

**NoSQL Database with MongoDB  
(CSEN 4136)**

**Time Allotted : 3 hrs**

**Full Marks : 70**

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and  
any 5 (five) from Group B to E, taking at least one from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

**Group – A  
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The data model available within MongoDB allows us to represent \_\_\_\_\_.  
(a) Hierarchical relationships (b) Able to handle complex structures  
(c) Both (a) and (b) (d) None of the mentioned above
- (ii) On startup of each mongod instance, mongoDB engine inserts a document into startup\_log collection of local database. What type of collection is it?  
(a) Normal collection (b) Capped collection  
(c) Expandable collection (d) None of these.
- (iii) Say you have used following command to insert documents  
db.students.insert([  
  { \_id: 2011, name: "K Gupta", age: 22 },  
  { \_id: 2100, name: "Pinaki Sen", age: 20, gender: "M" },  
  { \_id: 2011, name: "Anindita Pal", age: 25 }  
  { \_id: 2022, name: "Bivas Kundu", gender: "M" }  
],  
{ ordered: false } )  
How many documents will be inserted in the collection?  
(a) 3 (b) 1 (c) 4 (d) 0.
- (iv) Say you have a collection inventory containing following documents  
{ "\_id" : 5, "type" : "food", "item" : "aaa", "ratings" : [ 5, 8, 9 ] }  
{ "\_id" : 6, "type" : "food", "item" : "bbb", "ratings" : [ 5, 9 ] }  
{ "\_id" : 7, "type" : "food", "item" : "ccc", "ratings" : [ 9, 5, 8 ] }  
Which document will not be returned by following query?  
db.inventory.find( { ratings: { \$elemMatch: { \$gt: 5, \$lt: 9 } } } )  
(a) { "\_id" : 6, "type" : "food", "item" : "aaa", "ratings" : [ 5, 8, 9 ] }  
(b) { "\_id" : 6, "type" : "food", "item" : "bbb", "ratings" : [ 5, 9 ] }  
(c) { "\_id" : 6, "type" : "food", "item" : "ccc", "ratings" : [ 9, 5, 8 ] }  
(d) All three.
- (v) Which one is not a MongoDB query behaviour?  
(a) All queries in MongoDB address a single collection.  
(b) You cannot modify the query to impose limits, skips.  
(c) sort() defines the order of documents returned by a query  
(d) Update command use the same query syntax as queries to select documents to update.
- (vi) Say you have a collection inventory containing following documents :  
{ "\_id" : 5, "type" : "food", "item" : "aaa", "ratings" : [ 5, 8, 9 ] }  
{ "\_id" : 6, "type" : "food", "item" : "bbb", "ratings" : [ 5, 9 ] }  
{ "\_id" : 7, "type" : "food", "item" : "ccc", "ratings" : [ 9, 5, 8 ] }  
How many document will be returned by db.inventory.find( { 'ratings.0': 5 } )?  
(a) Only First (b) All three documents  
(c) First two (d) No document.

- (vii) You have a collection named scores to contain scores of 60 students. Out of them 20 students get more than 60 marks. What will be the result of following aggregation command?  
`db.getCollection('scores').aggregation([  
 {$match: { score: { $gt: 60}}}, { $count : 'passScore' } ])`  
 (a) { output : 20 }      (b) { result : 60 }      (c) { passScore : 60 }      (d) { passScore : 20 }
- (viii) You have written following code snippet in a node.js application using mongoDB native client where MongoClient is the native driver already required and url is a valid mongoDb database url. What will be the result?  
`MongoClient.connect(url, function(err,db){  
 var res = db.collection('Student').find();  
 res.each(function(err, doc) {  
 console.log(doc);  
 })  
})`  
 (a) It will give connection error if mongoDB instance is not running  
 (b) Nothing will be displayed in console  
 (c) Display all the documents of Student collection if mongoDB instance is running  
 (d) (a) and (c).
- (ix) Assume you define an index as : `db.people.createIndex( {city: 1, state: -1} )`  
 Which of the following queries will not use this index?  
 1. `db.people.find( ).sort( city: -1, state: 1)`  
 2. `db.people.find( ).sort( { city: -1, state: -1} )`  
 3. `db.people.find( ).sort( { city: 1, state: 1} )`  
 (a) 1 and 3      (b) 1 and 2      (c) 2 and 3      (d) 2
- (x) You have specified a validation rule for location field as follows:  
`"location": {  
 "bsonType": "array",  
 "description": "Location must be an array of strings",  
 "minItems": 1, "uniqueItems": true, "items": { "bsonType": "string" }  
}`  
 Which of the following location value will give validation error?  
 (a) ["Nepal", "China"]      (b) "Nepal"      (c) ["Nepal", "Nepal"]      (d) (b) and (c).

