



**BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT**  
(Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE New Delhi)  
Yelahanka, Bengaluru 560119



**Bachelor of Engineering**  
**Department of Information Science and Engineering**

**VI Semester Scheme and Syllabus 2022**  
**Scheme**  
**Effective from the AY 2025-26**  
**Approved in the BoS Meeting Held on 31st - January -2026**

*Sundares*

*T. Kalur*

## **Vision and Mission of the Department**

### **Vision:**

Emerge as center of learning in the field of Information Science & Engineering with technical competency to serve the society.

### **Mission:**

To provide excellent learning through balanced curriculum, best teaching methods, innovation, mentoring and industry institute interaction.

## Program Educational Objectives (PEOs)

PEOs	
PEO1	Successful professional career in Information Science and Technology.
PEO2	Pursue higher studies & research for advancement of knowledge in IT industry.
PEO3	Exhibit professionalism and team work with social concern.

## Program Specific Outcomes (PSOs)

PSOs	
PSO-1	Apply the Knowledge of Information technology to develop software solutions.
PSO-2	Design and develop hardware systems, manage and monitor resources in the product life cycle.



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**BMS Institute of Technology and Management**

(An Autonomous Institution, Affiliated to VTU Belagavi)

Avalahalli, Doddaballapur Main Road, Bengaluru, Karnataka - 560064

**REVISED**

Date: 18-12-2024

**CONTINUOUS INTERNAL EVALUATION (CIE)**

**AND**

**SEMESTER END EXAMINATION (SEE) PATTERN**

(Applicable to UG students admitted from the 2022 batch, effective from the Academic year 2024-25 onwards)

The UG students admitted from the 2022 batch onwards are hereby informed to note the following regarding Continuous Internal Evaluation and Semester End Examination pattern:

- The Weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Examination (SEE) is 50%.
- The Minimum passing mark for the CIE is 40% of the Maximum marks (i.e. 20 marks out of 50) and for the SEE minimum passing mark is 35% of the Maximum marks (i.e. 18 out of 50 marks).
- A student will be declared to have passed the course if they secure a minimum of 40% (i.e. 40 marks out of 100) in the combined total of the CIE and SEE.

The following tables summarize the CIE and SEE Patterns for the courses of various credits:

IPCC COURSES: 4 CREDITS OR 3 CREDITS						
Evaluation Type		Internal Assessments (IAs)	Test/ Exam Marks Conducted for	Marks to be scaled down to	Min. Marks to be Scored	Evaluation Details
Theory Component	CIE - IA Tests	CIE - Test 1 (1.5 hr)	40	20	-	The sum of the two internal assessment tests will be <b>80 Marks</b> and the same will be scaled down to <b>20 Marks</b> .
		CIE - Test 2 (1.5 hr)	40			

	CIE - CCA (Comprehensive Continuous Assessment)	CCA	10	05	-	Any one assessment method can be used from the list appended below.
<b>Total CIE Theory</b>				<b>25</b>	<b>10</b>	
Practical Component	CIE - Practical		30	15	-	Each laboratory experiment is to be evaluated for <b>30 Marks</b> using appropriate rubrics.
	CIE Practical Test		20	10	-	One test after all experiments to be conducted for <b>20 Marks</b>
	<b>Total CIE Practical</b>			<b>25</b>	<b>10</b>	
<b>Total CIE Theory + Practical</b>				<b>50</b>	<b>20</b>	
<b>SEE</b>			100	50	18	SEE exam is a theory exam, conducted for <b>100 Marks</b> , scored marks are scaled down to <b>50 Marks</b> .
<b>CIE + SEE</b>				<b>100</b>	<b>40</b>	

The laboratory component of the IPCC shall be for CIE only.

Professional Core Courses (PCC) / Engineering Science Courses (ESC): 03 and 02 Credit						
Evaluation Type		Internal Assessments (IAs)	Test/Exam Marks Conducted for	Marks to be scaled down to	Min. Marks to be Scored	Evaluation Details
Theory Component	CIE - IA Tests	CIE - Test 1 (1.5 hr)	40	30	-	The sum of the two internal assessment tests will be <b>80 Marks</b> and the same will be scaled down to <b>30 Marks</b> .  Any Two assessment methods can be used from the list. If it is project-based, one CCA shall be given.
		CIE - Test 2 (1.5 hr)	40			
	CIE - CCAs	CCA	20	20	-	
	<b>Total CIE Theory</b>			<b>50</b>	<b>20</b>	
<b>SEE</b>			100	50	18	SEE is a theory exam, conducted for <b>100 Marks</b> , scored marks are scaled down to <b>50 Marks</b> .
<b>CIE + SEE</b>				<b>100</b>	<b>40</b>	

NON-IPCC COURSES: 01 Credit Course - MCQ						
Evaluation Type		Internal Assessments (IAs)	Test/Exam Marks Conducted for	Marks to be scaled down to	Min. Marks to be Scored	Evaluation Details
Continuous Internal Evaluation on Component	CIE - IA Tests (MCQs)	CIE - Test 1 (1 hr)	40	40	-	<p>The question paper pattern for this course shall be an <b>MCQ of 1 or 2 Marks (s)</b>.</p> <p>The questions with 2 Marks can be framed based on a higher Bloom's level.</p> <p>The sum of the two internal assessment tests will be <b>80 Marks</b>, and the same will be scaled down to <b>40 Marks</b>.</p>
		CIE - Test 2 (1 hr)	40			
	CIE - CCAs	CCA	10	10	-	
	<b>Total CIE</b>				<b>50</b>	
<b>SEE (MCQ Type)</b>				<b>50</b>	<b>18</b>	<p>The question paper pattern for this course shall be an <b>MCQ of 1 or 2 Marks (s)</b>.</p> <p>The questions with 2 Marks can be framed based on higher Bloom's level.</p> <p>MCQ-type question papers of 50 questions with each question of a <b>01 Mark</b>, examination duration is 01 hour.</p>
<b>CIE + SEE</b>				<b>100</b>	<b>40</b>	

Professional Core Course Laboratory (PCCL) / Ability Enhancement Course Laboratory (AEC) - 01 Credit					
Evaluation Type	Internal Assessments (IAs)	Test/ Exam Marks Conduct ed for	Marks to be scaled down to	Min. Marks to be Scored	Evaluation Details
Continuous Internal Evaluation	CIE - Practical	30	30		Each laboratory experiment is to be evaluated for <b>30 Marks</b> using appropriate rubrics.
	CIE - Practical Test	50	20		One test after all experiments is to be conducted for <b>50 Marks</b> and to be scaled down to <b>20 Marks</b> .
	<b>Total CIE</b>	-	<b>50</b>	<b>20</b>	
Semester End Examination		100	50	18	SEE to be conducted for <b>100 Marks</b> .
<b>CIE+SEE</b>		<b>100</b>		<b>40</b>	

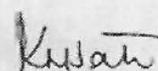
#### Learning Activities for CCAs:

A faculty member may choose the following CCAs based on the needs of the course:

1. Course project
2. Literature review
3. MOOC
4. Case studies
5. Tool exploration
6. GATE-based aptitude test
7. Open book tests
8. Industry integrated learning
9. Analysis of Industry / Technical / Business reports
10. Programming assignments with higher Bloom level
11. Group discussions
12. Industrial / Social / Rural projects

  
CoE 18/12/2024

  
Principal 18/12/24

  
Dean AA 18.12.24

#### Copy To:

1. The Vice-Principal, Deans, HoDs, and Associate HoDs
2. All faculty members and students of 2022, 2023, and 2024 batch.
3. Examination Section



## BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institution Affiliated to VTU, Belagavi)

### B. E. Information Science and Engineering

#### Scheme of Teaching and Examinations – 2022 Scheme

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)  
(Effective from the academic year 2025-26 onwards)

**UG PROGRAM: Department of Information Science and Engineering**

**VI SEMESTER**

Sl. No.	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours					Examination				Credit
					L	T	P	S	Total	CIE Marks	SEE Marks	Total Marks	SEE Duration (H)	
1	IPCC	BCS601	Cloud Computing	TD: CSE PSB: CSE/ISE	40	0	28	52	120	50	50	100	3	4
2	PCC	BCS602	Machine Learning		50	0	0	70	120	50	50	100	3	4
3	PCC	BIS603	IOT: Concepts and Applications		40	0	0	50	90	50	50	100	3	3
4	PEC	BCS604X	Professional Elective Course II		40	0	0	50	90	50	50	100	3	3
5	OEC	BCS605X	Open Elective Course I		40	0	0	50	90	50	50	100	3	3
6	PW	BCS606	Major Project Phase I		0	0	90	0	90	100	-	100	-	3
7	PCCL	BCSL607	Machine Learning Lab		0	0	28	2	30	50	50	100	3	1
8	AEC	BCS608X	Ability Enhancement Course/Skill Enhancement Course		For Theory course					50	50	100	1	1
				14	0	0	16	30						
				For Practical course					0				0	
9	NCMC	BNSK609	National Service Scheme (NSS)	NSS Coordinator	0	0	28	0	28	100	-	100	-	0
		BPEK609	Physical Education (Sports and Athletics)	PED										
		BYOK609	Yoga	Yoga Teacher										
		BNCK609	National Cadet Corps (NCC)	NCC officer										
		BMUK609	Music	Music Teacher										
10	NCMC	BIKS610	Indian Knowledge System	Any Department	14	0	0	0	14	100	-	100	-	0
<b>TOTAL</b>										<b>650</b>	<b>350</b>	<b>1000</b>	<b>-</b>	<b>22</b>

**IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Courses, **PEC:** Professional Elective Course, **OEC:** Open Elective Course, **PCCL:** Professional Core Course laboratory, **NCMC:** Non Credit Mandatory Course, **ESC:** Engineering Science Course, **AEC:** Ability Enhancement Course, **L:** Lecture, **T:** Tutorial, **P:** Practical, **CIE:** Continuous Internal Evaluation,

**SEE:** Semester End Evaluation.

Professional Elective Course II		Open Elective Course I		Ability Enhancement Course	
Course Code	Course Name	Course Code	Course Name	Course Code	Course Name
BCS604A	Cyber Security	BCS605A	Introduction to Data Structures	BCS608A	Generative AI
BCS604B	Block Chain Essentials	BAI605B	Data Analytics	BCS608B	Mobile Application Development
BCS604C	Full Stack Development			BCS608C	DevOps
BCS604D	Data warehousing and Datamining			BCS608D	Automated Software Testing
BCS604E	Cyber Security Essentials			BCS608E	Robotic Process Automation
<p><b>Integrated Professional Core Course (IPCC):</b> Refers to Professional Core Course Theory Integrated with practical's of the same course. Credit for IPCC can be 04 and its Teaching-Learning hours (L: T: P: S) can be considered as (40: 0: 28: 52) or (3: 0: 1: 0). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.</p>					
<p><b>National Service Scheme /Physical Education/Yoga/NCC/Music:</b> All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), Yoga (YOG), National Cadet Corps (NCC) and Music with the concerned coordinator of the course during the beginning of each semester starting from III semester to VII semester. In every semester, students should choose any one mandatory course among the available 5 courses without repeating the course again. Activities shall be carried out in each of the semesters from III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.</p>					
<p><b>Professional Elective Courses (PEC):</b> A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.</p>					
<p><b>Open Elective Courses (OEC):</b> Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.</p> <p><b>Selection of an open elective shall not be allowed if,</b></p> <ul style="list-style-type: none"> <li>➤ The candidate has studied the same course during the previous semesters of the program.</li> <li>➤ The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.</li> <li>➤ A similar course, under any category, is prescribed in the higher semesters of the program.</li> <li>➤ The minimum students' strength for offering open electives is 10. However, this condition shall not be applicable to cases where the admission to the program is less than 10.</li> </ul>					
<p><b>Project Phase-I:</b> Student have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.</p>					

**B.E. INFORMATION SCIENCE AND ENGINEERING**  
Choice Based Credit System (CBCS) for 2022 scheme  
**SEMESTER-VI**

**Cloud Computing (40:0:28:52)4**  
(Effective from the academic year 2025-26)

Course Code	BCS601	CIE Marks	50
Teaching Hours (L:T:P:S)	40:0:28:52	SEE Marks	50
Total Number of Contact Hours	40 Hours Theory + 28 Hours Practical	Exam Hours	3
Examination Nature	Theory		

**Course Objectives:**

This course will enable students to:

1. Explain the technology and principals involved in building a cloud environment.
2. Contrast various programming models used in cloud computing.
3. Choose appropriate cloud model for a given application.

