ROHINI
COLLEGE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
Approved By AICTE & Affiliated to Anna University
NBA Accredited for All Eligible B.E/B.Tech Programs | NAAC Accredited with A+ Grade
Near Anjugramam - Kanyakumari Main Road, Palkulam, Variyoor P.O.-629401, Kanyakumari Dist, Tamil Nadu.

HONOURS / MINOR CREDIT COURSE (MCC)

Curriculum & Syllabus

(2024-2025 Admitted Students Onwards)

CREDIT INFO		
Sl.No	**Category**	**Credits**
1	HONOURS / MINOR CREDIT COURSE (MCC)	18

CREDIT DISTRIBUTION

Sl. No.	Course Category	Credit/Semester								No. of Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HONOURS / MINOR CREDIT COURSE (MCC)	--	--	--	--	--	6	6	6	18

HONOURS / MINOR PROGRAM							
Sl.No	**Course Code**	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
SMART CITIES							
PROGRAMMES ELIGIBLE FOR HONOURS- B.E – CIVIL, ECE PROGRAMMES ELIGIBLE FOR MINOR- ALL OTHER UG BRANCHES							
1	24SY501	Fundamentals of Smart Cities and Sustainable Urban Development	MCC	3	0	0	3
2	24SY502	Internet of Things (loT) and Sensor Networks for Smart Cities	MCC	3	0	0	3
3	24SY601	Data Analytics, GIS and Digital Twin for Smart Cities	MCC	3	0	0	3
4	24SY602	Smart Infrastructure, Energy and Mobility Systems	MCC	3	0	0	3
5	24SY701	Al, Cybersecurity and Governance for Smart Cities	MCC	3	0	0	3
6	24SY702	Smart City Innovation Project / Capstone	MCC	3	0	0	3

Course Code:	**24SY501**	**Course Title:**	**FUNDAMENTALS OF SMART CITIES AND SUSTAINABLE URBAN DEVELOPMENT**
Credits:	**3**	**L – T – P**	**3-0-0**
Pre -requisite			

Course objectives:

- Understand the basics of climate change, sustainability, smart technologies, and green energy management.
- Optimizing resource management, designing resilient infrastructure, and enhancing citizen quality of life in rapidly expanding urban environments

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – FUNDAMENTALS OF SMART CITIES AND SUSTAINABLE URBANISM	**[9 hours]**
Urbanization, need of focused development, role of Authorities, Smart city, Opportunity and Challenges- Smart infrastructures for city, Smart Cities Mission	

UNIT II –IOT AND SMART CITY ARCHITECTURE	**[9 hours]**
Sensing & IoT Layer: Types of urban sensors (environmental, acoustic, optical); actuators; and smart utility meters. Communication Infrastructure: Networking protocols (5G, fiber optic networks, LPWAN technologies like LoRaWAN). Data Science for Cities: Big data analytics; spatial analysis using Geographic Information Systems (GIS) and Building Information Modeling (BIM). Digital Twins: Concept, implementation, and simulation-based decision-making in city government.	

UNIT III – SMART PHYSICAL INFRASTRUCTURE	[9 hours]
Infrastructure development in Smart Cities – Physical Infrastructure, Land Use – Compact/mixed-use development, Transit oriented development (TOD); Smart City Management-Transportation Unified governance structure (UMTA). Smart public transportation, Smart parking, Intelligent traffic management, Detour management; Low emission vehicles, Electric Mobility – Environmental projects etc	

UNIT IV – SUSTAINABILITY AND SMART PLANNING	[9 hours]
Relationship Between Sustainability and Smart planning – Place making project guidelines Surveillance, Smart Street Lighting, Intelligent Emergency Services, Intelligent Disaster Forecasting and Management, GIS-based Spatial Decision Support Systems, Smart Communication Services	

UNIT V – SMART MOBILITY, LOGISTICS, AND TRANSPORTATION	[9 hours]
Intelligent Transportation Systems (ITS): Dynamic traffic management; automated incident detection; real-time traveler information systems. Mobility-as-a-Service (MaaS): App-based aggregation of public transit, micro-mobility (e-bikes/scooters), and on-demand shared shuttles. Vehicle Electrification: Charging infrastructure allocation; vehicle-to-grid (V2G) power flow; and smart logistics/last-mile delivery solutions. Pedestrianization and Public Space: Street reclaiming; active transit networks; and tactical urban interventions.	

TOTAL: 45 PERIODS

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Assess the core opportunities and challenges of the Smart Cities Mission, and determine the structural roles that urban authorities play in driving focused, sustainable development.
CO2	Design IoT and Data-Driven Architecture for Digital Twins
CO3	Evaluate Smart Physical Infrastructure and Land-Use Planning
CO4	Formulate Smart Planning Strategies for Resilient Cities
CO5	Implement Intelligent Transportation Systems and Smart Logistics

COs and POs Mapping:

COs	POs										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
CO1	3	2	-	-	-	-	-	2	-	-	-
CO2	2	3	2	1	-	-	-	2	-	-	2
CO3	2	2	3	3	2	-	-	2	-	-	2
CO4	2	3	3	3	2	2	-	2	-	2	3
CO5	2	3	2	3	3	1	-	1	2	2	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped,
Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of Assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIA – I	100	50	100	40
	CIA – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	**100**

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or)
- All the fifteen questions have to be answered.

