Permission List

Report Title	Permission List
Run Date and Time	2025-11-01 00:55:16 Pacific Daylight Time
Run by	System Administrator
Table name	promin_permission
Query Condition	Project definition = Copy of Evaluation Project: Incidents resolved within the past 7 days, max. 3.6K records
Sort Order	None

2 Permissions

Project definition	User	Group	Role	Created	Updated	Created by	Updated by
Copy of Evaluation Project: Incidents resolved within the past 7 days, max. 3.6K records			itil	2025-11-01 00:52:40	2025-11-01 00:52:40	admin	admin
Copy of Evaluation Project: Incidents resolved within the past 7 days, max. 3.6K records				2025-11-01 00:52:40	2025-11-01 00:52:40	admin	admin

Project definition	User	Group	Role	Created	Updated	Created by	Updated by
Copy of Evaluation Project: Incidents resolved within the past 7 days, max. 3.6K records	Bob p	Team Development Code Reviewers		2025-11-01 00:13:53	2025-11-01 00:28:36	admin	admin
Copy of Evaluation Project: Incidents resolved within the past 7 days, max. 3.6K records	alice p	Project Team	itil	2025-11-01 00:13:53	2025-11-01 00:28:07	admin	admin

NM1051 – SERVICENOW ADMINISTRATOR

OPTIMIZING USER GROUP AND ROLE MANAGEMENT WITH ACCESS CONTROL AND AND WORKFLOWS

A PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this project "**OPTIMIZING USER GROUP AND ROLE MANAGEMENT WITH ACCESS CONTROL AND WORKFLOWS**" is the bonafide work of **ARUNA M (962722104010), HARINI S (962722104018), PAVITHRA N (962722104037), SNEKA K (962722104046),** who carried out the project work under any supervision.

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

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Table of Contents:

Contents

1.Abstract

In the current era of digital transformation, organizations increasingly rely on information systems to manage users, resources, and workflows across distributed environments. However, as the number of users and applications grows, manually assigning and maintaining access privileges becomes both inefficient and risky. Traditional static access control mechanisms, such as simple Role-Based Access Control (RBAC), often fail to accommodate the dynamic nature of modern enterprises where user roles and responsibilities evolve continuously. This project, titled **"Optimizing User Group and Role Management with Access Control and Workflows,"** proposes a systematic and automated approach to streamline user management and enforce robust access control policies.

The primary objective of this project is to design and implement a dynamic role and group management system that integrates workflow automation with access control mechanisms. By doing so, it ensures that users are automatically assigned the correct permissions based on their current role, department, and task in a workflow. The system uses **RBAC** principles as its foundation, enhanced with workflow-driven automation that updates access rights in real-time as users transition through various business processes. This automation not only minimizes administrative overhead but also strengthens organizational security by preventing privilege escalation and unauthorized data access.

The proposed system consists of key components such as a **centralized role repository**, **policy-based access control engine**, and **workflow manager**. Administrators can define hierarchical roles, user groups, and access policies that dynamically adapt to operational changes. The system logs all access activities, providing transparency and accountability for compliance audits. It is developed

using a modular architecture, ensuring scalability and easy integration with existing enterprise systems.

Through optimization of user group and role management, this project achieves several benefits: improved efficiency in access provisioning, reduced manual intervention, enhanced security through least-privilege enforcement, and a clear audit trail for governance. The integration of workflows ensures that access control is not static but evolves automatically with business processes. In conclusion, the proposed solution represents a significant step toward intelligent, secure, and automated identity and access management suitable for modern organizations, enabling them to balance operational flexibility with stringent data protection standards.

2. Introduction

In today's rapidly evolving digital landscape, organizations are becoming increasingly dependent on information systems to handle sensitive data, manage users, and control access to various resources. As businesses expand, the number of users, departments, and software systems grows exponentially. Managing who can access what information and when becomes a complex and critical task. Ensuring that every user has the right level of access—no more and no less—is essential not only for operational efficiency but also for safeguarding data integrity and preventing unauthorized activities. Traditional manual methods of managing user permissions and roles are error-prone, time-consuming, and difficult to scale. This has led to the need for a more automated, optimized, and secure approach to user group and role management.