**Preamble:**

Cloud computing is a modern paradigm that enables on-demand access to shared computing resources over the internet. It allows users to store, process, and manage data without relying on local hardware or infrastructure. Cloud services are typically delivered through models such as Infrastructure as a Service, Platform as a Service, and Software as a Service. One of the key advantages of cloud computing is scalability, enabling resources to be adjusted based on demand. It reduces operational costs by eliminating the need for expensive physical servers and maintenance. Cloud computing supports remote access, making collaboration and data sharing more efficient. Service providers ensure high availability and reliability through distributed data centers.

**Module - 1**

The cloud ecosystem: Significance and scope of Cloud Computing, Cloud Computing in Economic growth of Nation, Impact of Cloud Computing on societal problems, sustainable solutions, Career perspective of Cloud Computing, current innovations in Cloud Computing, Cloud Computing in Research Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead. Enabling technologies: Distributed Systems, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development

**Text book-1: Chapter-1**

**(8 Hours)**

**Module - 2**

Virtualization: Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples Xen: Paravirtualization, VMware: Full Virtualization, Microsoft Hyper-V.

**Text book-1: Chapter-3**

**(8 Hours)**

**Module - 3**

Cloud Computing: Architecture, Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Definition, Cloud Interoperability and Standards Scalability and Fault Tolerance Security, Trust, and Privacy Organizational Aspects.

**Text book-1: Chapter-4**

**(8 Hours)**

#### Module - 4

Aneka: Cloud Application Platform, Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud, Deployment Mode, Public Cloud Deployment Mode, Hybrid Cloud Deployment Mode, Cloud Programming and Management, Aneka SDK, Management Tools.

**Text book-1: Chapter-5**

**(8 Hours)**

#### Module - 5

Cloud applications: Cloud application development and architectural styles, Coordination of multiple activities, Workflow patterns. Coordination based on a state machine model—zookeeper, Map Reduce programming model, Case study: the GrepThe Web application, Hadoop,Yarn, and Tez, SQL on Hadoop: Pig, Hive, and Impala.

**Text book-2: Chapter-11**

**(8 Hours)**

#### Course Outcomes:

CO1: Apply the Knowledge of cloud technology to demonstrate the working principles of cloud.

CO2: Analyse the role of security aspects in cloud computing

CO3: Design cloud environment for different real time requirements

CO4: Analyse cloud resource management and virtualization techniques to to evaluate their impact on performance and security

#### Textbooks:

1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi Mastering Cloud. Computing McGraw Hill Education. ISBN-13 (978-9355329509), 2nd Edition, 10th reprint-June 2024
2. Dan C. Marinescu, Cloud Computing Theory and Practice, 3rd Edition - February 15, 2022 Paperback ISBN: 9780323852777, eBook ISBN: 9780323910477

#### References:

1. Thomas Eri, Eric Barcelo Monroy, Cloud Computing: concepts, technology and Architecture, Pearson Education (29 February 2024); Pearson Education, ISBN-13: 978-8196943219, India.
2. Shailendra Singh, Cloud Computing, Publisher : Oxford University Press; First Edition (1 June2018), ISBN-13 : 978-0199477388, , India.

#### Cloud Computing Laboratory

##### PART A

##### Programs List

1	Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.
2	Create an AWS skill builder account and explore the AWS Management Console
3	Demonstrate how to manage access and permissions to AWS services using AWS Identity and Access Management (IAM). Practice the steps to add users to groups, manage passwords, log in with IAM-created users, and see the effects of IAM policies on access to specific services.
4	Demonstrate how to create an Amazon S3 bucket, add an object, view an object, move an object, and delete an object and bucket in the AWS Management Console.
5	Create a VPC, attach an Internet Gateway, add a subnet and then define routing for the VPC so that traffic can flow between the subnet and the Internet gateway.
6	Demonstrate steps to launch an EC2 instance in a public subnet to host a web server and another EC2 instance in a private subnet for the database.

<p><b>PART B:-</b> <b>Continuous Comprehensive Assessments (CCAs) suggested:</b> <b>As part of the CCA Activity students have to do the following certifications Course.</b></p> <p>1.. Google Cloud Computing Foundations (GCCF)</p>
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16/2/2026

17/2/26

18/2/26

**B.E. INFORMATION SCIENCE AND ENGINEERING**  
Choice Based Credit System (CBCS) for 2022 scheme  
**SEMESTER-VI**

**Machine Learning (50:0:0:70)4**  
(Effective from the academic year 2025-26)

Course Code	BCS602	CIE Marks	50
Teaching Hours (L:T:P:S)	50:0:0:70	SEE Marks	50
Total Number of Contact Hours	50 Hours Theory	Exam Hours	3
Examination Nature	Theory		
<p><b>Course Objectives:</b> Students will be able to:</p> <ol style="list-style-type: none"> <li>1. Familiarize students with the fundamental concepts, theories and applications of Machine Learning.</li> <li>2. Demonstrate the characteristics of Decision Trees, Neural Networks, Bayesian Techniques for solving real world problems.</li> <li>3. Perform statistical analysis of machine learning techniques.</li> <li>4. Evaluate hypothesis and investigate Ensemble learning, Instance Based Learning and Reinforcement Learning.</li> </ol>			
<p><b>Preamble:</b> This syllabus aims to equip students with a comprehensive understanding of the fundamental principles, algorithms, and techniques used to enable computers to learn from data, allowing them to build intelligent systems capable of making predictions and decisions, thereby preparing them to apply these transformative technologies on various applications.</p>			
<b>Module -1</b>			
<p><b>Introduction:</b> Machine learning Landscape: what is ML?, Why, Types of ML, main challenges of ML. <b>Concept Learning:</b> Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm. <b>Text book 1: Chapter 1, Text Book2, Sections: 2.1-2.5</b></p> <p align="right"><b>(10 Hours)</b></p>			
<b>Module -2</b>			
<p><b>Introduction to Classification:</b> MNIST, training a Binary classifier, performance measure, multiclass classification, error analysis, multi label classification, multi output classification. <b>Decision Tree Learning:</b> Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm –ID3. <b>Text book 1: Chapter 3, Text Book 2, Sections: 3.1-3.4</b></p> <p align="right"><b>(10 Hours)</b></p>			
<b>Module -3</b>			
<p><b>Artificial Neural Networks:</b> Introduction, Neural Network representation, Appropriate problems, Perceptron- Perceptron Training rule, Back propagation algorithm. <b>Support Vector Machine:</b> Linear, Nonlinear, SVM regression. <b>Text book 2: Sections: 4.1 – 4.5 ,Text book 1: Chapter 5</b></p> <p align="right"><b>(10 Hours)</b></p>			
<b>Module -4</b>			

<p><b>Bayesian Learning:</b> Introduction, Bayes theorem, Bayes theorem and concept learning, Naive Bayes classifier, Bayesian belief networks, EM algorithm</p> <p><b>Instance-Based Learning:</b> Introduction K- Nearest Neighbor Learning, locally weighted regression.  <b>Text book 2 Sections: 6.1, 6.2,6.9, 6.11,6.12., Text book 2 Chapter 8 (8.1-8.3)</b></p> <p style="text-align: right;"><b>(10 Hours)</b></p>
<b>Module -5</b>
<p><b>Ensemble learning and Random Forest:</b> Voting classifiers, Bagging and pasting, Random patches, Random forests, Boosting-Ada Boost, stacking.</p> <p><b>Reinforcement Learning:</b> Introduction, The learning task, Q-Learning.</p> <p><b>Textbook1: Chapter 7</b></p> <p><b>Textbook2: Chapter 13 (13.1 - 13.3)</b></p> <p style="text-align: right;"><b>(10 Hours)</b></p>
<p><b>Course Outcomes:</b> The students will be able to:</p> <p>CO1:Apply the key concepts, types, and challenges of Machine Learning to identify appropriate learning algorithms for solving problems</p> <p>CO2:Develop machine learning models using appropriate algorithms for classification, regression, and decision-making tasks.</p> <p>CO3:Make use of advanced techniques like ensemble learning, instance-based learning, and Bayesian methods to enhance model accuracy and efficiency.</p> <p>CO4: Analyze the performance of different machine learning models using statistical and evaluation metrics</p>
<p><b>Textbooks:</b></p> <ol style="list-style-type: none"> <li>1. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn &amp; Tensor Flow, O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2021</li> <li>2. Tom M Mitchell, "Machine Learning", 1st Edition, Mc Graw Hill Education, 2017.</li> </ol>
<p><b>Reference Books:-</b></p> <ol style="list-style-type: none"> <li>1. Ethem Alpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd, 2nd Ed., 2013</li> <li>2. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, Springer, 1st edition, 2001</li> <li>3. Machine Learning using Python, Manaranjan Pradhan, U Dinesh Kumar, Wiley, 2019</li> <li>4. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson, 2020</li> </ol>
<p><b>Continuous Comprehensive Assessments (CCAs) suggested:</b></p> <ul style="list-style-type: none"> <li>• Choose a real-world dataset and design a complete machine learning pipeline. Justify your choice of preprocessing techniques, algorithm, and evaluation metrics. Analyze how changes in parameters affect model performance.</li> </ul>

Staty  
16/02/2026

SKP  
17/2/26

T. R. R. R.  
17/2/26

Srividya

**B.E. INFORMATION SCIENCE AND ENGINEERING**  
Choice Based Credit System (CBCS) for 2022 scheme  
**SEMESTER -VI**

**IOT: Concepts and Applications (40:0:0:50) 3**

(Effective from the academic year 2025-26)

Course Code	BIS603	CIE Marks	50
Teaching Hours(L:T:P:S)	40:0:0:50	SEE Marks	50
Total Number of Contact Hours	40 Theory	Exam Hours	3
Examination Nature	Theory		

**Course Objectives:**

This course will enable students to:

1. To provide an in-depth understanding of the Internet of Things (IoT) architecture, conceptual framework, and the technologies enabling IoT applications.
2. To study the principles of internet connectivity, communication protocols, and data acquisition, processing, and cloud-based storage for IoT systems.
3. To examine the role of sensors, actuators, RFID, and wireless sensor networks in various IoT applications, including industrial and automotive IoT.
4. To assess security challenges, vulnerabilities, and solutions in IoT systems, along with practical applications in asset management, industrial automation, and smart grids.

**Preamble:**

This course provides a fundamental understanding of the Internet of Things (IoT), covering its architecture, communication protocols, and cloud-based services. It explores key components like sensors, actuators, RFID, and wireless sensor networks. Emphasis is placed on IoT security, privacy, and threat analysis. Real-world applications in smart cities, industrial automation, and asset management are discussed. The course also covers data acquisition, processing, and analytics using cloud platforms. It equips students with the skills to design and implement secure and efficient IoT solutions.

**Module - 1**

**Internet of Things: An Overview:** Internet of Things, IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M Communication, and Examples of IoT.

**Principles for Connected Devices Introduction:** IoT/M2M Systems Layers and Designs, Standardization Communication Technologies, Gateway, Ease of Designing and Affordability.

**Textbook 1: Chapter — 1 (1.1- 1.7), 2 (2.1-2.5) (8 Hours)**

**Module - 2**

**Design Principles for Web Connectivity:** Introduction, Web Communication Protocols for Connected Devices, Message Communication Protocols for Connected Devices, Web Connectivity for Connected-Devices Network using Gateway SOAP, REST, HTTP RESTful and WebSockets.

**Internet Connectivity Principles:** Introduction, Internet Connectivity Internet-Based Communication IP Addressing in the IoT, Media Access Control, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet and Others.

