NOSQL DATABASE WITH MONGODB
(CSEN 4136)

Time Allotted : 2½ hrs   **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 4 (four)</u> from Group B to E, taking <u>one</u> from each group.

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

Group – A

1.   Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i)   When should you use NoSQL database?
(a) The relationship between the data you store very important
(b) The data is structured
(c) The data is growing continuously and you need to scale the database regular interval to handle the data
(d) Support of Constraints and Joins is required at database level.

(ii)   Which statements is correct about mongoose in MongoDB?
(a) It is Java library to connect with MongoDB   (b) It is used for modelling your application data in node.js
(c) It is Python library to connect with MongoDB   (d) It is a PHP library to connect with MongoDB.

(iii)   Say you have issued following update command:
db.items.update({ itemId: "desktp" },
{ itemId: "desktp1",details: { "model" : "14Q4", "manufacturer" : "ABC Com"},
{ upsert: true }
}
What will happen?
(a)   Either updates a matching document by replacing it with a new document or   adds a new document if no matching document exists
(b)   Either updates a matching document or do nothing
(c)   Insert a new document as _id is not specified
(d)   If no matching document found give not found error.

(iv)   Say you have a collection student containing following documents :
{ "_id" : 5, "name" : "Arijit", "grades" : [5, 8, 9] }
{ "_id" : 6, "name" : "Anupam", "grades" : [5, 9] }
{ "_id" : 7, "name" : "Mukul", "grades" : [9, 5, 8] }
How many documents will be returned by db.student.find({ grades: 5 })?
(a) First two   (b) last two   (c) all three documents   (d) No document.

(v)   Which is considered as strength of Referencing?
(a) Better Data consistency   (b) Improved data integrity
(c) Faster writes   (d) All of these.

(vi)   Which one is a NoSql database of type Document Store?
(a) Redis   (b) Progress   (c) Cassandra   (d) Apache CouchDB.

(vii)   Which is not considered as strength of Embedding?
(a)   Retrieve all relevant information in a single query
(b)   Avoid implementing joins in application code or using $lookup
(c)   Update related information as a single atomic write operation
(d)   Data duplication.

(viii)   Which pattern(s) is suitable for modeling Tree structure in MongoDb?
(a) Array of Ancestors   (b) Materialized Paths
(c) Nested Sets   (d) All of these.

(ix)   Assume you define an index as :   db.people.createIndex({city: 1, state: -1})
Which of the following queries will not use this index?
         (i) db.people.find( ).sort(city: -1, state: 1)
         (ii) db.people.find( ).sort({ city: -1, state: -1})
         (iii) db.people.find( ).sort({ city: 1, state: 1})
(a) 1 and 3   (b) 1 and 2   (c) 2 and 3   (d) 2

(x) Why Mongoose is preferred over MongoDB native driver?
(a) Mongoose is faster than mongodb native driver for CRUD operations
(b) In Mongoose open and close database connection for each request is optimized for better performance when serving millions of concurrent requests
(c) Mongoose provides better maintainability of the application.
(d) (b) and (c).

Fill in the blanks with the correct word

(xi) NoSQL database is a highly _____ and _____ database management system.

(xii) _____ is faster than mongodb native driver for CRUD operations and provides better maintainability of the application.

(xiii) Reserve database named _____ in MongoDB is used to store the information related to _____ and its metadata.

(xiv) You can define structure of the document and casting of properties, _____ methods and _____ methods in Mongoose schema.

(xv) Mongoose model created by compiling a schema is a _____ that represents a MongoDB collection.