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Terminal Examination
	1	2	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse	0	0	0
Evaluate	0	0	0
Create	0	0	0

TEXTBOOKS:

1. P Sharma, Sustainable Smart cities in India, Challenges and Future Perspectives, Springer Link, 2017
2. Sameer Sharma, Smart Cities Unbounded- Ideas and Practice of Smart Cities in India, Bloomsbury India, 2018.

REFERENCES:

1. Anilkumar, Introduction to Smart Cities, Pearson India Education Services, 2020.
2. Jonathan Reichenta, Smart Cities for Dummies, 2020
3. Kassim Rehana Dr, Big Data for a Sustainable Smart City, Partridge Publishing Singapore, 2020
4. Mani.N, Smart Cities and Urban Development in India, New Century Publications, 2016
5. Stan Geertman, Joseph Ferreira, Jr., Robert Goodspeed, John Stillwell, "Planning Support Systems and Smart Cities", Lecture Notes in Geoformation and Cartography, Springer, 2015
6. Anthony M Townsend, Smart Cities – Big Data, Civic Hackers, and the Quest for a New Utopia, W. W. Norton & Company, 2013

Web Links and Video Lectures (E-Resources):

https://nptel.ac.in/courses/105106832

COURSE CODE:	24SY502	COURSE TITLE:	INTERNET OF THINGS AND SENSOR NETWORKS FOR SMART CITIES
Credits:	3	L – T – P	3-0-0
Pre-requisite			24EE404-IOT SENSORS AND DEVICES

Course objectives:

- Introduce the fundamental concepts of the Internet of Things (IoT), wireless sensor networks, and their significance in smart city ecosystems.
- Provide knowledge of smart city architectures, IoT communication technologies, sensor networks, and urban IoT infrastructure.
- Develop the ability to apply IoT technologies for designing smart city applications in transportation, energy, healthcare, water, waste management, and environmental monitoring.
- Familiarize students with IoT security, privacy, data management, and cloud/edge computing techniques for smart city systems.
- Expose students to emerging technologies such as Artificial Intelligence of Things (AIoT), Digital Twins, 5G, Edge Computing, and Green IoT for sustainable smart city development.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Technology-Enabled Learning
3. Project based Learning
4. Experiential Learning
5. Collaborative Learning
6. Smart Class Room
7. Flipped Class

UNIT I – INTRODUCTION TO IoT AND SENSOR NETWORKS	[9 hours]
Introduction to Smart Cities: Smart City Concepts, Smart City Architecture, Smart City Infrastructure, IoT-enabled Smart City Applications. **Emerging Trends:** Edge Computing, Fog Computing, AIoT (Artificial Intelligence of Things), Digital Twin Technology, Blockchain for IoT, TinyML, 5G-enabled Smart Cities.	

UNIT II – SMART CITY IoT ARCHITECTURE AND URBAN SENSOR NETWORKS	[9 hours]
Introduction to Smart Cities: Smart City Concepts, Smart City Architecture, Smart City Infrastructure, IoT-enabled Smart City Applications. **Emerging Trends:** Edge Computing, Fog Computing, AIoT (Artificial Intelligence of Things), Digital Twin Technology, Blockchain for IoT, TinyML, 5G-enabled Smart Cities.	

UNIT II – SMART CITY IoT ARCHITECTURE AND URBAN SENSOR NETWORKS	[9 hours]
Smart City Architecture: Layered Smart City Architecture, ICT Infrastructure, Urban IoT Architecture, Smart City Reference Models. **Urban Sensor Networks:** Wireless Sensor Networks (WSN), Internet of Everything (IoE), Sensor Deployment Strategies, Heterogeneous Sensor Networks, Gateway Architecture. **Communication Infrastructure:** LPWAN Technologies (LoRaWAN, NB-IoT, LTE-M), 5G-enabled Smart Cities, Edge and Fog Computing for Urban IoT, Cloud-based Smart City Platforms.	

UNIT III – SMART CITY APPLICATIONS	[9 hours]
Smart Transportation: Intelligent Traffic Management, Smart Parking, Connected Vehicles. **Smart Energy:** Smart Grid, Smart Metering, Energy Monitoring. **Emerging Trends:** AI-based Smart City Services, Sustainable Smart Cities.	

UNIT IV – IoT SECURITY AND DATA MANAGEMENT FOR SMART CITIES	[9 hours]
IoT Security: Security Challenges, Authentication, Authorization, Encryption, Secure Communication. **Privacy:** Data Privacy, Access Control, Secure Data Sharing. **Data Management:** Data Collection, Cloud Storage, Edge Computing, Real-time Data Processing. **Smart City Analytics:** Big Data Analytics, Data Visualization, Decision Support Systems. **Emerging Trends:** Blockchain for IoT, AI-based Security, Federated Learning.	