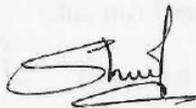
**Textbook 1: Chapter — 3 (3.1- 3.4), 4 (4.1-4.6) (8 Hours)**

**Module - 3**

**Data Acquiring, Organising, Processing and Analytics:** Introduction, Data Acquiring and Storage, Organising the Data Transactions, Business Processes, Integration and Enterprise Systems, Analytics, Knowledge Acquiring, Managing and Storing Processes. **Data Collection, Storage and Computing Using a Cloud Platform:** Introduction, Cloud Computing Paradigm for Data Collection, Storage and Computing, Everything as a Service and Cloud Service Models, IoT Cloud-Based Services Using the Xively, Nimbits and Other Platforms.

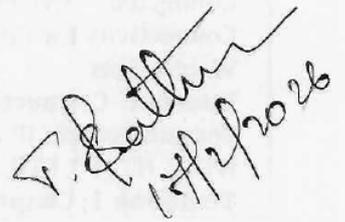
**Textbook 1: Chapter — 5 (5.1- 5.6), 6 (6.1-6.4) (8 Hours)**

<b>Module - 4</b>	
<b>Sensors, Participatory Sensing, RFIDs, and Wireless Sensor Networks:</b> Introduction, Sensor Technology, Participatory Sensing, Industrial IoT and Automotive IoT, Actuator, Sensor Data Communication Protocols, Radio Frequency Identification Technology, Wireless Sensor Networks Technology.	
<b>Textbook 1: Chapter — 7 (7.1- 7.7)</b>	<b>(8 Hours)</b>
<b>Module - 5</b>	
<b>IoT Privacy, Security and Vulnerabilities Solutions:</b> Introduction, Vulnerabilities, Security Requirements, and Threat Analysis, Use Cases and Misuse Cases, IoT Security Tomography and Layered Attacker Model, Identity Management and Establishment, Access Control and Secure Message Communication, Security Models, Profiles, and Protocols for IoT	
<b>Textbook 1: Chapter — 10(10.1- 10.6)</b>	<b>(8 Hours)</b>
<b>Course Outcomes:</b>	
The students will be able to:	
CO1: Analyze IoT concepts, architectural models, M2M communication, and internet/web connectivity protocols used in connected devices.	
CO2: Apply data acquisition, storage, processing, and cloud-based analytics techniques to manage IoT-generated data efficiently.	
CO3: Analyze the role of sensors, actuators, RFID, and wireless sensor networks in industrial, automotive, and participatory IoT applications.	
CO4: Design a conceptual IoT solution for real-world applications such as smart grids, industrial automation, or asset management, considering security and scalability constraints.	
<b>Textbooks:</b>	
1. Raj Kamal, "Internet of Things – Architecture and Design Principles", Mc Graw Hill Education Pvt. Ltd., 2017.	
<b>References:</b>	
1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015, Editors Ovidiu Vermesan	
2. Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment' River Publishers, 2014	
3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.	
<b>Continuous Comprehensive Assessments (CCAs) suggested:</b>	
<ul style="list-style-type: none"> <li>IoT-based mini projects focused on solving real-time problems using appropriate hardware components and software tools. Students may work in teams of <b>two to three members</b> and are free to <b>identify and select problem statements of their choice</b>.</li> </ul>	

  
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**B.E. INFORMATION SCIENCE AND ENGINEERING**  
Choice Based Credit System (CBCS) for 2022 scheme  
**SEMESTER -VI**

**Machine Learning Laboratory (0:0:28:2) 1**  
(Effective from the academic year 2025-26)

Course Code	BCSL607	CIE Marks	50
Teaching Hours (L:T:P:S)	0:0:28:2	SEE Marks	50
Total Number of Contact Hours	28 Hours Practical	Exam Hours	3
Examination Nature	Practical		

**Course Objectives:**

This course will enable students to:

1. Learn and understand the Importance of Machine learning Algorithms
2. Compare and contrast the learning techniques like ANN approach, Bayesian learning and reinforcement learning.
3. Solve and analyze the problems on ANN, Instance based learning and Reinforcement learning techniques.
4. Impart the knowledge of clustering and classification Algorithms for predictions and evaluating Hypothesis.

**Program List**

1.	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
2.	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
3.	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets
4.	Write a program to implement the naive Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
5.	Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
6.	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Python ML library classes/API in the program.
7.	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
8.	Implement the SVM algorithm for classification
9.	Implement Random Forest in Python and calculate result matrices, evaluation matrices, and accuracy

**PART B**

1.	Using a historical weather dataset, implement a Linear Regression model to predict a weather parameter such as temperature or rainfall. Evaluate the model performance using appropriate evaluation metrics.
2.	Implement an AdaBoost classifier to predict whether an email is Spam or Not spam based on simple features like message length, number of special characters and presence of keywords.
3.	Implement gradient descent to find a local minimum and visualize the same using matplotlib.

**Course Outcomes: The student should be able to:**

CO1: Apply the concepts of classification, clustering and regression algorithms with respect to training and test data sets.

CO2: Analyze the performance of machine learning models using appropriate evaluation and performance metrics

CO3: Analyze the principles of Instance based and Ensemble Learning techniques.

**Text books:**

1. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn & Tensor Flow, O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2021
2. Tom M Mitchell, "Machine Learning", 1st Edition, Mc Graw Hill Education, 2017.

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**PROFESSIONAL  
ELECTIVE COURSE II**

**B.E. INFORMATION SCIENCE AND ENGINEERING**  
Choice Based Credit System (CBCS) for 2022 scheme  
**SEMESTER - VI**

**Cyber Security (40:0:0:50) 3**  
(Effective from the academic year 2024-25)

Course Code	BCS604A	CIE Marks	50
Teaching Hours/Week (L: T:P:S)	(40:0:0:50)	SEE Marks	50
Total Number of Contact Hours	40 Hours Theory	Exam Hours	3

**Course Objectives:** This course will enable students to:

1. Understand the fundamental concepts of cybersecurity, cryptography, network security, and cloud security.
2. Develop practical skills in Cyber threat intelligence, Vulnerability Scanning and Data Protection.
3. Learn about cyber laws, compliance standards, and risk management frameworks.
4. Gain hands-on experience with security tools and real-world case studies.
5. Self-Learning for industry certifications such as CEH, CISSP, and Security+.

**Preamble:**

In today's digital age, network and cybersecurity are crucial for safeguarding information systems by ensuring data confidentiality, integrity, and availability. As cyber threats rapidly evolve, organizations and individuals must implement robust security measures to protect networks from malicious actors, unauthorized access, and data breaches. Understanding key principles such as secure communication protocols, firewalls, intrusion detection and prevention systems (IDS/IPS), and Virtual Private Networks (VPNs) is essential. Additionally, adopting cybersecurity frameworks, cryptographic techniques, and vulnerability management strategies strengthens defences against cyber threats. By enforcing strong security policies, access controls, and proactive monitoring, we can establish a secure digital environment, fostering trust and reliability in cyberspace.

**Module - 1**

**Importance of cyber security:** Scenarios for security, Understanding the attack surface, the threat landscape, the importance of securing the network and Applications, the history of breaches, how security helps to build trust.

Legacy cybersecurity systems, Transformations in cybersecurity, Advancements in security technology to security 2.0, How ML and AI will play a larger role in cybersecurity,

**(Chapter 1 & 2 from Textbook1)**

**(8 Hours)**

**Module - 2**

Learning cybersecurity Technologies Mobile security, advanced data security, cloud security, Modern day regulations, Incidence response and forensic, Enterprise security at scale, penetration testing, DevSecOps, IoT Security, User behaviour analytics (UBA), Endpoint detection and response (EDR).

Attacker Mindset, the category of hackers, the traits of hackers, Social Characteristics of hackers, How hackers think (Motivators), What can be learned from the psychology of hackers?

**(Chapter 3 & 5 from Textbook1)**

**(8 Hours)**

**Module - 3**

**Authentication:** one way authentication (password based, certificate based), Mutual authentication (shared secret based, Asymmetric key-based, Authentication and key Agreement, use of Timestamps), Dictionary attacks (attack types, defeating Dictionary attacks).

**Firewalls:** firewall basics-firewall functionality, policies and access control lists, firewall types; practical issues-placement of firewalls, firewall configuration.

**Textbook 2: Chapter 11 (11.1-11.3), Chapter 21 (21.1- 21.2)**

**(8 Hours)**

**Module - 4**

**Non-Cryptographic Protocol Vulnerabilities:** DoS and DDoS (attack types, impact of SYN flooding), Session Hijacking and Spoofing (impersonation and session Hijacking, ARP spoofing); cross-site scripting (XSS): Vulnerabilities, SQL injection.

**Intrusion Prevention and Detection:** Introduction, Prevention versus Detection, Types of Intrusion Detection Systems,

Cyber Kill Chain: what is a kill chain, applying the cyber kill chain to detection

**Textbook 2: Chapter 17 ,18,22 (17.1, 17.2, 18.4, 22.1- 22.4,)**

**Textbook 4: Chapter 16**

**(8 Hours)**

**Module - 5**

**Web Application Security:** This Site Is Secure, The Core Security Problem: Users Can Submit Arbitrary Input, Key Problem Factors, The New Security Perimeter, Core Defense Mechanisms: Handling User Access, Handling User Input, Handling Attackers.

**Penetration Testing of Web Applications:** Using tools like BURP Suit and OWASP ZAP to find vulnerabilities in a web application.

<https://portswigger.net/burp>,

<https://owasp.org/> (Chapters 1 & 2 from TextBook 3)

**(8 Hours)**

**Course Outcomes:**

The students will be able to: **(List the COs as per the course requirements)**

**CO1:** Examine cybersecurity fundamental concepts, including cyber threats, attack types, cryptography, security frameworks and advanced security technologies while solving problems addressing threat detection, regulatory, data protection and regulatory compliance.

**CO2:** Analyze the psychology of hackers, including their traits and motivations, and their

influence on security strategies.

**CO3:** Analyze security mechanisms including authentication, firewalls, intrusion detection and prevention systems, and secure communication protocols for the given problems.

**CO4:** Investigate network vulnerabilities, including DoS/DDoS attacks, session hijacking, SQL injection, and cross-site scripting to propose the solution to overcome the attacks.

**CO5:** Demonstrate hands-on skills using cybersecurity tools for Web applications vulnerability Assessment.

#### **Textbooks:**

1. Cybersecurity: The Beginner's Guide by Dr. Erdal Ozkaya 1st Edition 2019, Published by Packt Publishing Ltd. ([Click Here - e-book](#))
2. Bernard L. Menezes, Ravinder Kumar, **Cryptography, Network Security, and Cyber Laws**, 2018 Cengage Learning India Pvt. Ltd.
3. The Web Application Hacker's Handbook Finding and Exploiting Security Flaws by Dafydd Stuttard Marcus Pinto 2nd Edition 2011 ( [Click Here - e-book](#) )
4. Ira Winkler and Araceli Treu Gomes- Advanced Persistent Security, A Cyberwarfare Approach to Implementing Adaptive Enterprise Protection, Detection, and Reaction Strategies ISBN: 978-0- 12-809316-0 , Publisher: Todd Green

#### **References:**

1. Thoms J. Mowbray, Cybersecurity, managing systems, Conducting Testing, and Investigating Intrusions
2. The Cyber Security Body of Knowledge (CyBok)- Awais Rashid, Howard Chivers, George Danezis, Emil Lupu, Andrew Martin
3. Cybersecurity and Cyberwar" by P.W. Singer for policy/ethics or "Blue Team Handbook" for incident response
4. Sunit Belapure, Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives Wiley India Pvt Ltd 2013
5. Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla, Introduction to information security and cyber laws, Dreamtech Press 2015
6. Thomas J. Mowbray, Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions John Wiley & Sons 2013
7. James Graham, Ryan Olson, Rick Howard, Cyber Security Essentials CRC Press 2010

