



**Tulsiramji Gaikwad - Patil College of Engineering and Technology**

Wardha Road, Nagpur-441108

NAAC Accredited with A+ Grade

(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)



**Scheme of Instructions for Fourth Year of B.Tech.(UG) Programme CSE - Data Science  
Seventh Semester**

Sr	Sem	Type	BoS/ Dept	Sub Code	Subject	T/ P	Contact Hours			Credits	% Weightage			ESE Duration	Total Marks
							L	P	Hrs		CT/IA	CA	ESE		
1	VII	PCC	DS	BDS34801	Data Modeling & Optimization	T	3	0	3	3	30	10	60	3 Hrs	100
2		PCC	DS	BDS34802	Data Modeling & Optimization - Lab	P	0	4	4	2	-	25	25	2 Hrs	50
3		PEC	DS	BDS34703-06	Program Elective Course -IV	T	4	0	4	4	30	10	60	3 Hrs	100
4		PEC	DS	BDS34707-10	Program Elective Course-V	T	4	0	4	4	30	10	60	3 Hrs	100
5		MDM	ECE	BEC34710	Embedded Systems	T	3	0	3	3	30	10	60	3 Hrs	100
6		MDM	ECE	BEC34711	Embedded Systems - Lab	P	0	4	4	2	-	25	25	2 Hrs	100
7		PROJECT	DS	BDS34711	Project	P	0	8	8	4	-	100	100	2 Hrs	200
<b>Total</b>							<b>14</b>	<b>12</b>	<b>26</b>	<b>22</b>	<b>120</b>	<b>190</b>	<b>390</b>		<b>750</b>





Course Category	BSC/ ESC (Basic Science Course/ Engineering Science Course.)	PCC/PEC (Programme Core courses)	VSEC (Skill Course)	Multidisciplinary Courses		Humanities Social Science & Management				Experiential Learning Courses				CC (Co- Curricula r Courses)
				MDM (Multidisciplinary minor)	OE(Open Elective)	AEC (Ability Enhancement Course)	IKS(Indian Knowledge System)	VEC(Value education Course)	Management Course	Research Methodology	CEP	Project	Internship /OJT	
Credits	-	04/08	-	04	-	-	-	-	-	-	-	04	-	-
Cumulative Sum	16 / 13	45/20	08	14	08	06	02	04	02	04	02	04	12	04

**PROGRESSIVE TOTAL CREDITS: 128 +20=148**

				June, 2026	2.00	Applicable for AY 2023-24 Onwards
Chairperson	Vice-Principal/ Director Academics	Director Administration	Principal	Date of Release	Version	

## PEC List:-

Domain wise Cluster	Program Elective - I	Program Elective -II	Program Elective - III	Program Elective - IV	Program Elective - V
Semesters	Semester V	Semester VI	Semester VI	Semester VII	Semester VII
<b>Domain-1</b> Network and Security	<b>BDS33506</b> Cyber Law and Ethics	<b>BDS33606</b> Cryptography	<b>BDS33610</b> Computer Security	<b>BDS34703</b> Cloud Security	<b>BDS34707</b> Network Security Administration
<b>Domain-2</b> AI ML	<b>BDS33507</b> Artificial Intelligence	<b>BDS33607</b> Machine Learning	<b>BDS33611</b> Natural Language Processing	<b>BDS34704</b> Neural Network	<b>BDS34708</b> Deep Learning
<b>Domain-3</b> IoT	<b>BDS33508</b> TCP/IP	<b>BDS33608</b> Mobile Computing	<b>BDS33612</b> Ad-Hoc Sensor Networks	<b>BDS34705</b> Internet of Things	<b>BDS34709</b> Cloud Computing and IoT
<b>Domain-4</b> Digital Healthcare	<b>BDS33509</b> Introduction of Digital Healthcare	<b>3609BDS3</b> Medical Imaging Analysis with AI	<b>BDS33613</b> Introduction to Internet of Medical Thing	<b>BDS34706</b> Healthcare Data Management and Security	<b>BDS34710</b> Mobile Health Applications

		 Dr. P.	 remanand Naktode	June, 2026	2.00	Applicable for AY 2023-24 Onwards
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**Program: B. Tech Final Year (CSE- Data Science)**

Semester		Course Code		Course Name	
VII		BDS34701		<b>Data Modeling &amp; Optimization</b>	
<b>Teaching Scheme</b>		<b>Examination Scheme (Th)</b>		<b>Examination Scheme (P)</b>	
Theory (Th)	3 Hrs/Week	CT-I	15	-	-
Practical (P)	0	CT-II	15	-	-
<b>Total Credits</b>	<b>3</b>	<b>CA</b>	<b>10</b>	-	-
<b>Duration of ESE: 3Hrs</b>		<b>ESE</b>	<b>60</b>	-	-
		<b>Total Marks</b>	<b>100</b>	-	-

**Pre-Requisites:**

**Course Objective:** To equip students with the knowledge and skills required to design, model, and implement efficient database and data warehouse systems using conceptual, logical, physical, and dimensional modeling techniques.

<b>BDS34701.1</b>	To understand the fundamental concepts, types, and importance of data modeling in database design.
<b>BDS34701.2</b>	To learn and apply database object naming standards and normalization concepts for efficient data structuring.
<b>BDS34701.3</b>	To develop and implement a physical data model through forward and reverse engineering techniques.
<b>BDS34701.4</b>	To design data warehouse structures using OLAP/OLTP concepts, fact/dimension modeling, and schema design techniques.
<b>BDS34701.5</b>	To understand and apply advanced dimensional modeling concepts such as SCDs, special dimensions, and metadata management.



**Course Content**

<b>Unit I</b>	Introduction to Data Modeling, Overview of data modeling concepts, Importance of data modeling in database design, Data Modeling development life cycle Types of data models (Conceptual, Logical, Physical, Enterprise) Data Modeling tools
<b>Unit II</b>	Data Model Standard Naming Standard of objects, Main object Table, Column, Datatype Database, Schema, Tablespace, Segment, Extent, Privileges, Index, View, Synonym, Normalization process
<b>Unit III</b>	Physical Data Model, Database & Scripts: Forward Engineering, Reverse Engineering, Create a data model from a database & script, Database Vs data model. Implementation of Physical data model in a database.
<b>Unit IV</b>	Data Warehouse, Data Mart, Design of Data Warehouse & Data Mart. Difference Between OLAP Modeling & OLTP Modeling, Design of Dimension & the Fact Tables. Designing using Inmon's or Kimball's approach. Snowflake Modeling, Star Schema Modeling.
<b>Unit V</b>	Slowly Changing Dimensions Type 1, Type II & Type III, Degenerate Dimension, Causal Dimension, Junk Dimension, Outrigger Dimension, Repository, Meta Data and Maintenance of the Data Model.



