**SECTION I**

1. **Block diagram of ultrasonic imaging**:

**Pulse repetition frequency generator**

Time delay

If needed

Astable circuit

Time base

Train of pulses

X-Plate

X-Plate

**CRT tube**

Swept gain controller

**Receiver** (echo signal)

**Transmitting crystal**

SCR circuit

Y-Plate

ultrasound

Detector

Wide band amplifier

Human body

2. Image processing techniques for classification of optical images:

* Image segmentation- Image will be partitioned into distinct regions containing each pixel with similar attributes.
* Image enhancement – By operating on individual pixel, a transformed image can be obtained with better enhancement. The contrast can be changed so as to get greater level of detail in an image.
* Image representation - can be classified on the basis of extraction of features from an image as: color, texture, and shape.
* Image restoration – estimation of original image from noisy image

3.**”**Stress and strain analyses of single and segmental lumbar spines based on an accurate finite element model for vertebrae **“**, Jong ki shin et.al., an international journal of biomedical sciences, ISSN: 0970-938X (2018)

Initially CT image of human spine has been collected. From DICOM image, it is converted into 3D geometry of human spine in .stl format. Finite element model was generated for lumbar spine L5 and L3-L5. Now stress and strain relation is obtained by applying compression load. In L5 and L5-L6 FE model, two types of bones were considered, one with cortical (type 1)and other with cortical bone with cancellous core(type 2). On applying load,

* L5 type 2 exhibit large stress on cortical bone while no stress on the cancellous bone.
* L5 type 1, high stress is generated in pedicle and exhibit longitudinal deformation.
* Longitudinal deformation of L3 –L5 vertebrae and intervertebral disc strain proportional to the applied stress.

4. Simple derivation of the Kramers-Kronig relation from tissue model

Electrical impedance of living tissue generally contains three major frequency regions where the electrical impedance decreases with increasing frequency separated by regions with almost constant electrical impedance. The skin can be modelled as a three-layer entity, comprising Stratum Corneum (SC), Viable skin (VS), and Adipose tissue (AT).

Let h(t) be impulse response of linear and time- variant system of skin. The frequency response of the system is given by Fourier transform

,

Which for an electrical impedance of skin

Simplified to,

, h(t)=0

Equivalent to,

= F{h(t) . }

Where denoting the Heaviside step function

By evaluating the Fourier transform of Heaviside step function,

H( H(

This equation denotes Kramers-Kronig relation since it connects real and imaginary parts.

5. Diffractive scattering: a proton brakes up forming particles, when detected the particles found at forward and backward gaps. Example: Pomeron exchange resulting in scattered proton, anti-proton, two jets.

6.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Modality | Ultrasound | X-Ray | Computer Tomography | Magnetic Resonance |
| What is imaged? | Veins and fetus screening | 2D image. For imaging bone fracture, lung infections | 3D imaging. Internal organs, soft tissues, blood vessels | Imaging spinal cord, nerves |
| Access | 5(easy access) | 4 | 2 | 1 |
| Spatial Resolution | 3 | 4 | 5(high) | 4 |
| Temporal Resolution | 2 | 3 | 5(high) | 4 |
| Penetration Depth | 1(poor penetration) |  |  |  |
| Safety | 5(highly safe) | 1 | 3 | 4 |
| Cost | 3 | 2(reliably cheaper) | 4 | 5(highly costly) |
| Speed | 5(fast scanning speed) | 4 | 3 | 1(low scanning speed) |
| Portability | 5(easy to cary) | 3 | 2 | 1(fixed) |

7.

|  |  |  |
| --- | --- | --- |
| S.NO | LINEAR PROBE | PHASED ARRAY PROBE |
| 1. |  |  |

Design consideration –Probe:

* Piezoelectric material should be chosen based on their performance, stability, dielectric properties, performance.
* To improve sensitivity and acoustic energy in forward direction, the front end should be coated with acoustic matching material.
* To prevent excessive vibration backing material should be used.
* To provide focussed beam, acoustic lens should be fixed.
* Temperature standards should be followed.

8. Ring down artefact – series of parallel line