**General Classification:**

1. External Entities
2. Things
3. Occurrence/Events
4. Organizational Unit
5. Role
6. Places
7. Structures

List of Nouns:

| **Sl. No.** | **Noun** | **P / S** | **General Classification** |
| --- | --- | --- | --- |
|  | Library Management System (LMS) | S | 4 |
|  | User | S | 4,5,7 |
|  | Student | S | 4,5,7 |
|  | Teacher | S | 4,5,7 |
|  | Staff | S | 4,5,7 |
|  | Name | S | 2 |
|  | Phone number | S | 2 |
|  | OTP | S | 1 |
|  | Verification | S | 3 |
|  | Roll number | S | 2 |
|  | Registration number | S | 2 |
|  | Session | S | 2 |
|  | Hall | S | 6 |
|  | Email | S | 1 |
|  | Address | S | 6 |
|  | Designation | S | 2 |
|  | User ID | S | 2 |
|  | Password | S | 2 |
|  | Account | S | 2 |
|  | Due date | S |  |
|  | Fine | S |  |
|  | Payment | S | 3 |
|  | Status | S |  |
|  | Notification | S |  |
|  | SMS | S |  |
|  | E-Library | S |  |
|  | Book PDF | S |  |
|  | Title | S |  |
|  | Author | S | 5 |
|  | Subject | S |  |
|  | Summary PDF | S |  |
|  | Review | S |  |
|  | Rating | S |  |
|  | Feedback | S |  |
|  | Smart search function | S |  |
|  | Filtering option | S |  |
|  | Borrowing request | S |  |
|  | Borrowing form | S |  |
|  | Classification number | S | 2 |
|  | Integrated library catalog | S | 2 |
|  | Book information | S |  |
|  | Availability | S |  |
|  | Waitlist | S |  |
|  | Eligibility | S |  |
|  | Approval | S |  |
|  | Real-time stock | S |  |
|  | Queue | S |  |
|  | Role | S |  |
|  | Application time | S |  |
|  | Teacher priority | S |  |
|  | Category | S |  |
|  | Return deadline | S |  |
|  | Fine policy | S |  |
|  | Library seal | S |  |
|  | Blacklist status | S |  |
|  | Cancellation notice | S |  |
|  | Mobile Financial Services (bKash, Nagad) | S | 1 |
|  | Transaction confirmation | S |  |
|  | Demerit point | S | 2 |
|  | Outstanding fine | S | 2 |
|  | Reactivation | S | 3 |
|  | Renewal | S | 3 |
|  | Borrowing record | S |  |
|  | Book purchase committee | S | 4 |
|  | Clearance | S | 3, 7 |
|  | Request | S |  |
|  | Type | S |  |
|  | Form | S |  |
|  | Certificate | S |  |
|  | Marksheet | S |  |
|  | Pension | S |  |
|  | Pending book | S |  |
|  | Department | S |  |
|  | Book | S |  |
|  | Amount | S |  |
|  | Transaction ID | S |  |
|  | Payment | S | 3,7 |
|  | OTP | S | 1, 2, 3, 7 |
|  | Admin | S | 4, 5, 7 |

Possible Classes:

1. User
2. Student
3. Teacher
4. Staff
5. MFS
6. OTP
7. Book
8. Admin
9. EmailGenerator
10. SummaryGenerator

**Analysis:**

We can remove “Student, Teacher, Staff” class because all attributes and responsibilities can be found in “User” class.

**Selection Criteria:**

1. Retained Information
2. Needed Service
3. Multiple Attributes
4. Common Operation
5. Common Attributes
6. Essential Requirements

| **No** | **Classes** | **Selection Criteria** |
| --- | --- | --- |
| 1. | User | 1, 3, 5, 6 |
| 2. | Student | 1, 3, 5, 6 |
| 3. | Teacher | 1, 3, 5, 6 |
| 4. | Staff | 1, 3, 5, 6 |
| 5. | MFS | 6 |
| 6. | OTP | 6 |
| 7. | Book | 1, 2, 3, 6 |
| 8. | Admin | 1, 3, 6 |
| 9. | EmailGenerator | 6 |
| 10. | SummaryGenerator | 6 |

**List of Verbs:**

| No | Verbs | No | Verbs |
| --- | --- | --- | --- |
| 1. | Begin | 41. | View |
| 2. | Select | 42. | Borrow |
| 3. | Register | 43. | Activity |
| 4. | Provide | 44. | Ensure |
| 5. | Submit | 45. | Request |
| 6. | Sent | 46. | Need |
| 7. | Verify | 47. | Browse |
| 8. | Enter | 48. | Search |
| 9. | Create | 49. | Download |
| 10. | Access | 50. | Participate |
| 11. | Grant | 51. | Review |
| 12. | Complete | 52. | Leave |
| 13. | Login | 53. | Offer |
| 14. | Recognize | 54. | Engage |
| 15. | Forget | 55. | Promote |
| 16. | Recover | 56. | Encourage |
| 17. | Allow | 57. | Enable |
| 18. | Reset | 58. | Find |
| 19. | Confirm | 59. | Filter |
| 20. | Initiate | 60. | Fill out |
| 21. | Find | 61. | Display |
| 22. | Click | 62. | Forward |
| 23. | Process | 63. | Check |
| 24. | Redirect | 64. | Reject |
| 25. | Cancel | 65. | Receive |
| 26. | Reserve | 66. | Hold |
| 27. | Ensure | 67. | Move |
| 28. | Add | 68. | Place |
| 29. | Give | 69. | Organize |
| 30. | Monitor | 70. | Notify |
| 31. | Return | 71. | Align |
| 32. | Include | 72. | Save |
| 33. | Meet | 73. | Pay |
| 34. | Update | 74. | Settle |
| 35. | Clear | 75. | Approve |
| 36. | Renewal | 76. | Handle |
| 37. | Analyze | 77. | Depend |
| 38. | Remove | 78. | Publish |
| 39. | Apply | 79. | Appear |
| 40. | Contain |  |  |