**Text Books**

1	Data Modeling and Database Design, Narayan S. Umanath, Cengage Learning, 2014
2	Data-Driven Modeling & Scientific Computation, J. Nathan Kutz,
<b>Reference Books</b>	
1	Data Modeling Made Simple: A Practical Guide for Business & IT Professionals, Steve Hoberman, Technics Publications, 2009
2	Beginning Data Science in R: Data Analysis, Visualization, and Modelling for Data Scientists, Thomas Mailund, Apress
<b>Useful Links</b>	
1	<a href="https://youtu.be/gw_ZEUjI9KM?si=Pbbd0iWeNYSu5WkT">https://youtu.be/gw_ZEUjI9KM?si=Pbbd0iWeNYSu5WkT</a>
2	<a href="https://youtu.be/BMdLYXKZZtE?si=CtCMvkgL2mQKrhu5">https://youtu.be/BMdLYXKZZtE?si=CtCMvkgL2mQKrhu5</a>



Course Code	Course Outcomes
	At the end of the course, students should be able to
<b>BDS34701.1</b>	<b>Recall</b> the fundamental principles of data modeling and optimization.
<b>BDS34701.2</b>	<b>Analyze</b> a given database schema and identify potential areas for optimization.
<b>BDS34701.3</b>	<b>Compare</b> and contrast different data modeling approaches and their implications on database performance.
<b>BDS34701.4</b>	Critique the <b>design</b> of a database schema in terms of its adherence to best practices and optimization principles.
<b>BDS34701.5</b>	<b>Design</b> a comprehensive data model for a specific business scenario, considering both conceptual and physical aspects.

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<b>Program: B.Tech Final Year (CSE- Data Science)</b>					
<b>Semester</b>		<b>Course Code</b>		<b>Course Name</b>	
VII		BDS34702		Data Modeling & Optimization - lab	
<b>Teaching Scheme</b>		<b>Examination Scheme(Th)</b>		<b>Examination Scheme(P)</b>	
<b>Theory(Th)</b>	-	<b>CT-I</b>	-	-	
<b>Practical(P)</b>	4	<b>CT-II</b>	-	-	
<b>Total Credits</b>	2	<b>CA</b>	-	<b>CA</b>	25
<b>Duration of ESE:</b>		<b>ESE</b>	-	<b>ESE</b>	25
		<b>Total Marks</b>	-	<b>Total Marks</b>	<b>50</b>
<b>Course Outcomes:</b> After the completion of this course, students will be able to-					
CO1	Understand the fundamentals of data modeling and the need for optimization in data-driven systems.				
CO2	Apply ER modeling and normalization to design efficient and consistent databases.				
CO3	Implement and analyze data retrieval optimization techniques such as indexing and hashing.				
CO4	Design advanced data models like dimensional and NoSQL structures for real-world applications.				
CO5	Formulate and solve optimization problems using linear, non-linear, and computational algorithms.				
<b>Pre-Requisites:</b> Python					
<b>Sr.no</b>	<b>List of Experiments</b>				<b>COs</b>
1	Design an ER Model for a real-world system (e.g., Library or College Management System) using Draw.io or MySQL Workbench.				CO 1
2	Convert an ER Diagram to Relational Schema and implement using SQL (CREATE TABLE, INSERT, SELECT).				CO 1
3	Apply Normalization up to 3NF or BCNF on a given dataset to remove anomalies.				CO 2
4	Implement and Analyze Query Optimization using indexes and query execution plans.				CO 2
5	Implement Hashing and Indexing Techniques for faster data access.				CO 3
6	Design and Implement a Star Schema for a data warehouse (e.g., Sales or Inventory data).				CO 3
7	Model and Query a NoSQL Database using MongoDB or Firebase.				CO 4
8	Solve Linear Programming Problems using Excel Solver or Python (SciPy/OR-Tools).				CO 4
9	Apply the Simplex Method to solve a linear optimization problem manually or using Python.				CO 5
10	Implement Gradient Descent Algorithm to minimize an objective function.				CO 5
<b>Text Books</b>					
1	Ramez Elmasri & Shamkant B. Navathe, Fundamentals of Database Systems, Pearson Education.				
2	Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, Database System Concepts, McGraw Hill				
<b>Reference Books</b>					
1	Hector Garcia-Molina, Jeffrey D. Ullman & Jennifer Widom, Database Systems: The Complete Book, Pearson Education.				
2	Jiawei Han, Micheline Kamber & Jian Pei, Data Mining: Concepts and Techniques, Morgan Kaufmann.				



<b>Useful Links</b>	
1	<a href="http://nptel.ac.in/courses/112105268">http://nptel.ac.in/courses/112105268</a>
2	<a href="http://nptel.ac.in/courses/106106157">http://nptel.ac.in/courses/106106157</a>



