MERN Stack Developer – Complete Node.js Syllabus

1. Introduction to Node.js

- What is Node.js?
- Node.js Architecture (Event Loop)
- Non-blocking I/O
- V8 engine
- Node.js vs Backend languages (Java, PHP, Python)
- When to use Node.js? Use cases

2. Node.js Environment Setup

- Install Node.js, npm
- package.json & package-lock.json
- npm commands
- Dependency types: dependencies vs devDependencies
- Semantic Versioning

3. Core Node.js Modules

- fs – file system module
- path – path utilities
- os – system info
- events – event emitter
- http – create server
- url, querystring
- Buffers
- Global objects

4. Asynchronous JavaScript in Node

- Callback functions
- Callback Hell
- Promises
- async/await
- Event Loop Phases (Call Stack, Event Queue, Microtasks)
- Error handling in async code

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5. Express.js Framework (MOST IMPORTANT FOR MERN)

Express Basics

- What is Express?
- Creating Express app
- Request & Response basics
- Routing (GET, POST, PUT, DELETE, PATCH)
- Static files

Middleware

- Application middleware
- Router-level middleware
- Error-handling middleware
- Built-in middleware (express.json, express.urlencoded)
- Third-party middleware

Advanced Express

- Express Router
- File Upload (Multer)
- Cookies & Sessions
- Rate Limiting
- CORS handling
- Error handling best practices

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6. REST API Development

- What is REST?
- REST API design standards
- Query Params, Path Params, Body Params
- CRUD operations
- API Versioning
- Pagination
- Error responses & status codes
- API folder structure (MVC pattern)

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7. Database Integration (MongoDB – for MERN)

MongoDB Basics

- Database, Collections & Documents
- BSON vs JSON
- CRUD operations
- Indexing

Mongoose

- Schema & Models
- Data validation
- Hooks (pre/post)
- Virtuals
- Populate (Relationships)
- Aggregation Pipeline
- Query building (find, sort, skip, limit)

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8. Authentication & Authorization

- Password hashing (bcrypt)
- Login / Signup

- JWT Authentication
- Access token & Refresh token
- Role-based Access (Admin, User, etc.)
- Securing protected routes
- Logout functionality
- Storing tokens securely (cookies, headers)

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9. Working With Files

- Multer (Single/Multiple upload)
- Image upload
- File validation
- Upload to cloud (Cloudinary, ImageKIT)

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10. Node.js + Frontend Integration (React)

- CORS setup
- Connecting React with Node API
- Sending form data
- Sending cookies & JWT

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11. Realtime Applications (Optional but Useful)

- WebSockets
- Socket.io
- Real-time chat system
- Notifications
- Live updates

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12. Security in Node.js

- Input sanitization

- Prevent XSS
- Prevent SQL/NoSQL Injection
- CORS configuration
- HTTPS setup
- Helmet
- Rate limiting
- API key management

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13. Backend Architecture & Patterns

- MVC structure
- Layered architecture (Controller, Service, Repository)
- Clean folder structure for MERN projects
- Environment variables (.env)
- Config service
- Logging using Morgan / Winston

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14. Testing

- Unit testing with Jest
- API testing with Supertest
- Mocking
- Writing test suites
- Test coverage

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15. Deployment

- Deploy Node.js Apps on:
  - Vercel (Serverless functions)
  - Heroku
  - Railway

    - Render
    - AWS EC2
    - DigitalOcean
- Deployment Concepts
    - PM2 process manager
    - Reverse proxy (Nginx)
    - Environment variables
    - Production build optimization

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16. Node.js Tools Every MERN Developer Must Know

- nodemon
- Postman / Thunder Client
- dotenv
- bcrypt
- jsonwebtoken
- mongoose
- morgan
- multer
- cors
- express-validator

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17. Node.js Projects for MERN Developers

Beginner

- Basic User CRUD API
- To-Do App Backend

Intermediate

- Authentication System with JWT
- File Upload System (Images/PDF)

- Blog API with Admin Panel

Advanced

- E-Commerce Backend (Cart, Orders, Payments)
- Realtime Chat App (Socket.io)
- Role-Based Store/Shop System
- Hospital Management API
- Learning Management System (LMS) backend