Q.1 : Describe Lifecycle (biology), caste determination and Division of Labour found in Honeybees.

Ans. : Lifecycle of Honeybees and Division of Labour

Introduction

Understanding the lifecycle, development stages, division of labour, and interrelationship among individuals in a honeybee colony is essential for effective beekeeping. Honeybees exhibit a well-organized social structure that allows them to function efficiently as a colony.

Lifecycle of Honeybees

Honeybees undergo complete metamorphosis, passing through four distinct life stages:

1. **Egg**
2. **Larva**
3. **Pupa**
4. **Adult**

This transformation is known as complete metamorphosis because the form of the bee changes drastically from larva to adult.

1. Egg Stage

- The queen lays both fertilized and unfertilized eggs.
    - **Fertilized Eggs** → Develop into females (Worker or Queen)
    - **Unfertilized Eggs** → Develop into drones (Males)
- Eggs are tiny, white, cylindrical objects attached to the base of the comb cells.
- They are covered by a thin, tough membrane called **chorion**.
- After about **3 days**, the eggs hatch into larvae.

2. Larval Stage

- The newly hatched larvae are legless grubs.
- **Feeding Pattern:**
    - All larvae are fed **royal jelly** for the first three days.
    - After three days:
        - **Worker and Drone Larvae** are fed a mixture of royal jelly, honey, and pollen (called **bee bread**).
        - **Queen Larvae** continue to receive royal jelly throughout their development.
- Caste determination is influenced by the feeding scheme:
    - Continuous royal jelly feeding → **Queen**
    - Mixed feeding → **Worker or Drone**

- The larval stage ends with the larvae spinning a silken cocoon and entering the **Pupal Stage**.

3. Pupal Stage

- This is a transition stage where the larva transforms into an adult.
- The pupa does not feed and remains sealed inside the cell.
- During this stage:
    - **Head, thorax, and abdomen** become distinguishable.
    - **Compound eyes** and other appendages develop.
- After completing pupal development, the adult bee emerges from the sealed cell.

4. Adult Stage

- The adult bee emerges by chewing its way out of the sealed cell.
- There are three types of adult honeybees, each with specific roles:
    1. **Queen** – Sole reproductive female.
    2. **Drone** – Male bee whose primary role is to mate with a virgin queen.
    3. **Worker** – Non-reproductive female responsible for various colony tasks.

Table 1: Developmental Timeline for Honeybee Castes

Caste	Egg Stage	Larval Stage	Pupal Stage	Adult Emergence	Sexual Maturity	Adult Longevity
Queen	3 days	5.5 days	7.5 days	16 days	5-7 days	2-4 years
Worker	3 days	6 days	12 days	21 days	Not applicable	6 weeks
Drone	3 days	6.5 days	14.5 days	24 days	8-10 days	Few weeks (expelled after mating season)

Division of Labour in Honeybee Colony

Honeybees live in highly organized colonies with a well-defined division of labour. Each caste performs specific duties to ensure the colony's survival and efficiency.

1. Queen Bee

- The **only fully developed female** in the colony.
- Primary functions:
    - **Laying eggs:** Can lay over **1500 eggs per day** during favorable periods.
    - **Pheromone Production:** Releases pheromones to maintain social order and suppress worker reproduction.
- **Lifespan:** 1-4 years but often replaced after 2 years in intensive beekeeping.
- **Mating Behaviour:**
    - Takes **nuptial flights** and mates with multiple drones.
    - Stores sperm in the **spermatheca** for lifetime egg-laying.
    - After mating, **drones die** and are often expelled from the colony.

2. Drone Bee

- **Male bees** whose sole function is to mate with the virgin queen.
- **Characteristics:**

    - Larger than workers but lack a sting.
    - Do not participate in foraging or hive duties.
- **Lifecycle:**
    - Hatch from **unfertilized eggs** (haploid).
    - Die after mating or are **expelled from the colony** during off-seasons.
- **Lifespan:** A few weeks, depending on mating opportunities and season.

3. Worker Bee

- **Non-reproductive females** responsible for most colony tasks.
- **Lifecycle and Role Changes by Age:**
    - **1-3 Days:** Cell cleaning and feeding older larvae.
    - **4-10 Days:** Secreting royal jelly to feed the queen and young larvae.
    - **11-20 Days:** Wax secretion for comb building, nectar processing, and guarding the hive.
    - **21+ Days:** Foraging for nectar, pollen, water, and propolis.

Indoor Duties of Worker Bees

- **Cell Cleaning:** Ensures hygiene and prevents disease.
- **Royal Jelly Production:** Fed to the queen and young larvae.
- **Comb Construction:** Using wax secreted from glands on the abdomen.
- **Hive Ventilation and Cooling:** Regulate temperature by wing fanning.
- **Guarding the Hive:** Protecting against predators and intruders.

Outdoor Duties of Worker Bees

- **Foraging:** Collecting nectar, pollen, water, and propolis.
- **Nectar Processing:** Converting nectar into honey.
- **Communication:** Scout bees perform dances to communicate food sources.

Communication Among Honeybees

- **Dance Language:**
    - **Round Dance:** Indicates food is nearby (within 50m).
    - **Waggle Dance:** Communicates the direction and distance of distant food sources.
- **Pheromones:** Chemical signals used for communication within the colony.
    - **Alarm Pheromones** – Released when the hive is threatened.
    - **Nasonov Pheromone** – Used for orientation and colony cohesion.

Summary and Importance

- Honeybees exhibit **complex social behaviour** and a well-organized division of labour.
- Understanding the **lifecycle and division of labour** helps beekeepers manage colonies effectively.
- The **queen's reproductive role**, the **drone's mating role**, and the **worker's multifunctional role** are essential for colony survival and productivity.