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<b>Program: B.Tech Final Year (CSE- Data Science)</b>					
<b>Semester</b>		<b>Course Code</b>		<b>Course Name</b>	
<b>VII</b>		<b>BDS34703</b>		<b>PEC –IV (Cloud Security)</b>	
<b>Teaching Scheme</b>		<b>Examination Scheme(Th)</b>		<b>Examination Scheme(P)</b>	
<b>Theory(Th)</b>	4	<b>CT-I</b>	15	-	-
<b>Practical(P)</b>	0	<b>CT-II</b>	15	-	-
<b>Total Credits</b>	<b>4</b>	<b>CA</b>	10	-	-
<b>Duration of ESE: 3Hrs</b>		<b>ESE</b>	60	-	-
		<b>Total Marks</b>	<b>100</b>	-	-
<b>Course Outcomes:</b> After the completion of this course, students will be able to-					
CO1	<b>Explain</b> cloud computing models, architecture, and security challenges.				
CO2	<b>Apply</b> core cloud security concepts like IAM, encryption, and data protection.				
CO3	<b>Analyze</b> network and infrastructure security mechanisms in cloud environments.				
CO4	<b>Evaluate</b> cloud risk management, compliance, and governance practices.				
CO5	<b>Explore</b> emerging cloud security trends and assess real-world case studies.				
<b>Course Content</b>					
<b>Unit I</b>	Introduction to Cloud Security: Overview of Cloud Computing and its Service Models (IaaS, PaaS, SaaS), Cloud Deployment Models (Public, Private, Hybrid, Community), Security Challenges in Cloud Environments, Cloud Security Architecture and Principles, Shared Security Responsibility Model, Key Threats and Vulnerabilities in Cloud				
<b>Unit II</b>	Cloud Security Concepts and Technologies: Identity and Access Management (IAM), Authentication, Authorization, and Accounting (AAA), Encryption and Key Management in Cloud, Data Privacy and Data Protection Techniques, Virtualization Security, Security in Multi-Tenancy Environments				
<b>Unit III</b>	Network and Infrastructure Security: Cloud Network Security Controls, Secure Communication (SSL/TLS, VPNs), Firewalls and Intrusion Detection/Prevention Systems, Security of Virtual Machines and Containers, API Security in Cloud, Security for Cloud Infrastructure and Data Centers				
<b>Unit IV</b>	Cloud Security Management and Compliance: Risk Management and Assessment in Cloud, Cloud Security Policies and Best Practices, Security Monitoring, Logging, and Incident Response, Compliance Standards: ISO 27017, ISO 27018, PCI DSS, HIPAA, GDPR, Governance, Legal, and Regulatory Issues in Cloud				
<b>Unit V</b>	Emerging Trends and Case Studies in Cloud Security: Security in Edge and Fog Computing, Cloud Forensics and Threat Intelligence, AI/ML for Cloud Security, Zero-Trust Security Model, Case Studies on Cloud Security Breaches and Mitigation, Tools and Frameworks: AWS Security, Azure Security Center, Google Cloud Security				
<b>Text Books</b>					
1	Cloud Computing Security – John R. Vacca; 2nd Edition; O’Reilly (2019) (Handbook style reference)				

2	Practical Cloud Security: A Guide for Secure Design and Deployment – Chris Dotson; O'Reilly; (1st edition 2019)
<b>Reference Books</b>	
1	Eyal Estrin., “ <i>Cloud Security</i> ”, Packt Publishing, 2025.
2	Author: Jamuna S. Murthy., “Cloud Security: Concepts, Applications and Practices “, CRC Press. 2024., ISBN 9781032596112.
<b>Useful Links</b>	
1	<a href="https://onlinecourses.nptel.ac.in/noc21_cs14/preview">https://onlinecourses.nptel.ac.in/noc21_cs14/preview</a>
2	<a href="https://nptel.ac.in/courses/106105167">https://nptel.ac.in/courses/106105167</a>



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<b>Program: B.Tech Final Year (CSE- Data Science)</b>						
<b>Semester</b>		<b>Course Code</b>			<b>Course Name</b>	
VII		BDS34704			PEC –IV (Neural Network)	
<b>Teaching Scheme</b>		<b>Examination Scheme(Th)</b>		<b>Examination Scheme(P)</b>		
<b>Theory(Th)</b>	4	<b>CT-I</b>	15	-	-	
<b>Practical(P)</b>	0	<b>CT-II</b>	15	-	-	
<b>Total Credits</b>	<b>4</b>	<b>CA</b>	10	-	-	
<b>Duration of ESE: 3Hrs</b>		<b>ESE</b>	60	-	-	
		<b>Total Marks</b>	<b>100</b>	-	-	
<b>Course Outcomes:</b> After the completion of this course, students will be able to-						
CO1	<b>Understand</b> the evolution and key milestones of neural networks, and applications.					
CO2	<b>Explain</b> and implement basic neural network models to solve logical functions.					
CO3	<b>Analyze</b> and apply learning methods for neural network training.					
CO4	<b>Classify</b> associative memories and apply training and retrieval methods.					
CO5	<b>Use</b> deep learning techniques for efficient model optimization.					
<b>Course Content</b>						
<b>Unit I</b>	<b>Introduction to Neural Networks:</b> Biological neuron overview, analogy to artificial neuron models, Evolution of neural networks, Activation functions: threshold, signum, sigmoid, tanh, ramp, linear, identity, Artificial Neural Network (ANN) architectures: feedforward, feedback, single/multilayer, recurrent					
<b>Unit II</b>	<b>Neural Network Models:</b> McCulloch-Pitts Model: architecture, AND/OR function solutions, Hebb model: theory and procedures, Perceptron networks: single/multi-output models, Concepts of linear separability, implementing logical functions					
<b>Unit III</b>	<b>Training Methodologies:</b> Learning paradigms: supervised, unsupervised, reinforcement, Learning algorithms: gradient descent, delta rule, competitive learning, Backpropagation network: architecture, training/testing					
<b>Unit IV</b>	<b>Associative Memories:</b> Associative memory types: auto, hetero, Training and retrieval algorithms: Hebb rule, outer-product rule, Storage capacity, testing strategies, Bidirectional memory networks					
<b>Unit V</b>	<b>MLP, advanced deep learning techniques:</b> Multilayer perceptron: batch, online learning, Backpropagation algorithm details, XOR problem Optimization heuristics, adaptive learning rates, Generalization, function approximation, complexity regularization, network pruning, Convolutional neural networks, supervised learning as optimization, nonlinear filtering					
<b>Text Books</b>						
1	Neural Networks and Deep Learning January 1, 2018 - © Springer International Publishing AG, part of Springer Nature 2018 C. C. Aggarwal					
2	Artificial Intelligence: A Modern Approach, 4th US ed.,2020 by Stuart Russell and Peter Norvig					
<b>Reference Books</b>						

1	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron (2022)
2	Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms by Nikhil Buduma, Nithin Buduma, & Joe Papa (2017)
<b>Useful Links</b>	
1	<a href="https://onlinecourses.nptel.ac.in/noc19_ee53/preview">https://onlinecourses.nptel.ac.in/noc19_ee53/preview</a>
2	<a href="https://onlinecourses.nptel.ac.in/noc23_ee87/preview">https://onlinecourses.nptel.ac.in/noc23_ee87/preview</a>