#### **Tools for Cyber Security Demonstration**

- a. OpenSSH, Hydra, Wireshark, Squid Proxy (**Module 3**)
- b. MITRE ATT&CK Navigator, Metasploit Framework, Atomic Red Team, Snort, Hping3, UFONet , Nessus Essentials (**Module 4**)
- c. BURP suite and OWASP Zap (**Module 5**)
- d. Threat Modeling Tool, Threat Dragon, TMT (Threat Modeling Tool by IriusRisk) SIEM (Security Information and Event Management), Sysmon (Windows), OpenVAS, Nmap, Virus Total
- e. **Indian Digital Signature Providers** –
  - o eMudhra
  - o SafeScript
  - o Capricorn CA
- f. Autopsy, The Sleuth Kit (TSK), FTK Imager

#### **Continuous Comprehensive Assessments (CCAs) suggested:**

**Practical demonstration of Tools in a team of two-three members choosing any 4-5 tools in the given list or any other tools in consultation with the course coordinator and report submission)**

- Network Intrusion Detection and Analysis - (Tool: **Snort**)
- Event Log Aggregation, Correlation, and analysis- (Tool: **Splunk Enterprises/IBM Q**)

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- Web Proxies - (caching, URI Filtering, Content Filtering, Squid Configuration, Squid Access Logfiles, Squid Cache, Web proxy analysis, Encrypted Web Traffic,)- (Tool: **Squid**)
- Traffic Analysis - Protocol Analysis, Packet Analysis, Higher-layer Traffic analysis- (Tool: **Wireshark**)
- Vulnerability Scanning and Management (Tools: **Nessus Essentials, Burp suite**)
- Servers Configuration - DHCP server, Name servers, Authentication Servers, Firewalls, Application Servers
- SMTP, Fishing Email Analysis - Tool: **Mx Toolbox, Virus Total, IP Void, URL Void, OpenVAS**

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**B.E. INFORMATION SCIENCE AND ENGINEERING**  
Choice Based Credit System (CBCS) for 2022 scheme  
**SEMESTER-VI**

**Block Chain Essentials (40:0:0:50) 3**

(Effective from the academic year 2025-26)

Course Code	BCS604B	CIE Marks	50
Teaching Hours (L:T:P:S)	40:0:0:50	SEE Marks	50
Total Number of Contact Hours	40 Hours Theory	Exam Hours	3
Examination Nature	Theory		

**Course Objectives:**

This course will enable students to:

1. Understand the structure of a blockchain and why/when it is better than a simple distributed database.
2. Analyze the incentive structure in a blockchain based system and critically assess its functions, benefits and vulnerabilities.
3. Evaluate the setting where a blockchain based structure may be applied, its potential and its limitations.
4. By implementing, learners will have idea about private and public Blockchain, and smart contract.

**Preamble:**

Blockchain, the underlying technology powering cryptocurrencies like Bitcoin and Ethereum, has emerged as a groundbreaking innovation with far-reaching implications across industries. Its decentralized and immutable nature promises to revolutionize traditional systems, offering unprecedented levels of transparency, security, and efficiency.

**Module - 1**

**Introduction:** The growth of blockchain technology: progress towards maturity, increasing interest, Distributed systems. The history of blockchain and bitcoin: The events that led to blockchain, electronic cash. Blockchain: Blockchain defined, Blockchain architecture, Generic elements of a blockchain, Benefits, features, and limitations of blockchain, Types of blockchain. Consensus: Consensus mechanism, Types of consensus mechanisms, Consensus in blockchain.

**Text book-1: Chapter- 1**

**(8 Hours)**

**Module - 2**

**Decentralization using blockchain, Methods of decentralization:** Disintermediation, Contest-driven decentralization. Routes to decentralization: How to decentralize, Decentralization framework example, Blockchain and full ecosystem decentralization: Storage, Communication, Computing power and decentralization. Pertinent terminology: Smart contracts, Autonomous agents, Decentralized organizations, decentralized autonomous organizations, Decentralized autonomous corporations, Decentralized autonomous societies, Decentralized applications. Platforms for decentralization: Ethereum, MaidSafe, Lisk, EOS. Innovative trends: Decentralized web, Decentralized identity, Decentralized finance (DeFi).

**Text book-1: Chapter-2**

**(8 Hours)**

<b>Module - 3</b>	
<b>Ethereum an overview:</b> The yellow paper, Ethereum a user's perspective. The Ethereum network: The mainnet, testnets, Private nets. Components of the Ethereum ecosystem: Keys and addresses, Accounts, Transactions and messages, Ether cryptocurrencies/tokens(ETC and ETH). The Ethereum Virtual Machines(EVM):Execution environment, The machine state, The iterator function. Smart contracts: Native contracts.	
<b>Text book-1: Chapter-11</b>	<b>(8 Hours)</b>
<b>Module - 4</b>	
<b>Further Ethereum:</b> Blocks and Blockchain, The genesis block, The block validation mechanism, Block finalization, Block difficulty mechanism, Gas, Fee schedule. Wallets and client software: Wallets, Geth, Eth, Parity, Trinity, Light clients, Installation and usage, MetaMask. Nodes and miners: The consensus mechanism, Forks in the blockchain, Ethash. APIs, tools, and DApps: Applications (DApps and DAOs) developed in Ethereum, Tools, Geth JSON RPC API	
<b>Text book-1: Chapter-12</b>	<b>(8 Hours)</b>
<b>Module - 5</b>	
<b>Development Tools and Frameworks:</b> Languages, Compilers: The solidity compiler, Tools and Libraries: Node.js, Ganache. Frameworks: Truffle, Drizzle, Embark, Brownie, Waffle, Etherlime, OpenZeppelin. Contract development and deployment: Writing smart contracts, Testing smart contracts, Deployment smart contracts. The layout of a Solidity source code file: Version pragma, Import, Comments. The Solidity language: Variables, Data types, Control structures, Events Inheritance, Libraries, Functions, Error handling.	
<b>Text book-1: Chapter-14</b>	<b>(8 Hours)</b>
<b>Course Outcomes:</b>	
<ol style="list-style-type: none"> <li>1. Apply decentralized block chain technologies to real-time applications.</li> <li>2. Analyze security, scalability, and performance challenges in working of Ethereum tools for developing smart contracts.</li> <li>3. Analyze the development and testing process of decentralized applications and implement them using Ganache tool in a local Ethereum environment.</li> </ol>	
<b>Textbooks:</b>	
<ol style="list-style-type: none"> <li>1. <b>Mastering Blockchain:</b> A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, Third Edition, Imran Bashir.</li> </ol>	
<b>References:</b>	
<ol style="list-style-type: none"> <li>1. S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan , Blockchain Technology: Cryptocurrency and Applications Oxford University Press 2019.</li> <li>2. Arvind Narayanan et. al. "Bitcoin and cryptocurrency technologies: a comprehensive Introduction" Princeton University Press 2016.</li> </ol>	
<b>Continuous Comprehensive Assessments (CCAs) suggested:</b>	
Demonstration of real time application with block chain using Ganache	

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<b>B.E. INFORMATION SCIENCE AND ENGINEERING</b> Choice Based Credit System (CBCS) for 2022 scheme <b>SEMESTER –VI</b>			
<b>Full Stack Development (40:0:0:50) 3</b> (Effective from the academic year 2025-26)			
Course Code	BCS604C	CIE Marks	50
Teaching Hours (L:T:P:S)	40:0:0:50	SEE Marks	50
Total Number of Contact Hours	40 Hours Theory	Exam Hours	03
Examination Nature	Theory		
<b>Course Objectives:</b>			
This course will enable students:			
<ol style="list-style-type: none"> <li>1. To outline the framework of full stack development.</li> <li>2. To illustrate the JavaScript with its functional frameworks.</li> <li>3. To apply Node.js features and applications with MongoDB.</li> <li>4. To design simple responsive web applications using different frameworks.</li> </ol>			
<b>Preamble:</b> This course provides experience and exposures to develop front end and back end for web applications. Also this course builds strong foundations on JavaScript, Node.js & MongoDB for developing responsive web applications. Combining frameworks and libraries allow the students to build full-stack web applications that can handle complex logic on the server side while providing a responsive and interactive user interface on the client side.			
<b>Module – I</b>			
<b>Basics of Full Stack:</b>			
Understanding the Basic Web Development Framework – User – Browser – Webserver – Backend Services, Understanding the different stack components – The role of Express – Angular – Node – MongoDB – React, JavaScript: Defining Variables, Understanding JavaScript Data Types, Using Operators.			
<b>Text book 1:</b> Chapters 1 & 2.1,2.2,2.3			
<b>(8 Hours)</b>			
<b>Module – 2</b>			
<b>JavaScript:</b> Implementing Looping, Creating Functions, Understanding Variable Scope, Using, JavaScript object Manipulating Strings, working with array, Adding Error Handling: throw your own errors.			
<b>Text book 1:</b> Chapters 2.4 to EOC.			
<b>(8 Hours)</b>			
<b>Module – 3</b>			
<b>Node.js:</b>			
Basics of Node.js, Installation of Node.js, Working with Node packages, Using Node package manager, creating a simple Node.js application, Using Events, Listeners, Timers.			
<b>Text Book 1:</b> Chapters 3&4.			
<b>(8 Hours)</b>			

<b>Module - 4</b>	
<b>Handling Data I/O in Node.js</b>	
Callbacks in Node.js: Implementing Callbacks, Handling Data I/O in Node.js: Working with JSON Using the Buffer Module to Buffer Data, Using the Stream Module to Stream Data, Compressing and Decompressing Data with Zlib.	
<b>Text Book 1:</b> Chapters 5	
<b>(8 Hours)</b>	
<b>Module - 5</b>	
<b>MongoDB:</b>	
Understanding NoSQL and MongoDB, Building MongoDB Environment, User accounts, Access control, administering databases, Managing collections, MongoDB and Node.js.	
<b>Text Book 1:</b> Chapters 11, 12 & 13	
<b>(8 Hours)</b>	
<b>Course outcomes:</b>	
CO1: Apply full stack frameworks to develop web applications.	
CO2: Analyze JavaScript frameworks to select a suitable framework for full stack development.	
CO3: Apply Node.js features along with MongoDB to build and integrate server-side logic and database operations for dynamic web applications.	
CO4: Analyze the working of complete web applications and databases to identify performance issues, data flow, and system behavior in full stack environments.	
<b>Text books:</b>	
1.	Brad Dayley & Brendan Dayley, "Node.js, MongoDB and Angular Web Development", 2nd Ed., Addison-Wesley.
<b>References:</b>	
1.	Chris Northwood, The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer, Apress publisher.
2.	Adam Bretz & Colin J Ihrig, Full Stack JavaScript Development With MEAN, Sitepoint publisher.
3.	Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2012.
4.	Kirupa Chinnathambi, "Learning React: A Hands-On Guide to Building Web Applications Using React and Redux", Second Edition, Addison-Wesley Professional.
5.	Jon Duckett, "HTML and CSS-Design and Build Websites", John Wiley Sons.
6.	Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett and Tim Hawkins, "MongoDB in Action", Second Edition, Manning Publication, 2016.
<b>Continuous Comprehensive Assessments (CCAs) suggested:</b>	
<ul style="list-style-type: none"> <li>• Design and develop a small-scale web application with an interactive frontend, server-side processing, and database integration to perform complete CRUD operations, demonstrating end-to-end full stack development skills.</li> <li>• Problem Based Learning Activity Presentation.</li> </ul>	