Access control lies at the heart of organizational security. It defines how users interact with systems and ensures that only authorized individuals can access

specific data or functions. Conventional **Role-Based Access Control (RBAC)** models assign permissions to roles rather than individual users, simplifying management to some extent. However, these models are often static, failing to adapt to changes in user responsibilities, departmental transfers, or evolving organizational workflows. As a result, users may retain unnecessary permissions even after their roles change, increasing security vulnerabilities and violating the principle of least privilege.

To overcome these challenges, the concept of **workflow-driven access control** has emerged as a modern approach. In this model, access permissions are dynamically adjusted according to user activities and the stage of the workflow they are involved in. For instance, an employee handling a document review process may gain edit access during the review phase but lose that access once the document is approved and archived. This ensures both operational flexibility and compliance with data protection policies.

The proposed project, **"Optimizing User Group and Role Management with Access Control and Workflows,"** aims to design a system that automates and optimizes the management of user roles, groups, and permissions. The system integrates access control mechanisms with workflow automation to ensure that user privileges align precisely with their active tasks and responsibilities. By combining **RBAC** with **workflow automation**, the project minimizes administrative effort, enforces dynamic access adjustments, and enhances overall system security.

Furthermore, the proposed solution incorporates features such as **centralized role repositories**, **automated role assignment**, and **audit logging**, which collectively provide transparency and accountability. Administrators can easily monitor who

has access to what resources, when changes occur, and why. The outcome is an efficient, scalable, and secure access management framework that supports modern organizations in maintaining both productivity and compliance with security standards.

3. Methodology

The methodology adopted for this project follows a **systematic and structured approach** aimed at designing, developing, and implementing an efficient user group and role management system integrated with workflow-based access control. The goal is to create a secure, scalable, and automated environment where user permissions are dynamically adjusted according to their roles and workflow status. The methodology involves several key phases, described below.

1. Requirement Analysis

The first step is to gather and analyze both **functional** and **non-functional requirements**. Functional requirements focus on identifying user roles, types of access (read, write, modify, delete), workflow stages, and administrative actions. Non-functional requirements include performance, security, scalability, and usability. Stakeholder interviews and system audits are conducted to understand organizational structures, role hierarchies, and existing access management challenges.

2. System Design

In this phase, the system architecture is designed to define the interactions between various components—users, access control modules, and workflows. The design includes:

- **Data Model Design:** Defining entities such as *Users*, *Roles*, *Permissions*, *Groups*, and *Workflows*.
- **Role Hierarchy:** Establishing inheritance between roles (e.g., Admin > Manager > Employee).
- **Workflow Mapping:** Associating user actions and role transitions with specific workflow stages.
  The system design follows a **modular and layered architecture**, typically including the presentation layer (UI), application layer (business logic), and database layer (data storage).

3. Role and Access Control Implementation

The access control mechanism is implemented using **Role-Based Access Control (RBAC)**, enhanced with **workflow-based rules**.

- **RBAC Module:** Assigns permissions to roles rather than individual users, simplifying management.
- **Dynamic Role Assignment:** Users' permissions are automatically updated as their workflow progresses (for instance, once a task is approved, the editing permission is revoked).
- **Access Policy Engine:** Ensures that all access requests are validated against defined security policies before granting permissions.

4. Workflow Integration

Workflows are integrated into the access control system to dynamically manage user privileges. Each workflow (e.g., document approval, purchase request, project review) defines stages, actions, and associated access rules. The system automatically updates the user's privileges depending on the workflow stage they

are in. This integration minimizes human intervention, enforces process consistency, and maintains data integrity.

5. Database Management

A relational database (such as MySQL or PostgreSQL) is used to store user profiles, roles, permission sets, and workflow definitions. Tables are normalized to reduce redundancy and ensure fast retrieval. Secure authentication mechanisms are used for data access, and all transactions are logged for audit purposes.

