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Department of Biomedical Engineering

Course Name: 19BMT204 Biomedical Instrumentation

II Year : IV Semester

Unit IV – SKELETAL MUSCULAR EQUIPMENT

Topic : Muscle Fatigue characteristics and EMG biofeedback

Analysis of EMG Waveform

- **Qualitative** – visual inspection (Size, shape and morphology of EMG signal
- **Quantitative** – Quantitative information about EmG signal
  - Amplitude of signal
  - Frequency response of the EMG
  - Time Duration
  - Power spectrum

Muscle Fatigue Characteristics

- decreased capacity to perform a maximum voluntary muscle action of a series of repetitive muscle action
- Decline in ability of muscle to generate force

Causes of Muscle fatigue

- Lactic acid – increase activity levels in muscle → muscle pain, soreness, fatigue, spasm & cramp
- Mineral deficiencies – minerals required for muscle function – deficiencies leads to muscle fatigue and cramps
- Failure to stretch or warm up
- Reduced activity – myasthenia gravis

Symptoms of muscle fatigue

- muscle weakness
- Localized pain
- Trembling/Shivering
- Weak grip
- Muscle cramps
- Shortness of breath
- Muscle twitching pain

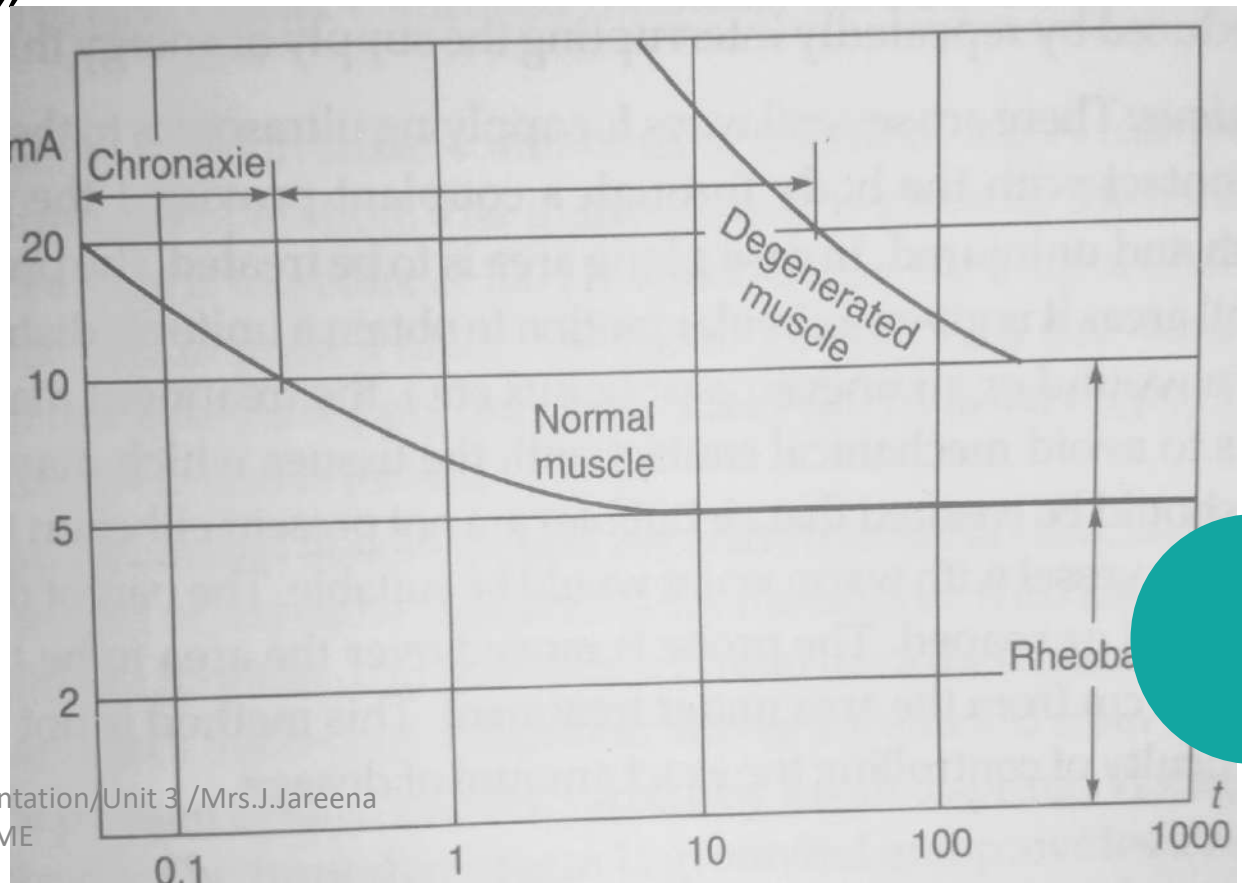
Treatment of muscle fatigue

- Warm up /cool down
- Cold & hot therapy
- Eat enough
- Professional massage

Muscle Stimulator

- Stimulator are device used to stimulate innervated muscle & nerve
- Used for the treatment of paralysis with totally or partially
- Used for the treatment of pain of muscle spasm
- This technique is called “ Electrotherapy”

Intensity Vs Time curve (I-T curve)



- Chronaxie and rheobase can be easily read from curves
  - Rheobase – minimum intensity of current that will produce a response if the stimulus is infinite
  - Chronaxie – minimum duration of impulse that will produce a response with a current of double rheobase

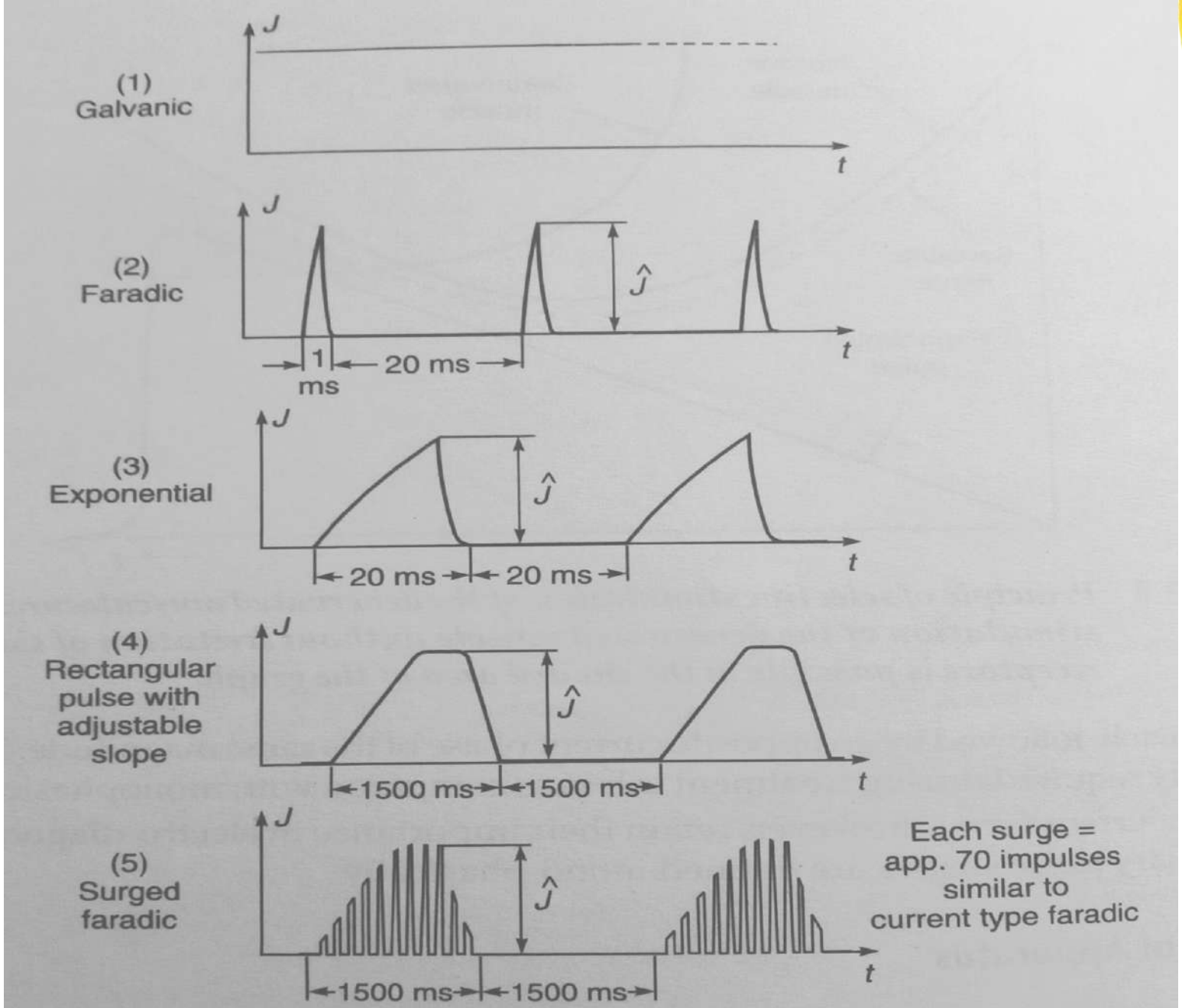
Types of current waveforms required for electrotherapy unit