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<b>B.E. INFORMATION SCIENCE AND ENGINEERING</b>			
Choice Based Credit System (CBCS) for 2022 scheme			
<b>SEMESTER – VI</b>			
<b>Data warehousing and Data mining (40:0:0:50) 3</b>			
(Effective from the academic year 2025-26)			
Course Code	BCS604D	CIE Marks	50
Teaching Hours (L:T:P:S)	40:0:0:50	SEE Marks	50
Total Number of Contact Hours	40 Hours Theory	Exam Hours	3
Examination Nature	Theory		
<b>Course Objectives:</b>			
This course will enable students to:			
<ol style="list-style-type: none"> <li>1. Be familiar with mathematical foundations of data warehousing and OLAP.</li> <li>2. Implement classical models and algorithms in data warehouses and data mining &amp; OLAP queries.</li> <li>3. Discover interesting patterns using clustering, classification, association finding on real world data.</li> <li>4. Develop skill in selecting the different algorithms and analyse it with the support of tools for solving practical problems.</li> </ol>			
<b>Preamble:</b>			
This course focuses on the concepts, techniques, design and applications of data warehousing and OLAP. The students opting for this course will understand and implement classical algorithms in data warehousing. The course demonstrates how to analyse the data, identify the problems, and choose the relevant algorithms to apply. The students will be able to assess the strengths and weaknesses of the algorithms and analyse their behaviour on real datasets.			
<b>Module - 1</b>			
<b>Data warehousing and OLAP:</b> Data Warehouse basic concepts, Data Warehouse Modeling, Data Cube and OLAP: Characteristics of OLAP systems, Multidimensional view and Data cube, Data Cube Implementations, Data Cube operations, Implementation of OLAP and overview on OLAP Software, Typical OLAP Operations.			
<b>Textbook 2: Ch.4.1,4.2</b>			
<b>R1(Ch-8: 8.1 - 8.5)</b>			
<b>(08 Hours)</b>			
<b>Module - 2</b>			
<b>Data warehouse implementation &amp; Data Mining :</b> Introduction, What is Data Mining?, Motivating Challenges, Data Mining Tasks, Which technologies are used for data mining, Kinds of pattern that can be mined, Data Mining Applications, Data Pre-processing, Data cleaning, data integration, data reduction and data transformation, An overview, Indexing OLAP Data: Bitmap index and join index, Efficient processing of OLAP Queries, OLAP server Architecture ROLAP versus MOLAP Versus HOLAP.			
<b>Textbook 2: Ch.4.4</b>			
<b>Textbook1(Ch-1: 1.1 - 1.4)</b>			
<b>Textbook1(Ch-2: 2.3.1 - 2.3.7)</b>			
<b>(08 Hours)</b>			
<b>Module - 3</b>			
<b>Association Analysis:</b> Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Item sets, FPGrowth Algorithm, Evaluation of Association Patterns.			
<b>Textbook 1: Ch 6.1 to 6.7 (Excluding 6.4)</b>			
<b>(08 Hours)</b>			
<b>Module - 4</b>			
<b>Classification:</b> Decision Trees Induction, Method for Comparing Classifiers, Rule Based Classifiers, Nearest Neighbor Classifiers, Bayesian Classifiers.			
<b>T1(Ch-4: 4.1 - 4.3)</b>			
<b>(08 Hours)</b>			

## Module - 5

**Clustering Techniques:** Overview, Features of cluster analysis, Types of Data and Computing Distance, Types of Cluster Analysis Methods, Partitional Methods, Hierarchical Methods, Density Based Methods, Quality and Validity of Cluster Analysis.

**T1(Ch-7: 7.1 - 7.5)**

**(08 Hours)**

### Course Outcomes:

The students will be able to:

- CO1:** Demonstrate knowledge of the basic concepts and modelling involved in data Ware housing.
- CO2:** Examine data and select suitable methods for applying data mining techniques and methods to data sets.
- CO3:** Analyze the frequent patterns using association analysis algorithms.
- CO4:** Demonstrate various algorithms based on data mining tools & OLAP.

### Textbooks:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, "Introduction to Data Mining", Addison-Wesley, First impression, 2014.
2. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining - Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publisher, 2012.

### References:

1. G. K. Gupta, "Introduction to Data Mining with Case Studies", 3rd Edition, PHI, New Delhi, 2009.
2. Sam Anahory, Dennis Murray: Data Warehousing in the Real World, Pearson, Tenth Impression, 2012.

### Continuous Comprehensive Assessments (CCAs) suggested:

- Case Study on different Classification and clustering techniques.
- Case Study on different OLAP server Architecture ROLAP versus MOLAP Versus HOLAP.

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**B.E. INFORMATION SCIENCE AND ENGINEERING**  
Choice Based Credit System (CBCS) for 2022 scheme  
**SEMESTER-VI**

**Cyber Security Essentials (40:0:0:50)3**  
(Effective from the academic year 2025-26)

Course Code	BCS604E	CIE Marks	50
Teaching Hours (L:T:P:S)	40:0:0:50	SEE Marks	50
Total Number of Contact Hours	40 Hours Theory	Exam Hours	3
Examination Nature	Theory		

**Course Objectives:**

This course will enable students:

1. To **Develop** an understanding of cybersecurity fundamentals, Information gathering & Scanning, and security principles.
2. To **Learn** to identify, assess, and manage cybersecurity risks and vulnerabilities using assessments.
3. To **provide** hands-on experience with essential cybersecurity tools and best practices to protect digital assets.
4. To **understand** the ethical, legal, and social implications of cybersecurity, including privacy responsible disclosure practices.

**Preamble:**

In this course, It explains how networks can be protected from hackers, how cyber- attacks happen, and what steps can be taken to stop them. Students will also learn about cybersecurity governance, which focuses on rules, policies, and responsibilities that organizations must follow to stay secure. Along with this, the course explains risk management, helping learners understand how to identify risks and reduce them. Finally, the course teaches the basics of incident response, which includes what to do when a cyber-attack happens and how to recover safely.

**Module - 1**

**Safeguarding the Digital Realm:**

Fundamental Concepts of Cybersecurity, Illustrating the Significance of Cybersecurity, Empowering You with Actionable Tips and Emerging Trends, The CIA Triad: Safeguarding Data in the Digital Realm, Information Gathering and Footprinting in Cybersecurity : Importance, Significance, Methods, Passive and Active Footprinting Techniques, Real- World Examples of Footprinting Methods, Tools and techniques, Ethical Considerations in Information Gathering, Scanning and Enumeration : Introduction, Types, Real-World Application, Enumeration, Legal Regulations and Consequences, . Best Practices for Scanning and Enumeration.

**Practical & Case Studies:** Targeted Enterprise Network Intrusion, Government Agency Data Breach, E-commerce Platform Vulnerability Discovery, Case Studies: Scanning and Enumeration, Nmap.

**T1: 1-4**

**(8 Hours)**

**Module - 2**

**A Comprehensive Guide to Vulnerability Assessment :** Definition, Importance, Identifying Common Vulnerabilities, Vulnerability Assessments, Illustrating Scenarios of Exploitation, Step-by-Step Guide to Conducting Vulnerability Assessments, Tools for Vulnerability Scanning and Assessment, Common Vulnerabilities in Digital Systems, Real- World Examples, Analyzing Successful Mitigation Strategies, Legal Compliance, Best Practices for Continuous Improvement in Vulnerability Assessment, Exploitation Unveiled : Process, Gaining Access: Breaching the Digital Perimeter, Ethical Considerations, Exploitation Methods, Real-World Exploitation Scenarios, Prevention and Mitigation Strategies, Legal Implications, Laws and Regulations Governing Cyber Activities, Defining Post-exploitation, Significance, Persistence Mechanisms, Common Methods Employed, Mitigation Strategies, Covering Tracks and tactics, Strategies for Effective Response and Recovery, Preventing and Mitigating Post-exploitation Risks.

<p><b>Practical:</b> Wappanalyzer , Dradis , Nikto , Wapiti , Qualys, Nessus.  <b>T1: 5-7</b></p>	<b>(8 Hours)</b>
<b>Module – 3</b>	
<p><b>Network Security:</b> Building Blocks of Cyber Resilience , Firewall , VPN's , SSL , Network Access Controls and the Three A's , Network Wireless Security , Network Security Monitoring and Incident Response , Best practices , Unique Challenges in Securing Cloud-Based Networks , The Shared Responsibility Model in Cloud Security , Implementation , Prioritizing Strong Authentication Mechanisms , Essentials of Wireless Security : Nature and Importance , IoT security , Mobile security , Overview of Wi-Fi Encryption Methods , Importance of Encryption in Wireless Security , Multi factor authentication , security audit and assessments.</p> <p><b>Practical:</b> Wireshark, TCP Dump.</p>	
<p><b>T1: 8-9</b></p>	<b>(8 Hours)</b>
<b>Module – 4</b>	
<p><b>Mastering Web Application Security:</b> Common Vulnerabilities in Web Applications , Secure Coding Practices , Compliance with Legal Requirements , Tools for Testing and Securing Web Applications , Static and Dynamic Application Security Testing , Web application firewall , Vulnerability scanners , Best practices , Securing the Internet of Things and Mobile World : Security Challenges in Mobile and IoT , Best practices , Securing Mobile Applications , Methods and Tools for Securing Mobile Apps , Network Security for Mobile and IoT Devices , Network segmentation , Data Protection and Compliance, Cloud security : Introduction of cloud , Cloud Identity Access Management , Incident response, Compliance and Regulatory Considerations , Cloud Security Case Studies.</p> <p><b>Practical:</b> Demo of Top 10 OWASP vulnerabilities , Checkmarx , Accunetix . OWASP ZAP. Burp Suite.</p>	
<p><b>T1: 10-12</b></p>	<b>(8 Hours)</b>
<b>Module – 5</b>	
<p><b>Incident Response, Business Continuity, and Disaster Recovery:</b> The Incident Response Process, Creating and Testing Incident Response , The Importance of Continuous Adaptation , Understanding and designing Business Continuity plan, Disaster Recovery , Incident Response Tools and Technologies, Forensic Tools in Incident Investigation , Threat Intelligence and Information Sharing , Real world examples and case studies , Legal framework and compliance, Legal and Compliance Considerations .</p> <p><b>Case study:</b> Ransomware Outbreak in an Organization, Compromise from Open Source Software / Dependency, Industrial Control System (ICS) Security Breach.</p>	
<p><b>T1: 14-15</b></p>	<b>(8 Hours)</b>
<p><b>Case Study Link:</b> <a href="https://www.cisa.gov/resources-tools/resources/cybersecurity-scenarios">https://www.cisa.gov/resources-tools/resources/cybersecurity-scenarios</a></p>	
<p><b>(8 Hours)</b></p>	
<p><b>Course Outcomes:</b>  The students will be able to:</p> <ul style="list-style-type: none"> <li><b>C01:</b> Apply cybersecurity principles with legal and ethical considerations to identify vulnerabilities in real-world systems.</li> <li><b>C02:</b> Analyze vulnerability assessment, exploitation, and post-exploitation using industry-standard tools for secure and compliant systems.</li> <li><b>C03:</b> Explain network security mechanisms and monitoring techniques for wired, wireless, cloud, and IoT environments.</li> <li><b>C04:</b> Analyze ethical cybersecurity practices through incident response, business continuity, and disaster recovery case studies.</li> <li><b>C05:</b> Demonstrate and apply security testing and monitoring tools to analyze vulnerabilities and security controls across web, network, cloud, and IoT systems.</li> </ul>	
<p><b>Textbooks:</b></p> <ol style="list-style-type: none"> <li>1. Cybersecurity Essentials: Practical tools for today's digital defenders , Kodi A.Cochran by APress, 2024.</li> </ol>	
<p><b>Reference Books:</b></p>	

1. The Art of Deception: Controlling the Human Element of Security , Kevin D. Mitnick and William L. Simon by Wiley, 2020.
2. Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software, Michael Sikorski and Andrew Honig by Starch Press, 2022.
3. Cybersecurity Essentials , Charles J. Brooks, Christopher Grow, Philip Craig, and Donald Short by Wiley, 2022.
4. Introduction to Computer Security" (1st Edition), Michael T. Goodrich and Roberto Tamassia by Pearson, 2020.

