

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING



B.TECH (CSE (IBM) –SPECIALIZATION PROGRAMS)

FOUR YEAR PROGRAM

**CURRICULUM STRUCTURE & SYLLABI
(2023-2027 BATCH ONWARDS)**



**SCHOOL OF ENGINEERING AND TECHNOLOGY
MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH**

Curriculum Components

Component	Credits
1. University Core (4 Courses)	8
2. University Elective (2 Courses)	6
3. Basic Science (9 Courses)	24
4. Engineering Science (9 Courses)	21
5. Program Core (38 Courses)	71
6. Program Elective / MOOCs (5 Courses)	21
7. Project / Summer Internship Project (7 Courses)	17
8. Proficiency (Non-Graded) (6 Courses)	6
Total	168

First Year - Autumn Semester

Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage			
		L	T	P			CW	MTE	PBL	ETE
UC 23.101	Human Values & Professional Ethics	2	0	0	2	3	10	40		50
MA 23.101	Mathematics I	3	1	0	4	3	10	40		50
PY 23.101	Engineering Physics	3	0	0	3	3	10	40		50
CY 23.102	Environmental Sciences	2	0	0	2	3	10	40		50
EE 23.101	Basics of Electrical Engineering	3	1	0	4	3	10	40		50
CS 23.101	Programming for problem solving	3	0	0	3	3	10	40		50
CS 23.103	S/W Foundation and Programming I (with C)	3	0	0	3	3	10	40		50
CS 23.111	Programming laboratory	0	0	4	2	2	20	20	20	40
PY 23.111	Physics laboratory	0	0	2	1	2	20	20	20	40
ME 23.112	Mechanical Workshop	0	0	2	1	2	20	20	20	40
EE 23.111	Electrical Laboratory	0	0	2	1	2	20	20	20	40
SF 101	Personal Grooming and Fine Dining(Non Grade)	0	0	2	1	2	50			50
Total					26		100			

First Year -Spring Semester

Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage			
		L	T	P			CW	MTE	PBL	ETE
UC 23.102	Pragmatic English Communication	2	0	0	2	3	10	40		50
MA 23.102	Mathematics-II	3	1	0	4	3	10	40		50
CY 23.101	Engineering Chemistry	3	0	0	3	3	10	40		50
ME 23.101	Applied Mechanics	3	1	0	4	3	10	40		50
EC 23.101	Basics of Electronics Engineering	3	1	0	4	3	10	40		50
CS 23.104	Advanced Concepts of OOPs	3	0	0	3	3	10	40		50
ME 23.111	Computer aided Engineering Drawing	0	0	4	2	2	20	40		40
CY 23.111	Chemistry Lab	0	0	2	1	2	20	20	20	40
EC 23.111	Electronics Lab	0	0	2	1	2	20	20	20	40
SF 102	Social Grooming, Home & Decor and Business Communication (Non Grade)	0	0	2	1	2	50			50
Total					24		100			

Second Year - Autumn Semester										
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage			
		L	T	P			CW	MTE	PBL	ETE
UC 23.201	Introduction to Management & Leadership	2	0	0	2	3	10	40		50
MA 23.201	Mathematics-III	3	1	0	4	3	10	40		50
CS 23.201	Discrete Mathematics	3	1	0	4	3	10	40		50
CS 23.203	Data Structures	3	0	0	3	3	10	40		50
CS23.205	General Purpose Programming	3	0	0	3	3	10	40		50
EC 23.202	Digital Electronics	3	0	0	3	3	10	40		50
CS 23.207	Application Development for Cloud	3	0	0	3	3	10	40		50
CS 23.253	Data Structures Lab	0	0	2	1	2	20	20	20	40
CS 23.255	General Purpose Programming laboratory	0	0	2	1	2	20	20	20	40
EC 23.224	Digital Electronics Laboratory	0	0	2	1	2	20	20	20	40
SF 201	Personal Grooming Fine Dining and Home Safety (Non Grade)	0	0	2	1	2	50			50
Total					25		100			

Second Year -Spring Semester										
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage			
		L	T	P			CW	MTE	PBL	ETE
UC 23.202	Entrepreneurship Development	2	0	0	2	2	10	40		50
	University Elective-I	3	0	0	3	3	20			80
CS23.204	Database Management Systems	3	0	0	3	3	10	40		50
CS 23.202	Advanced Programming	3	0	0	3	3	10	40		50
CS23.206	Theory of Computation	3	0	0	3	3	10	40		50
CS23.208	Computer Organization and Architecture	3	0	0	3	3	10	40		50
CS 23.210	Essentials of Software Engineering (OOAD & S/w Life cycle)	3	0	0	3	3	10	40		50
	Program Elective-1 (Industry Track)	3	0	0	3	3	10	40		50
CS23.252	Advanced Programming Laboratory	0	0	2	1	2	20	20	20	40
CS23.254	Database Management Systems Laboratory	0	0	2	1	2	20	20	20	40
SF 202	Social Grooming and Professional Skills(Non Grade)	0	0	2	1	2	50			50
Total					25		100			

Project Based Learning (PBL) in Group of 3-5 Students

Third Year - Autumn Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P			CW	MTE	ETE
RM 23.101	Research Methodology	2	0	0	2	3	10	40	50
CS23.301	Design and Analysis of Algorithms	3	1	0	4	3	10	40	50
CS23.303	Operating System	3	0	0	3	3	10	40	50
CS23.305	Cyber Security	3	0	0	3	3	10	40	50
	Program Elective-2 (Industry Track)	3	0	0	3	3	10	40	50
CS23.351	Design and Analysis of Algorithms Laboratory	0	0	2	1	2	20	40	40
CS23.355	Cyber Security Laboratory	0	0	2	1	2	20	40	40
CS23.353	Operating System Laboratory	0	0	2	1	2	20	40	40
CS 23.373	Summer Internship-I**	0	0	0	2		100		
CS 23.371	Project-1	0	0	4	2	2	-	50	50
SF 301	Civility and Ethics Business and Professional Grooming, Corporate Dinning Etiquettes (Non Grade)	0	0	2	1	2	50	0	50
	Total				22		100		

Third Year -Spring Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P			CW	MTE	ETE
CS 23.302	Artificial Intelligence and Machine Learning	3	0	0	3	3	10	40	50
CS23.304	Compiler Design	3	0	0	3	3	10	40	50
CS23.306	Computer Networks	3	0	0	3	3	10	40	50
CS 23.308	Digital Image Processing and Computer Graphics	3	0	0	3	3	10	40	50
	Program Elective-3 (Industry Track)	3	0	0	3	3	10	40	50
CS 23.392	Colloquium	0	0	2	1	-	100		
CS 23.354	Compiler Design Laboratory	0	0	2	1	2	20	40	40
CS 23.356	Computer Networks Laboratory	0	0	2	1	2	20	40	40
CS 23.358	Digital Image Processing and Computer Graphics Laboratory	0	0	2	1	2	20	40	40
CS 23.372	Project-2	0	0	4	2	2	-	50	50
SF 302	Soft Skills and Interview Skills (Non Grade)	0	0	2	1	2	50	0	50
	Total				21		100		

Fourth Year - Autumn Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P			CW	MTE	ETE
UE	University Elective-II	3	0	0	3	3	20		80
	Program Elective-4 (Industry Track)	3	0	0	3	3	10	40	50
	Program Elective-5 (Common to All Tracks)	3	0	0	3	3	10	40	50
CS 23.473	Summer Internship-II**	0	0	0	2	-	100		
CS 23.471	Capstone Project-1	0	0	4	2	-	100		
	Total				13				

Fourth Year -Spring Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P			CW	MTE	ETE
	Program Elective-6	3	0	0	3	3	10	40	50
	Program Elective-7	3	0	0	3	3	10	40	50
CS23.472	Capstone Project-2	0	0	12	6			50	50
	Total				12		100		

** Summer Internship-I & II must be performed in an Industry between summer vacation of end of Second Year and end of Third Year.

Credit Distribution across all Components								
Semester	UC	UE	BS	ES	PC	PE	Proj/SIP	Total
First	2	0	10	6	8	0	0	26
Second	2	0	8	11	3	0	0	24
Third	2	0	4	4	15	0	0	25
Fourth	2	3	0	0	17	3	0	25
Fifth	0	0	2	0	13	3	4	22
Sixth	0	0	0	0	15	3	3	21
Seventh	0	3	0	0	0	6	4	13
Eighth	0	0	0	0	0	6	6	12
Total	8	6	24	21	71	21	17	168

UC	University Core
UE	University Elective
BS	Basic Science
ES	Engineering Science
PC	Program Core
PE	Program Elective / MOOC
Proj/SIP	Project/Summer Internship

CODE	Program Elective Tracks - Industry
Big Data (IBM) - Industry Track	
CS 23.212	Business Intelligence
CS 23.311	Big Data Programming
CS 23.316	Artificial Intelligence
CS 23.416	Predictive Modeling Analytics
Cloud Computing (IBM) - Industry Track	
CS 23.292	Application Security
CS 23.311	Big Data Programming
CS 23.316	Artificial Intelligence
CS 23.496	Block Chain
AI & Deep Learning (IBM)-Industry Track	
CS 23.282	Machine Learning with Python
CS 23.381	Deep Learning
CS 23.316	Artificial Intelligence
CS 23.416	Predictive Modeling Analytics

List of Program Elective Options

Code	Industry Electives (Common to All Tracks)
CS 23.461	Cloud Computing (Infosys)
CS 23.462	Mobile App Development (Infosys)
	MOOC-1*
	MOOC-2*
	*Mooc-1 and Mooc-2 should be selected only in 7th and 8th Semester respectively from NPTEL with prior permission from Department #Courses included from 2021-22 session onwards

Elective 6	
CS 23.493	Foundations and Applications of IoT
CS 23.495	Principles and Practices of Secure Computing
CS 23.463	Agile Software Development (Infosys)

Elective 7	
CS 23.494	Software Defined Networking
CS 23.464	Business Intelligence and its application (Infosys)
CS 23.465	Machine Learning using R (Infosys)

