Topic 4: Movement Analysis

* 1. **Neuromuscular function – 4 hours**

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| **Group** |  | **Assessment statement** | **Obj** | **Teacher’s notes** |
| A | 4.1.1 | Label a diagram of a motor unit. | 1 | Limit to dendrite, cell body, nucleus, axon, motor end plate, synapse and muscle. |
| A | 4.1.2 | Explain the role of neurotransmitters in stimulating skeletal muscle contraction. | 3 | Limit to acetylcholine and cholinesterase. |
| B | 4.1.3 | Explain how skeletal muscle contracts by the sliding filament theory. | 3 | Include the terms myofibril, myofilament, sarcomere, actin and myosin, H zone, A band, Z line, tropomyosin, troponin, sarcoplasmic reticulum, calcium ions and ATP. |
| C | 4.1.4 | Explain how slow and fast twitch fiber types differ in structure and function. | 3 | Limit fiber types to slow twitch (type I) and fast twitch (type IIa and type IIb).  Type IIa and IIb are high in glycogen content depending on training status. |

* 1. **Joint and movement type – 3 hours**

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| **Group** |  | **Assessment statement** | **Obj** | **Teacher’s notes** |
| D | 4.2.1 | Outline the types of movement of synovial joints. | 2 | Consider flexion, extension, abduction, adduction, pronation, supination, elevation, depression, rotation, circumduction, dorsi flexion, plantar flexion, eversion and inversion. |
| E | 4.2.2 | Outline the types of muscle contraction. | 2 | Consider isotonic, isometric, isokinetic, concentric and eccentric. |
| E | 4.2.3 | Explain the concept of reciprocal inhibition. | 3 | Consider agonist and antagonist. |
| F | 4.2.4 | Analyze movements in relation to joint action and muscle contraction. | 3 | For example, during the upward motion of a bicep curl the joint action is flexion. The bicep contracts concentrically while the tricep relaxes eccentrically. |
| F | 4.2.5 | Explain delayed onset muscle soreness (DOMS) in relation to eccentric and concentric muscle contractions. | 3 | DOMS results primarily from eccentric muscle action and is associated with structural muscle damage, inflammatory reactions in the muscle, overstretching and overtraining.  DOMS is prevented/minimized by reducing the eccentric component of muscle actions during early training, starting training at a low intensity and gradually increasing the intensity, and warming up before exercise, cooling down after exercise. |

* 1. **Fundamentals of biomechanics – 8 hours**

In this sub-topic, no calculations are required.

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| **Group** |  | **Assessment statement** | **Obj** | **Teacher’s notes** |
| G | 4.3.1 | Define the terms *force*, *speed*, *velocity*, *displacement, acceleration*, *momentum* and *impulse*. | 1 | Encourage the use of vectors and scalars. |
| G | 4.3.2 | Analyze velocity–time, distance– time and force–time graphs of sporting actions. | 3 |  |
| H | 4.3.3 | Define the term *center of mass.* | 1 |  |
| H | 4.3.4 | Explain that a change in body position during sporting activities can change the position of the center of mass. | 3 | Consider one example of an activity where the center of mass remains within the body  throughout the movement and one activity where the center of mass temporarily lies outside the body. Students should understand the changes in body position and center of mass pathway. |
| I | 4.3.5 | Distinguish between *first*, *second*  and *third class levers*. | 2 |  |
| I | 4.3.6 | Label anatomical representations of levers. | 1 | Limit to the triceps–elbow joint, calf–ankle joint and biceps–elbow joint. Students will be expected to indicate effort, load, fulcrum and the muscles and bones involved. |
| J | 4.3.7 | Define Newton’s three laws of motion. | 1 |  |

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| **Group** |  | **Assessment statement** | **Obj** | **Teacher’s notes** |
| J | 4.3.8 | Explain how Newton’s three laws of motion apply to sporting activities. | 3 | For example, consider how Newton’s second and third laws enable an athlete to accelerate out of starting blocks. Impulse momentum relationship. The law of conservation of momentum should also be considered. |
| K | 4.3.9 | State the relationship between angular momentum*,* moment of inertia and angular velocity*.* | 1 |  |
| K | 4.3.10 | Explain the concept of angular momentum in relation to sporting activities. | 3 | Include consideration of moments of inertia, major axes of rotation and an appreciation of the law of conservation of angular momentum. |
| K | 4.3.11 | Explain the factors that affect projectile motion at take-off or release. | 1,3 | Include speed of release, height of release and angle of release. |
| L | 4.3.12 | Outline the Bernoulli principle with respect to projectile motion in sporting activities. | 2 | The relationship between air flow velocity and air pressure is an inverse one, and is expressed in Bernoulli’s principle.  The pressure difference causes the spinning golf ball to experience a force directed from the  region of high air pressure to the region of low air pressure. A golf ball with backspin will experience higher air pressure on the bottom of the ball and lower air pressure on the top of the ball, causing  a lift force (from high air pressure to low air pressure).  Consider how airflow affects the golf ball and one other example. When an object is moving through the air it is important to consider the relative air flow on different sides of the object. The airflow difference between opposite sides (eg bottom and top of a spinning golf ball) of the object moving through the air causes a pressure difference between the two sides. The lift force is perpendicular to the direction of the air flow.  **Aim 7:** Still photography and video can be used to record and analyze movement.  A visit to a university may be possible to see the use of high-speed photography, photoelectric cells and motion analysis software. |