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<b>Program: B.Tech Final Year (CSE- Data Science)</b>					
<b>Semester</b>		<b>Course Code</b>		<b>Course Name</b>	
VII		BDS34705		PEC - IV (Internet of Things)	
<b>Teaching Scheme</b>		<b>Examination Scheme(Th)</b>		<b>Examination Scheme(P)</b>	
<b>Theory(Th)</b>	4	<b>CT-I</b>	15	-	-
<b>Practical(P)</b>	0	<b>CT-II</b>	15	-	-
<b>Total Credits</b>	<b>4</b>	<b>CA</b>	10	-	-
<b>Duration of ESE: 3Hrs</b>		<b>ESE</b>	60	-	-
		<b>Total Marks</b>	<b>100</b>	-	-
<b>Course Outcomes:</b> After the completion of this course, students will be able to-					
CO1	<b>Explain</b> IoT fundamentals, architecture, layers, and applications.				
CO2	<b>Describe</b> IoT components, sensing, networking, and communication protocols.				
CO3	<b>Identify</b> IoT system design, platform requirements, and device integration.				
CO4	<b>Understand</b> IoT networking, computing concepts, and cloud communication.				
CO5	<b>Apply</b> IoT cloud platforms and data analytics tools for data management.				
<b>Course Content</b>					
<b>Unit I</b>	<b>Introduction &amp; Fundamentals of IoT:</b> IoT Definition, Applications, Benefits/challenges IoT layers and components: Sensors, signal processing, data transmission (wired/wireless), data analysis, IoT levels based on complexity, IoT hardware and computing platforms, Technological trends in IOT, IoT Examples, M2M.				
<b>Unit II</b>	<b>IoT: Components, Communication and Networking:</b> Introduction to Sensing and Networking: Sensing & actuation, Wireless Sensor network, Sensor nodes, Communication Protocols, M2M Communication, Networking Hardware, Networking Protocols.				
<b>Unit III</b>	<b>IoT System Management:</b> Network Operator Requirements, IoT Platform Design Specification – Requirements, Process, Domain Model, Service, IoT Level, Function, Operational view, Device and Component Integration, Application development				
<b>Unit IV</b>	<b>Networking and Computing:</b> Networking, Communication and computing, Introduction to basic Communication Network functioning: Layers, Spectrum bands used for IoT communications, Challenges in Networking of IoT Nodes File Handling, Python Packages for IoT, IoT Physical Servers – Cloud Storage Models, Communication APIs.				
<b>Unit V</b>	<b>IoT Clouds and Data Analytics:</b> RESTful Web API, Amazon Web Services for IoT, Apache, Hadoop, Batch Data Analysis, Chef, Chef Case Studies, Puppet, NETCONF-YANG.				
<b>Text Books</b>					
1	Alessandro Bassi, "Enabling Things to Talk- Designing IoT solutions with the IoT Architectural Reference Model", Springer, 2013.				
2	Jacob Freden, Handbook of Modern Sensors – Physics, Designs, and Applications, 4th ed, Springer, 2010.				
<b>Reference Books</b>					
1	Kamal, R., "Internet of Things – Architecture and Design Principles," 1st Edition, Mcgraw Hill, 2017.				
2	Simone Cirani, "Internet of Things- Architectures, Protocols and Standards", WILEY, 2018.				
<b>Useful Links</b>					
1	<a href="https://onlinecourses.nptel.ac.in/noc20_cs69/preview">https://onlinecourses.nptel.ac.in/noc20_cs69/preview</a> .				
2	<a href="https://onlinecourses.nptel.ac.in/noc22_cs53/preview">https://onlinecourses.nptel.ac.in/noc22_cs53/preview</a> .				

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<b>Program: B.Tech. Final Year (CSE- Data Science)</b>					
<b>Semester</b>		<b>Course Code</b>		<b>Course Name</b>	
VII		BDS34706		<b>PEC - IV (Healthcare Data Management and Security)</b>	
<b>Teaching Scheme</b>		<b>Examination Scheme(Th)</b>		<b>Examination Scheme(P)</b>	
<b>Theory (Th)</b>	4	<b>CT-I</b>	15	-	-
<b>Practical(P)</b>	0	<b>CT-II</b>	15	-	-
<b>Total Credits</b>	<b>4</b>	<b>CA</b>	10	-	-
<b>Duration of ESE: 3Hrs</b>		<b>ESE</b>	60	-	-
		<b>Total Marks</b>	<b>100</b>	-	-
<b>Course Outcomes:</b> After the completion of this course, students will be able to-					
CO1	<b>Understand</b> healthcare data content, structure, standards and clinical and administrative applications				
CO2	<b>Explore</b> information management strategic planning, processes for selecting and implementing health information systems				
CO3	<b>Identify</b> trends from health data, usability and accessibility of consumer health information				
CO4	<b>Analyze</b> health information exchange systems and address current trends				
CO5	<b>Review</b> threat actors used to target healthcare organizations and security of healthcare data				
<b>Course Content</b>					
<b>Unit I</b>	Introduction to Health Care Data, Data Content, Structure and Standards Data Management: Collect and maintain health data, graphical tools for data presentations, Informatics, Analytics and Data Use, Health Information Technologies, policies and procedures of networks, including intranet and Internet to facilitate clinical and administrative applications				
<b>Unit II</b>	Information Management Strategic Planning, Process used in the selection and implementation of health information management systems Analytics and Decision Support, analytics and decision support, report generation technologies to facilitate decision-making				
<b>Unit III</b>	Health Care Statistics, basic descriptive, Institutional and healthcare statistics, data to identify trends, Consumer Informatics, Usability and accessibility of health information by patients, including current trends and future challenges				
<b>Unit IV</b>	Health Information Exchange, Current trends and future challenges in health information exchange, Leadership Subdomain, Project Management, Project management methodologies Vendor/Contract Management, vendor/contract management, Enterprise Information Management, knowledge or database architecture and design				
<b>Unit V</b>	Data Management Security: Legal and Regulatory Affairs pertaining to Health Data, Threat Actors and Cybersecurity, Threat, Vulnerabilities, and IT Hygiene, Data Protection and Access Management				
<b>Text Books</b>					
1	Biedermann, S. & Dolezel, D (2017) Introduction to Healthcare Informatics, 2nd Edition. Chicago, IL: AHIMA Press ISBN: 978-1-58426-528-3				
2	Webster, M. (2021). Do No Harm: Protecting Connected Medical Devices, Healthcare, and Data from Hackers and Adversarial Nation States. John Wiley & Sons.				
<b>Reference Books</b>					