Prerequisite(s): Basic knowledge of Linux • Basic SQL knowledge • Working knowledge with big data and Hadoop technologies • Have a basic understanding of notebook technologies for data science • Students can attend free courses at www.bigdatauniversity.com to acquire the necessary requirements • Exposure to the IBM Skills Academy Portal learning environment • Exposure to the IBM Skills Academy Cloud hands-on labs platform

Objective(s):

- To Understand what Big Data is
- To understand how the growth of interconnected devices helps big data.
- To Learning the tools that will enable to continue big data education after the course

1. **BIG DATA OVERVIEW:** Introduction to Big Data, Introduction to the Big Data Ecosystem, Introduction to Hortonworks Data Platform (HDP), Apache Ambari, Hadoop and HDFS, MapReduce and YARN, Apache Spark, Storing and querying data, ZooKeeper, Slider, and Knox, Loading data with Sqoop, Security and Governance, Stream Computing, Exercise: Exploration of the lab environment, Managing Hadoop clusters with Apache Ambar, File access and basic commands with HDFS, Running MapReduce and YARN jobs, Creating and coding a simple MapReduce job, Working with a Spark RDD with Scala, Using Hive to access Hadoop/HBase data, Explore Zookeeper, Moving data into HDFS with Sqoop, [20]
2. **Introduction to Data Science:** Data Science and Data Science Notebooks, Data Science with Open Source Tools, Exercise: Moving data into HDFS with Sqoop [5]
3. **Big SQL:** Using Big SQL to access data residing in the HDFS, Creating Big SQL schemas and tables, File formats and querying Big SQL tables, Managing the Big SQL Server, Configuring Big SQL security, Data federation with Big SQL, Exercise: Connecting to the IBM Big SQL Server, Creating and managing Big SQL schemas and tables, Querying Big SQL tables, Managing the Big SQL Server, Configuring Big SQL security, Configuring impersonation in Big SQL, Using Fluid Query with Big SQL. [9]
4. **IBM Watson Studio:** Introduction to IBM Watson Studio, Analyzing data with Watson Studio, Exercise: Getting started with Watson Studio, Analyzing data with Watson Studio. [6]

Outcome(s): On the successful completion of the course, the student will be able to:

- Hadoop and the Hadoop Distributed File System • Analyze the time and space complexity of algorithms.
- Apache Spark.
- ZooKeeper, Slider, and Knox

Text Books: 1. IBM Study Material

Reference Books:

Prerequisite(s):	• English Proficiency • Basic Internet and web browser usage experience • Basic analytics experience
Objective(s):	➤ To understand how analytics provided a solution to industries using real case studies ➤ To Explain what is analytics, the various types of analytics, and how to apply it ➤ To Improve efficiency, sample records, and work with sequence data ➤ To Integrate and collect data ➤ To Understand the principles of data mining
1.	Business Analytics Overview: Analytics overview, Analytics trends, Towards a predictive enterprise, Analytics: Industry domains , Case studies and solutions. Business Intelligence and Analytics [5]
2.	Introduction to A Predictive Analytics Platform & Data Mining: Introduction to data mining, Working with modeler, A Data-mining tour ,Collecting initial data , Understanding your data ,Setting the unit of analysis ,Integrating data ,Deriving and reclassifying fields, Looking for relationships ,Introduction to modeling , Exercise: On the basis of all above topics. [10]
3.	Advanced data preparation: Using functions, Data transformations, Working with sequence data, Sampling records, Improving efficiency. Exercise on the basis of all above topics. [10]
4.	Automated Data Mining: Introduction to data mining ,The basics of using a modeler ,Reading data files , Data exploration , Automated data preparation ,Data partitioning, Predictor selection for modeling ,Automated models for categorical targets , Model evaluation , Automated models for continuous targets ,Deploying models Exercise :Adding nodes and creating streams in the modeler ,Reading a data file and typing the data in the source node , Review missing values in modeler and use the data audit node on the charity data , Practice using the ADP node to prepare data for modeling ,Use a partition node to split the charity data for modeling ,Use the feature selection node to select fields and predict a response ,Using the auto classifier node to construct a model in order to predict a response, Evaluate the model created to predict the field response ,Develop a model to predict the total spending , Use a scoring stream to make predictions [15]
Outcome(s):	On the successful completion of the course, the student will be able to: • Understand the principles of data mining • Use the user interface of modeler to create basic program streams • User a partition node to create training and testing data subsets • Use a model to score new data
Text Books:	IBM Study Material.
Reference Books:	

- Prerequisite(s):**
- Basic knowledge of JavaScript, Node.js, Angular.js, Golang, Docker, and Kubernetes
 - Exposure to the IBM Skills Academy Portal learning environment
 - Exposure to the IBM Skills Academy Cloud hands-on labs platform

- Objective(s):**
- To Explain block chain and how it is applied across industries
 - To Understand the benefits of a blockchain platform
 - To Explain what is Hyperledger Composer, how it fits into blockchain, and its applications
 - To Explain the elements of a business network, the role of channels, and how the world state is maintained
 - To Understand block chain deployment, security and integration capabilities