UNIT V – EMERGING TECHNOLOGIES FOR SMART CITIES	[9 hours]
Artificial Intelligence in IoT: AIoT, Machine Learning for Smart Cities. **Digital Twin:** Smart City Modeling and Simulation. **Advanced Communication:** 5G, LPWAN, Edge and Fog Computing. **Sustainable Smart Cities:** Green IoT, Energy-efficient Sensor Networks. **Future Trends:** Internet of Everything (IoE), Autonomous Smart Cities, Smart Governance	

Course outcomes:

On completion of the course, the student will have the ability to:

CO No	Course Outcomes	Cognitive Level
CO1	Explain the fundamentals of Internet of Things (IoT), wireless sensor networks, communication technologies, and their role in smart city applications.	**K2**
CO2	Describe IoT architectures, urban sensor network infrastructures, communication protocols, and smart city platforms used for smart city services.	**K2**
CO3	Apply IoT technologies and sensor networks to develop solutions for smart transportation, healthcare, energy, water, waste management, and environmental monitoring.	**K3**
CO4	Apply appropriate security, privacy, and data management techniques for IoT-enabled smart city systems.	**K3**
CO5	Demonstrate the use of emerging technologies such as AIoT, Edge Computing, Digital Twins, 5G, and Green IoT in smart city applications.	**K3**

COs and POs Mapping:

COs	POs										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
CO1	3	2	-	-	-	-	-	2	-	-	-
CO2	2	3	2	1	-	-	-	2	-	-	2
CO3	2	2	3	3	2	-	-	2	-	-	2
CO4	2	3	3	3	2	2	-	2	-	2	3
CO5	2	3	2	3	3	1	-	1	2	2	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped,

Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
Total					100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Terminal Examination
	1	2	
Remember	20	20	10
Understand	40	20	30
Apply	40	60	60
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

Text Books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos and David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Academic Press (Elsevier), 2nd Edition, 2023.
2. Arshdeep Bahga and Vijay Madisetti, Internet of Things – A Hands-on Approach, Universities Press, 2nd Edition, 2021.
3. Zaigham Mahmood (Ed.), Smart *Cities: Development and Governance Frameworks*, Springer, **2022**.

Reference Books:

1. Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on Approach), Universities Press, 2021
2. Houbing Song, Ravi Srinivasan, Tamim Sookoor and Sabina Jeschke (Eds.), Smart Cities: Foundations, Principles, and Applications, Wiley, 2017.
3. Rajkumar Buyya and Amir Vahid Dastjerdi (Eds.), Internet of Things: Principles and Paradigms, Morgan Kaufmann (Elsevier), 2016.

Web Links and Video Lectures (E-Resources):

1. https://www.nptel.ac.in/courses/106105166– NPTEL – Introduction to Internet of Things (IIT Kharagpur)
2. https://www.nptel.ac.in/courses/105106832– NPTEL – Smart Cities (IIT Indore)

Skill Development Activities

1. **IoT Hardware Interfacing**: Interface sensors and actuators with Arduino/ESP32/Raspberry Pi for smart city applications.
2. **IoT Communication**: Configure and demonstrate communication using MQTT, Wi-Fi, Bluetooth, ZigBee, or LoRa for sensor data transmission.
3. **Smart City Prototype Development**: Develop mini-projects such as smart parking, smart street lighting, smart waste monitoring, smart water quality monitoring, or environmental monitoring systems.
4. **Cloud and Dashboard Development**: Connect IoT devices to cloud platforms (ThingSpeak, Blynk, AWS IoT, or Azure IoT) and visualize real-time sensor data.
5. **Simulation and Case Studies**: Simulate IoT-based smart city systems using Cisco Packet Tracer, NS-3, or similar tools and analyze real-world smart city case studies.
6. **Seminar and Technical Presentation**: Present recent advancements in AIoT, Digital Twins, 5G, Edge Computing, Green IoT, and Smart City technologies.
7. **Mini Project**: Design and implement an IoT-enabled smart city application integrating sensors, communication, cloud services, and data visualization.
8. **Industry Interaction**: Participate in webinars, workshops, hackathons, or industrial visits related to IoT, sensor networks, and smart city technologies.

COURSE CODE:	24SY601	COURSE TITLE:	DATA ANALYTICS, GIS AND DIGITAL TWIN FOR SMART CITIES
Credits:	3	L – T – P	3-0-0
Pre-requisite			24SY502-INTERNET OF THINGS AND SENSOR NETWORKS FOR SMART CITIES

Course objectives:

- Introduce the concepts of Data Analytics, Geographic Information Systems (GIS), and Digital Twin technologies in the context of smart cities.
- Provide knowledge of data acquisition, preprocessing, visualization, and spatial analytics for urban decision-making.
- Develop the ability to apply GIS techniques for mapping, spatial analysis, and urban infrastructure management.
- Familiarize students with Digital Twin architecture, IoT integration, BIM-GIS integration, and real-time urban monitoring.
- Expose students to emerging technologies and applications for sustainable, resilient, and intelligent smart cities.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Technology-Enabled Learning
3. Project based Learning
4. Experiential Learning
5. Collaborative Learning
6. Smart Class Room
7. Flipped Class

UNIT I – INTRODUCTION TO SMART CITIES, DATA ANALYTICS AND GIS	[9 hours]

Introduction to Smart Cities: Urbanization, Smart City Concepts, Components, Digital Infrastructure, Smart City Architecture. Data Analytics Fundamentals: Types of Data, Data Lifecycle, Data Collection, Data Cleaning, Data Preprocessing, Data Visualization. GIS Fundamentals: Spatial Data Models, Coordinate Systems, Raster and Vector Data, GPS, Remote Sensing. Emerging Trends: Open Data Platforms, Urban Digital Transformation.

