Note Write your name on all pages of exam (including extra sheets of paper given to you). *Please make sure you read all questions. There are 4 pages of questions. You can answer on exam paper.*

1) [10 points] – List 5 different tiers/layers of **Service Oriented Architecture**. No explanation necessary.

2) [6 points] – Explain the difference between "**field**" vs. "**property**" accesses in Hibernate?

3) [4 points] – What are two main advantages of using an ORM (versus using plain database calls)?

4) [10 points] – Explain the difference between implicit vs. explicit updates in Hibernate?

5) [10 points] – Explain the **Single-Table** inheritance strategy in JPA?

6) [10 points] – Name two advantages and two disadvantages of using the **Joined-Table** inheritance strategy. Provide a little explanation so that I know that you understand it.

7) [10 points] – Under what situations Hibernate flushes the cache and writes all updates to DB? Name 3.

8) [10 points] – Is this the proper way to map a bi-directional mapping in JPA? Explain.

```java
@Entity
public class Person {
  @Id
  @GeneratedValue
  private int id;
  private String firstname;
  private String lastname;
  @OneToMany
  @JoinColumn(name="person_id")
  private List<Car> cars =
            new ArrayList();
```

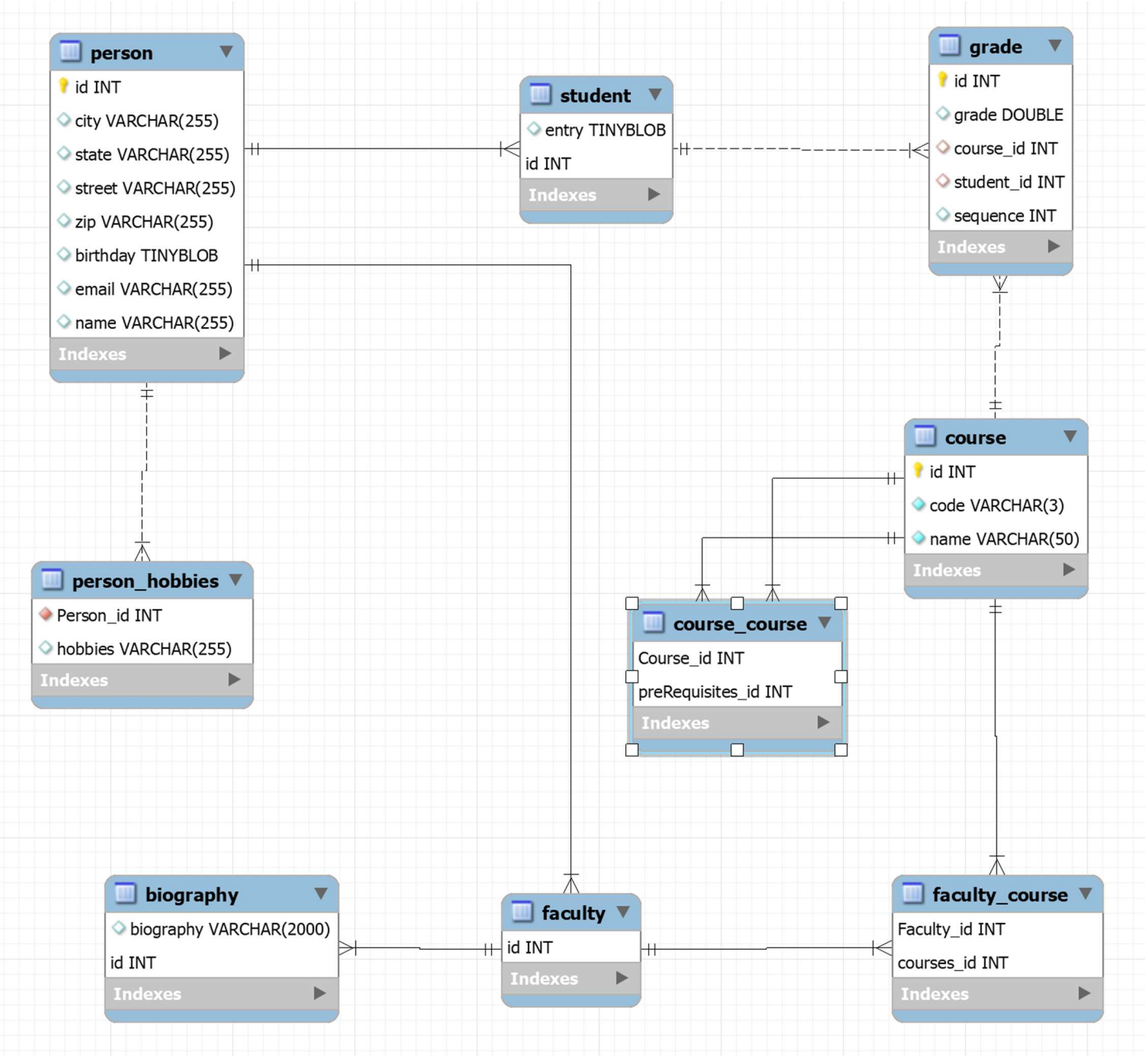
```java
@Entity
public class Car {
  @Id
  @GeneratedValue
  private int id;
  private short year;
  private String model;
  private String maker;
  @ManyToOne
  @JoinColumn(name="owner_id")
  private Person owner;
```

9) [10 points] – Given the requirements of next questions (DB and Java design), write an HQL query to find out:

   a) List of students who have taken course with code 544 and have a grade of 3.8 or better

   b) List of faculty whose biography is more than 1000 characters

10) [40 points] – Given the following database ER (Entity Relationship) diagram:



Annotate the following classes with JPA annotations to map them to the above DB.

Note: Pay attention to relationships in Java and where each attribute is potentially going to be mapped to

Use field access.

```
public class Address {
	private String street;

	private String city;

	private String state;

	private String zip;
… // getters and setters
}


public class Course {

	private Integer id;

	private String code; // Maximum of 3 characters (e.g. “544”), required field

	private String name; // Maximum of 50 characters, required field

	// Set of pre-requisite courses for this course. Can be empty.
	private Set<Course> preRequisites = new HashSet<>();
… // Getters and setters
}


public class Grade {

	private Integer id;

	private Double grade;

	private Course course;

	private Student student;
… // Getters and setters
}
```

```
public abstract class Person {

	private Integer id;

	private String name;

	private String email;

	private LocalDate birthday;

	private List<String> hobbies = new ArrayList<>();

	private Address address;

… // Getters and setters
}



public class Student extends Person {

	private LocalDate entry;


	private List<Grade> grades = new ArrayList<>();

… // Getters and setters
}



public class Faculty extends Person {


	private String biography; //optional field with a maximum length of 2000 characters


	private Set<Course> courses = new HashSet<>();

… // Getters and setters
}
```