**Selected Classes:**

1. User

Attributes: Name, Phone No, Email, Address, User Id, Password, Role, Demerit Point, Amount

Methods: register(), login(), recoverPassword(), updateProfile(), submitClearanceRequest(), borrowBook(), payFine(), receiveNotification()

1. Admin

Attributes: Name, Phone No, Email, adminId, Password

Methods: approveBorrowRequest(), rejectBorrowRequest(), approveClearance(), rejectClearance(), setReturnDeadline(), uploadResearchJournal(), addBook(), updateBook(), deleteBook(), verifyPurchaseBills()

1. Book

Attributes: bookId, title, author, subject, classificationNo, category, rating, bookPDF, archived

Methods: searchBook(), viewDetails(), downloadPDF(), updateAvailability(),

archiveBook(), addRating()

1. MFS

Attributes: transactionId, phoneNo, serviceName

Methods: processPayment(), verifyTransaction(), notifyUser()

1. OTP

Attributes: otpNo, phoneNo, time, date

Methods: generateOTP(), sendOTP(), verifyOTP(), expireOTP()

1. EmailGenerator

Attributes: email, date

Methods: sendAccountEmail(), sendBorrowingEmail(), sendClearanceEmail(), sendNotificationEmail()

1. SummaryGenerator

Attributes: pdf, bookTitle

Methods: generateSummary(), exportSummaryPDF(), saveSummary()

CRC:

1. User

| **Attributes** | **Methods** |
| --- | --- |
| Name  Phone No  Email  Address  User Id  Password  Role  Demerit Point  Amount | register()  login()  recoverPassword()  updateProfile()  submitClearanceRequest()  borrowBook()  payFine()  rateBook() |
| **Responsibilities** | **Collaborator** |
| Register and log in with role-specific details | Admin |
| Recover password using OTP | OTP |
| Pay fines via MFS | MFS |
| Request clearance (certificate, marksheet, pension) | Admin |

1. Admin

| **Attributes** | **Methods** |
| --- | --- |
| name  phoneNo  email  adminId  password | approveBorrowRequest()  rejectBorrowRequest()  approveClearance()  rejectClearance()  setReturnDeadline()  uploadResearchJournal()  addBook()  updateBook()  deleteBook()  verifyPurchaseBills() |
| **Responsibilities** | **Collaborator** |
| Approve/reject borrow requests | User |
| Add, update, or delete book records | Book |
| Verify bills for purchased books | MFS, OTP |

1. Book

| **Attributes** | **Methods** |
| --- | --- |
| bookId  title  author  subject  classificationNo  category  rating  bookPDF  archived | searchBook()  viewDetails()  downloadPDF()  updateAvailability()  archiveBook()  addRating() |
| **Responsibilities** | **Collaborator** |
| Maintain book metadata | Admin |
| Provide PDF downloads | SummaryGenerator |

1. MFS

| **Attributes** | **Methods** |
| --- | --- |
| transactionId  phoneNo  serviceName | processPayment()  verifyTransaction()  notifyUser() |
| Responsibilities | Collaborator |
| Process payments (fines, fees) | User |
| Verify transaction IDs | Admin |
| Notify users of successful or failed payments | User |

1. OTP

| **Attributes** | **Methods** |
| --- | --- |
| otpNo  phoneNo  time  date | generateOTP()  sendOTP()  verifyOTP() |
| **Responsibilities** | **Collaborators** |
| Generate & send OTP for registration and password recovery | User |
| Verify OTP for authentication | Admin |

1. EmailGenerator:

| **Attributes** | **Methods** |
| --- | --- |
| Email  Date | sendAccountEmail()  sendBorrowingEmail()  sendClearanceEmail()  sendNotificationEmail() |
| **Responsibilities** | **Collaborators** |
| Send account-related emails | User |
| Send borrowing approval/rejection | Admin |
| Send clearance approval/rejection | User, Admin |
| Send due/fine notifications | User |
| Log email with date | OTP, MFS, SummaryGenerator |

1. Summary Generator

| **Attributes** | **Methods** |
| --- | --- |
| pdf  bookTitle | generateSummary()  exportSummaryPDF()  saveSummary() |
| **Responsibility** | **Collaborator** |
| Generates summary of book or journal | User |

CRC Diagram:

