Tides - Comprehensive Oceanography Notes

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1. Introduction to Tides

- Tides are the periodic rise and fall of sea level caused primarily by gravitational forces of the Moon and the Sun and the rotation of the Earth.
- They are long-period waves that move through oceans in response to these forces.
- The Moon has a greater tidal effect than the Sun due to its proximity to Earth.

2. Tide-Generating Forces

- Gravitational pull of the Moon.
- Gravitational pull of the Sun.
- Centrifugal force produced by the Earth-Moon system rotation.
- Differential gravitational force creates two tidal bulges on opposite sides of Earth.

3. Types of Tides (Based on Frequency)

- Semi-diurnal Tides – Two high tides and two low tides daily (e.g., Atlantic coast).
- Diurnal Tides – One high tide and one low tide daily (e.g., Gulf of Mexico).
- Mixed Tides – Two unequal high and low tides daily (e.g., Pacific coast of USA).

4. Types of Tides (Based on Position of Sun & Moon)

- Spring Tide – Occurs during full moon and new moon when Sun, Moon, and Earth are aligned; highest tidal range.
- Neap Tide – Occurs during first and third quarter when Sun and Moon are at right angles; lowest tidal range.

5. Tidal Range

- Difference between high tide and low tide levels.

- Macrotidal coasts – Range greater than 4 meters (e.g., Bay of Fundy).
- Mesotidal coasts – Range between 2–4 meters.
- Microtidal coasts – Range less than 2 meters.

6. Theories of Tides

- Equilibrium Theory (Newton) – Assumes uniform ocean covering Earth; explains tidal bulges conceptually.
- Dynamic Theory (Laplace) – Considers continents, ocean basins, Coriolis force, and water depth; explains real tidal patterns.

7. Factors Affecting Tides

- Shape and size of ocean basins.
- Coastline configuration.
- Ocean depth and submarine topography.
- Coriolis force.
- Local meteorological conditions (storm surges).

8. Tidal Currents and Bore

- Tidal currents are horizontal water movements caused by tides.
- Tidal bore – Sudden high wave moving upstream in narrow estuaries (e.g., Hooghly River).

9. Importance of Tides

- Aid navigation by raising water levels in shallow ports.
- Help in fishing activities.
- Prevent stagnation and help coastal sanitation.
- Tidal energy generation (renewable energy source).

10. Tides and Coastal Processes

- Influence erosion and deposition.

- Formation of tidal flats, salt marshes, and estuaries.
- Play role in sediment transport.

Exam-Oriented Points

- Moon contributes about 2.2 times more tidal force than the Sun.
- Spring tides do not relate to season but to 'springing forth' of water.
- Bay of Fundy has the highest tidal range in the world (~16 meters).
- India experiences semi-diurnal tides along most coasts.