i) **Galvanic current** – constant flow of current

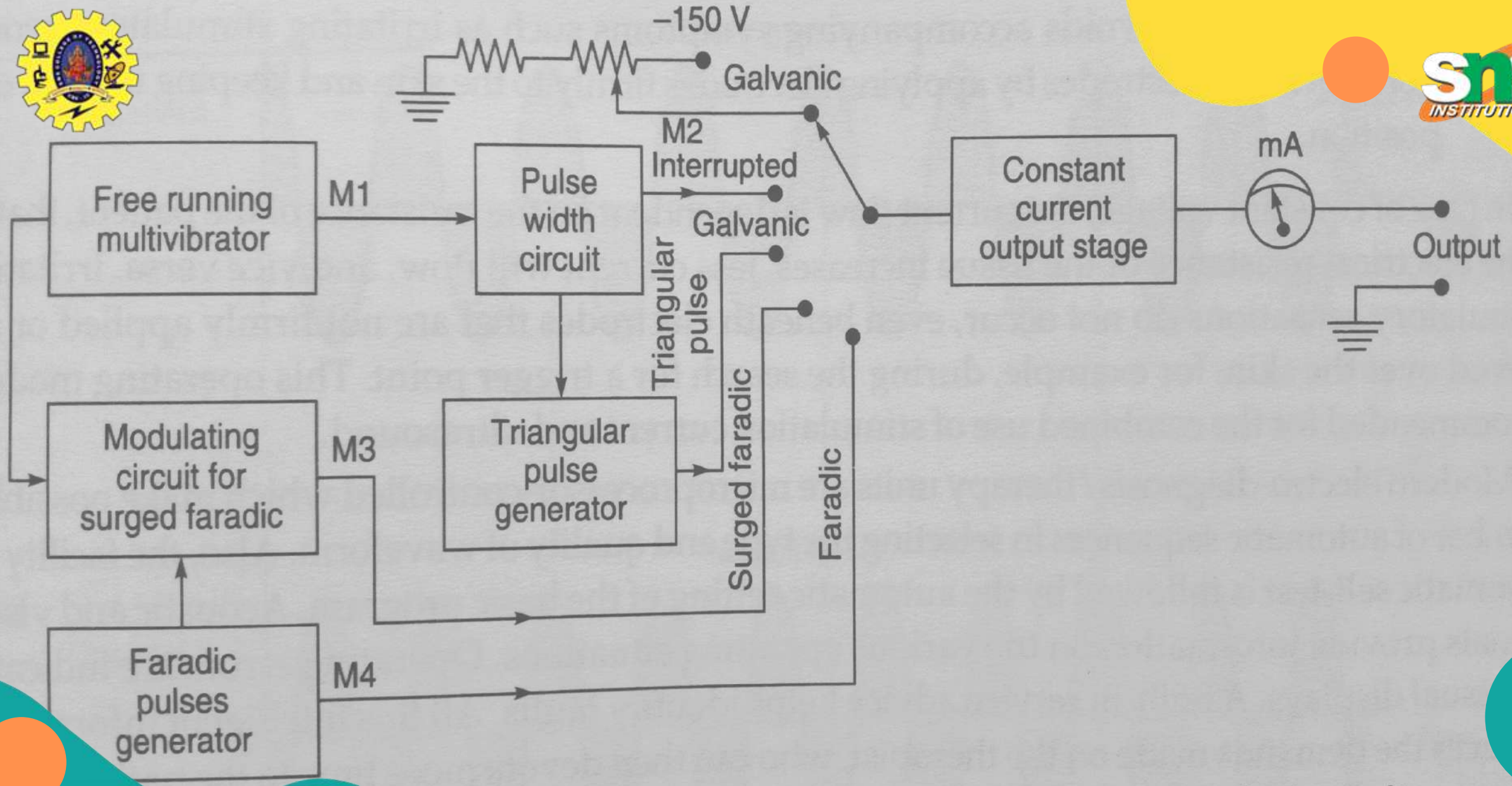
ii) **Faradic current** – sequence of pulses with defined shape & current intensity