6. System Optimization

Optimization techniques are applied to ensure high performance and security. These include:

- **Caching** frequently accessed permissions.
- **Automating Role Provisioning** using scripts or triggers.
- **Audit and Logging** to track user activity and detect anomalies.
- **Encryption and Authentication** for secure communication and data protection.

7. Testing and Validation

After development, the system undergoes multiple testing phases:

- **Unit Testing:** Each component (e.g., login, role assignment, permission check) is tested independently.
- **Integration Testing:** Ensures modules (user management, workflow, access control) work together correctly.

- **Security Testing:** Verifies that unauthorized access attempts are blocked and audit logs are generated.
- **User Acceptance Testing (UAT):** Conducted with actual users to ensure usability and functional accuracy.

8. Deployment and Maintenance

The final system is deployed on a secure server environment. Continuous monitoring tools are integrated to detect performance bottlenecks or unusual access patterns. Regular updates and audits are conducted to align with new security policies or organizational changes.

4. Existing Work

User group and role management with access control has been a central focus in information security and enterprise system design for many years. Various frameworks, models, and technologies have been developed to manage user identities, assign roles, and control access to digital resources. However, most existing systems are limited in their ability to adapt to dynamic environments and integrate seamlessly with workflow processes. This section examines the commonly used access control models and systems currently in practice, highlighting their advantages and shortcomings.

1. Traditional Manual Role Management

In early systems, user access was managed manually by system administrators. Each user was assigned specific permissions for files, folders, or applications. While this approach was straightforward for small organizations, it became

inefficient and error-prone as systems grew in size. Manual role management often led to issues such as:

- **Privilege Creep:** Users retaining access to resources after changing roles or departments.
- **Administrative Overhead:** High workload for administrators to maintain and update user permissions.
- **Inconsistent Policies:** Difficulty enforcing organization-wide security policies due to manual intervention.

This approach lacks scalability and is unsuitable for organizations with complex role hierarchies or frequent employee transitions.

2. Role-Based Access Control (RBAC) Systems

The **Role-Based Access Control (RBAC)** model emerged to simplify permission management. Instead of assigning permissions directly to users, permissions are assigned to roles, and users inherit permissions through their roles. Popular implementations of RBAC include operating systems, database systems, and enterprise identity management platforms. RBAC provides a structured and hierarchical approach, reducing redundancy and improving security.

However, RBAC has notable limitations:

- Roles are **static** and do not adapt to contextual or workflow changes.
- Managing a large number of roles and permissions in big organizations can become complex.
- Lacks dynamic adaptability — for example, temporary project roles or task-specific permissions are difficult to automate.

3. Attribute-Based Access Control (ABAC)

To overcome RBAC's rigidity, **Attribute-Based Access Control (ABAC)** introduced a more flexible approach by considering user attributes (e.g., department, location, time, or device) in access decisions. ABAC is widely used in cloud-based systems and modern security frameworks due to its fine-grained control. However, ABAC is computationally more complex and harder to manage at scale, especially when integrated with legacy systems that were designed for simpler access control models.

4. Identity and Access Management (IAM) Solutions

Commercial platforms such as **Microsoft Azure Active Directory**, **AWS Identity and Access Management (IAM)**, **Okta**, and **Google Cloud IAM** offer advanced access control capabilities. These systems provide centralized user management, single sign-on (SSO), and policy-based access enforcement. They also include compliance and auditing tools for enterprise governance. While these systems are powerful, they are often:

- **Expensive** for small and medium-sized organizations.
- **Complex to configure** and require specialized expertise.
- **Limited in workflow integration**, meaning access control policies still need to be manually adjusted to match operational processes.

5. Workflow-Based Access Management Research

Recent academic research has proposed integrating workflows with access control mechanisms. Workflow-Based Access Control (WBAC) focuses on automatically adjusting user permissions based on task progress within a process. For example, a

user may have edit rights on a document only during the "review" stage and read-only rights after approval. Although promising, many of these models remain theoretical or limited to specific domains such as document management or healthcare systems, lacking a general, adaptable framework for broader enterprise use.