Group - B

2. (a) Briefly define NoSQL database. Write names of two popular document store databases. What characteristics of an application suggest that Document store NoSQL databases is not a right choice for that application? Define Graph databases and write names of two popular graph databases. *[(CO1)(Remember/LOCQ)]*
(b) Define at least four features of MongoDB. Write names of four application domain where you should suggest using MongoDB. *[(CO1)(Remember/LOCQ)]*
(c) What is replication? State at least four advantages of replication. *[(CO1)(Understand/LOCQ)]*
(1 + 1 + 2 + 1) + (2 + 2) + 3 = 12

3. (a) Define writeConcern and ordered options used in MongoDb insert operation.
What will happen if you do not set writeConcern during insert operation? Say you have issued following command :
db.item.insert(
{ _id: 1, qty : 100, category: "Mobile" },
{ writeConcern: { w: 2, j: true, wtimeout: 5000 } })
What is the meaning of this writeConcern? *[(CO3)(Analyse/LOCQ)]*
(b) Define the save() method. What will happen when you issue following command?
db.products.save({ item: "book", qty: 40 })
What is the result returned after execution above command? *[(CO4) (Remember/LOCQ)]*
(c) In a supply chain management system item status is tracked by raising memo by each department handling the item and those memos are stored in the memos field of item collection as shown below:
{
_id: 100,   type: "food", qty: 25,
memos: [{ status : "on time", by: "shipping" },
{ status: "approved", by: "billing" }]
}
{
_id: 101,   type: "fruit", qty: 10,
memos: [{ status : "on time", by: "payment" },
{ status: "delayed", by: "shipping" }]
}
Write following queries and indicate which document will be returned after execution of each query :
▪ find all documents where the first element of memos field is a document raised by 'shipping' department.
▪ find all documents where the memos field contains at least one memo raised by 'shipping' department.
▪ find all documents where the memos field contains at least one embedded document that is raised by 'shipping' department and status is 'on time'. *[(CO2)(Apply/IOCQ)]*
(1.5 + 1.5 + 1) + 2 + (2 + 2 + 2) = 12

Group - C

4. (a) Compare Embedded and References approach used for data modelling in MongoDB. *[(CO3)(Remember/LOCQ)]*
(b) Explain two approaches namely child referencing and parent referencing generally used to establish One-to-Many relationship with suitable examples. What approach is suitable for unbounded One-to-Many Relationships and why? *[(CO3)(Understand/IOCQ)]*
4 + (3 + 3 + 2) = 12

5. (a) Write three pattern names used for modelling tree structure in MongoDB.
Suppose you have categories collection to describe the relationship between books category :
{ _id: "MongoDB", parent: "Databases" },
{ _id: "dbm", parent: "Databases" },
{ _id: "Databases", parent: "Programming" },

        { _id: "Languages", parent: "Programming" },
        { _id: "Programming", parent: "Books" },
        { _id: "Books", parent: null }

Model above tree-like structure using Child References. *[(CO3)(Analyse/LOCQ)]*

(b) What is view in MongoDB? What are the different types of view available in MongoDB? State at least two features of a view. *[(CO2) (Remember/LOCQ)]*

(c) Say you have collected survey data from employees and stored in survey collection which contains following documents:
{ _id: 1, feedback: { management: 3, environment: 3 }, department: "A" }
{ _id: 2, feedback: { management: 2, environment: 3 }, department: "B" }
{ _id: 3, feedback: { management: 3, environment: 4 }, department: "A" }

Create a view using this collection to project the feedback on management using either createView or createCollection command. Write a find command based on this view and its output.

[(CO2)(Apply/LOCQ)]

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

Group - D

6. (a) Briefly explain aggregation pipeline. Write down the name of five important stages used in this pipeline. Explain the $unwind stage with suitable example. *[(CO2/CO6)(Remember/IOCQ)]*

(b) Say you have stored marks obtained in each course by each student in a collection name students. The marks are stored as an array of embedded collection as shown below :
{ studentName : 'Bibhas' , rollNo : 290 , courses : [
    { courseId : 1112 , marks : 75 }, { courseId : 1113 , marks : 70 }]}
Write a query to generate total marks obtained by each student along with his/her roll no using aggregation pipeline.