1	Horton, L. (2017) Calculating and Reporting Healthcare Statistics, 5th Edition (reprint). Chicago, IL: AHIMA Press ISBN: 978-1-58426-595-5
2	Curtis, E., & Drennan, J. (2013). Quantitative health research: issues and methods: issues and methods. McGraw-Hill Education (UK). [selected chapters provided on Blackboard, <a href="https://ebookcentral-proquestcom.ezproxymcp.flo.org/lib/mcphs/detail.action?docID=1336598">https://ebookcentral-proquestcom.ezproxymcp.flo.org/lib/mcphs/detail.action?docID=1336598</a> ]
<b>Useful Links</b>	
1	<a href="https://nptel.ac.in/courses/109107190">https://nptel.ac.in/courses/109107190</a> , Exploring Survey Data on Health Care by Prof. Pratap C. Mohanty IIT Roorkee
2	<a href="https://nptel.ac.in/courses/114106017">https://nptel.ac.in/courses/114106017</a> , Health, Safety and Environmental Management in Petroleum and Offshore Engineering by Dr. Srinivasan Chandrasekaran, IIT Madras

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**Program: B.Tech Final Year (CSE- Data Science)**

Semester		Course Code		Course Name	
VII		BDS34707		PEC – V (Network Security Administration)	
<b>Teaching Scheme</b>		<b>Examination Scheme(Th)</b>		<b>Examination Scheme(P)</b>	
<b>Theory(Th)</b>	4	<b>CT-I</b>	15	-	-
<b>Practical(P)</b>	0	<b>CT-II</b>	15	-	-
<b>Total Credits</b>	4	<b>CA</b>	10	-	-
<b>Duration of ESE: 3Hrs</b>		<b>ESE</b>	60	-	-
		<b>Total Marks</b>	<b>100</b>	-	-

**Course Outcomes:** After the completion of this course, students will be able to-



CO1	<b>Understand Foundational Principles.</b>
CO2	<b>Explain Cryptographic Techniques</b> like DES, AES, RSA, Diffie-Hellman.
CO3	<b>Analyze Authentication and Hashing</b> like MAC, hash functions (MD5, SHA),
CO4	<b>Classify Configure Network Security</b> such as Firewalls, Intrusion Detection Systems (IDS) etc.
CO5	<b>Use System Vulnerabilities, Cyber Laws.</b>

**Course Content**



<b>Unit I</b>	<b>Introduction and Foundational Cryptography:</b> Need for Information Security: Legal, ethical, and professional issues; security attributes (authentication, access control, confidentiality, integrity, OSI Security Architecture: Security attacks (e.g., passive and active attacks), services, and mechanisms. Classical Encryption Techniques: Ciphers such as Caesar, Transposition, Playfair, Hill, Vigenere, including problems and security architecture. Mathematics of Cryptography: Modular arithmetic, Euclidean and extended Euclidean algorithms, number theory principles.
<b>Unit II</b>	<b>Symmetric and Asymmetric Key Cryptography :</b> Symmetric Key (Secret Key): Principles, block ciphers, stream ciphers, modes of operation. Specific algorithms covered include DES, Triple DES, AES, IDEA, RC5, Blowfish. Asymmetric Key (Public Key): Principles, algorithms like RSA, Diffie-Hellman key exchange, Elliptical Curve Cryptography (ECC), and their security. Key Management: Principles and techniques for key distribution and exchange.
<b>Unit III</b>	<b>Message Integrity and Authentication :</b> Authentication Requirements and Functions: Message Authentication Codes (MAC), Hash Functions (MD5, SHA, HMAC). User Authentication: Methods like Kerberos. Digital Signatures and Certificates: X.509 certificate format, certificate types, and authentication processes.
<b>Unit IV</b>	<b>Network and System Security :</b> Network/Transport Security: Study and implementation analysis of IPsec, SSL, and TLS. Security Devices: Firewalls (design principles), trusted systems, Intrusion Detection Systems (IDS), and Intrusion Prevention Systems (IPS). Email Security: Pretty Good Privacy (PGP) and S/MIME. System Security: Operating System security, wireless network security, and VPNs (Virtual Private Networks).
<b>Unit V</b>	<b>Software Vulnerabilities and Cybercrime :</b> Software Vulnerability: Common vulnerabilities such as phishing, buffer overflow, Cross-site Scripting (XSS), SQL Injection, DoS/DDoS attacks. Legal Perspectives: The Indian IT Act, cyber laws, and the legal landscape around cybercrime.

**Text Books**



1	William Stallings, “Cryptography and Network Security: Principles and Practice”, 8 <sup>th</sup> Edition, 2023.
2	Behrouz A. Forouzan and Debdeep Mukhopadhyay, “Cryptography and Network Security”, 3 <sup>rd</sup> Edition, 2016.
<b>Reference Books</b>	
1	Derek S. Reveron, “Security in Cyber Age”, 1 <sup>st</sup> Edition, 2024.
2	Diana Kelley, Craig Maio, et al, “Practical Cybersecurity Architecture: A Guide to Creating and Implementing Robust Designs”, 1 <sup>st</sup> Edition, 2023
<b>Useful Links</b>	
1	<a href="https://nptel.ac.in/courses/106105031">https://nptel.ac.in/courses/106105031</a> .
2	<a href="https://www.coursera.org/courses?query=network%20security">https://www.coursera.org/courses?query=network%20security</a> .