5. Proposed Work

The proposed system is designed to **automate and centralize access control** within an organization. It integrates **role-based access management (RBAC)** and **workflow automation** to ensure that users have the right permissions at the right time—no more, no less. This reduces manual administrative work, enforces compliance policies, and enhances overall system security.

Core Components and Their Functions

1. Automated Role Assignment

What it does:

- Automatically assigns roles and permissions to users based on attributes such as:
    - **Department** (e.g., HR, Finance, IT)
    - **Position or job title** (e.g., Manager, Analyst, Developer)
    - **Project participation or team membership**

How it works:

- When a user joins or moves within the organization, the system references predefined **role templates**.

- Rules and conditions (defined by HR or IT administrators) determine which roles and permissions apply.
- This eliminates the need for manual intervention and minimizes human error.

Benefits:

- Rapid onboarding and offboarding.
- Consistent application of access policies.
- Reduced risk of unauthorized access due to misconfigured roles.

2. Dynamic Workflow Integration

What it does:

- Integrates user access control directly with organizational workflows.
- Access privileges change dynamically as users **progress through different workflow stages**.

Example:

- A user working on a project might:
  - Gain access to certain systems or folders when the project starts.
  - Lose that access automatically when the project closes or they are reassigned.

Benefits:

- Ensures “just-in-time” access — users only have permissions when needed.
- Prevents lingering permissions that can lead to security vulnerabilities.

- Improves operational efficiency by automating access updates as workflows evolve.

3. Centralized Role Repository

What it does:

- Maintains all roles, permissions, and access policies in **one unified interface**.
- Administrators can create, modify, and review roles centrally.

Key Features:

- Role hierarchy management (e.g., parent-child role relationships).
- Support for **multi-level organizational structures**.
- Integration with **Identity and Access Management (IAM)** systems or directories like Active Directory, LDAP, etc.

Benefits:

- Simplifies governance by providing a single source of truth.
- Facilitates auditing and compliance checks.
- Makes it easy to apply global policy changes across all departments.

4. Audit and Logging

What it does:

- Records all access-related activities, including:
    - Role assignments and revocations.
    - Permission changes.

    - User login and data access events.
- Generates **detailed audit trails** for compliance and forensic investigations.

Benefits:

- Helps meet regulatory requirements (e.g., GDPR, HIPAA, ISO 27001).
- Provides transparency for internal and external audits.
- Detects and alerts on abnormal access patterns or security breaches.

5. Scalability

What it does:

- Supports **large, complex organizations** with:
    - Thousands of users.
    - Multiple departments and sub-departments.
    - Cross-functional teams and temporary projects.

How it scales:

- Modular architecture that can handle high user volume.
- Integration with distributed systems and cloud-based services.
- Load balancing and redundancy to ensure reliability.

Benefits:

- Seamlessly adapts as the organization grows.
- Maintains consistent performance and security even with increased demand.

6. System Requirements

System requirements define the **minimum and recommended specifications** needed to develop, deploy, and run the proposed system efficiently. They are divided into two main categories:

1. **Hardware Requirements** – the physical components (servers, computers, storage, etc.)
2. **Software Requirements** – the operating systems, platforms, tools, and applications required.

A. Hardware Requirements

The hardware specifications depend on the **scale of deployment** (small organization vs. large enterprise). Below are generalized and scalable hardware requirements:

1. Server-Side Hardware

This refers to the machines hosting the system (application server, database server, and possibly a backup or log server).

Component	Minimum Specification	Recommended Specification	Description
Processor (CPU)	Quad-Core Intel/AMD (2.5 GHz or higher)	8-Core or higher (3.0 GHz or higher)	Handles request processing, role computation, and workflow automation.
RAM (Memory)	8 GB	16–32 GB	Ensures smooth performance when handling concurrent user access and logging.
Storage (Hard Disk/SSD)	500 GB HDD	1–2 TB SSD	Stores user data, access logs, and workflow configurations. SSD preferred for faster read/write.
Network	1 Gbps Ethernet	10 Gbps Ethernet	Supports multi-user access and data transfers.
Backup Device	External HDD / NAS	Cloud backup or RAID storage	Provides redundancy and data recovery.

