which component of the ultrasound machine is responsible for converting electrical energy into mechanical vibrations?**
   a) Transducer
   b) Amplifier
   c) Oscillator
   d) Coupling medium

4. **What is the typical frequency range used in therapeutic ultrasound?**
   a) 0.1-0.5 MHz
   b) 1-3 MHz
   c) 5-10 MHz
   d) 20-50 MHz

5. **In the biophysical context, what happens to ultrasound waves at tissue interfaces with different acoustic impedances?**
   a) Complete transmission
   b) Reflection
   c) Absorption only
   d) Dispersion

2. Short-Answer Questions (Technique or Method of Application in Different Inflammatory Conditions)

6. Describe the direct contact method of ultrasound application and its suitability for chronic inflammatory conditions.
7. Explain the water bath method for ultrasound therapy and when it is preferred in acute inflammatory conditions.
8. What treatment parameters (intensity, mode, frequency) should be adjusted for applying ultrasound in subacute inflammatory conditions?
9. Outline the use of phonophoresis as a technique in ultrasound therapy for inflammatory conditions, including drugs commonly used.
10. (Design-Thinking Question) Propose how ultrasound therapy can be integrated into a treatment plan for a patient with acute inflammatory conditions. Consider indications, contraindications, and potential physiotherapy interventions to optimize outcomes.

3. Answer Key with Explanations and References

3.1 Multiple-Choice Questions

1. **Answer: c) Absorption**
   Explanation: Absorption is the biophysical property where ultrasound energy is converted to heat in tissues, depending on tissue type and frequency, crucial for therapeutic heating.
   Reference: Syllabus, Page 64, Chapter C-Ultrasound Therapy, 4. Properties of ultrasound-Reflection, Transmission, Absorption.

2. **Answer: b) Piezoelectric effect**
   Explanation: The piezoelectric effect in crystals like quartz generates ultrasound waves when an alternating current is applied, forming the basis of production.
   Reference: Syllabus, Page 64, Chapter C-Ultrasound Therapy, 7. Production of ultrasound.

3. **Answer: a) Transducer**
   Explanation: The transducer contains the piezoelectric crystal that converts electrical signals into ultrasonic vibrations.
   Reference: Syllabus, Page 64, Chapter C-Ultrasound Therapy, 7. Production of ultrasound.

4. **Answer: b) 1-3 MHz**
   Explanation: Therapeutic ultrasound uses 1 MHz for deeper penetration and 3 MHz for superficial tissues.
   Reference: Syllabus, Page 64, Chapter C-Ultrasound Therapy, 8. Technique of application of ultrasound, C. Treatment parameters, 3. Frequency-1 MHz or 3 MHz.

5. **Answer: b) Reflection**
   Explanation: At interfaces with acoustic impedance mismatch, ultrasound waves are reflected, affecting energy distribution in tissues.
   Reference: Syllabus, Page 64, Chapter C-Ultrasound Therapy, 4. Properties of ultrasound-Reflection, Transmission, Absorption.

3.2 Short-Answer Questions

6. **Answer**: The direct contact method involves applying coupling gel to the skin and moving the transducer in circular motions. It is suitable for chronic conditions as it allows continuous mode for thermal effects to reduce stiffness and promote healing.
   Reference: Syllabus, Page 64, Chapter C-Ultrasound Therapy, 8. Technique of application of ultrasound, B. Application of ultrasound, 1. Direct contact method.

7. **Answer**: The water bath method immerses the body part in water with the transducer also submerged, avoiding direct pressure. It is preferred in acute conditions over irregular surfaces to minimize pain and use pulsed mode for non-thermal effects.
   Reference: Syllabus, Page 64, Chapter C-Ultrasound Therapy, 8. Technique of application of ultrasound, B. Application of ultrasound, 2. Water bath method.

8. **Answer**: For subacute, use moderate intensity (0.5-1.5 W/cm^2), pulsed mode (1:4 ratio), 1-3 MHz frequency depending on depth, to balance thermal and non-thermal effects for reducing inflammation.
   Reference: Syllabus, Page 64, Chapter C-Ultrasound Therapy, 8. Technique of application of ultrasound, C. Treatment parameters.

9. **Answer**: Phonophoresis uses ultrasound to drive drugs transdermally. Common drugs: hydrocortisone for inflammation. Technique: Mix drug with coupling medium, apply via direct contact in continuous or pulsed mode.
   Reference: Syllabus, Page 64, Chapter C-Ultrasound Therapy, 4. Phonophoresis (A-E).

10. **Answer**: In acute inflammatory conditions, use pulsed ultrasound (low intensity, 1:4 ratio, 1-3 MHz) to promote non-thermal effects like micromassage for reducing swelling (indication: acute inflammation). Avoid continuous mode or high intensity (contraindications: acute phases with risk of increasing inflammation). Integrate with RICE protocol, manual therapy, and progressive exercises for patient-centered recovery.
    Reference: Syllabus, Page 64, Chapter C-Ultrasound Therapy, 3. Indication & contraindication of ultrasound; 2. Physiological & Therapeutic effects of ultrasound.

4. Suggested Digital Platform

Google Forms is recommended for delivering this quiz and collecting responses. It is user-friendly, allows for multiple-choice and short-answer question formats,

and provides automatic response collection and analysis. Features include:

- Customizable question types (MCQs, short-answer).
- Option to include answer explanations post-submission.
- Data export for grading and feedback.
- Accessibility for students via a link, compatible with mobile and desktop devices.

To implement:

1. Create a new Google Form.
2. Add the 10 questions, ensuring MCQs have radio buttons and short-answer questions have paragraph response fields.
3. Enable response collection and set a submission deadline.
4. Share the form link with students via email or a learning management system.
5. Use the “Responses” tab to review and grade submissions, providing feedback based on the answer key.