### Group - B

2. (a) State at least four important NoSQL Database characteristics.  
 Write name of two preferred application areas and database names of each type of NoSql database type namely the column-oriented database, document store database and graph database. What is the function of MongoDB Atlas and MongoDB Compass? [[CO1]](Remember/LOCQ)]
- (b) Define write concern. What is the behavior of default write concern?  
 Say you have issued an insert command in the shell using the write concern flag  
`{ writeConcern: { w: 2, j: true, wtimeout: 5000 } }`  
 What is the meaning of this writeConcern flag? If you don't specify wtimeout what may happen? What is the purpose of ordered flag used in insert command? [[CO1,CO2]](Understand/LOCQ)]  
**(2 + 3 + 2) + (2 + 2 + 1) = 12**
3. (a) Say you have created Laptop models in MongoDB which contains a field components to store the specification of each Laptop. Each element of components field is an embedded document containing two fields to store each component spec. Now to find all the laptops having memory of 16GB you use following query:  
`db.laptops.find( { " components.compName": "memory",  
 " components.compValue": "16GB" } )`  
 But the result also returns a document where {compName: 'storage', compValue: '16GB'}.  
 Write the query appropriately so that it only returns the desktop with 16GB memory.  
 Write another query to find all the laptops whose memory is 16GB and storage is 1TB. [[CO2]](Understand/LOCQ)]
- (b) Write at least 4 behaviours exhibited by MongoDB queries?  
 Say you have issued following query:  
`db.users.find( { age: { $gt: 18 } }, { name: 1, address: 1 } ).limit(5)`  
 How many documents will be returned? What are the fields returned by matched documents? [[CO2]](Understand/LOCQ)]
- (c) Say you issued following command to update a document:

```
db.inventory.update( { item: "TBD1" },
{
item: "TBD1",
details: { "model" : "14Q4", "manufacturer" : "ABC Company" },
stock: [ { "size" : "S", "qty" : 25 } ], category: "houseware"
},
{ upsert: true }
)
```

What will happen if no document satisfies the selection criteria? Write the content of WriteResult object returned after this operation. What is the content of the document inserted in the collection after this operation?

[[CO2](Understand/LOCQ)]  
**(3 + 3) + (1 + 1) + (1 + 1 + 2) = 12**

### Group - C

4. What are the ways to establish the relationships between the data in MongoDB? Write two important points to be considered before choosing appropriate way. Explain each way with suitable example indicating strengths and weaknesses. [CO3(Analyze/IOCQ)]

**(1 + 1 + 10) = 12**

5. (a) What are the two different patterns you can use to model One-to-Many relationship in MongoDB? You need to build a product page for an e-commerce website to show product information. You also need to save information about all the parts those make up each product for repair services. How would you design a schema to save all this data, but still make your product page performant?

What are the two important things you should consider with respect to storage optimization for Small Documents? [CO3(Analyze/IOCQ)]

(b) What pattern you are going to suggest for modeling Unbounded One-to-Many Relationships? Explain it with a suitable example. [CO3(Analyze/HOCQ)]

**(1 + 5 + 1) + 5 = 12**

### Group - D

6. (a) What do you mean by aggregation in MongoDB? What are the different ways to perform aggregations in MongoDB?

Write the name of seven important stages used in aggregation framework? Explain the function of \$group and \$unwind stages. [[CO2,CO4](Understand/IOCQ)]

(b) Say you have two collections : (i) Geners contains documents with fields named title, generalist where generalist is array type contains all the genres in that title, (ii) movies contains document with fields named movieName, gener\_type, rating. Write a query by joining genes with movies to show each gener document along with movies of all genres in generalist.