2. Client-Side Hardware

These are the user computers or terminals accessing the system through a web or desktop interface.

Component	Minimum	Recommended	Description
Processor	Dual-Core (2.0 GHz)	Quad-Core (2.5 GHz or higher)	Handles user interface operations.
RAM	4 GB	8 GB	Supports smooth browser or desktop app operation.
Storage	100 GB	256 GB SSD	For local cache and temporary data.
Display	1024×768 resolution	1920×1080 (Full HD)	For clear visualization of dashboards and reports.
Internet Connection	5 Mbps	25 Mbps or higher	Ensures smooth real-time workflow updates.

B. Software Requirements

The software stack includes the **operating systems, databases, development tools, frameworks**, and **third-party integrations** required to build and maintain the system.

1. Operating Systems

Layer	Options	Description
Server OS	Linux (Ubuntu Server, CentOS, Red Hat), Windows Server	Stable platforms for hosting application and database services.
Client OS	Windows 10/11, macOS, Linux	Supports web or desktop access interfaces.

2. Application and Web Server

Component	Example Technologies	Description
Web/Application Server	Apache Tomcat, Nginx, Node.js, IIS	Hosts the web interface and application logic.
API Gateway (optional)	Kong, AWS API Gateway	Manages communication between services and enhances scalability.

3. Database Management System (DBMS)

Type	Options	Description
Relational Database	MySQL, PostgreSQL, MS SQL Server	Stores user, role, group, and audit data in structured form.
NoSQL (optional)	MongoDB, Cassandra	Used for logging and high-volume audit trails.

4. Development Environment

Component	Example Tools	Purpose
Programming Languages	Python, Java, C#, JavaScript (Node.js)	For backend and workflow logic.
Frontend Frameworks	React.js, Angular, Vue.js	For building user dashboards and management interfaces.
Integrated Development Environment (IDE)	Visual Studio Code, Eclipse, IntelliJ IDEA	For code development and debugging.
Version Control	Git, GitHub, GitLab	Tracks changes in source code.

5. Access Control and Security Software

Tool	Function
Identity and Access Management (IAM)	Central authentication, SSO, and MFA (e.g., Keycloak, Okta, Azure AD).
Encryption Libraries	Protect sensitive data in storage and transmission

Tool	Function
Audit & Monitoring Tools	ELK Stack (Elasticsearch, Logstash, Kibana) for real-time tracking.

6. Workflow and Automation Tools

Tool	Description
Workflow Engine	Camunda, Activiti, or custom BPMN engine to handle workflow transitions.
Notification Services	Email (SMTP), SMS API, or Slack/Teams integration for user notifications.