UNIT II – DATA ANALYTICS FOR SMART CITY APPLICATIONS	**[9 hours]**
Urban Data Analytics: Descriptive, Diagnostic, Predictive and Prescriptive Analytics. Big Data Analytics for Smart Cities. Machine Learning Basics: Regression, Classification, Clustering. Data Visualization Techniques. Applications: Smart Transportation, Energy Management, Water Distribution, Waste Management, Environmental Monitoring. Emerging Trends: AI-assisted Analytics, Real-time Urban Dashboards	

UNIT III – GIS FOR SMART CITY PLANNING	**[9 hours]**
Spatial Analysis Techniques: Buffer Analysis, Overlay Analysis, Network Analysis, Hotspot Analysis, Spatial Querying. Urban Mapping: Land Use/Land Cover Mapping, Urban Growth Analysis, Infrastructure Mapping, Utility Mapping. Spatial Databases: PostgreSQL/PostGIS, GeoServer. Web GIS and Geospatial Data Sharing. Emerging Trends: 3D GIS, CityGML, Cloud GIS.	

UNIT IV – DIGITAL TWIN FOR SMART CITIES	**[9 hours]**
Digital Twin Fundamentals: Concepts, Architecture, Digital Thread, Digital Shadow. IoT-enabled Data Acquisition. BIM–GIS Integration. Real-time Monitoring and Simulation. Urban Asset Management. Applications: Smart Buildings, Transportation Systems, Utilities, Disaster Management, Predictive Maintenance. Emerging Trends: Edge Computing, Cloud Digital Twins, AI-driven Digital Twins.	

UNIT V – EMERGING TECHNOLOGIES AND SMART CITY APPLICATIONS	**[9 hours]**
Advanced Technologies: Internet of Things (IoT), Artificial Intelligence, Edge Computing, Cloud Computing, Blockchain for Smart Cities. Sustainable Urban Development. Urban Resilience. Digital Governance and Decision Support Systems. Ethical Issues, Data Privacy, Security and Future Research Trends in Smart Cities	

Course outcomes:

On completion of the course, the student will have the ability to:

CO No	Course Outcomes	Cognitive Level
CO1	Explain the concepts of Data Analytics, GIS, and Digital Twin technologies in smart city ecosystems.	**K2**
CO2	Describe spatial data models, GIS techniques, and urban data analytics methods.	**K2**
CO3	Apply data analytics and GIS tools for solving urban planning and infrastructure management problems.	**K3**
CO4	Develop Digital Twin models by integrating GIS, IoT, and urban datasets for smart city applications.	**K3**
CO5	Demonstrate the use of emerging technologies such as AI, BIM-GIS integration, Cloud Computing, and Digital Twins for sustainable smart cities.	**K3**

COs and POs Mapping:

COs	POs										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
CO1	3	2	-	-	-	-	-	2	-	-	-
CO2	2	3	2	1	-	-	-	2	-	-	2
CO3	2	2	3	3	2	-	-	2	-	-	2
CO4	2	3	3	3	2	2	-	2	-	2	3
CO5	2	3	2	3	3	1	-	1	2	2	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
Total					100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Terminal Examination
	1	2	
Remember	20	20	10
Understand	40	20	30
Apply	40	60	60
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

Text Books:

1. Paul Longley, Michael Goodchild, David Maguire and David Rhind, Geographical Information Systems and Science, 5th Edition, Wiley, 2021.
2. Michael Batty, The New Science of Cities, MIT Press, 2018
3. Foster Provost and Tom Fawcett, Data Science for Business, O'Reilly Media, 2013.

Reference Books:

1. Zaigham Mahmood (Ed.), Smart Cities: Development and Governance Frameworks, Springer, 2022.
2. Qi Hao, Digital Twin Driven Smart Manufacturing, Academic Press, 2021.
3. Houbing Song et al. (Eds.), Smart Cities: Foundations, Principles and Applications, Wiley, 2017.
4. O'Sullivan D. and Unwin D., Geographic Information Analysis, 3rd Edition, Wiley, 2014.

Web Links and Video Lectures (E-Resources):

1. https://www.nptel.ac.in/courses/106105166– NPTEL – Introduction to Internet of Things (IIT Kharagpur)
2. https://www.nptel.ac.in/courses/105106832– NPTEL – Smart Cities (IIT Indore)

Skill Development Activities

1. Perform exploratory data analysis on smart city datasets using Python.
2. Develop thematic and spatial maps using QGIS or ArcGIS.
3. Conduct spatial analysis such as buffer, overlay, hotspot, and network analysis.
4. Build dashboards using Power BI or Tableau for urban analytics.
5. Integrate IoT sensor data with GIS platforms for real-time visualization.
6. Develop a simple Digital Twin prototype using GIS and IoT datasets.
7. Analyze case studies on Digital Twin implementations in transportation, utilities, and urban infrastructure.
8. Mini Project: Design a Smart City solution integrating Data Analytics, GIS, and Digital Twin technologies.
9. Participate in workshops, hackathons, webinars, or industrial visits related to GIS, Digital Twins, Smart Cities, and Urban Analytics.

Course Code:	24SY602	Course Title:	SMART INFRASTRUCTURE, ENERGY AND MOBILITY SYSTEMS
Credits:	3	L – T – P	3-0-0
Pre -requisite			NIL

Course objectives:

The student should be able to:

- Explain the concepts of smart infrastructure and sustainable development.
- Understand smart energy systems and renewable energy integration.
- Learn intelligent transportation and smart mobility technologies.
- Apply IoT, AI and digital technologies in infrastructure management.
- Analyze smart city applications for sustainable urban development.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Lab experiment videos
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – SMART INFRASTRUCTURE	[9 hours]
Introduction to Smart Infrastructure – Smart Cities – Sustainable Urban Development – Components of Smart Infrastructure – Smart Buildings – Smart Utilities – Infrastructure Asset Management – Building Information Modelling (BIM) – Geographic Information System (GIS) – Internet of Things (IoT) in Infrastructure – Structural Health Monitoring – Introduction to Digital Twins – AI-based Infrastructure Monitoring – Climate-resilient Infrastructure.	