1. **Blockchain overview:** What is Blockchain? The business backdrop, The problem area, Relation to Bitcoin, Difference between Bitcoin and Blockchain, Requirements for a blockchain in a business environment, Requirements deep dive, Apply blockchain to business, Why blockchain is relevant for business, Consensus: Shared Reference Data Example, Provenance: Supply Chain Example, Immutability: Audit and Compliance Example, Finality: Letter of Credit Example, Industry Use Cases, Hyperledger Composer, Hyperledger Fabric, Blockchain for Financial Services [10]
2. **Blockchain Foundations:** HTML5 overview, JavaScript programming for web applications, HTML5 features, Working with HTML 5 features, Node.js, Server-Side JavaScript, Creating a Node.js Web Application, Asynchronous I/O with callback programming, Refactor weather project, , Working with JavaScript in HTML documents. [10]
3. **Docker Essentials :** Introduction to Docker, Add value CI/CD with Docker Images, Introduction to Orchestration, Get started with Kubernetes, Virtual machines, containers, and Kubernetes, Relationship between Kubernetes and containers, Deploy an application with IBM Watson services. [10]
4. **Blockchain Developer:** Blockchain Overview, Introducing Hyperledger Composer, Understanding Blockchain Solution Architecture, Blockchain in-depth, Hyperledger Fabric Application Development, Understanding Blockchain Deployment Options, Understanding Blockchain Security, Blockchain Integrated, Applying blockchain concepts to the vehicle manufacture lifecycle use case, Developing a blockchain user application with Hyperledger Composer SDK, Developing a client application for Hyperledger Fabric, Integrating blockchain with other systems, [10]

- Outcome(s):**
- On the successful completion of the course, the student will be able to:
 - Understand blockchain and how it is applied across industries
 - Understand the role of a shared ledger
 - Understand the benefits of a blockchain platform
 - Understand what is Hyperledger Composer, how it fits into blockchain, and its applications
 - Understand the blockchain solution architecture

Text Books: IBM Study Material.

Reference Books:

Prerequisite(s):

- Basic web development knowledge
- Basic knowledge on HTML and HTTP
- Basic knowledge of application security
- Exposure to the IBM Skills Academy Portal learning environment

Objective(s):

- Exposure to the IBM Skills Academy Cloud hands-on labs platform
- To Describe the emerging threats and leaks as the world is becoming digitalized
- To Understand the security dynamics of securing the enterprise
- To Understand relational database concepts and how to work with database objects
- To Describe how to work with select statements, DML statements, and multiple tables
- To Understand how to use JOINS in SQL
- To Understand the basics of HTML5 (objectives, document types that are supported, browser support etc.)
- To Understand glass box scanning, content based scanning, and troubleshooting

1. **Cyber Security Overview:** Emerging threats and leaks as the world is becoming digitalized, The changing dynamics of securing the enterprise, A new approach to security, The foundation of approach to security the enterprise, IT Security Frameworks, Security Intelligence as a foundation of all security programs, IBM Security. [5]
2. **Application Security Foundations:** SQL Fundamentals, Relational database concepts, Working with database objects, Reading data, Inserting, updating, and deleting data, Working with multiple tables, exercises on Relational database exercise, Creating, modifying and deleting database objects ,Inserting, updating, and deleting data. [9]
3. **Introduction to HTML5 and JavaScript Programming:** HTML5 overview, JavaScript programming for web applications, HTML5 features, Working with JavaScript in HTML documents, Working with HTML5 features. [9]
4. **Web Application Security Fundamentals:** The web application security problem, Web application basics, Injection flaws, Broken authentication and session management, Cross-Site scripting, Insecure direct object reference, Security misconfiguration, Sensitive data exposure, Missing function level access control, Cross-site request forgery (CSRF), Using components with known vulnerabilities, Unvalidate redirects and forwards, Integrating security in the software development lifecycle [9]
5. **Web Application Security Solution Fundamentals:** Web application security overview, Installation and setup, Preparing for scan, Configuring first scan, Reviewing the results, Reporting, Logging in and managing sessions, Configuring explore options, Optimizing your scan, Glass box scanning, Content-based scanning, Reviewing scan coverage, Scanning web services, Extending the security web application solution, Troubleshooting, [8]

Outcome(s):

- Understand relational database concepts and how to work with database objects
- Describe how to work with select statements, DML statements, and multiple tables
- Understand how to use JOINS in SQL
- Understand the basics of HTML5 (objectives, document types that are supported, browser support etc.)
- Understand the basics of JavaScript
- Describe the web application security problem and web application basics

Text Books:

IBM Study Material.

Reference Books:

Prerequisite(s):

- English proficiency
- Microsoft Windows operating system basic experience
- Basic Internet and web browser usage experience
- Knowledge of an organization's business intelligence and reporting needs
- Basic database background is preferred
- Basic knowledge of XML is preferred
- Exposure to the IBM Skills Academy portal learning environment
- Exposure to the IBM Skills Academy cloud hands-on labs platform

Objective(s):

- To Understand how analytics provided a solution to industries using real case studies
- To Explain what is analytics, the various types of analytics, and how to apply it
- To Understand how a business analysis software works, and its architecture
- To Describe a reporting application, its interface, and the different report types
- To Create different types of advanced reports
- To Understand Active Reports and how to create them

