B. Tech with

HONORS

in

COMPUTER SCIENCE AND ENGINEERING

Academic Regulations, Course Structure and Syllabus

Effective from 2023-24 admitted batches

Offered by

Department of Computer Science and Engineering

KSRM College of Engineering (A) – Kadapa

(Approved by AICTE, Accredited by NAAC with A+ Grade and NBA and Affiliated to JNTUA, Anantapuramu)

ELIGIBILITY / REGISTRATION / AWARD OF HONORS

The objective of introducing B.Tech. (Hons.) is to facilitate the students to choose additionally the specialized courses of their choice and build their competence in a specialized area in the UG level. The program is a best choice for academically excellent students having good academic record and interest towards higher studies and research.

i) Honors is introduced in the curriculum of all B. Tech. programs offering a major degree and is applicable to all B.Tech (Regular and Lateral Entry) students admitted in Engineering & Technology.

ii) Those students with **at least 7.0 CGPA without any course backlogs up to III Semester in the major degree are only eligible to register for Honor degree**.

iii) A student shall earn **additional 18 credits for award of Honors** from same branch / department / discipline registered for major degree. This is in addition to 163 credits by a regular student and 123 Credits by a Lateral Entry student for the award of Major degree.

iv) A student is permitted to register for Honors in IV Semester after the results of III Semester are declared. Students shall register and pass in all the courses prescribed and being offered from V semester under the respective Honor degree.

v) Students have to attend classwork for courses under Honor degree beyond regular academic hours meant for major degree. Students can also undergo the courses under Honor through any proctored online platforms with the prior approval of the BoS Chairman and the HoD of the respective department offering Honor degree.

vi) The attendance for the registered courses under Honors and regular courses offered for Major degree in a Semester will be considered separately.

vii) A student shall have an aggregate of 75% attendance in all courses registered under Honors in that particular semester to become eligible for attending Semester-End examinations.

viii) The registration for the Honor will be cancelled, if the student is detained due to lack of attendance in Major,

ix) The registration for the Honor will be cancelled, if the student fails in any course of either Honor / Major in any semester from V to VIII Semester.

x) A student registered for Honors shall pass in all subjects that constitute the requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) will be awarded for Honors degree program.

xi) A separate grade sheet will be issued for the Honor degree courses semester-wise.

xii) If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into open or core electives; they will remain extra.

xiii) The Honors will be mentioned in the degree certificate as Bachelor of Technology (Honors) in XYZ. For example, B.Tech. (Honors) in Mechanical

Engineering.

xiv) There shall be a minimum enrolment of 20% OR 20 enrollments from the list of eligible students to offer Honors program.

xv) There is no fee for registration of courses for Honors program offered.

xvi) A student can register for either Minor / Honor but not both.

xvii) Student shall submit an application for either Minor / Honor at least one week before the commencement of the V Semester.

HONORS PROGRAMS OFFERED

Offering Department	Title	Who can Register
Civil Engineering	Civil Engineering	B.Tech. CE
	Tunnel Engineering	
	Interior Design	
Mechanical Engineering	Mechanical Engineering	B.Tech. ME
Electrical and Electronics Engineering	Electric Vehicles	B.Tech. EEE
Electronics and Communication Engineering	VLSI	B.Tech. ECE
	Embedded Systems and IoT	
Computer Science and Engineering	Computer Science and Engineering	B.Tech. CSE, B.Tech. AIML, B.Tech. CSE(DS), B.Tech. CSE(AIML)
	Artificial Intelligence and Machine Learning	
	Data Science	
	CSE-Artificial Intelligence and Machine Learning	

COURSE STRUCTURE

for

HONORS

in

COMPUTER SCIENCE AND ENGINEERING

S.No	COURSE CODE	COURSE TITLE	Semester Offered	L	T	P	IM	EM	CR
1	2305571H	NoSQL Databases	V	3	0	0	30	70	3
2	2305572H	Software Defined Data Centre	V	3	0	0	30	70	3
3	2305671H	Robotics and Intelligent Systems	VI	3	0	0	30	70	3
4	2305672H	Cloud Security	VI	3	0	0	30	70	3
5	2305771H	Large Language Models	VII	3	0	0	30	70	3
6	2305772H	Applied Project Work	VII	0	0	6	60	140	3
Total				**15**	**0**	**6**	**210**	**490**	**18**

2305571H	HONORS IN COMPUTER SCIENCE AND ENGINEERING NoSQL DATABASES (CSE)	L	T	P	C
		3	0	0	3

Pre-Requisites: My SQL, Data Base Management Systems.