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<b>Program: B.Tech Final Year (CSE- Data Science)</b>					
<b>Semester</b>		<b>Course Code</b>		<b>Course Name</b>	
VII		BDS34708		PEC – V (Deep Learning)	
<b>Teaching Scheme</b>		<b>Examination Scheme(Th)</b>		<b>Examination Scheme(P)</b>	
<b>Theory(Th)</b>	4	<b>CT-I</b>	15	-	-
<b>Practical(P)</b>	0	<b>CT-II</b>	15	-	-
<b>Total Credits</b>	<b>4</b>	<b>CA</b>	10	-	-
<b>Duration of ESE: 3Hrs</b>		<b>ESE</b>	60	-	-
		<b>Total Marks</b>	<b>100</b>	-	-
<b>Course Outcomes:</b> After the completion of this course, students will be able to-					
CO1	<b>Understand</b> the fundamental concepts of deep learning and neural network				
CO2	<b>Analyze</b> Gradient Descent and its variants along with linear algebra for efficient optimization				
CO3	<b>Explore</b> Principal Component Analysis and various types of Autoencoders to extract, represent, and reconstruct meaningful features from data				
CO4	<b>Apply</b> Convolutional Neural Networks and their architectures along with visualization and interpretability techniques				
CO5	<b>Apply</b> Recurrent Neural Network, Truncated BPTT, GRU, LSTM and GAN				
<b>Course Content</b>					
<b>Unit I</b>	<b>Deep Learning:</b> Introduction to Deep Learning, Difference between Machine Learning and Deep Learning <b>Neural network:</b> Biological neuron, Artificial neuron, McCulloch Pitts Neuron, Hidden Markov Model (HMM), Perceptron Learning Algorithm, Multilayer Perceptron, Feedforward neural network, Back Propagation				
<b>Unit II</b>	<b>Gradient Descent (GD):</b> GD, Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Eigenvalues and eigenvectors, Eigenvalue Decomposition, Basis				
<b>Unit III</b>	<b>Principal Component Analysis (PCA):</b> PCA and its interpretations, Singular Value Decomposition <b>Autoencoders:</b> Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders				
<b>Unit IV</b>	<b>Convolutional Neural Networks (CNN):</b> CNN, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks				
<b>Unit V</b>	<b>Recurrent Neural Networks (RNN):</b> RNN, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs, GAN				
<b>Text Books</b>					
1	Goodfellow, I., Bengio, Y., and Aaron Courville, A Deep Learning, MIT Press, 2016.				
2	Introduction to Artificial Neural Systems BY Jacek M. Zurada				
<b>Reference Books</b>					
1	François Chollet, “Deep Learning with Python”, Manning Publications, 2nd edition, 2021				
2	Magnus Ekman, “Learning Deep Learning”, Addison-Wesley Professional, 2021				
3	Charu C. Aggarwal, “Neural Networks and Deep Learning”, Springer, 2nd edition, 2021				
<b>Useful Links</b>					



1	<a href="https://nptel.ac.in/courses/106105215">https://nptel.ac.in/courses/106105215</a> , Deep Learning by Prof. Prabir Kumar Biswas, IIT Kharagpur
2	<a href="https://nptel.ac.in/courses/106106184">https://nptel.ac.in/courses/106106184</a> , Deep Learning by Prof. Sudarshan Iyengar, IIT Ropar

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<b>Program: B.Tech Final Year (CSE- Data Science)</b>					
<b>Semester</b>		<b>Course Code</b>		<b>Course Name</b>	
VII		BDS34709		PEC - V (Cloud Computing and IoT)	
<b>Teaching Scheme</b>		<b>Examination Scheme(Th)</b>		<b>Examination Scheme(P)</b>	
<b>Theory(Th)</b>	4	<b>CT-I</b>	15	-	-
<b>Practical(P)</b>	0	<b>CT-II</b>	15	-	-
<b>Total Credits</b>	<b>4</b>	<b>CA</b>	10	-	-
<b>Duration of ESE: 3Hrs</b>		<b>ESE</b>	60	-	-
		<b>Total Marks</b>	<b>100</b>	-	-
<b>Course Outcomes:</b> After the completion of this course, students will be able to-					
CO1	<b>Understand</b> the fundamental concepts, service, and deployment models of cloud computing.				
CO2	<b>Apply</b> cloud resource management, storage, networking, and security principles effectively.				
CO3	<b>Explain</b> IoT architecture, sensors, actuators, protocols, and data acquisition methods.				
CO4	<b>Integrate</b> IoT devices with cloud platforms for real-time data processing and analytics.				
CO5	<b>Design</b> and deploy an IoT-cloud application using advanced analytics, AI, or serverless computing.				
<b>Course Content</b>					
<b>Unit I</b>	<b>CLOUD COMPUTING:</b> Cloud Enabling Technologies, Characteristics of Cloud Computing -Benefits of Cloud Computing, Cloud Service Models, Cloud Deployment models, Cloud computing Infrastructure, Cloud Challenges, Understanding IaaS-Improving performance through Load balancing, Server Types within IaaS solutions, utilizing cloud based NAS devices, Understanding Cloud based data storage, Cloud based backup devices				
<b>Unit II</b>	<b>Cloud Infrastructure, Management &amp; Security:</b> Resource provisioning and scalability, Cloud storage systems (block, file, object storage), Cloud networking and load balancing, Cloud security fundamentals: authentication, IAM, encryption, Monitoring, auditing, and SLA management, Cloud automation tools: Terraform, Ansible, Cloud Formation.				
<b>Unit III</b>	<b>Introduction to Internet of Things (IoT):</b> Definition and characteristics of IoT, IoT architecture: perception, network, and application layers. Types of sensors and actuators, Embedded systems and microcontrollers (Arduino, Raspberry Pi), Communication models: M2M, IoT protocols (MQTT, CoAP, HTTP, AMQP), IoT data acquisition and processing.				
<b>Unit IV</b>	<b>Cloud-IoT Integration:</b> Role of cloud computing in IoT ecosystems, IoT data storage and analytics on cloud platforms, Edge and fog computing concepts, Real-time data streaming and processing (AWS IoT Core, Azure IoT Hub, Google IoT Core), Case studies: Smart home, smart city, and industrial IoT applications, Security and privacy challenges in IoT-Cloud integration.				
<b>Unit V</b>	<b>Advanced Topics and Applications:</b> Big Data analytics in cloud and IoT, Artificial Intelligence and Machine Learning for IoT data, Server less computing and event-driven architectures, Green computing and sustainable IoT systems, Future trends: Digital twins, 5G integration, block chain in IoT, Capstone project: Design and deploy an IoT system using a cloud backend.				
<b>Text Books</b>					
1	Cloud-IoT Technologies in Society 5.0 by Kamta Nath Mishra & Subhash Chandra Pandey – Explores cloud and IoT integration in the context of smart societies (Industry 4.0/5.0).				
2	Internet of Things, 3rd Edition — Shriram K. Vasudevan, R. M. D. Sundaram, Abhishek S. Nagarajan, Wiley.				
<b>Reference Books</b>					
1	Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Zaigham M. Madhav & Ricardo Puttini – A comprehensive foundation on cloud computing concepts, service models, and				