1. **Business Analytics Overview:** Analytics overview, Analytics trends: past, present & future, Towards a predictive enterprise, Analytics: Industry domains, Case studies and solutions. [5]
2. **Business Intelligence and Analytics 101 and Business analytics foundations:** Business Intelligence and Analytics 101, IBM Cognos Analytics for Consumers, Business analysis solution for consumers. [7]
4. **Business intelligence analyst:** IBM Cognos Analytics: Author Reports Fundamentals, Introduction to IBM Cognos Analytics, Create list reports, Focus reports using filters, Create crosstab reports, Present data graphically, Focus reports using prompts, Extend reports using calculations, Use additional report building techniques, Customize reports with conditional formatting, Drill-through definitions, Enhance report layout, Overview of IBM Cognos Analytics [12]
5. **IBM Cognos Analytics: Author Reports Advanced:** Create query models, Create reports based on query relationships, Create advanced dynamic reports, Design effective prompts, Create additional advanced reports, Examine the report specification, Distribute reports through bursting, Enhance user interaction with HTML. [11]
6. **IBM Cognos Analytics: Author Active Reports:** Introduction to IBM Cognos Active Reports, Use Active Report connections, Active Report charts, visualizations, and decks. [5]

Outcome(s):

- Describe a reporting application, its interface, and the different report types
- Create different types of advanced reports
- Understand Active Reports and how to create them

Text Books:

IBM Study Material.

Reference**Books:**

CS 23.210

**Essentials of Software Engineering (OOAD & SW
Lifecycle)**

Total Lectures: 40

Credit: 3-0-0-3

Prerequisite(s): Object Oriented Technologies

Objective(s):

- To acquire fundamental knowledge of Software designing using UML.

1. **Software Engineering Overview:** Best Practices of Software Engineering Concepts of Object Orientation Essentials of Visual Modeling Requirements Overview [8]
2. **Requirement analysis:** Analysis and Design Overview Architectural Analysis Use-Case Analysis Identify Design Elements [8]
3. **Design analysis:** Identify Design Mechanisms Describe the Run-time Architecture Describe Distribution Use-Case Design Object store Mechanism Security Mechanism. [8]
4. **UML and mapping:** UML to C++ Mapping UML to Java Mapping UML to Visual Basic Map UML to Visual Basic Map [8]
5. **Coding and Testing:** Software testing fundamentals, test case design, white box testing:-basis path testing, control structure testing, black box testing: boundary value analysis, equivalence class testing, decision table testing, cause effect graphing, level of testing, debugging, testing tools & standards [8]

Outcome(s):

- After completion of this course student get the understandings of object-oriented analysis and design concepts, as well as hands-on practical experience applying the techniques within a use-case-driven, architecture-centric, and iterative development process.

Text Books:

1. Pressman R.S., “Software Engineering”, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Sommerville, Ian “Software Engineering”, Pearson Education

Reference Books:

1. Jalote Pankaj, “An Integrated Approach to Software Engineering”, NAROSA.
2. Fairly, R.E., “Software Engineering Concepts”, McGraw-Hill

Prerequisite(s): C Programming , Fundamental of Computers

Objective(s): To understand the advanced concept of c programming to solve the real world programming problems.

1. **Pointers in C** : Pointers, declaring pointer variables, dereferencing and addressof [9]
operators, pointer expression and pointer arithmetic, null pointers, generic pointers, passing arguments to function using pointers, pointers and array, handling multidimensional array using pointers, passing an array to a function, pointers and strings, array of pointers, pointer-to- pointer, function pointers, dynamic memory allocation functions- malloc(), calloc (), realloc (), free(), drawbacks of pointers- memory leak, dangling pointer, memory corruption
2. **File Handling in C** : Streams-stdin, stdout and stderr, types of files-text file [5]
and binary file, file pointer, file modes-r,w,a,rb,wb and ab, file handling functions-fopen(), fclose(), fscanf(), fread(), fgetc(), fgets(), fprintf(), fputc(), fputs(), fwrite(), ferror(), feof(), fseek(), ftell(), rewind(), fgetpos(), fsetpos(), remove(), rename ()
3. **Searching and Sorting**- Searching techniques- linear search, binary search, [6]
hashing, sorting techniques-bubble sort, insertion sort, selection sort, quick sort, merge sort, heap sort, shell sort, radix sort, bucket sort
4. **Stack, Queue and Linked List** : Introduction to data structures, linear and non- [12]
linear data structures, stack, push and pop operations on stack, application of stacks, queue, circular queue, priority queue, deque, insertion and deletion operations in queue, linked list, single linked list, circular linked list, double linked list, insertion, deletion and searching in linked list, application of linked lists
5. **Trees and Graphs** : Binary tree, Binary search tree, AVL tree, Red-Black tree, [8]
Splay tree, B+ tree, insertion , deletion and searching operations on trees, graph terminologies, operations of graphs

Outcome(s): Upon successful completion of the course ,students will be able to
-solve complex programming problems using the concepts of pointers
- handle various file operations in c for real world applications
- implement various data structures using c language

Text Books:

1. Brain W. Kernighan and Dennis M. Ritchie, The C Programming Language, Second edition, Pearson Education, 2013
2. D. Samantha, Classic Data Structures, Second edition, PHI learning, 2013

Reference Books:

1. Aaron M. Tenebaum, YedidyahLangsam and Moshe J. Augenstein, Data Structures Using C and C++, PHI, 2nd Edition, 2012
2. D. Samanta, Classic Data Structures, PHI, 2nd Edition, 2009
3. Jean Paul Trembley and Paul G. Sorenson, An Introduction to Data Structures with applications, McGraw Hill, 2nd Edition, 2003

CS 23.104

Advanced Concepts of OOPs

Total Lectures: 40

Credit: 3-0-0-3

Prerequisite(s): NIL

Objective(s):

- Provide the foundation of good programming skills by discussing key issues of the design of object-oriented software, including programming design and documentation.
- Cover the basics of API and to explore the Java abstract programming interface.

1. **Basic OOPS and Core Java:** Core object concepts (Encapsulation, Abstraction, Polymorphism, Classes, Messages Association, Interfaces), Concept of inheritance. Derived class and base class. Managing memory with garbage collector, abstraction, access specifiers, Collection framework, keywords (static, final, abstract etc.), Swing API. [12]
2. **Java Database Connectivity (JDBC):** accessing data from tables: Joining, manipulating Databases with JDBC, Prepared Statements, Transaction Processing. [4]
3. **Modeling & Practice:** UML diagrams (structural & behavioral), ER diagrams, Data Flow Diagrams (DFD), logical complexity, effective modularization. Case study: automation tools, agile testing strategy, agile sprints. [6]
4. **Servlets and Java Server Pages (JSP):** Servlet Overview and Architecture, Interface Servlet and the Servlet Life Cycle, Handling HTTP get Requests, Handling HTTP post Requests, Redirecting Requests to Other Resources, using cookies. Introduction, Java Server Pages Overview, A First Java Server Page Example, Implicit Objects, Scripting, Standard Actions, Directives, Custom Tag Libraries. [13]
5. **Introduction to Application Development:** Introduction to Android platform, Creating application template, adding activity, intent, services to application, using Google Map API. [5]

Outcome(s): Identify classes, objects, members of class and the relationships among them needed for a specific problem.
Develop programs using the in-built Java API and the Java standard class library.
Create Java application programs using sound OOP practices (e.g., interfaces and APIs) and proper program structuring (e.g., by using access control identifiers, automatic documentation through comments, error exception handling).

Text Books:

1. Herbert Schildt, Java The Complete Reference, Herbert Schildt, 8th Edition, 2011.
2. Bert Bates and Kathy Sierra, Head First Java, O'Reilly, 2005

Reference Books:

1. Advanced Java 2 Platform HOW TO PROGRAM by H. M. Deitel, P. J. Deitel, S. E. Santry – Prentice Hall
3. Beginning Java™ EE 6 Platform with GlassFish 3 From Novice to Professional by Antonio Goncalves – Apress publication

Prerequisite(s): Nil

- Objective(s):**
- To understand complexity of Deep Learning algorithms and their limitations.
 - To understand modern notions in data analysis oriented computing.
 - To be capable of performing experiments in Deep Learning using real-world data.
 - To be capable of confidently applying common Deep Learning algorithms in practice and implementing their own;
1. **Introduction to TensorFlow:** :Computational Graph, Key highlights, Creating a Graph, Regression example, Gradient Descent, TensorBoard, Modularity, Sharing Variables,Keras **Perceptrons:** What is a Perceptron, XOR Gate [7]
 2. **Activation Functions and Artificial Neural Networks:** Sigmoid, ReLU, Hyperbolic Fns, Softmax, Introduction, Perceptron Training Rule, Gradient Descent Rule. [7]
 3. **Gradient Descent and Backpropagation:** Gradient Descent, Stochastic Gradient Descent, Backpropagation, Some problems in ANN, Optimization and Regularization : Overfitting and Capacity, Cross Validation, Feature Selection, Regularization, Hyperparameters [5]
 4. **Introduction to Convolutional and Recurrent Neural Networks:** Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, CNN applications, Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, RNN applications [12]
 5. **Deep Learning applications:** Image Processing, Natural Language Processing, Speech Recognition, Video Analytics [8]

- Outcome(s):** At the end of the course student will be able to:
- Understand the concepts of TensorFlow, its main functions, operations and the execution pipeline
 - Learn topics such as convolutional neural networks, recurrent neural networks, training deep networks and high-level interfaces
 - Differentiate between machine learning, deep learning and artificial intelligence.

- Text Books:**
1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.

- Reference Books:**
1. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
 2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
 3. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
 4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004

Prerequisite(s):

- English Proficiency
- Exposure to the IBM Skills Academy Portal learning environment

Objective(s):

- To Describe the field of AI and its subfields machine learning, NLP and computer vision
- To Describe the types of AI
- To Describe the types of machine learning: Supervise learning, unsupervised learning, and deep learning
- To Describe the purpose of training the various Watson services to adapt them to a closed-domain
- To Use Watson API Explorer to interact with the Watson services REST API, to rest your calls to the
- To Define chatbots
- To Explain the factors that lead to the growing popularity of chatbots
- To Identify applications that are good candidates to integrate with chatbots
- To Describe the main components that are involved when building a chatbot and explain their purpose
- To Describe how to build a chatbot by using the IBM Watson Conversation service