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Explain the history, evolution, and need for NoSQL databases.
CO2. Compare and contrast Relational Databases (RDBMS) with different types of NoSQL databases.
CO3. Define and describe the four main types of NoSQL databases: Document-oriented, Key-Value, Column-oriented, and Graph databases.
CO4. Demonstrate the architecture, perform data operations, and optimize the performance of Document, Column, Key-Value, and Graph databases.
CO5. Evaluate various NoSQL database development tools, programming languages, and real-world applications.

SYLLABUS:

UNIT – I: OVERVIEW AND HISTORY OF NO SQL DATA BASES (08 Periods)

Definition of the four types of No SQL data bases. The value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The emergence of No SQL, Key Points.

UNIT – II: RDBMS Vs No SQL (10 Periods)

Comparison of relational databases to new No SQL stores, Mongo DB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges No SQL approach, Key-Value and Document Data Models, Column-Family Stores, Aggregated-Oriented Databases, Replication and Sharding, Map Reduce on databases, Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication.

UNIT – III: DOCUMENT DATA BASES (08 Periods)

No-SQL Key-Value Databases using Mongo DB, Document Databases, Document oriented Database Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analysis or Real Time Analytics.

UNIT - IV: COLUMN ORIENTED DATABASES (10 Periods)

Column-oriented No SQL databases using Apache HBASE, Column-oriented No SQL databases using Apache Cassandra, Architecture of HBASE, Column-Family Data Store Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage.

UNIT – V: KEY VALUE DATABASES (10 Periods)

No SQL Key-Value databases using Riak, Key-Value Databases, Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preferences,
Shopping Cart Data, Relationships among Data, Multi operation Transactions, Query by Data, Operations by Sets, Firebase- Cloud hosted No SQL Database, Graph No SQL databases using Neo4j, No SQL database development tools and programming languages, Graph Databases features, consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases.

Total Periods: 46

TEXT BOOKS:

T1. Sadalage, P. & Fowler, No SQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications, 1st Edition 2019.

REFERENCE BOOKS:

R1 Redmond, E. & Wilson, J. (2012). Seven Databases in Seven Weeks: A Guide to Modern Databases and the No SQL Movement (1st Ed.). Raleigh, NC: The Pragmatic Programmers, LLC. ISBN-13: 978-1934356920, ISBN-10: 1934356921

R2 Guy Harrison, Next Generation Database: No SQL and big data, Apress.

WEB RESOURCES:

1. https://www.ibm.com/cloud/learn/nosql-databases
2. https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp
3. https://www.geeksforgeeks.org/introduction-to-nosql/

		L	T	P	C
2305572H	**HONORS IN COMPUTER SCIENCE AND ENGINEERING SOFTWARE DEFINED DATA CENTER (CSE)**	**3**	**0**	**0**	**3**

Pre-Requisites: Fundamentals of software development and maintenance

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Understanding of difference between Conventional Data Center Vs Modern Data Centers
CO2. Differentiate Cloud computing and Software Defined Data Centers
CO3. Differentiate Virtualization with conventional techniques
CO4. Explore the techniques of Software Defined Compute, Storage and Networking components
CO5. Able Manage Software Defined Data Centers and Develop the techniques for future Data Centers.

SYLLABUS:

UNIT - I: INTRODUCTION (12 Periods)

Data Center evolution, A history of Modern Data Center, Focus on cost reduction, Focus on Customer service in the business, Flattening of the IT organization, IT as an operational Expense, Monolithic Storage Array rise and fall, Move From Disk to Flash, Emergence of Convergence, The Role of Cloud computing.

UNIT - II: EMERGING DATA CENTER TRENDS (12 Periods)

Emergence of SDCC, Commoditization of Hardware, Software Defined – Compute, Storage, Networking and Security, Software Defined Storage (SDS), Hyper convergence, Hyper Converged Infrastructure(HCI) and SDS relationship, Flash in Hyper convergence, Modern IT business Requirements.