Say the genres collection contains a document { \_id: 1, title: "Gener-1", genrelist: ["comedy", "romance", "fiction" ]} and the movies collection contains 2 movies of type romance, 5 movies of type comedy, 3 movies of type horror. How many movie documents will be returned in the array used in "as" field of above command?

[[CO4](Analyze/IOCQ)]  
**(1 + 1 + 1 + 1.5 + 1.5) + (5 + 1) = 12**

7. (a) What is the main function of Model in Mongoose? Write a node.js code snippet to create a model for student collection which contains student information like name, rollNo, age and save a student ( name = 'Pijus Bose', RollNo = '362345', age=24 ) in MongoDB database. [[CO5](Understand/LOCQ)]

(b) Write the command for creating index in mongoDB and explain the sparse, TTL and unique options used in index creation. [[CO4](Understand/LOCQ)]

**(1 + 2) + (3 + 3 + 3) = 12**

### Group - E

8. (a) What is the name of the tool provided by MongoDB to import external data to MongoDB database? Briefly describe the functionality of this tool. What is the function of import mode flag available in mongoimport? Describe briefly each of the Import Modes available in it. [[CO2,CO4](Understand/LOCQ)]

(b) Say you have created a json file ride001.json containing following information in a folder fileDoc. Write the command to import the json file data to a collection name rides in MongoDB database named locDB in local server.

{

```
"tripduration": 602,
"starttime": "2019-12-01 00:00:05.5640",
"stoptime": "2019-12-01 00:10:07.8180",
"start station id": 3382,
"start station name": "Kolkata",
"start station latitude": 40.680611,
"start station longitude": -73.99475825,
"end station id": 3304,
"end station name": "New Delhi",
"end station latitude": 40.668127,
"end station longitude": -73.98377641,
}
```

Write the command to import data from more than one json files residing in the same folder in the same collection.

What will be the type of values in starttime and stoptime? What is the reason for it? How can you change the type to date?

For importing data from csv file train.csv you have defined the types of fields in a separate file fldType.txt. Write the command to import data with this type information.

[[CO4](Analyse/HOCQ)]  
**(2 + 4) + (2 + 1 + 2 + 1) = 12**

9. You need to develop a RESTful APIs using Express and Mongoose with MongoDB Atlas for CRUD operation. For simplicity you can assume:

- Node.js development environment is already set up. All the packages including express and mongoose are installed in your project folder.
- MongoDB database connection string in Atlas is already available to you.
- One collection named Games is inserted in the database using Atlas service which contains a document  
`{ title: "Pac", publisher: "Nintendo", tags: ["adventure", "action"], price: 230 }`

You have to develop following code snippets:

- Routes to perform create, update, delete and find all document operations in gameRoutes.js in Routers subfolder of the project
- Develop codes for model using Mongoose in gameModel.js in Models subfolder of the project with following validations:
  - title: it is a lowercase string , mandatory and length > 4 and < 200
  - tags : it is mandatory and value may contain more than one value from the list [ 'sports', 'racing', 'action']
  - price : it is number , default value 0 , if <0 show error message "Negative prices aren't allowed."
- server.js for running server to serve client requests.

Write the urls to be used in Postman or any other tools to test all the operations of this API.

[[CO5,CO6](Analyse/HOCQ)]  
**(10 + 2) = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	43.75	32.29	23.96

**Course Outcome (CO):**

After completion of the course, students will be able to:

- CSEN4136.1. Identify the basic needs of migrating to NoSQL database like MongoDB.
- CSEN4136.2. Understand the concepts of documents and various features in MongoDB
- CSEN4136.3. Understand the data model used for MongoDB and design document based database
- CSEN4136.4. Handling CRUD operations of MongoDB using various tools (Compass, Mongo Shell)
- CSEN4136.5. Understand the concept of ODM/ORM tool like Mongoose and using its methods
- CSEN4136.6. Developing REST API using Express application for CRUD operations using Mongoose/Native driver of MongoDB.

\*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question