	architecture.
2	Cloud IoT: Concepts, Paradigms, and Applications edited by Jitendra K. Verma, Deepak K. Saxena, Vicente González-Prida Díaz & Vira Shendryk – Focuses explicitly on the integration of IoT and cloud computing paradigms.
<b>Useful Links</b>	
1	<a href="https://nptel.ac.in/courses/106104242">https://nptel.ac.in/courses/106104242</a> .
2	<a href="https://onlinecourses.nptel.ac.in/noc23_cs65/preview">https://onlinecourses.nptel.ac.in/noc23_cs65/preview</a> .

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<b>Program: B.Tech Final Year (CSE- Data Science)</b>					
<b>Semester</b>		<b>Course Code</b>		<b>Course Name</b>	
VII		BDS34710		PEC – V (Mobile Health Application)	
<b>Teaching Scheme</b>		<b>Examination Scheme(Th)</b>		<b>Examination Scheme(P)</b>	
<b>Theory(Th)</b>	4	<b>CT-I</b>	15	-	-
<b>Practical(P)</b>	0	<b>CT-II</b>	15	-	-
<b>Total Credits</b>	4	<b>CA</b>	10	-	-
<b>Duration of ESE: 3Hrs</b>		<b>ESE</b>	60	-	-
		<b>Total Marks</b>	<b>100</b>	-	-
<b>Course Outcomes:</b> After the completion of this course, students will be able to-					
CO1	<b>Understand and Define mHealth Solutions.</b>				
CO2	<b>Explain Design Principles</b> UCD, engaging user interfaces (UI/UX).				
CO3	<b>Analyze Functional Prototypes.</b>				
CO4	<b>Classify Integrate Health Data and Technology.</b>				
CO5	<b>Use Evaluate App Effectiveness.</b>				
<b>Course Content</b>					
<b>Unit I</b>	<b>Introduction to mHealth and Health Informatics</b> : Definition and Scope of mHealth: Understanding mobile health (mHealth) and its role in modern healthcare delivery, Types of mHealth Apps: Overview of apps for fitness/wellness, chronic disease management (diabetes, asthma), remote patient monitoring, mental health support, and clinical reference. Healthcare Systems Overview: The current healthcare delivery system and the integration of mHealth into existing Electronic Health Records (EHR) and clinical workflows. Ethical and Regulatory Landscape: Key healthcare regulations and compliance standards (e.g., HIPAA in the US, GDPR in the EU) for patient data security and privacy.				
<b>Unit II</b>	<b>Mobile App Design and User Experience (UX/UI)</b> : Human-Centered Design: Principles of designing applications with the patient/provider in mind. UI/UX Principles for Healthcare: Creating intuitive, accessible, and engaging interfaces for diverse user groups, including those with varying levels of tech literacy or health conditions. Accessibility and Usability: Ensuring apps are usable by a wide range of people, considering factors like age and physical limitations. Prototyping and User Testing: Methods for creating low-fidelity prototypes and iterating designs based on user feedback.				
<b>Unit III</b>	<b>Mobile Technology and Development</b> : Mobile Platforms: Overview of major platforms (Android and iOS) and development frameworks (Native vs. Cross-platform like Flutter/React Native). Programming Fundamentals: Applying programming concepts (e.g., Java, Kotlin, Swift) to mobile development. Key Mobile Features: Utilizing device capabilities such as GPS, cameras, notifications, and multimedia in health applications. Data Storage and Management: Storing data locally on the device (e.g., SQLite) and integrating with cloud platforms and databases.				
<b>Unit IV</b>	<b>Data Integration and Security:</b> Sensor and Wearable Integration: Collecting data from wearables and IoT devices (e.g., Apple HealthKit, Google Fit) for real-time				

	monitoring. Interoperability: Understanding standards like DICOM for medical imaging and ensuring seamless data exchange between different health systems. Data Security: Implementing robust measures for data encryption and secure transmission to protect sensitive patient information.
<b>Unit V</b>	<b>Implementation and Evaluation :</b> Testing and Quality Assurance: Methodologies for testing the app for performance, stability, and clinical accuracy. Deployment and Maintenance: Packaging, signing, and publishing applications to app stores. Statistical Analysis and Evaluation Metrics: Methods for evaluating the effectiveness and impact of mHealth interventions on health outcomes. Business and Marketing: Strategies for marketing, monetization, and ongoing app maintenance.
<b>Text Books</b>	
1	<b>mHealth: New Horizons for Health Through Mobile Technologies</b> by the World Health Organization (WHO) and the International Telecommunication Union (ITU).
2	<b>Medical Informatics: EHealth and Biomarkers</b> edited by Igor Litvinchev, Boris Sokolov, and Klaus-Dieter Thoben.
<b>Reference Books</b>	
1	m-Health: Fundamentals and Applications by Robert Istepanian, Swamy Laxminarayan, and Constantinos Pattichis
2	Developing Medical Apps and mHealth Interventions: A Guide for Researchers, Physicians and Informaticians by Susan Kirshner.
<b>Useful Links</b>	
1	<a href="https://developer.apple.com/healthkit/">https://developer.apple.com/healthkit/</a>
2	<a href="https://developer.android.com/health">https://developer.android.com/health</a>