UNIT - III: DATA CENTER AGILITY (12 Periods)

Principles and Strategies, Transform Data Center, Align Data Center and Business Needs, Server virtualization, VDI, Eliminate and Implement Monolithic to Hyper convergence, Full Stack Management.

UNIT - IV: HYPER CONVERGED INFRASTRUCTURE (12 Periods)

Software Defined Storage, SDS comparison to Traditional Storage, SDS requirements, SDS in Hyper converged, Hyper convergence Design Model, Virtual Storage appliances, Appliance vs. Software/Reference Architecture,

UNIT - V: FUTURE DATA CENTERS (12 Periods)

Data growth, Storage capacity, flash storage deployment, Deployment Experiences SDS and HCI, IT transformations- Automation, Orchestration, Dev Ops, Open Standards and Interoperability, Performance Benchmarking Standards, Future Trends, Containers Instead of virtual machines, Open Source tools, Beyond Today‘s Flash, Pooling of Resources.

. **Total Periods: 60**

TEXT BOOKS:

T1. Building a Modern Data Center, Principles and Strategies of Design, Scott D. Lowe, James Green, David Davis. Actual Tech Media, 2016.

Reference Books:

R1: Data Center Handbook: Plan, Design, Build, and Operations of a Smart Data Center, Second Edition, Hwaiyu Geng P.E.,2021 John Wiley & Sons.

WEB RESOURCES:

1. https://www.redhat.com/en/topics/automation/what-is-a-sddc
2. https://www.geeksforgeeks.org/software-engineering/overview-of-software-defined-data-center-ssdc/

		L	T	P	C
2305671H	**HONORS IN COMPUTER SCIENCE AND ENGINEERING ROBOTICS AND INTELLIGENT SYSTEMS (CSE)**	**3**	**0**	**0**	**3**

Pre-Requisites: Nil

Course Out comes:

After completion of the course, students will be able to

CO1. Understand general concepts of Robotics and intelligent systems.
CO2. Understand robotics control systems
CO3. Analyze and understand the various programming languages of robotics
CO4. Understand Industrial robots and its applications
CO5. Create IoT solutions using sensors, actuators and Devices

Syllabus

UNIT - I: INTRODUCTION TO ROBOTICS (8 periods)

Back ground, Historical development, Robot Arm Kinematics and Dynamics, Manipulator Trajectory planning and Motion Control, Robot Sensing

UNIT - II: ROBOT ARM KINEMATICS AND DYNAMICS (9 Periods)

Introduction to Kinematics, Direct and Inverse Kinematics Problem and solution, Dynamics introduction, Lagrange-Euler Formulation, Newton Euler Formation, Generalized D'Alembert Equations of motion. Trajectory planning

UNIT – III: SENSING AND VISION (9 Periods)

Introduction to Sensing, Proximity Sensing, Touch Sensors, Force and Torque Sensing, Image acquisition, Illumination techniques, Imaging Geometry, Recognition and Interpretation.

UNIT – IV: ROBOT PROGRAMMING LANGUAGES (8 periods)

Introduction to Robot Programming Languages, Characteristics of Robot Level Languages, three levels of robot programming, requirements of a robot programming language, Task Level Languages, problems peculiar to robot languages, Introduction to

Robot Operating System (ROS)

UNIT – V: ROBOT INTELLIGENCE **(8 periods)**

Introduction, State Space Search, Problem Reduction, Use of Predicate Logic, Means-Ends Analysis, Problem solving, Robot Learning, Robot Task Planning, Basic Problems in Task Planning, Expert systems and knowledge engineering.

Total Periods: 42

TEXT BOOKS:

T1. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, Robotics: Control, Sensing, Vision and Intelligence

T2. Aaron Martinez, Enrique Fernandez, Learning ROS for Robotics Programming: A practical, instructive, and comprehensive guide to introduce yourself to ROS, the top-notch, leading robotics framework, PACKT publishing, Open Source.

REFERENCE BOOKS:

R1. John J. Craig, Introduction to Robotics: Mechanics and Control, Addison Wesley publication, Third Edition.