iii) **Surged current** – current intensity is rapidly increasing and decreasing rhythmically

iv) **Exponential current** – exponentially varied current



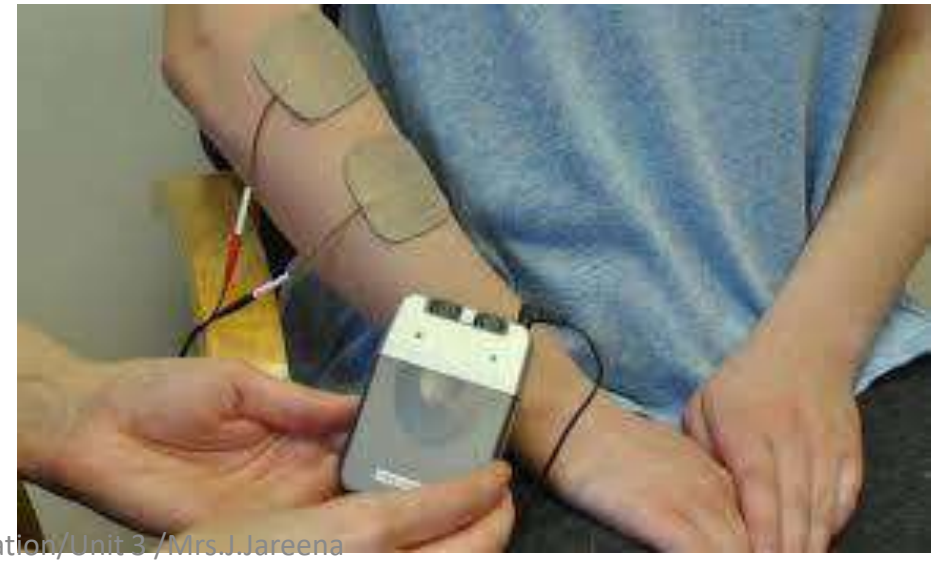
29.9 *Current waveforms normally employed in electrodiagnos electrotherapy*



hematic diagram of a diagnostic/therapeutic stimulating unit

Nerve stimulator (TENS)

- TENS – Transcutaneous Electrical Nerve Stimulator
- Method of non destructive, non invasive & effective way of relieving pain
- Uses electrical impulses to block the pathways of transmission of pain
- Components - Battery operated pulse generator, leads and electrodes



Pain Control Theory

- Gate Control theory : Electrically stimulating sensory nerve receptors, a gate mechanism is closed in a segment of the spinal cord, preventing pain carrying messages from reactive the brain & Blocking the perception
- Endorphin Release theory: Electrical impulse stimulate the production of endorphin and enkaphalins in the body. These natural, morphine – like substance block pain messages from reaching brain.

Two types of current waveform

- Square
- Spike wave

Square wave :

Current – 25mA

Time frequency – 0.1 to 1.0ms

Frequency – 20-200Hz

Voltage – 0 to 120 V

Spike wave :