UNIT II – SMART ENERGY SYSTEMS	**[9 hours]**
Conventional and Smart Grid – Renewable Energy Sources – Distributed Energy Resources – Solar and Wind Energy Integration – Microgrids – Energy Storage Systems – Smart Metering – Energy Management Systems – Demand Side Management – Electric Vehicle Charging Infrastructure – Vehicle-to-Grid (V2G) Concepts – AI-based Energy Forecasting – Introduction to Green Hydrogen – Grid Cyber Security.	

UNIT III – SMART MOBILITY SYSTEMS	**[9 hours]**
Intelligent Transportation Systems (ITS) – Traffic Monitoring and Management – Smart Parking – Public Transport Systems – Electric Vehicles – Battery Technologies – Battery Management Systems – EV Charging Technologies – Connected Vehicles – Autonomous Vehicles – Vehicle-to-Everything (V2X) Communication – Mobility as a Service (MaaS) – AI-based Traffic Signal Control – Shared Mobility.	

UNIT IV – ENABLING DIGITAL TECHNOLOGIES	**[9 hours]**
Internet of Things (IoT) – Wireless Sensor Networks – Cloud Computing – Edge Computing – Artificial Intelligence – Machine Learning – Big Data Analytics – Blockchain Applications – Cyber Security – Digital Twin Applications – Predictive Maintenance – 5G-enabled Smart Infrastructure – Introduction to Generative AI in Smart Cities.	

UNIT V – SMART CITIES AND SUSTAINABLE DEVELOPMENT	**[9 hours]**
Smart Water Management – Smart Waste Management – Green Buildings – Circular Economy – Smart Governance – Disaster Management – Carbon Neutral Infrastructure – Net-Zero Energy Buildings – Urban Digital Twins – Smart Campus – Sustainable Development Goals (SDGs) – Future Trends in Smart Infrastructure, Energy and Mobility Systems.	

TOTAL: 45 PERIODS

Course outcomes:

On completion of the course, the student will have the ability to:

CO1	Explain the concepts of smart infrastructure and sustainable urban development.
CO2	Describe smart energy systems and renewable energy technologies.
CO3	Analyze intelligent transportation systems and smart mobility solutions.
CO4	Apply IoT, AI and digital technologies for infrastructure monitoring and management.
CO5	Evaluate smart city solutions for sustainable and resilient infrastructure.

COs and POs Mapping:

COs	**POs**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
CO1	3	2	1	-	-	3	-	-	2	-	1
CO2	3	2	2	-	2	3	-	-	1	-	2
CO3	2	3	3	2	2	2	-	1	2	1	1
CO4	2	2	2	2	3	2	-	1	2	1	2
CO5	2	3	3	2	2	3	1	2	2	2	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of Assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIA – I	100	50	100	40
	CIA – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	**100**

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or)
- All the fifteen questions have to be answered.

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Terminal Examination
	1	2	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse	0	0	0
Evaluate	0	0	0
Create	0	0	0

TEXTBOOKS:

1. Anil Kumar, P.P., Introduction to Smart Cities, Pearson Education India, First Edition, 2019. (Covers smart infrastructure, smart energy, smart mobility, ICT, Indian and international case studies.)
2. Houbing Song, Ravi Srinivasan, Tamim Sookoor and Sabina Jeschke (Eds.), Smart Cities: Foundations, Principles, and Applications, John Wiley & Sons, 2017. (Comprehensive coverage of smart infrastructure, transportation, energy systems, IoT, and cyber-physical systems.)
3. Stan McClellan, Jesus A. Jimenez and George Koutitas (Eds.), Smart Cities: Applications, Technologies, Standards, and Driving Factors, Springer, 2018. (Focuses on infrastructure, mobility technologies, standards, and implementation.)

REFERENCES:

1. Juan Carlos Augusto (Ed.), Handbook of Smart Cities, Springer, 2021. (A comprehensive reference covering smart infrastructure, energy, mobility, governance, AI, and urban sustainability.)
2. Rashid Mehmood, Simon See, Iyad Katib and Imrich Chlamtac (Eds.), Smart Infrastructure and Applications: Foundations for Smarter Cities and Societies, Springer, 2019. (Covers smart transportation, smart grids, AI, IoT, and urban infrastructure.)
3. Deepak Kumar (Ed.), Urban Energy Systems: Modeling and Simulation for Smart Cities, Wiley-Scrivener, 2023. (Focuses on urban energy systems, renewable integration, and sustainable smart cities.)
4. Anirudh Gautam, Sudipta De, Atul Dhar et al. (Eds.), Sustainable Energy and Transportation: Technologies and Policy, Springer, 2018. (Discusses sustainable transport, energy technologies, and smart city applications.)