**Continuous Comprehensive Assessments (CCAs) suggested:**

Practical demonstration of Tools in a team of two-three members choosing any 4 tools in the given list or any other tools in consultation with the course coordinator and report submission)

[https://docs.google.com/spreadsheets/d/1GTenBjkNl29fjFIS7ar8zlb8o\\_7ow6cre7V6k8h6x5M/edit?gid=0#gid=0](https://docs.google.com/spreadsheets/d/1GTenBjkNl29fjFIS7ar8zlb8o_7ow6cre7V6k8h6x5M/edit?gid=0#gid=0)

- Network Security & Traffic Analysis Tools
- Vulnerability Assessment & Penetration Testing Tools
- Security Operations, Monitoring & Threat Intelligence Tools
- Digital Forensics & Incident Response Tools

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# OPEN ELECTIVE COURSE I

<b>B.E. INFORMATION SCIENCE AND ENGINEERING</b> Choice Based Credit System (CBCS) for 2022 scheme <b>SEMESTER -VI</b>			
<b>INTRODUCTION TO DATA STRUCTURES (40:0:0:50) 3</b> (Effective from the academic year 2025-26)			
Course Code	BCS605A	CIE Marks	50
Teaching Hours (L:T:P:S)	40:0:0:50	SEE Marks	50
Total Number of Contact Hours	40 Hours Theory	Exam Hours	3
Examination Nature	Theory		
<b>Course Objectives:</b> This course will enable students to: <ol style="list-style-type: none"> <li>1. Learn and identify different data structures in C programming language.</li> <li>2. Assess the use of suitable data structures in problem-solving.</li> <li>3. Implement data structures using C programming language.</li> <li>4. Develop solutions for practical problems.</li> </ol>			
<b>Preamble:</b> Data structures are fundamental in computer science for organizing and manipulating data efficiently. They form the backbone of algorithms and significantly affect software performance. This course will cover essential data structures like arrays, stacks, queues, linked lists, trees, and graphs, exploring their properties, operations, and applications. By mastering this course, students will be able to write efficient code and solve complex problems.			
<b>Module - I</b>			
<b>C Recap:</b> Pointers. <b>Data Structures:</b> Introduction, Classification, Operations. <b>Arrays:</b> Declarations, Accessing/Storing of Elements, Operations, Passing arrays to Functions, Pointers and Arrays, Arrays of Pointers. Sorting (selection, insertion, bubble), and searching (Linear, Binary), Programming Examples. <b>Dynamic memory allocation.</b> <b>Text book 1: 1.11, 2.1-2.3, 3.1-3.8, 14.1-14.3, 14.7-14.9. Text Book 2: 1.2.2.</b> <div style="text-align: right;"><b>(8 Hours)</b></div>			
<b>Module - II</b>			
<b>Structures:</b> Introductions, Nested Structures, Arrays of Structures, Structures and Functions, Self-referential Structures. <b>Linked Lists:</b> Definition, Representation of linked lists in Memory, Singly Linked List, <b>Linked list operations:</b> Traversing, Searching, Insertion, and Deletion. Doubly Linked lists, Circular linked lists, Circular Doubly Linked List—programming Examples. <b>Text Book 1: 5.1-5.5, 6.1-6.5.</b> <div style="text-align: right;"><b>(8 Hours)</b></div>			
<b>Module - III</b>			
<b>Stacks:</b> Definition, Stack Operations, Array Representation of Stacks, Linked representation of Stacks, Operations on Linked Stack, Programming Examples. <b>Recursion:</b> Factorial, GCD, Fibonacci Sequence, Tower of Hanoi. <b>Text Book 1: 7.1-7.5, 7.7.4.</b> <div style="text-align: right;"><b>(8 Hours)</b></div>			

<b>Module - IV</b>	
<p><b>Queues:</b> Introduction, Array representation of Queues, Linked representation of Queues, Types of Queues (Circular Queue, Dequeue, Priority Queue), Applications of Queues (Excluding Josephus Problem), Programming Examples.</p> <p><b>Hashing:</b> Introduction, Hash Tables, Hash Functions, Different Hash Functions, Collisions, Pros and Cons of Hashing, Applications of Hashing.</p> <p><b>Text Book 1:</b> 8.1-8.3,8.4.1-8.4.3,8.5, 15.1-15.7</p>	
<b>(8 Hours)</b>	
<b>Module - V</b>	
<p><b>Trees:</b> Introduction, Types of Trees, Creating a Binary Tree, Binary Tree Traversals - Inorder, Postorder, Preorder, Level Order.</p> <p><b>Binary Search Trees:</b> BST create, Insert, and search, Programming Examples.</p> <p><b>Graphs:</b> Introduction, Terminologies, Directed graphs, Matrix and Adjacency List Representation of Graphs, Breadth First Search, Depth First Search - Programming Examples.</p> <p><b>Text Book 1:</b> 9.1-9.4, 10.1, 10.2.1, 10.2.2, 10.2.3, 13.1-13.3, 13.5, 13.6.</p>	
<b>(8 Hours)</b>	
<p><b>Course outcomes:</b></p> <p>CO1: Understand the concepts of data structures.</p> <p>CO2: Implement data structures using C Programming language.</p> <p>CO3: Apply various data structures in problem-solving using C language.</p> <p>CO4: Design and develop solutions using Data Structures for practical problems.</p>	
<b>Text books:</b>	
1.	Reema Thareja, Data structures using C, 2nd Ed, Oxford University Press.
2.	Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
<b>References:</b>	
1.	Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014
<p><b>Continuous Comprehensive Assessments (CCAs) suggested:</b></p> <ul style="list-style-type: none"> <li>• Case Study</li> <li>• Programming Assignment</li> <li>• Gate Based Aptitude Test</li> <li>• Project Based Learning</li> </ul>	

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**B.E. INFORMATION SCIENCE AND ENGINEERING**  
Choice Based Credit System (CBCS) for 2022 scheme  
**SEMESTER-VI**

**Data Analytics (40:0:0:50) 3**  
(Effective from the academic year 2025-26)

Course Code	BAI605B	CIE Marks	50
Teaching Hours (L:T:P:S)	40:0:0:50	SEE Marks	50
Total Number of Contact Hours	40 Hours Theory	Exam Hours	3
Examination Nature	Theory		

**Course Objectives:**

This course will enable students to:

- Understand different techniques of Data Analysis.
- Be familiar with concepts of data streams. Be exposed to data analytics algorithms.
- Derive the performance measures of Regression and Classification algorithms.
- Examine the applications of data analytics for real time applications.

**Preamble:**

To provide strong foundation for data analytics and application area related to it and understand the underlying core concepts and emerging technologies in data analytics. This course provides a understanding and framework for basic analytics tasks, including data extraction, cleaning, manipulation, and analysis. This course also guides in decision making and examine real-world examples to improve decision-making.

**Module - 1**

**What Can We Do with Data?** -Big Data and Data Science, Big Data Architectures, Small Data, what is Data? A Short Taxonomy of Data Analytics, Examples of Data Use, A Project on Data Analytics.

**Descriptive Statistics, Scale Types, Descriptive Univariate Analysis, Descriptive Bivariate Analysis** Final Remarks.

**Textbook 1: Chapter 1.1- 1.7, 2.1 - 2.5 (8 Hours)**

**Module - 2**

**Descriptive Multivariate Analysis:** Multivariate Frequencies, Multivariate Data Visualization, Multivariate Statistics, Infographics and Word Clouds, Final Remarks,

**Data Quality and Preprocessing,** -Data Quality, converting to a Different Scale Type, Converting to a Different Scale, Data Transformation, Dimensionality Reduction.

**Textbook 1: Chapter 3,4 (8 Hours)**

**Module - 3**

**Clustering: Distance Measures, Clustering Validation, Clustering Techniques.**

**Frequent Pattern Mining-** Frequent Itemset, Association Rules, Behind Support and Confidence, Other Types of Patterns

**Textbook 1: Chapter 5,6 (8 Hours)**

**Module - 4**

**Regression** -Predictive Performance Estimation, Finding the Parameters of the Model, Technique and Model Selection.

**Classification** -Binary Classification, Predictive Performance Measures for Classification, Distance-based Learning Algorithm

**Textbook 1: Chapter 8,9 (8 Hours)**

**Module - 5**

**Applications for Text, Web and Social Media-Working with Texts, Recommender Systems, Social Network Analysis.**

**Textbook 1: Chapter 13**

**(8 Hours)**

**Course Outcomes:**

The students will be able to:

- C01: Explore the fundamental concepts of data analytics
- C02: Understand data analysis techniques for applications handling large data
- C03: Understand various algorithms used in data analytics process
- C04: Apply and present the inference of Regression and Classification algorithms
- C05: Analyze the applications of a data analytics for real time applications.

**Textbooks:**

1. "A general Introduction to Data Analytics "by Joao Mendes Moreira, Andre C.P.L.F. de Carvalho and Tomas Horvath, Wiley, 2019.

**References:**

1. Data Analytics Made Accessible by Dr. Anil Maheshwari
2. Principles of Data Wrangling, by Joseph M. Hellerstein, Tye Rattenbury, Jeffrey Heer, Sean Kandel, Connor Carreras, Released July 2017
3. Visual Analytics with Tableau by Alexander Loth , Nate Vogel, et al.

**Continuous Comprehensive Assessments (CCAs) suggested:**

- Experiential Learning/ MOOC/Certification Courses (Infosys Springboard, Geek for Geeks, IBM, Hacker earth, Math works)
- Model presentation Video
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**B.E. INFORMATION SCIENCE AND ENGINEERING**  
Choice Based Credit System (CBCS) for 2022 Scheme  
**SEMESTER-VI**

**Generative AI (0:0:28:2)1**  
(Effective from the academic year 2025-26)

Course Code	BCS608A	CIE Marks	50
Teaching Hours (L:T:P:S)	0:0:28:2	SEE Marks	50
Total Number of Contact Hours	28 Hours Practical	Exam Hours	3
Examination Nature	Practical		

**Course Objectives:**

This course will enable students to:

1. Understand and apply word embeddings to explore semantic relationships using pre-trained and custom-trained models.
2. Analyze word relationships and visualize embeddings using vector arithmetic and dimensionality reduction techniques such as PCA and t-SNE.
3. Develop domain-specific embedding models by training Word2Vec on specialized corpora and evaluating domain-specific semantics.
4. Apply pre-trained Transformer-based models for real-world NLP tasks such as sentiment analysis, text summarization, and code generation.
5. Design and implement basic Transformer architectures for sequence-to-sequence tasks, demonstrating an understanding of self-attention mechanisms.

**Description:** Design, develop, and implement the specified programs as given in the list given below using Python under LINUX /Windows environment.

**Program List**

**PART A**

1. Explore pre-trained word vectors. Explore word relationships using vector arithmetic. Perform arithmetic operations and analyze results.
2. Use dimensionality reduction (e.g., PCA or t-SNE) to visualize word embeddings for Q 1. Select 10 words from a specific domain (e.g., sports, technology) and visualize their embeddings. Analyze clusters and relationships. Generate contextually rich outputs using embeddings. Write a program to generate 5 semantically similar words for a given input.
3. Train a custom Word2Vec model on a small dataset. Train embeddings on a domain-specific corpus (e.g., legal, medical) and analyze how embeddings capture domain-specific semantics.
4. Use word embeddings to create meaningful sentences for creative tasks. Retrieve similar words for a seed word. Create a sentence or story using these words as a starting point. Write a program that: Takes a seed word. Generates similar words. Construct a short paragraph using these words.
5. Use a pre-trained Hugging Face model to analyze sentiment in text. Assume a real-world application, Load the sentiment analysis pipeline. Analyze the sentiment by giving sentences to input.
6. Summarize long texts using a pre-trained summarization model using Hugging face model. Load the summarization pipeline. Take a passage as input and obtain the summarized text.
7. Construct a small Transformer model by stacking multiple layers of self-attention and feedback. Train the model in a simple sequence-to-sequence task (e.g., reversing a sequence).
8. Build a chatbot for the Indian Penal Code. We'll start by downloading the official Indian Penal Code document, and then we'll create a chatbot that can interact with it. Users will be able to ask questions about the Indian Penal Code and have a conversation with it.

**PART B**

The advancement of artificial intelligence (AI) has resulted in the emergence of a remarkable field known as generative AI. Generative AI is a type of AI technology that allows machines to generate new content, data, or outputs that are like human-created content. It uses large datasets to learn the underlying structure and characteristics of the data, enabling it to produce original and contextually relevant outputs. Generative AI can generate various data types, including text, images, sounds, animations, and 3D models, and it can create entirely new data based on the patterns it has learned.