Current – 75 mA

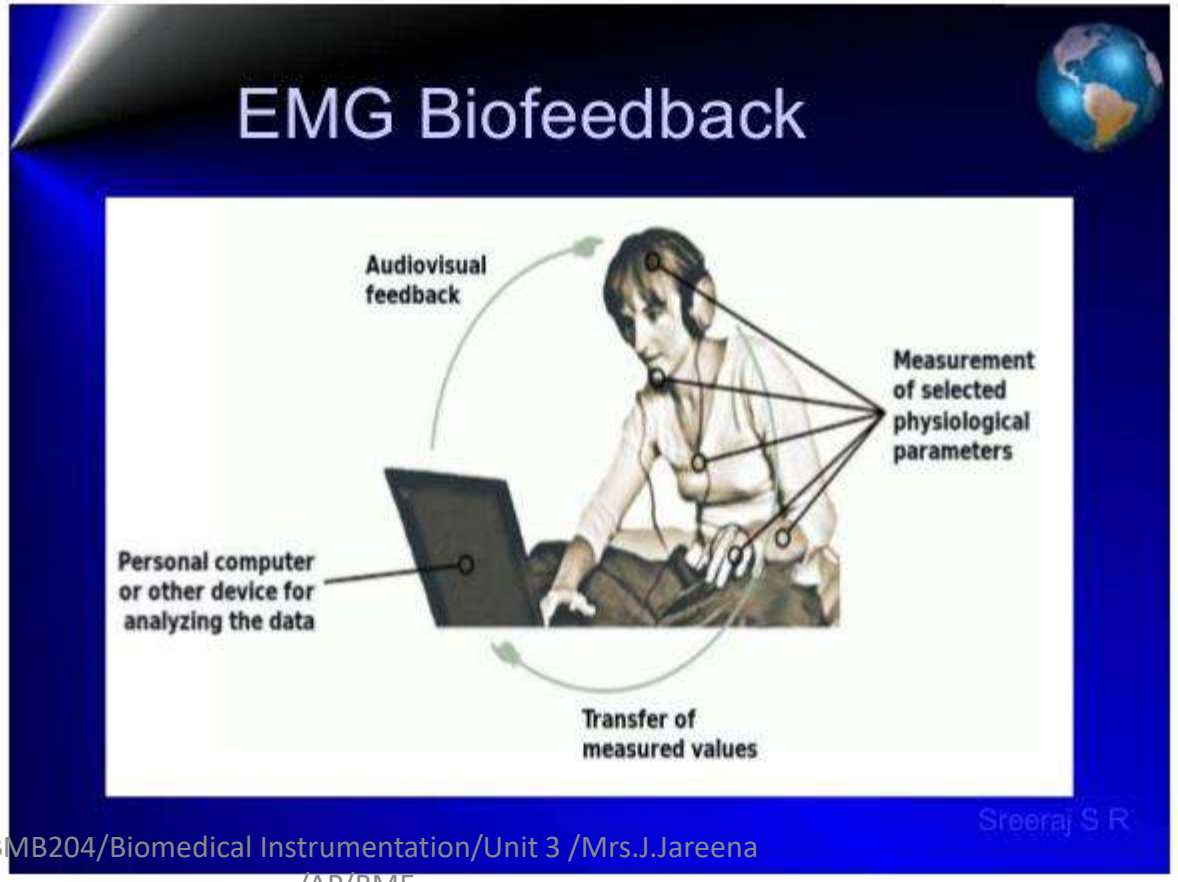
Time – 500 ms

Frequency – 12 to 100 pulses per second

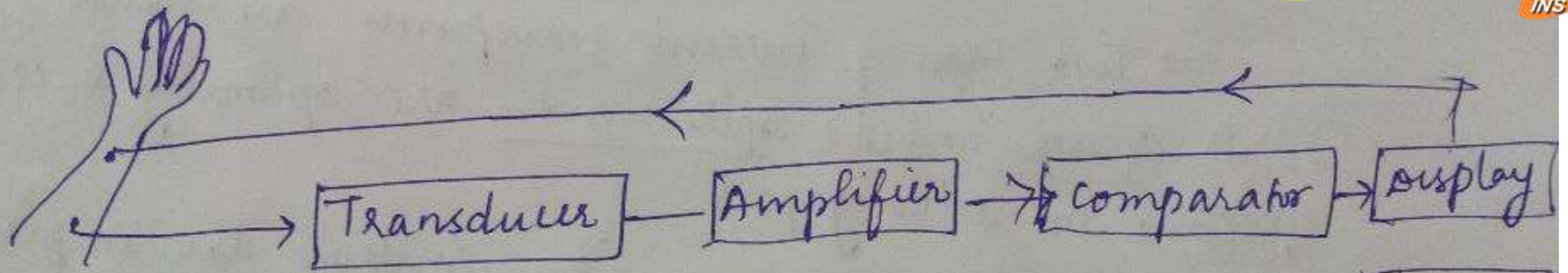
- (TENS) electrodes are commonly moulded from an elastomer such as silicon rubber, loaded with carbon particles to provide good conductance
- Conformability is achieved by making the electrode thin

EMG BIOFEEDBACK INSTRUMENTATION

- Used in the treatment of bruxism.
- Paralytic patient are trained through biofeedback method to use paralysed muscle
  - EMG activity is measured via electroes
  - EMG signal is amplified, compared and filtered out for noise
  - Error signal is converted into more suitable visual or auditory signal



Basic principle of biofeedback



EMG feedback block diagram