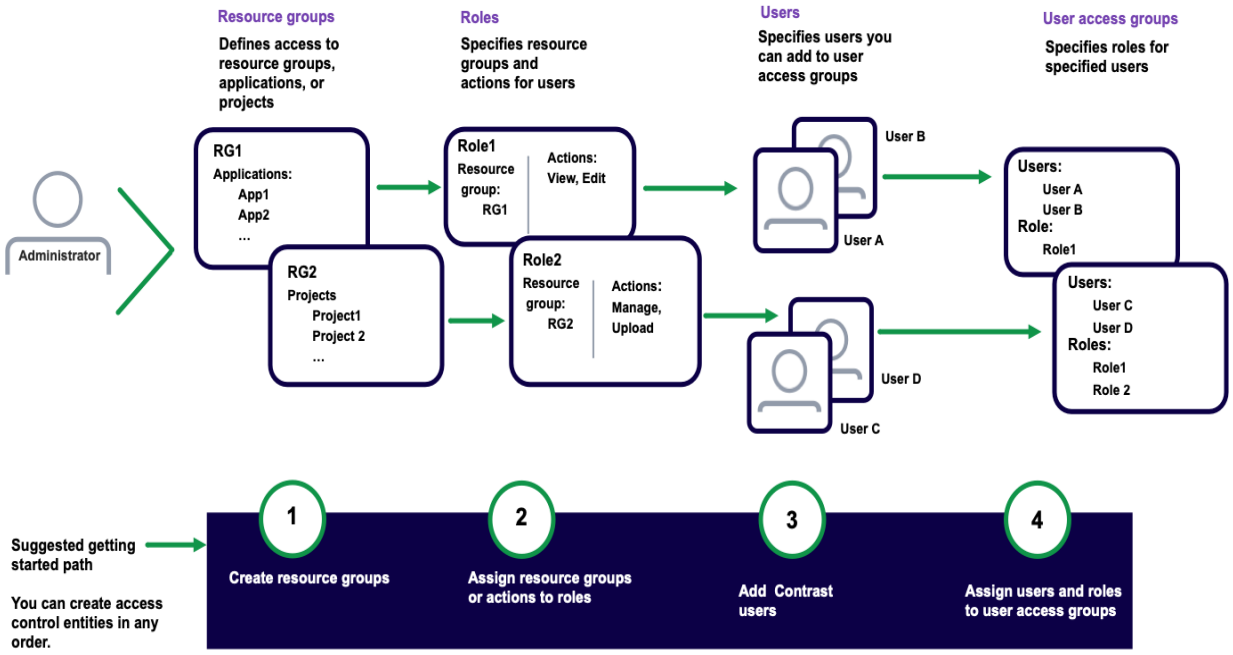
7. Additional Software (Optional Enhancements)

Tool	Purpose
Containerization Platform	Docker, Kubernetes – for scalable deployment.
Backup & Recovery Tools	Veeam, Acronis, or cloud-based backups.
Testing Frameworks	Selenium, JUnit, PyTest for quality assurance.

Example Architecture Setup

- **Backend Server:** Ubuntu Server 22.04 running Nginx + Node.js + PostgreSQL
- **Frontend:** React-based web app served via Nginx
- **Authentication:** Keycloak for SSO and RBAC integration
- **Workflow Engine:** Camunda integrated with backend APIs
- **Logging & Auditing:** ELK Stack for real-time monitoring
- **Deployment:** Docker containers managed via Kubernetes for scalability

7. Block Diagram



The diagram outlines how an **Administrator** creates and manages access permissions for users through four major entities:

1. **Resource Groups**
2. **Roles**
3. **Users**
4. **User Access Groups**

At the bottom, it shows a **suggested workflow** (steps 1–4) for implementing access control — from defining resources to assigning users and roles.

Step-by-Step Detailed Explanation

1. Resource Groups (RG)

Definition:

A *resource group* is a logical container that organizes related assets (applications, projects, files, or services).
Each resource group defines what type of resources users can access.

In the diagram:

- **RG1** includes applications: *App1, App2, ...*
- **RG2** includes projects: *Project1, Project2, ...*

Purpose:

To simplify access control by grouping resources that require similar permissions.

Administrator's Role:

- Creates and names resource groups.
- Categorizes resources under each group (e.g., applications, projects, or databases).

Outcome:

Organized resources that are easier to assign and control access to.

2. Roles

Definition:

A *role* defines a set of permissions or actions that can be performed on specific resource groups.

In the diagram:

- **Role1** → Associated with **RG1** (Resource Group 1)
  - **Actions:** View, Edit
- **Role2** → Associated with **RG2** (Resource Group 2)
  - **Actions:** Manage, Upload

Purpose:

Roles are templates of permissions — instead of granting each permission to a user individually, the administrator assigns a role.

Administrator's Role:

- Defines which resource group(s) a role applies to.
- Specifies what actions (permissions) that role allows.

Example:

- A *Finance Analyst* role may have "View Reports" and "Edit Budgets" permissions.
- A *Project Manager* role may have "Manage Project" and "Upload Documents" permissions.