Say a RDBMS table Orders contains fields like custid, orderid, orderqty, status to store order information of each customer. To find the total order quantity for each customer with order status 'A' and total order quantity > 80 you issue following select query :

SELECT custid, SUM(orderqty) as totalqty FROM orders
WHERE status = 'A'
GROUP BY cust_id
HAVING totalqty > 80

Write an equivalent query for Orders collection in MongoDB which will generate same result using aggregation pipeline. *[(CO6)(Apply/IOCQ)]*

(c) Say you have a collection named population containing population data of each city. Each document contains the following information:
city: the city's name,   country: the country where the city is located.
continent: the continent where the city is located.
population: the city's population.

Write an aggregation pipeline to show maximum population, first city and number of cities for each country of a continent. *[(CO6)(Apply/HOCQ)]*

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

7. (a) Define $lookup operation. Write the syntax of lookup operation for equality match with a single join condition. *[(CO6)(Remember/IOCQ)]*

(b) Say you have a orders collection which contains order info like :
{ "_id" : "Ord1", "company" : "Microsoft", "products" : ["Prd1", "Prd2"] },
{ "_id" : "Ord2", "company" : "Apple", "products" : ["Prd2"] }

And another collection products contains information of product like :
{ "_id" : "Prd1", "name" : "Mouse logitech", "orders" : ["Ord1"] },
{ "_id" : "Prd2", "name" : "Keyboard logitech", "orders" : ["Ord1", "Ord2"] }

Write a query to join products with orders using lookup. What will be the output? *[(CO4,CO6) (Apply/IOCQ)]*

(c) Name at least 4 index types available in MongoDB. Explain the sparse, TTL, and unique options used in index creation. *[(CO2)(Remember/LOCQ)]*

(2 + 2) + 4 + 2 = 12

Group - E

8. (a) Explain the term schema used in Mongoose. What are the things you can define in schema beside structure of your document and casting of properties?
Say you have defined a schema like :
var AnimalSchema = new Schema({ name: String , type: String });

Write a command to add one more field weight of type Number and default value 10 in the above schema.

Write a code snippet to add an instance method findSimilarAnimal to find out animal of similar type to that schema, create a dog and call that method. *[(CO5)(Analyse/HOCQ)]*

(b) What are the two formats used to store geospatial data in mongoDB? Write the names of the geometry types supported in GeoJSON format. *[(CO2)(Remember/LOCQ)]*

(c) Define location of "Hertiage" and "Himalayan Rang" using GeoJSON assuming arbitrary coordinates needed for those purpose. *[(CO2)(Analyse/IOCQ)]*

(1 + 1 + 1 + 1 + 2) + (1 + 1) + (2 + 2) = 12

9. (a) What is Mongoose? What are the advantages of using Mongoose over MongoDB native driver? What is middleware function in Mongoose? Give an example of middleware function.

   What is model in Mongoose? Say you want to access a collection named activityGroup which has fields like_id : Number, agDescription: String, point: Number, maxPoint: Number and activitySubGrs: array of sub-documents representing activity subgroups. A schema named acSubGrSchema is provided for activity subgroup. Create a schema for acitivityGroup and create a model using that schema. *[(CO5)(Analyse/LOCQ)]*

   (b) What are the advantages of using Mongoose validation? Write important rules of validation in Mongoose. Write names of four built-in validator for SchemaType String. Which built-in validator is available in all Schema Types?

   Say you have a book collection to store information of books. Write a code snippet to save a book with properties (name: 'Introduction to Mongoose', author : ' Vinit Kumar' , price : 500, publisher : 'ABC Publication') using Mongoose. *[(CO5)(Analyse/IOCQ)]*

   (1 + 1 + 1 + 1 + 2) + (1 + 2 + 1 + 2) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	47.92	42.71	9.37

Course Outcome (CO):

After the completion of the course students will be able to
CO1:   Identify the basic needs of migrating to NoSQL database like MongoDB.
CO2:   Understand the concepts of documents and various features in MongoDB
CO3:   Understand the data model used for MongoDB and design document based database
CO41:   Handling CRUD operations of MongoDB using various tools (Compass, Mongo Shell)
CO5:   Understand the concept of ODM/ORM tool like Mongoose and using its methods.
CO6:   Developing complex queries using Aggregation pipeline and 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.