Skeletal Muscle Control
• Draw or describe the control pathway from stimulus to response for different types of reflexes.
• Explain the components and mechanism of action for spindles fibers and Golgi organs.
• State the role of different CNS integrating centers in control of skeletal muscle function.

Sensory Information
• Muscle spindle apparatus detects muscle length (stretch)
• Golgi tendon organs detect tension the muscle exerts on its tendons (stretch and contraction)

Muscle Spindle Apparatus
• Contains thin muscle cells: intrafusal fibers:
• (Other muscle fibers are called extrafusal)
• Contractile apparatus absent in center
• Stretching a muscle causes spindles to stretch, stimulating sensory neurons

Motor Neurons
• Alpha: neurons that innervate extrafusal fibers; cause muscle contraction
• Gamma:innervate the intrafusal fibers; cause muscle spindle fibers to shorten
Muscle spindles and the simple stretch reflex

A sensory neuron connected to a muscle spindle detects muscle stretch. A somatic alpha motor neuron causes muscle twitch.

**Muscle spindles**
- specialized muscle fibers (intrafusal fibers) + connective tissue + sensory nerve endings
- monitor rate and changes in muscle fiber length
- stretching of muscle spindles causes reflex stimulation causing agonist muscle fibers to contract and resist stretch
- functions to oppose sudden changes in muscle length

**Golgi tendon organs**
- sensory receptors in muscle tendons
- respond to tension, stretch or contraction
- stimulation causes reflex inhibition of agonist muscles and stimulation of antagonist muscles
- function as an inhibitory reflex for injury prevention and for fine motor control

**Reflex**
- 'involuntary motor acts' - not originated from cortex
- (but can be modulated by cortex)
- rapidly executed
- stereotyped

**Reflex - Examples**
- stretch reflex (Ex/knee jerk reflex)
- Golgi tendon r. (inverse myotatic reflex)
- withdrawal reflex
- crossed extensor reflex
- control of posture (typically, agonists and antagonists coordinated)

**THE STRETCH REFLEX (KNEE JERK REFLEX)**
- TAP PATELLAR TENDON BELOW KNEE
- SENSORY SIGNALS FROM MUSCLE SPINDLE INDICATE FLEXION AT KNEE
- FLEXOR IS INHIBITED
- EXTENSOR ACTIVATED
- LEG EXTENDS
THE INVERSE MYOTATIC REFLEX

- DETECTION OF EXCESS WEIGHT BY GOLGI TENDON ORGAN
- INHIBIT AGONIST MUSCLE
- STIMULATE ANTAGONIST
THE FLEXOR WITHDRAWAL REFLEX

- PAINFUL STIMULUS DETECTED
- IPSILATERAL EXTENSORS INHIBITED
- IPSILATERAL FLEXORS EXCITED
- LIMB IS WITHDRAWN

THE CROSSED EXTENSOR REFLEX

- PAINFUL STIMULUS DETECTED
- IPSILATERAL EXTENSORS INHIBITED
- IPSILATERAL FLEXORS EXCITED
- LIMB IS WITHDRAWN

* WHILE STANDING, CONTRALATERAL SIDE EXTENSORS ACTIVATED AND FLEXORS INHIBITED TO SUPPORT WEIGHT