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<b>Program: B.Tech Final Year (CSE- Data Science)</b>					
<b>Semester</b>		<b>Course Code</b>		<b>Course Name</b>	
VII		<b>BEC34710</b>		<b>Embedded System</b>	
<b>Teaching Scheme</b>		<b>Examination Scheme(Th)</b>		<b>Examination Scheme(P)</b>	
<b>Theory(Th)</b>	4	<b>CT-I</b>	15	-	-
<b>Practical(P)</b>	0	<b>CT-II</b>	15	-	-
<b>Total Credits</b>	<b>4</b>	<b>CA</b>	10	-	-
<b>Duration of ESE: 3Hrs</b>		<b>ESE</b>	60	-	-
		<b>Total Marks</b>	<b>100</b>	-	-
<b>Course Outcomes:</b> After the completion of this course, students will be able to-					
CO1	<b>Understand</b> Embedded system fundamentals, evolution, classifications, and applications				
CO2	<b>Explain</b> Embedded architectures, processor designs (8051, ARM, DSP), and system modeling concepts.				
CO3	<b>Analyze</b> Peripheral devices and communication protocols				
CO4	<b>Classify</b> Memory systems, interfacing methods, and program design principles.				
CO5	<b>Use</b> Big Data ingestion, analytics, and visualization tools.				
<b>Course Content</b>					
<b>Unit I</b>	<b>Introduction to Embedded Systems:</b> Definition and historical context of embedded systems, Key differences from general computing systems, Classification and major applications, Characteristics and quality attributes, Design metrics, Processor technology: general purpose, application specific, single purpose				
<b>Unit II</b>	<b>Embedded System Architecture:</b> Von Neumann vs Harvard architectures, CISC and RISC architectures, Embedded processor and microcontroller design (8051, ARM, DSP processors), System modeling and specification				
<b>Unit III</b>	<b>Peripheral Devices and Communication:</b> Timers, counters, watchdog timers, interrupt controllers, Analog to digital converters (ADC), real-time clock (RTC), Communication protocols: Serial: I2C, CAN, FireWire, USB, Parallel/Wireless: PCI, IrDA, Bluetooth, IEEE 802.11				
<b>Unit IV</b>	<b>Memory System and Program Design:</b> Caches, virtual memory, MMU, address translation, Memory interfacing: advanced RAM, microprocessor I/O addressing, interrupts, DMA, multilevel bus, Performance metrics and program design principles, Compilation, optimization, validation and testing				
<b>Unit V</b>	<b>Real-Time Operating Systems &amp; Embedded Development:</b> Operating system concepts and kernel for embedded systems, RTOS fundamentals: multitasking, multiprocessing, scheduling, context switching, Task communication and synchronization, Embedded development tools: IDE, cross-compilation, debugging, simulators/emulators Product design lifecycle				
<b>Text Books</b>					
1	Embedded Systems Architecture – 2nd Edition – by Daniele Lacamera,2023				
2	Henschen, Lawrence J. & Lee, Julia C. Embedded Systems Design: Methodologies and Issues (2023)				
<b>Reference Books</b>					
1	Making Embedded Systems: Design Patterns for Great Software (2nd Ed) – by Elecia White;				

	released 2024
2	Introduction to Embedded Systems, 2nd Edition: A Cyber-Physical Systems Approach (Springer)
<b>Useful Links</b>	
1	<a href="https://onlinecourses.nptel.ac.in/noc20_ee98/preview">https://onlinecourses.nptel.ac.in/noc20_ee98/preview</a>
2	<a href="https://onlinecourses.nptel.ac.in/noc20_cs14/preview">https://onlinecourses.nptel.ac.in/noc20_cs14/preview</a>

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<b>Program: B.Tech Final Year (CSE- Data Science)</b>					
<b>Semester</b>		<b>Course Code</b>		<b>Course Name</b>	
VII		<b>BEC34711</b>		<b>Data Modeling &amp; Optimization - lab</b>	
<b>Teaching Scheme</b>		<b>Examination Scheme(Th)</b>		<b>Examination Scheme(P)</b>	
<b>Theory(Th)</b>	-	<b>CT-I</b>	-	-	
<b>Practical(P)</b>	4	<b>CT-II</b>	-	-	
<b>Total Credits</b>	<b>2</b>	<b>CA</b>	-	<b>CA</b>	25
<b>Duration of ESE:</b>		<b>ESE</b>	-	<b>ESE</b>	25
		<b>Total Marks</b>	-	<b>Total Marks</b>	<b>50</b>
<b>Course Outcomes:</b> After the completion of this course, students will be able to-					
CO1	<b>Understand</b> Embedded system fundamentals, evolution, classifications, and applications				
CO2	<b>Explain</b> Embedded architectures, processor designs (8051, ARM, DSP), and system modeling concepts.				
CO3	<b>Analyze</b> Peripheral devices and communication protocols				
CO4	<b>Classify</b> Memory systems, interfacing methods, and program design principles.				
CO5	<b>Use</b> Big Data ingestion, analytics, and visualization tools.				
<b>Pre-Requisites:</b> Python					
<b>Sr.no</b>	<b>List of Experiments</b>				<b>COs</b>
1	To study different embedded system platforms and their applications.				CO 1
2	To understand the architecture and features of the 8051 microcontroller.				CO 1
3	To develop simple assembly language programs using 8051 microcontroller.				CO 2
4	To interface and control LED using a microcontroller.				CO 2
5	To interface Analog-to-Digital Converter (ADC) with a microcontroller.				CO 3
6	To implement serial communication using I2C/UART protocols.				CO 3
7	To study memory interfacing techniques in embedded systems.				CO 4
8	To implement interrupt handling in embedded systems.				CO 4
9	To study and implement basic RTOS task scheduling techniques.				CO 5
10	To develop, compile, and debug embedded programs using an IDE.				CO 5
<b>Text Books</b>					
1	Embedded Systems Architecture – 2nd Edition – by Daniele Lacamera,2023				
2	Henschen, Lawrence J. & Lee, Julia C. Embedded Systems Design: Methodologies and Issues (2023)				
<b>Reference Books</b>					
1	Making Embedded Systems: Design Patterns for Great Software (2nd Ed) – by Elecia White; released 2024				
2	Introduction to Embedded Systems, 2nd Edition: A Cyber-Physical Systems Approach (Springer)				
<b>Useful Links</b>					

1	<a href="https://onlinecourses.nptel.ac.in/noc20_ee98/preview">https://onlinecourses.nptel.ac.in/noc20_ee98/preview</a>
2	<a href="https://onlinecourses.nptel.ac.in/noc20_cs14/preview">https://onlinecourses.nptel.ac.in/noc20_cs14/preview</a>