COURSE CODE:	24SY701	COURSE TITLE:	AI, CYBERSECURITY AND GOVERNANCE FOR SMART CITIES
Credits:	3	L – T – P	3-0-0
Pre-requisite			24EE404-IOT SENSORS AND DEVICES 24SY502-INTERNET OF THINGS AND SENSOR NETWORKS FOR SMART CITIES

Course objectives:

- Introduce the concepts of Artificial Intelligence, Cybersecurity, and Smart Governance in the context of smart cities.
- Provide knowledge of AI techniques, cybersecurity principles, and digital governance frameworks for intelligent urban systems.
- Develop the ability to apply AI and data analytics to smart city applications and decision-making.
- Familiarize students with cybersecurity threats, privacy issues, and security mechanisms for IoT-enabled smart city infrastructure.
- Expose students to emerging technologies, standards, and governance models for sustainable, secure, and intelligent smart cities.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Technology-Enabled Learning
3. Project based Learning
4. Experiential Learning
5. Collaborative Learning
6. Smart Class Room
7. Flipped Class

UNIT I – INTRODUCTION TO SMART CITIES, AI AND CYBERSECURITY	**[9 hours]**
Introduction to Smart Cities: Smart City Concepts, Characteristics, Digital Infrastructure, Smart City Architecture. Artificial Intelligence: Fundamentals, AI Life Cycle, Machine Learning Basics, Deep Learning Overview. Cybersecurity Fundamentals: Security Principles, Threats, Vulnerabilities, Cyber Attacks, Security Requirements. Emerging Trends: AIoT, Digital Governance, Sustainable Smart Cities.	

UNIT II – AI FOR SMART CITY APPLICATIONS	**[9 hours]**
Machine Learning for Smart Cities: Supervised and Unsupervised Learning, Predictive Analytics. Computer Vision: Image Processing, Intelligent Surveillance, Traffic Monitoring. Natural Language Processing: Chatbots, Smart Citizen Services. AI Applications: Smart Transportation, Healthcare, Energy, Water, Waste Management, Environmental Monitoring. Emerging Trends: Generative AI, Explainable AI (XAI), Edge AI.	

UNIT III – CYBERSECURITY FOR SMART CITIES	**[9 hours]**
Cybersecurity Concepts: Authentication, Authorization, Encryption, Access Control, Identity Management. IoT Security: Device Security, Network Security, Secure Communication, Cloud Security. Privacy Protection: Data Privacy, Secure Data Sharing, Privacy Regulations. Security Standards: ISO 27001, NIST Cybersecurity Framework, Zero Trust Security. Emerging Trends: AI-driven Cybersecurity, Blockchain Security.	

UNIT IV – SMART CITY GOVERNANCE AND DATA MANAGEMENT	**[9 hours]**
Smart Governance: E-Governance, Digital Governance, Open Government Data, Citizen Engagement. **Urban Data Management:** Big Data Analytics, Cloud Computing, Edge Computing, Data Visualization, Decision Support Systems. **Governance Frameworks:** Smart City Policies, Ethics, Legal and Regulatory Issues, Sustainable Development Goals (SDGs). **Emerging Trends:** Data-driven Governance, AI-assisted Decision Making.	

UNIT V – EMERGING TECHNOLOGIES FOR SMART CITIES	**[9 hours]**
Digital Twin Technology: Urban Modeling and Simulation. Advanced Technologies: Blockchain, 5G/6G, Edge Computing, Internet of Everything (IoE). Sustainable Smart Cities: Green AI, Green Computing, Energy-efficient Systems. Future Smart Cities: Autonomous Urban Systems, Resilient Cities, Ethical AI, Responsible AI, Future Research Trends.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO No	Course Outcomes	Cognitive Level
CO1	Explain the fundamentals of Artificial Intelligence, cybersecurity, and smart governance in smart city ecosystems	**K2**
CO2	Describe AI techniques, cybersecurity mechanisms, and governance frameworks used in smart city applications.	**K2**
CO3	Apply AI methods and data analytics to solve problems in smart transportation, healthcare, energy, and urban management.	**K3**
CO4	Apply cybersecurity principles and privacy-preserving techniques to secure smart city infrastructure and services.	**K3**
CO5	Demonstrate the use of emerging technologies such as Explainable AI, Blockchain, Digital Twins, Zero Trust Security, and AI Governance in smart cities.	**K3**

COs and POs Mapping:

COs	POs										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
CO1	3	2	-	-	-	-	-	2	-	-	-
CO2	2	3	2	1	-	-	-	2	-	-	2
CO3	2	2	3	3	2	-	-	2	-	-	2
CO4	2	3	3	3	2	2	-	2	-	2	3
CO5	2	3	2	3	3	1	-	1	2	2	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped,

Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
Total					100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Terminal Examination
	1	**2**	
Remember	20	20	10
Understand	40	20	30
Apply	40	60	60
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson, 4th Edition, 2021.
2. William Stallings, Effective Cybersecurity: A Guide to Using Best Practices and Standards, Addison-Wesley, 2019.
3. Houbing Song, Ravi Srinivasan, Tamim Sookoor and Sabina Jeschke (Eds.), Smart Cities: Foundations, Principles, and Applications, Wiley, 2017.

Reference Books:

1. Zaigham Mahmood (Ed.), Smart Cities: Development and Governance Frameworks, Springer, 2022.
2. Michael Goodrich and Roberto Tamassia, Introduction to Computer Security, Pearson, 2nd Edition, 2021.
3. Nina Klimburg (Ed.), The Handbook of Cyber Security for Smart Cities, Springer, 2020.