**Course Outcomes:** Students will be able to:

**CO1:** Analyze semantic relationships among words using pre-trained word embeddings, vector arithmetic, and dimensionality reduction techniques to interpret similarity patterns.

**CO2:** Apply domain-specific Word2Vec training and embedding-based similarity methods to generate meaningful text and capture specialized semantics from custom corpora.

**CO3:** Apply pre-trained Transformer-based models for sentiment analysis, text summarization, and document-based conversational systems such as a domain-specific chatbot.

**CO4:** Analyze the working of self-attention and sequence-to-sequence Transformer models by implementing a basic Transformer architecture for simple NLP tasks.

**Text Books**

1. Modern Generative AI with ChatGPT and OpenAI Models: Leverage the Capabilities of OpenAI's LLM for Productivity and Innovation with GPT3 and GPT4, by Valentina Alto, Packt Publishing Ltd, 2023.
2. Generative AI for Cloud Solutions: Architect modern AI LLMs in secure, scalable, and ethical cloud environments, by Paul Singh, Anurag Karuparti, Packt Publishing Ltd, 2024.
3. Natural language processing with transformers. By Tunstall, Lewis, Leandro Von Werra, and Thomas Wolf. O'Reilly Media, Inc.", 2022.

**Reference Books**

1. The Artificial Intelligence and Generative AI Bible: [5 in 1] The Most Updated and Complete Guide from Understanding the Basics to Delving into GANs, NLP, Prompts, Deep Learning, and Ethics of AI, Kindle Edition by Alger Fraley.
2. "Ripples of Generative AI: How Generative AI Impacts, Informs and Transforms Our Lives" by Jacob Emerson, ISBN-10: 1088221610 Publisher: Artificial Intelligence, 2023
3. "Demystifying Prompt Engineering: AI Prompts at Your Fingertips (A Step-By-Step Guide)", Kindle Edition, by Harish Bhat

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**B.E. INFORMATION SCIENCE AND ENGINEERING**  
Choice Based Credit System (CBCS) for 2022 scheme  
**SEMESTER-VI**

**Mobile Application Development (0:0:28:2) 1**  
(Effective from the academic year 2024-25)

Course Code	BCS608B	CIE Marks	50
Teaching Hours (L:T:P:S)	0:0:28:2	SEE Marks	50
Total Number of Contact Hours	28 Hours Practical	Exam Hours	3
Examination Nature	Practical		

**Course Objectives:**

This course will enable students to:

1. Learn and acquire the art of Android Programming.
2. Install and Configure Android studio and its development tools to run the applications.
3. Use User Interface components for android application development.
4. Create Android applications using database like SQLITE.
5. Inspect different methods of sharing data using services.

**Preamble:**

This is a practical course on Mobile Application Development. The lab is designed to provide hands-on experience in creating, developing, and testing mobile applications across various platforms. By leveraging state-of-the-art tools and methodologies, students will gain a deep understanding of the entire mobile app lifecycle, from initial concept to the development of applications using SQLite that run on Android Operating System.

**Prerequisite**

Basic knowledge on programming and database concepts.

**List of Experiments**

**PART A**

- Installation of Android studio and Development Of Hello World Application. Create an application to design a Visiting Card.
  - The Visiting card should have a company logo at the top right corner. The company name should be displayed in Capital letters, aligned to the center. Information like the name of the employee, job title, phone number, address, email, fax and the website address is to be displayed. Insert a horizontal line between the job title and the phone number.
1. Develop an Android application using controls like Button, TextView, EditText for designing a Calculator having basic functionality like Addition, Subtraction, Multiplication, and Division.
  2. Design a basic alarm clock application that allows users to set a recurring alarm and provides an option to cancel the alarm
  3. Create a SIGN Up activity with Username and Password. Validation of password should happen based on the following rules:
    - a. Password should contain uppercase and lowercase letters.
    - b. Password should contain letters and numbers.
    - c. Password should contain special characters.
    - d. Minimum length of the password (the default value is 8).

On successful SIGN UP proceed to the next Login activity. Here the user should SIGN IN using the Username and Password created during signup activity. If the Username and Password are matched then navigate to the next activity which displays a message saying "Successful Login" or else display a toast message saying "Login Failed". The user is given only two attempts and after that display a toast message saying "Failed Login Attempts" and disable the SIGN IN button. Use Bundle to transfer information from one activity to another.

4. Create two files of XML and JSON type with values for City\_Name, Latitude, Longitude, Temperature, and Humidity. Develop an application to create an activity with two buttons to parse the XML and JSON files which when clicked should display the data in their respective layouts side by side.
5. Create an activity like a phone dialer with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phone contacts.
6. Write a program to enter Medicine Name, Date and Time of the Day as input from the user and store it in the SQLite database. Input for Time of the Day should be either Morning or Afternoon or Evening or Night. Application should input the Date and Time of the Day and display the Medicine Name.
7. Create an application to receive an incoming SMS which is notified to the user. On clicking this SMS notification, the message content and the number should be displayed on the screen. Use appropriate emulator control to send the SMS message to your application.
8. Develop an application that makes use of the clipboard framework for copying and pasting of the text. The activity consists of two EditText controls and two Buttons to trigger the copy and paste functionality.

#### PART B

##### Program 1

Write a program to enter Medicine Name, Date and Time of the Day as input from the user and store it in the SQLite database. Input for Time of the Day should be either Morning or Afternoon or Evening or Night. Trigger an alarm based on the Date and Time of the Day and display the Medicine Name.

**MEDICINE DATABASE**

Medicine Name:

Date:

Time of the Day:

##### Program 2

Develop a content provider application with an activity called "Meeting Schedule" which takes Date, Time and Meeting Agenda as input from the user and store this information into the SQLite database. Create another application with an activity called "Meeting Info" having DatePicker control, which on the selection of a date should display the Meeting Agenda information for that particular date, else it should display a toast message saying "No Meeting on this Date".



**B.E. COMPUTER SCIENCE AND ENGINEERING**

Choice Based Credit System (CBCS) applicable for 2022 Scheme

**SEMESTER - VI****DevOps (0:0:28:2) 1**

(Effective from the academic year 2024-25)

Course Code	BCS608C	CIE Marks	50
Teaching Hours (L:T:P:S)	0:0:28:2	SEE Marks	50
Total Number of Contact Hours	28 Hours Practical	Exam Hours	3
Examination Nature	Practical		

**Course Objectives:**

This course will enable students to:

1. Understand and apply the DevOps tools used in SDLC.
2. Examine the docker containerization in detail.

**Preamble:** The DevOps Foundation course provides a comprehensive overview of understanding the DevOps competencies needed to accelerate time-to-market by improving the flow of value through the continuous delivery pipeline. Students will map the current value stream through their delivery pipeline from idea to cash, and identify practices that will eliminate bottlenecks to workflow.

**Part A**

1. GitHub - Create an account and fork your application code.
2. To perform version control on websites or software using Git by managing repositories through a browser-based interface and synchronizing changes with push and pull commands from the command line and GUI.
3. Install Docker, explore its containerization commands, create Docker containers using various operating system images, and deploy containerized applications using Docker and Docker Hub.
4. Design, deploy, and manage a micro services architecture on your local machine using Docker and Docker-compose
5. Install Jenkins on local or cloud environment, and configure Jenkins for first use.
6. Install and configure SonarQube on your local machine and create a Jenkins CI/CD pipeline that integrates SonarQube to perform static code analysis.
7. Demonstrate the fundamentals of Maven and Gradle, and perform their installation and setup
8. Create a Maven project, understanding the POM File, dependency management and plugins.
9. Build and run a Java application with maven, migrate the same application to Gradle.

**Part B****Mini Project**

Application-based mini project utilizing Git, Jenkins, and Docker, focusing on CI/CD and DevOps workflows. Example applications may include a Library Management System, Bug/Issue Tracking System, or an Online Quiz/Examination System. (The project is not limited to these examples.)

**Course Outcomes:** The students will be able to:

- CO1. Apply version control concepts using Git for repository management, branching, merging, and collaboration through GitHub/GitLab.
- CO2. Implement Docker containerization for software applications, including building, running, and managing containers using Docker Hub and Docker Compose.
- CO3. Develop and manage a CI/CD pipeline using Jenkins integrated with SonarQube for automated builds, testing, and code quality analysis.
- CO4. Utilize Maven for project management, including POM files, dependency handling, and build automation, and migrate projects to Gradle.

**Textbooks:**

- 1. Effective DevOps Building a Culture of Collaboration, Affinity, and Tooling at Scale, Jennifer Davis and Ryn Daniels, June 2016: First Edition Published by O'Reilly Media Inc.

**References:**

- 1. The Devops Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations, by Gene Kim , Jez Humble, 2016, It Revolution Press.
- 2. DevOps on the Microsoft Stack, by Wouter de Kort, Apress.

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Steph  
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Sue  
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**B.E. INFORMATION SCIENCE AND ENGINEERING**  
Choice Based Credit System (CBCS) for 2022 Scheme  
**SEMESTER - VI**

**Automated Software Testing (0:0:28:2) 1**  
(Effective from the academic year 2025-26)

Course Code	BCS608D	CIE Marks	50
Teaching Hours (L:T:P:S)	0:0:28:2	SEE Marks	50
Total Number of Contact Hours	28 Hours Practical	Exam Hours	3
Examination Nature	Practical		
<b>Course Objectives:</b>			
This course will enable students to:			
<ol style="list-style-type: none"> <li>1. Study the fundamental concepts of software testing.</li> <li>2. Describe test suites for software.</li> <li>3. Discuss various software testing issues and solutions for unit, integration and system testing.</li> <li>4. Learn Selenium tool and demonstrate it using a script in Java/PHP.</li> </ol>			
<b>Preamble:</b>			
Automation Software Testing is essential for ensuring software quality, efficiency and reliability. This lab provides hands-on experience with designing and executing automated test cases, utilizing modern test automation tool - Selenium, and understanding the latest trends in software testing. Students will learn to develop and implement robust testing strategies, integrate testing into Continuous Integration/Continuous Deployment (CI/CD) pipelines, and leverage AI and machine learning to enhance testing processes. The lab focuses on practical skills required to perform effective automation testing for real-world software development and quality assurance.			
<b>Sl.No.</b>	<b>Experiments</b>		
<b>PART A</b>			
1	Write a program to check if a number is prime using the following constructs: <ol style="list-style-type: none"> <li>1. do...while</li> <li>2. while...do</li> <li>3. if...else</li> <li>4. switch</li> <li>5. for loop</li> </ol>		
2	Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on boundary-value analysis, execute the test cases and discuss the results.		
3	Take any system (ex: Library Management System) and study its system specification and report the various bugs.		
4	Design test cases for any application (ex: e-commerce).		
5	Install a basic setup for a Selenium test suite, creation of test scripts and configuration of the test environment to perform data scraping.		
6	Execute simple Selenium test cases to verify basic website functionality, such as navigating pages and interacting with elements.		
7	Organize a Selenium test suite using TestNG, grouping and executing multiple test cases.		

**B.E. INFORMATION SCIENCE AND ENGINEERING**  
Choice Based Credit System (CBCS) for 2022 scheme  
**SEMESTER-VI**

**Robotic Process Automation (0:0:28:2) 1**  
(Effective from the academic year 2024-25)

Course Code	BCS608E	CIE Marks	50
Teaching Hours (L:T:P:S)	0:0:28:2	SEE Marks	50
Total Number of Contact Hours	28 Hours Practical	Exam Hours	3
Examination Nature	Practical		

**Course Objectives:**

This course will enable students to:

1. Gain a clear understanding of RPA and benefits, understanding the limits and constraints of automation.
2. Understand the basic RPA components, features and technology.
3. Acquire the knowledge on purpose and use of the control center.
4. Understand the various use cases and write bots.