ONLINE LEARNING RESOURCES

1. https://nptel.ac.in/courses/107106090
2. https://nptel.ac.in/courses/112108298

2305672H	HONORS IN COMPUTER SCIENCE AND ENGINEERING CLOUD SECURITY (CSE)	L	T	P	C
		3	0	0	3

Pre- requisites: Computer Networks, Cryptography and Network Security, Cloud Computing.

Course Outcomes:

After completion of the course, students will be able to

CO1. Describe the fundamental concepts of cloud computing including its definitions, characteristics, service models, and deployment models.
CO2. Identify and analyze key cloud security and privacy issues including goals, concepts, and security requirements.
CO3. Classify different types of cloud attacks using established taxonomies and threat classifications.
CO4. Analyze security requirements for cloud software and rising threats to data in cloud environments.
CO5. Analyze cloud security management standards, access control, vulnerability, patch, and configuration management techniques.

SYLLABUS:

UNIT - I: OVER VIEW OF CLOUD COMPUTING (9 Periods)

Overview of Cloud Computing: Introduction, Definitions and Characteristics, Cloud Service Models, Cloud Deployment Models, Cloud Service Platforms, Challenges Ahead. Introduction to Cloud Security: Introduction, Cloud Security Concepts, CSA Cloud Reference Model, NIST Cloud Reference Model, NIST Cloud Reference Model.

UNIT – II: CLOUD SECURITY AND PRIVACY ISSUE (9 Periods)

Cloud Security and Privacy Issues: Introduction, Cloud Security Goals/Concepts, Cloud Security Issues, Security Requirements for Privacy, Privacy Issues in Cloud. Infrastructure Security: The Network Level, the Host Level, the Application Level, SaaS Application Security, PaaS Application Security, IaaS Application Security.

UNIT – III: THREAT MODEL AND CLOUD ATTACKS (9 Periods)

Threat Model and Cloud Attacks: Introduction, Threat Model- Type of attack entities, Attack surfaces with attack scenarios, A Taxonomy of Attacks, Attack Tools-Network-

level attack tools, VM-level attack tools, VMM attack tools, Security Tools, VMM security tools.

UNIT – IV: DATA SECURITY AND STORAGE (9 Periods)

Information Security Basic Concepts, an Example of a Security Attack, Cloud Software Security Requirements, Rising Security Threats. Data Security and Storage: Aspects of Data Security, Data Security Mitigation, Provider Data and Its Security.

UNIT – V: SECURITY MANAGEMENT IN THE CLOUD (9 Periods)

Evolution of Security Considerations, Security Concerns of Cloud Operating Models, Identity Authentication, Secure Transmissions, Secure Storage and Computation, Security Using Encryption Keys, Challenges of Using Standard Security Algorithms, Variations and Special Cases for Security Issues with Cloud Computing, Side Channel Security Attacks in the Cloud. Security Management in the Cloud- Security Management Standards, Availability Management, Access Control, Security Vulnerability, Patch, and Configuration Management.

Total Periods:45

TEXT BOOKS:

T1. Preeti Mishra, Emmanuel S Pilli, Jaipur R C Joshi Graphic Era., ―Cloud Security Attacks, Techniques, Tools, and Challenges‖, 1st Edition, 2022, CRC press.

T2. Tim Mather, SubraKumaraswamy, and ShahedLati―Cloud Security and Privacy‖,1st Edition, 2019, O'Reilly Media, Inc.

REFERENCE BOOKS:

R1 Naresh Kumar Sehgal Pramod Chandra, P. Bhatt John M. Acken., ―Cloud Computing with Security Concepts and Practices‖, 2nd Edition Springer nature Switzerland AG 2020.

R2 Essentials of Cloud Computing by K. Chandrasekaran Special Indian Edition CRC press.

R3 Raj Kumar Buyya, Cloud Computing Principles and Paradigms‖, John Wiley.