Web Links and Video Lectures (E-Resources):

1. https://www.nptel.ac.in/courses/106105166– NPTEL – Introduction to Internet of Things (IIT Kharagpur)
2. https://www.nptel.ac.in/courses/105106832– NPTEL – Smart Cities (IIT Indore)

Skill Development Activities

1. IoT Hardware Interfacing: Interface sensors and actuators with Arduino/ESP32/Raspberry Pi for smart city applications.
2. IoT Communication: Configure and demonstrate communication using MQTT, Wi-Fi, Bluetooth, ZigBee, or LoRa for sensor data transmission.

3. Smart City Prototype Development: Develop mini-projects such as smart parking, smart street lighting, smart waste monitoring, smart water quality monitoring, or environmental monitoring systems.
4. Cloud and Dashboard Development: Connect IoT devices to cloud platforms (ThingSpeak, Blynk, AWS IoT, or Azure IoT) and visualize real-time sensor data.
5. Simulation and Case Studies: Simulate IoT-based smart city systems using Cisco Packet Tracer, NS-3, or similar tools and analyze real-world smart city case studies.
6. Seminar and Technical Presentation: Present recent advancements in AIoT, Digital Twins, 5G, Edge Computing, Green IoT, and Smart City technologies.
7. Mini Project: Design and implement an IoT-enabled smart city application integrating sensors, communication, cloud services, and data visualization.
8. Industry Interaction: Participate in webinars, workshops, hackathons, or industrial visits related to IoT, sensor networks, and smart city technologies.

Course Code:	**24SY702**	**Course Title:**	**SMART CITY INNOVATION PROJECT /CAPSTONE**
Credits:	**3**	**L – T – P**	**3-0-0**
Pre-requisite			**24EE404-IOT SENSORS AND DEVICES 24SY502-INTERNET OF THINGS AND SENSOR NETWORKS FOR SMART CITIES 24SY701-AI, CYBERSECURITY AND GOVERNANCE FOR SMART CITIES**

Course objectives:

The course enables the students to:

- Identify and analyze real-world urban problems related to transportation, energy, water, environment, healthcare, and governance.
- Design citizen-centric smart city solutions using modern digital technologies and engineering tools.
- Integrate IoT, AI, cloud platforms, GIS, and digital twins for intelligent urban infrastructure and services.
- Evaluate the technical feasibility, performance, sustainability, and economic viability of smart city projects.
- Demonstrate professional, ethical, entrepreneurial, and project management skills through the development and deployment of smart city innovations.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

- Design Thinking Workshops
- Industry Mentoring Sessions
- Agile Development Methodology
- Collaborative Team Learning
- Hands-on Development using IoT Hardware and Cloud Platforms
- Simulation and Prototype Development
- Technical Design Reviews
- Project Demonstrations
- Viva Voce and Technical Presentations

UNIT I - PROBLEM IDENTIFICATION AND REQUIREMENT ANALYSIS	**[9 hours]**
Introduction to Smart Cities - Urban Challenges and Citizen-Centric Solutions - Design Thinking and Innovation - Stakeholder Analysis - Requirement Gathering - Feasibility Study - Literature Survey - Software Requirement Specification (SRS) - Project Planning and Risk Assessment	

UNIT II – SYSTEM DESIGN AND ARCHITECTURE	**[9 hours]**
Smart City System Architecture - IoT Sensors and Actuators - Communication Technologies (Wi-Fi, LoRaWAN, NB-IoT, 5G) - Cloud and Edge Computing - Database Design - Dashboard and Mobile - App Design - Security and Privacy Considerations - Prototype Design	

UNIT III – DEVELOPMENT AND INTEGRATION	**[9 hours]**
Hardware and Software Development - IoT Platform Integration - AI and Data Analytics - Digital Twin Concepts - Data Visualization - Alert and Decision Support Systems - Functional Testing - Performance Optimization	

UNIT IV – SMART SYSTEM DEPLOYMENT, EVALUATION AND ENTREPRENEURSHIP	**[9 hours]**
Smart System Deployment - Device Provisioning - Scalability Analysis - Energy Efficiency Evaluation - Cybersecurity Assessment - User Acceptance Testing – Documentation - Intellectual Property Rights (IPR) - Entrepreneurship and Startup Opportunities	

UNIT V – SMART CITY APPLICATIONS AND PROJECT DEMONSTRATION	**[9 hours]**
Smart Transportation - Smart Energy Management - Smart Water Management - Smart Waste Management - Smart Healthcare - Smart Governance - Environmental Monitoring - Public Safety Systems - Sustainable Smart City Solutions - Final Project Demonstration – Industrial case studies	

Total Period:45

Course outcomes:

On completion of the course, the student will have the ability to:

CO	Course Outcomes	Cognitive Level
CO1	Identify and analyze urban challenges suitable for smart city solutions.	K2
CO2	Design and develop smart city systems using IoT, AI, cloud computing, and data analytics.	K3
CO3	Integrate emerging technologies such as AI, Digital Twins, GIS, and intelligent automation to address urban challenges.	K4
CO4	Evaluate smart city solutions based on sustainability, scalability, security, usability, and societal impact.	K5
CO5	Demonstrate a professionally developed smart city solution through documentation, deployment, teamwork, and presentation.	K6

COs and POs Mapping:

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	1	3	-	-	2	1	3	1
CO2	3	3	3	1	3	-	1	2	1	2	1
CO3	3	3	3	2	3	-	-	2	1	2	1
CO4	2	3	3	3	3	-	-	2	2	2	2
CO5	3	3	3	2	3	-	-	2	1	3	1