**Preamble**

RPA is growing rapidly with changing IT climate & bringing up many tools & capabilities which are as deep as machine learning & artificial intelligence. UiPath is a powerful automation tool that can be used by technical professionals, including software engineers and IT professionals, to create complex and efficient automation workflows. This provides a range of advanced features and capabilities, such as the ability to integrate with multiple systems and applications, execute complex logic, and handle large amounts of data.

**List of Experiments**

Download, Install and Activate Ui-Path Studio. Learn all the basics of RPA (Variables, arguments and Control flow etc.)

1. Generate unicorn names from the website <https://www.rpasamples.com/> to an excel sheet.
2. Build a flowchart to:
  - a. Ask the user's name and extract the first 3 characters from the given name and display it.
  - b. Ask the user a number and display whether it is a odd or even number.
  - c. Show how an integer variable will increase from 5 to 50 in increments of 5 using while control flow activity.
3. Build a flowchart to:
  - a. Check whether the given year is leap year or not via do-while activity. You need to continue taking the input as long as the customer gives non leap year.
  - b. Ask two numbers from the user and check whether the sum is less than 20
  - c. Move all the files from a source folder to destination folder using for-each activity.
4. Perform the following operations on an Excel file
  - i) Read cell    ii) Write cell    iii) Read Range    iv) Write Range    v) Append Range.
5. UiPath Studio includes a recording feature, that can help you save time when automating your business processes. Demonstrate Basic, Desktop and Web recording for some use cases.
6. Flipkart.com or amazon.com has lot of mobile phones listed with all the details like price, model, make etc. Build an Automation Process to extract this and build a data table and dump into an excel sheet using data scraping via UiPath.

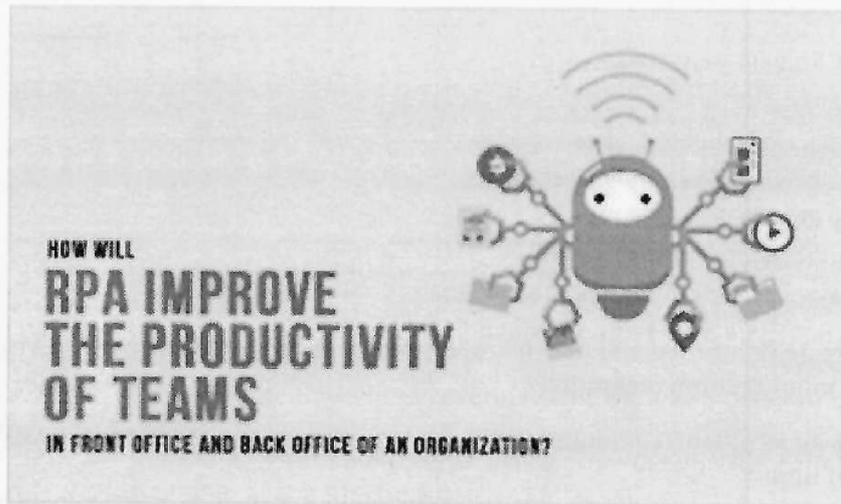
8	Integrate Selenium test suites with CI tools like Jenkins, including test execution and reporting setup.
9	Generate and analyse test reports for Selenium test suites using tools like Allure or Extent Reports.
10	Perform cross-browser testing within a Selenium test suite by running tests across multiple browsers and addressing any compatibility issues. Across multiple browsers and addressing any compatibility issues.
PART B	
1	Select any publicly available web application (for example: login page, e-commerce site, or demo testing site) and identify critical user functionalities. Develop Selenium automation script to test these functionalities and analyze the results.
<p><b>Course Outcomes:</b>  The students will be able to:  CO1: Apply manual and automation testing techniques.  CO2: Apply strategies for generating system test case and test plan document.  CO3: Examine the Selenium environment and execute test suites.  CO4: Design test cases for data-driven, cross-browser testing, CI integration, and report generation.</p>	
<p><b>Textbooks:</b></p> <ol style="list-style-type: none"> <li>1. Paul C. Jorgensen: Software Testing, A Craftsman"s Approach, 3rd Edition, Auerbach Publications, 2008.</li> <li>2. Aditya P Mathur: Foundations of Software Testing, Pearson Education, 2008.</li> <li>3. "Testing in 30+ Open Source Tools", Rahul Shende, Shroff Publishers &amp; Distributor Pvt. Ltd, ISBN 13: 9789350231005 (Page numbers from 15 to 117)</li> </ol>	

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7. Extract invoice details from multiple PDF files and consolidate them into an Excel sheet.
8. Compare two Excel sheets and update the cells accordingly using Lookup data table activity.
9. Take a look at the above image. Interpret how you can extract the text via OCR activity. Also discuss the types of OCR available in UiPath studio. (with UiPath flowchart)



## PART B

### RPA Mini Project:

Design and develop an **RPA solution using UiPath to automate the processing of student results**, including data extraction, validation, calculation, report generation, and email notification.

You are required to create a UiPath workflow that performs the following operations:

1. Input Data Handling
2. Business Logic Implementation
3. Result Processing
4. Report Generation
5. Email Automation
6. Exception Handling

#### Functional Requirements

- Use UiPath Studio
- Use Excel Application Scope
- Use Flowchart or Sequence workflows
- Implement If, For Each, Assign, and Try Catch activities
- Use proper variable naming and comments

#### Non-Functional Requirements

- Workflow should be reusable and scalable
- Code should be modular and readable
- Proper logging should be implemented
- Execution time should be optimized

#### Expected Deliverables

- UiPath Project (.xaml files)
- Input and Output Excel files

- Generated Report
- Screenshots of workflow execution
- Mini project report (PDF)

**Input**

- Excel file: Student\_Marks.xlsx

**Output**

- Updated Excel file with calculated results
- Separate sheets for Pass and Fail students
- Summary Report (Excel/PDF)
- Email notifications sent successfully

**Course Outcomes:** The students will be able to:

CO1: Demonstrate the record and play feature, task recorder, different types of variables, control flow and data manipulation techniques.

CO2: Apply various control techniques, OCR, strategies to handle exceptions in real time applications in RPA.

CO3: Interpret various case studies influencing customer experience in implementing RPA technology.

**Textbooks:**

1. Nandan Mullakara, Arun Kumar Asokan, Robotic Process Automation Projects: Build real-world RPA solutions using UiPath and Automation Anywhere, First Edition, Packt Publishing Ltd., 2020.
2. Alok Mani Tripathi, Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath, First Edition, Packt Publishing Ltd., 2018

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<b>SEMESTER – VI</b>			
<b>INDIAN KNOWLEDGE SYSTEM</b> <b>(Common to All UG Programs)</b> <b>Applicable for the Academic Year 2025-26 for 2022 scheme onwards</b>			
Course Code	<b>BIKS610</b>	CIE Marks	100
Teaching Hours(L:T:P:S)	14:0:0:0- NCMC	SEE Marks	-
Total Number of Lecture Hours	14 Hours Theory	Total marks	100
Examination Nature	MCQ		
<b>Course objectives:</b>			
1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the importance of roots of knowledge system.			
2. To make the students understand the traditional knowledge and analyse it and apply it to their day-to-day life.			
<b>Module – 1</b>			
<b>Introduction to Indian Knowledge Systems (IKS):</b> Overview, Vedic Corpus, Philosophy, Character, scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge. <span style="float: right;"><b>5 Hours</b></span>			
<b>Module – 2</b>			
<b>Traditional Knowledge in Humanities and Sciences:</b> Linguistics, Number and measurements- Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology. <span style="float: right;"><b>4Hours</b></span>			
<b>Module – 3</b>			
<b>Traditional Knowledge in Professional domain:</b> Town planning and architecture-Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals. <span style="float: right;"><b>4 Hours</b></span>			
<b>Course Outcomes: After completing the course, the students will be able to</b>			
<b>CO1:</b>	Provide an overview of the concept of the Indian Knowledge System and its importance.		
<b>CO2:</b>	Appreciate the need and importance of protecting traditional knowledge.		
<b>CO3:</b>	Recognize the relevance of Traditional knowledge in different domains.		
<b>CO4:</b>	Establish the significance of Indian Knowledge systems in the contemporary world.		
<b>Reference Books:</b>			
1.	<b>Introduction to Indian Knowledge System- concepts and applications</b> , B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93- 91818-21-0		
2.	<b>Traditional Knowledge System in India</b> , Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230,		
3.	<b>Knowledge Traditions and Practices of India</b> , Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334,		

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SECTION - VI

INDIAN KNOWLEDGE SYSTEM

(Courses to All UC Programs)

Department for the Academic Year 2022-23 for 2022 admission

Course Code	Course Title	Prerequisite	Elective
111-101	Introduction to Indian Knowledge System	None	None
111-102	History of Indian Knowledge System	111-101	None
111-103	Philosophy of Indian Knowledge System	111-101	None
111-104	Science and Technology in Indian Knowledge System	111-101	None
111-105	Medicine in Indian Knowledge System	111-101	None
111-106	Yoga in Indian Knowledge System	111-101	None
111-107	Art and Culture in Indian Knowledge System	111-101	None
111-108	Environment and Sustainability in Indian Knowledge System	111-101	None
111-109	Gender Studies in Indian Knowledge System	111-101	None
111-110	Leadership and Management in Indian Knowledge System	111-101	None
111-111	Entrepreneurship in Indian Knowledge System	111-101	None
111-112	Project Management in Indian Knowledge System	111-101	None
111-113	Business Law in Indian Knowledge System	111-101	None
111-114	Accounting in Indian Knowledge System	111-101	None
111-115	Marketing in Indian Knowledge System	111-101	None
111-116	Human Resource Management in Indian Knowledge System	111-101	None
111-117	Operations Management in Indian Knowledge System	111-101	None
111-118	Quality Management in Indian Knowledge System	111-101	None
111-119	Information Systems in Indian Knowledge System	111-101	None
111-120	Business Ethics in Indian Knowledge System	111-101	None
111-121	Business Communication in Indian Knowledge System	111-101	None
111-122	Business Negotiation in Indian Knowledge System	111-101	None
111-123	Business Writing in Indian Knowledge System	111-101	None
111-124	Business Presentations in Indian Knowledge System	111-101	None
111-125	Business Case Studies in Indian Knowledge System	111-101	None
111-126	Business Research in Indian Knowledge System	111-101	None
111-127	Business Statistics in Indian Knowledge System	111-101	None
111-128	Business Mathematics in Indian Knowledge System	111-101	None
111-129	Business English in Indian Knowledge System	111-101	None
111-130	Business Law in Indian Knowledge System	111-101	None
111-131	Business Accounting in Indian Knowledge System	111-101	None
111-132	Business Marketing in Indian Knowledge System	111-101	None
111-133	Business Human Resource Management in Indian Knowledge System	111-101	None
111-134	Business Operations Management in Indian Knowledge System	111-101	None
111-135	Business Quality Management in Indian Knowledge System	111-101	None
111-136	Business Information Systems in Indian Knowledge System	111-101	None
111-137	Business Ethics in Indian Knowledge System	111-101	None
111-138	Business Communication in Indian Knowledge System	111-101	None
111-139	Business Negotiation in Indian Knowledge System	111-101	None
111-140	Business Writing in Indian Knowledge System	111-101	None
111-141	Business Presentations in Indian Knowledge System	111-101	None
111-142	Business Case Studies in Indian Knowledge System	111-101	None
111-143	Business Research in Indian Knowledge System	111-101	None
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111-190	Business Negotiation in Indian Knowledge System	111-101	None
111-191	Business Writing in Indian Knowledge System	111-101	None
111-192	Business Presentations in Indian Knowledge System	111-101	None
111-193	Business Case Studies in Indian Knowledge System	111-101	None
111-194	Business Research in Indian Knowledge System	111-101	None
111-195	Business Statistics in Indian Knowledge System	111-101	None
111-196	Business Mathematics in Indian Knowledge System	111-101	None
111-197	Business English in Indian Knowledge System	111-101	None
111-198	Business Law in Indian Knowledge System	111-101	None
111-199	Business Accounting in Indian Knowledge System	111-101	None
111-200	Business Marketing in Indian Knowledge System	111-101	None

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