Outcome:

Standardized and reusable permission sets.

3. Users

Definition:
Users are the individuals (employees, contractors, or partners) who need access to specific applications, projects, or systems.

In the diagram:

- **User A** and **User B** are associated with **Role1** (and therefore RG1).
- **User C** and **User D** are associated with **Role2** (and therefore RG2).

Purpose:
Users inherit permissions indirectly through their assigned roles. This ensures consistency and scalability — changes to a role automatically affect all users with that role.

Administrator's Role:

- Adds users to the system.
- Assigns users to appropriate roles based on department, project, or function.

Outcome:
Users gain access based on business logic rather than individual assignments.

4. User Access Groups

Definition:
A *User Access Group* is a higher-level grouping that defines which users and roles belong together for access management.
It links **users** and **roles** for collective management.

In the diagram:

- The first access group includes:
  - **Users:** User A, User B
  - **Role:** Role1
- The second access group includes:
  - **Users:** User C, User D
  - **Roles:** Role1, Role2

Purpose:

Access groups simplify bulk management — instead of assigning roles to users individually, administrators can manage permissions for an entire group.

Administrator's Role:

- Creates access groups based on departments, teams, or projects.
- Assigns relevant roles and users to each group.

Outcome:

Centralized and scalable access management structure.

8. Program (Sample Code Snippet in Python – Flask)

```
from flask import Flask, request, jsonify
app = Flask(__name__)
# Sample role database
roles = {
   "admin": ["create_user", "delete_user", "view_reports"],
   "manager": ["approve_task", "view_reports"],
```

```
    "employee": ["submit_task"]
}
# Sample users with assigned roles
users = {
    "alice": "admin",
    "bob": "manager",
    "charlie": "employee"
}
@app.route('/check_access', methods=['GET'])
def check_access():
    username = request.args.get('user')
    action = request.args.get('action')
 role = users.get(username)
if not role:
return jsonify({"error": "User not found"}), 404
permissions = roles.get(role, [])
if action in permissions:
return jsonify({"access": "granted"})
else:
return jsonify({"access": "denied"})
if __name__ == '__main__':
app.run(debug=True)
```

9. Output

Example 1:

Input: /check_access?user=alice&action=delete_user

Output: {"access": "granted"}

Example 2:

Input: /check_access?user=charlie&action=approve_task

Output: {"access": "denied"}

Example 3:

Input: /check_access?user=bob&action=view_reports

Output: {"access": "granted"}

10. Conclusion

In conclusion, the proposed system offers an intelligent, automated, and centralized solution for managing user access, roles, and groups within an organization. It is built on the foundation of **Role-Based Access Control (RBAC)** integrated with **workflow automation**, enabling dynamic and efficient access management. Through this system, an administrator can define **resource groups** that represent applications, projects, or services, and then create **roles** that specify what actions users can perform within those resource groups. Users are assigned to these roles based on factors such as department, position, or project involvement, and their permissions are automatically updated as they move through different workflow stages. This automation eliminates the need for manual intervention, significantly reducing administrative workload and minimizing human error. The system's **centralized role repository** provides a single point of control for all access policies, ensuring consistency, accuracy, and ease of management across multiple

departments and organizational levels. It also features robust **audit and logging mechanisms** that record every access modification and user activity, supporting accountability and compliance with regulatory standards such as GDPR, HIPAA, or ISO 27001. Moreover, the system's **scalable architecture** supports large enterprises with multi-level hierarchies and complex workflows, while maintaining high performance and security. By combining automation, scalability, and transparency, the proposed system enhances security by ensuring that users only have access to the resources they need, when they need them—thereby adhering to the principle of least privilege. Overall, this system not only strengthens organizational governance and compliance but also streamlines workflow operations, reduces administrative overhead, and improves operational efficiency. It ultimately ensures that access control is consistent, dynamic, and secure, making it a vital tool for modern organizations seeking to balance productivity, compliance, and data protection.