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped,
Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Assessment	Evaluation of Different modules of work and Report	100	75	100	100
End Semester Examination (ESE)	Exam	100	25		
Total					**100**

TEXT BOOKS

1. Zaigham Mahmood (Ed.), Smart Cities: Development and Governance Frameworks, Springer International Publishing, 1st Edition, 2018, ISBN: 978-3319766683.
2. Kannimuthu Subramaniyam and Marcin Paprzycki (Eds.), Smart Cities and the Internet of Things: The Evolution of Cities, Springer Cham, 1st Edition, 2026, ISBN: 978-3-032-08289.
3. Vinay Kandpal et al. (Eds.), Smart Systems and Innovative Technologies for Smart Cities, Springer Singapore, 1st Edition, 2026, ISBN: 978-981-92-3184-3

REFERENCE BOOKS

1. Nuno Vasco Moreira Lopes (Ed.), Smart Governance for Cities: Perspectives and Experiences, Springer Cham, 2020, ISBN: 978-3-030-22069-3.
2. Elsa Estevez, Theresa A. Pardo and Hans J. Scholl (Eds.), Smart Cities and Smart Governance: Towards the 22nd Century Sustainable City, Springer Cham, 2021, ISBN: 978-3-030-61032-6.

3. Srikanta Patnaik, Siddhartha Sen and Sudeshna Ghosh (Eds.), Smart Cities and Smart Communities: Empowering Citizens through Intelligent Technologies, Springer Singapore, 2022, ISBN: 978-981-19-1145-3.
4. Sushobhan Majumdar, Vinay Kandpal and Leonidas G. Anthopoulos (Eds.), Smart Cities: Innovations, Challenges and Future Perspectives, Springer Cham, 2024, ISBN: 978-3-031-59845-6.
5. Priyanka Mishra and Ghanshyam Singh, Sustainable Smart Cities 2.0: Enabling Research Toward SDG 11, Springer Cham, 2025, ISBN: 978-3-032-01101-5.

WebLinks and Video Lectures (E-Resources):

1. https://www.youtube.com/watch?v=FzcsDGI_xj4
2. https://www.youtube.com/watch?v=-Bqx2BuFjik
3. https://www.youtube.com/watch?v=X5LRKLnGOx4&t=1s

Online Courses:

1. https://nptel.ac.in/courses/105106832
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ar12

Suggested Skill Activities:

Students shall complete the following project-oriented activities.

1. Students shall complete the following project-oriented activities:
2. Identify a Smart City Problem related to transportation, energy, water management, waste management, healthcare, public safety, or environmental sustainability.
3. Conduct Stakeholder and Requirement Analysis to understand citizen needs, government requirements, and technological constraints.
4. Prepare a Detailed Project Proposal including problem statement, objectives, scope, feasibility analysis, and expected outcomes.

5. Design a Smart City System Architecture incorporating IoT devices, communication networks, cloud platforms, data storage, and analytics components.
6. Develop a Prototype or Digital Solution using suitable technologies such as IoT, AI, GIS, cloud computing, mobile applications, or digital twins.
7. Collect, Analyze, and Visualize Urban Data using dashboards, data analytics tools, and business intelligence platforms.
8. Implement AI-Based Decision Support Models for prediction, optimization, monitoring, or resource management.
9. Develop Smart Monitoring Dashboards for real-time visualization of key performance indicators and city services.
10. Integrate Sustainability Metrics such as energy efficiency, carbon footprint reduction, resource utilization, and environmental impact assessment.
11. Perform Security, Privacy, and Risk Assessment of the proposed smart city solution.
12. Evaluate System Performance based on scalability, reliability, usability, efficiency, and societal impact.
13. Prepare Technical Documentation including system design reports, user manuals, deployment plans, and maintenance guidelines.
14. Develop a Business Model or Startup Plan for commercialization of the proposed smart city solution.
15. Present the Project through Demonstrations, Posters, and Technical Presentations to showcase innovation and practical applicability.
16. Prepare a Final Capstone Report and Viva Voce Presentation demonstrating the complete project lifecycle from problem identification to solution deployment.

SUGGESTED CAPSTONE PROJECT DOMAINS

- Smart Traffic Congestion Monitoring and Control System
- IoT-Based Intelligent Parking Management System
- Smart Street Lighting with Adaptive Brightness Control
- Real-Time Air Quality Monitoring and Alert System
- Smart Waste Bin Monitoring and Collection Optimization
- IoT-Based Water Quality Monitoring System
- Smart Water Leakage Detection and Management
- Urban Flood Monitoring and Early Warning System
- Smart Energy Metering and Consumption Analytics
- Renewable Energy Generation and Monitoring System
- Smart Public Transport Tracking and Information System
- Smart Healthcare Monitoring for Elderly Citizens
- Intelligent Surveillance and Public Safety Monitoring
- Smart Disaster Management and Emergency Response System
- Digital Twin-Based Urban Infrastructure Monitoring
- Smart Agriculture and Urban Farming Management
- IoT-Based Smart Building Energy Management System
- Smart Electric Vehicle Charging Station Management
- Smart Bike Sharing and Mobility Solutions
- Smart Noise Pollution Monitoring System
- Smart Water Resource Management for Cities
- AI-Based Urban Heat Island Monitoring
- Smart Fire Detection and Prevention System
- Smart Sewerage and Drainage Monitoring
- Citizen Grievance and Smart Governance Platform
- Smart Resource Management for Municipal Services
- Intelligent Pedestrian Safety Monitoring System