1. **Artificial intelligence overview:** Introduction to Artificial Intelligence, Machine Learning, Natural Language Processing, Computer vision, Cognitive Computing. [5]
2. **Artificial intelligence foundations:** Introduction to IBM Watson, Evolution from DeepQA to Watson services on IBM Cloud, Build with Watson, Exploring Watson services with Watson API Explorer. [10]
3. **Artificial intelligence analyst:** Introduction to Natural Language Processing, Pipeline and concepts, NLP and IBM Watson, Exercises on Ingest, Convert, Enrich, and Query with Watson Discovery Service. [10]
4. **Chatbots:** Introduction to Chatbots, Chatbot fundamentals, IBM Watson conversation service. [8]
5. **Computer Vision:** Introduction to Computer Vision, Computer Vision fundamentals, IBM Watson Visual Recognition service, Exercise on Classifying images with Watson Visual Recognition. [7]

Outcome(s):

Understand the relationship between AI and NLP
Know the history and advancement of Computer Vision
Understand Computer Vision components
Learn about the Vision services that are available from IBM Watson.

Text Books:

IBM Study Material.

Reference Books:

Prerequisite(s):

- English proficiency
- Microsoft Windows operating system basic experience
- Basic Internet and web browser usage experience
- Knowledge of an organization's business intelligence and reporting needs
- Basic database background is preferred
- Basic knowledge of XML is preferred
- Exposure to the IBM Skills Academy portal learning environment
- Exposure to the IBM Skills Academy cloud hands-on labs platform

Objective(s):

- To Understand how analytics provided a solution to industries using real case studies
- To Explain what is analytics, the various types of analytics, and how to apply it
- To Understand how a business analysis software works, and its architecture
- To Describe a reporting application, its interface, and the different report types
- To Create different types of advanced reports
- To Understand Active Reports and how to create them

1. **Business Analytics Overview:** Analytics overview, Analytics trends: past, present & future, Towards a predictive enterprise, Analytics: Industry domains, Case studies and solutions. [5]
2. **Business Intelligence and Analytics 101 and Business analytics foundations:** Business Intelligence and Analytics 101, IBM Cognos Analytics for Consumers, Business analysis solution for consumers. [7]
4. **Business intelligence analyst:** IBM Cognos Analytics: Author Reports Fundamentals, Introduction to IBM Cognos Analytics, Create list reports, Focus reports using filters, Create crosstab reports, Present data graphically, Focus reports using prompts, Extend reports using calculations, Use additional report building techniques, Customize reports with conditional formatting, Drill-through definitions, Enhance report layout, Overview of IBM Cognos Analytics [12]
5. **IBM Cognos Analytics: Author Reports Advanced:** Create query models, Create reports based on query relationships, Create advanced dynamic reports, Design effective prompts, Create additional advanced reports, Examine the report specification, Distribute reports through bursting, Enhance user interaction with HTML. [11]
6. **IBM Cognos Analytics: Author Active Reports:** Introduction to IBM Cognos Active Reports, Use Active Report connections, Active Report charts, visualizations, and decks. [5]

Outcome(s):

- Describe a reporting application, its interface, and the different report types
- Create different types of advanced reports
- Understand Active Reports and how to create them

Text Books:

IBM Study Material.

Reference Books:

CS 23.282

Machine Learning with Python

Total Lectures: 40

Credit:3-0-0-3

Prerequisite(s):

Familiarity with programming language will be beneficial

Objective(s):

- To understand the basic concepts and techniques of Machine Learning
- To develop the skills required for Machine Learning Technologies with use of Python to analyze data
- To develop the skills required for Machine Learning Technologies with use of Python to create beautiful visualizations, and problem solving using powerful machine learning algorithms

1. **Introduction to Python Programming:** Python Installation with various IDE's, [5]
Python data Types, Control Structure, Functions, Introduction of OOP's.
2. **Data analysis and Exploration:** Data Analysis & visualization –using numpy, [10]
panda matplotlib, scipy etc
3. **Machine learning & its Application:** Introduction to machine learning, [5]
Supervised machine learnin, Unsupervised machine learnings, Study of various
machine learning algorithms including, Supervised Learning Classification.
4. **Supervised Learning:**K-Nearest Neighbors , Decision Trees , Random Forests [10]
Reliability of Random Forests ,Advantages & Disadvantages of Decision Trees,
Regression Algorithms, Model Evaluation,Model Evaluation: Overfitting &
Underfitting
5. **Unsupervised Learning:**K-Means Clustering plus Advantages & Disadvantages [10]
Hierarchical Clustering plus Advantages & Disadvantages, Density-Based
Clustering, Dimensionality Reduction & Collaborative Filtering

Outcome(s):

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

- understand the basic concepts and techniques of Machine Learning
- understand Machine Learning Technologies
- create beautiful visualizations, and able to solve problem using powerful machine learning algorithms

Text Books:

1. Andreas C. Müller, Sarah Guido, Introduction to Machine Learning with Python. O'Reilly Media, Inc.,2016
2. P. Flach, Machine Learning: The art and science of algorithms that make sense of data, Cambridge University Press, 2012.