ONLINE LEARNING RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc19_cs64/preview

2 https://archive.nptel.ac.in/courses/106/105/106105167/

2305771H	HONORS IN COMPUTER SCIENCE AND ENGINEERING LARGE LANGUAGE MODELS (CSE)	L	T	P	C
		3	0	0	3

Pre-Requisites: Discrete Mathematics, Programming Fundamentals

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Explore the architecture of transformers, including attention mechanisms and positional encoding.
CO2. Apply language modeling techniques such as causal and masked language modeling using models like GPT and BERT.
CO3. Analyze advanced transformer models like T5 and explore prompt-based learning and model taxonomy.
CO4. Implement training strategies including optimization, fine-tuning methods, and handling common training challenges
CO5. Evaluate transformer models using benchmarks and understand scaling laws and large model training techniques.

SYLLABUS:

UNIT - I: FOUNDATIONS OF TRANSFORMERS AND ATTENTION MECHANISMS (08 Periods)

Introduction to Transformers, Self-Attention, Cross-Attention, Masked Attention, Positional Encoding, Types of Attention, A deep dive into number of parameters, computation complexity, and FLOPs.

UNIT - II: LANGUAGE MODELING WITH TRANSFORMERS (10 Periods)

Introduction to Language Modeling, Causal Language Modeling (CLM): What is a Language Model?, Generative Pretrained Transformers (GPT), Training and Inference Masked Language Modeling (MLM): BERT – Bidirectional Encoder Representations from Transformers, Fine-tuning BERT, Tokenization Techniques: BPE, SentencePiece, WordPiece

UNIT - III: ADVANCED ARCHITECTURES AND PROMPT-BASED LEARNING (08 Periods)

T5 and the Text-to-Text Framework, Genesis of Prompting, Taxonomy of Transformer

Models, Data: Datasets, Pipelines, Effectiveness of Clean Data

UNIT - IV: TRAINING TECHNIQUES AND OPTIMIZATION STRATEGIES (09 Periods)

Architecture Enhancements: PE Techniques, Scaling Techniques, Training Deep Transformers: Optimizers (Revisiting Optimizers, LION vs Adam), Loss Functions, Learning Schedules, Gradient Clipping, Typical Training Failures, Fine-Tuning Strategies: Prompt Tuning, Multi-task Fine-tuning, Parametric Efficient Fine-Tuning, Instruction Fine-Tuning Datasets

UNIT - V: EVALUATION, SCALING LAWS, AND TRAINING LARGE MODELS (09 Periods)

Evaluation Benchmarks: MMLU, BigBench, HELM, OpenLLM, Evaluation Frameworks Training Large Models: Mixed Precision Training, Activation Checkpointing,3D Parallelism, ZERO, Bloom as a Case Study, Scaling Laws: Chinchilla, Gopher, PaLM v2.

Total Periods: 45

TEXT BOOKS:

T1. Deep Learning- Ian Goodfelllow, Yoshua Benjio, Aaron Courville, The MIT Press.
T2. Zakaria Sabti, Prompt Engineering Demystified: Unleashing the Power of Large Language Models.

REFERENCE BOOKS

R1. Andrew Radford, “Transformational Grammar: A First Course.”
R2. Stephen Wolfram, “What is ChatGPT Doing .and Why Does It Work?”

ONLINE RESOURCES:

1 https://stanford-cs324.github.io/winter2022/lectures/

2305772H	*HONORS IN* *Computer Science and Engineering* **APPLIED PROJECT WORK** **(CSE)**	**L**	**T**	**P**	**C**
		0	**0**	**6**	**3**

Pre-Requisites: Programming Knowledge on C, Java and Python, Database Management Systems, Data Structures and Algorithms, Computer Networks, Machine Learning, Deep Learning.

Course Outcomes:

On successful completion of the course, student will be able to

CO1. Analyze and formulate complex problems in the field of Computer Science and Engineering by applying foundational principles, algorithms, and computational techniques.

CO2. Design and develop efficient software/hardware solutions that address real-world challenges using appropriate engineering and computational methods.

CO3. Implement projects effectively by utilizing suitable programming languages, development environments, tools, and frameworks relevant to Computer Science and Engineering applications.

CO4. Apply data pre-processing, feature engineering, and model optimization strategies to enhance the accuracy, efficiency, and overall performance of computational systems and applications.

CO5. Demonstrate effective project management skills through systematic planning, teamwork and collaboration, proper documentation, and clear presentation of technical outcomes.

CO6. Propose and implement solutions with a strong emphasis on professional ethics, while addressing societal needs and promoting environmental sustainability.