Reference Books:

1. William McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, O'Reilly , 2017.
2. Manaranjan Pradhan , U Dinesh Kumar, Machine Learning using Python,Wiley, 2019.

Prerequisite(s): CS 19.306 (Computer Networks)

Objective(s): To learn how to use cloud services.

To implement virtualization and task scheduling

- 1 **Overview of Cloud Computing:** Brief history and evolution - history of cloud computing, evolution of cloud computing, traditional vs. cloud computing, cloud service models (IaaS, PaaS & SaaS), cloud deployment models (public, private, hybrid and community cloud), benefits and challenges of cloud computing, introduction to AWS public cloud vendor, cost optimization in AWS, basics of virtualization, virtualization technologies, server virtualization, VM migration techniques, role of virtualization in cloud computing, introduction to EC2 service of AWS. [10]
- 2 **Working with Private Cloud:** Private cloud definition, characteristics of private cloud, private cloud deployment models, private cloud vendors - CloudStack, OpenStack, Eucalyptus Microsoft, private cloud – benefits and challenges, private cloud implementation in Amazon EC2 service. [8]
- 3 **Working with Public Clouds:** What is public cloud, why public cloud, when to opt for public cloud, public cloud service models, public cloud players, infrastructure as a service offering, IaaS vendors, PaaS offerings, PaaS vendors, software as a service, demonstrating public cloud with AWS – storage and database services, private vs. public cloud – when to choose. [10]
- 4 **Overview of Cloud Security:** Explain the security concerns in traditional IT, introduce challenges in cloud computing in terms of application security, server security, network security, security reference model, abuse and nefarious use of cloud computing, insecure interfaces and APIs, malicious insiders, shared technology issues, data loss or leakage, account or service hijacking, unknown risk profile, shared security model between vendor and customer in IaaS/PaaS/SaaS, implementing security in AWS. [8]
- 5 **Future directions in Cloud Computing:** When and not to migrate to cloud, migration paths for cloud, selection criteria for cloud deployment, issues/risks in cloud computing, future technology trends in cloud computing. [4]

Outcome(s): On successful completion the students will be able to:

- Analyze the cloud computing setup with its vulnerabilities and applications using different architectures.
- Design different workflows according to requirements and apply map reduce programming model.
- Create combinatorial auctions for cloud resources and design scheduling algorithms for computing clouds.

Text Books:

1. Raj Kumar Buyya, James Broberg and Andrezi M Goscinski, “Cloud Computing: Principles and Paradigms”, John Wiley & Sons, 2010
2. Nick Antonopoulos and Lee Gillam, “Cloud computing: Principles, Systems and Applications”, Springer, 2010.

Reference Books:

1. Anthony T Velte, Toby J Velte and Robert Elsenpeter, “Cloud Computing: A Practical Approach”, McGraw Hill, 2010
2. Borko Furht and Armando Escalante (Editors), “Handbook of Cloud Computing”, Springer, 2010
3. Judith Hurwitz, Robin Bllor, Marcia Kaufman and Fern Halper, “Cloud Computing for Dummies”, John Wiley & Sons, 2010.

CS 23.462

Mobile App Development

Total Lectures: 40

Credit: 3-0-0-3

Prerequisite(s): CS 19.202 (Object Oriented Programming)

Objective(s):

- To learn how mobile apps are different from other traditional apps by learning those aspects of mobile programming that make it unique from other platforms.
- Program mobile applications for the Android operating system that use basic and advanced phone features.
- Deploy applications to the Android marketplace for distribution.

- 1 **Getting started with Mobility:** Mobility landscape, mobile platform, mobile apps development, overview of android platform, setting up the mobile app development environment along with an emulator, a case study on mobile app development. [8]
- 2 **Building blocks of mobile apps: Apps user:** Interface designing-mobile UI resources (Layout, UI elements, Drawable, Menu), activity-states and life-cycle, interaction amongst activities. app-functionality beyond user interface-threads, async task, service –state and life cycle, notification, broad cast receivers, telephony and SMS APIs native data handling-on device file I/O, shared preferences, mobile database such as SQLite, and enterprise data access (via Internet/Intranet) [14]
- 3 **Sprucing up mobile apps:** Graphics and animation- custom views, canvas, animation APIs, multimedia-audio/video playback and record, location awareness, and native hardware access (sensor such as accelerometer and gyroscope). [8]
- 4 **Testing mobile apps:** Debugging mobile apps, white box testing, black box testing, and test automation of mobile app, JUnit for Android, Robotium, Monkey Talk. [6]
- 5 **Taking apps to market:** Versioning signing and packaging mobile apps, distributing apps on mobile market place. [4]

Outcome(s):

On successful completion of this course, students will be able to

- Understand the android operating system in details
- Create mobile application for various screens
- Deploy on play store market
- Use various sensors available in mobile

Text Books:

1. Barry Burd, Android Application Development All in One for Dummies, John Wiley & Sons Inc., 2011.
2. Anubhav Pradhan, Anil V Deshpandya, Mobile App Development, Edition I

Reference

Books:

1. Lauren Darcey, Shane Conder, “Teach Yourself Android Application Development in 24 Hours”, SAMS Publishing, 2012, 2nd Edition, 2012.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING



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