Department of Computer Science, University of Lucknow, Lucknow.

B.Sc.

Computer Science Syllabus

(Eight-Semester Program As Per NEP- New Education Policy-2021)

Syllabus passed by BOS on dated 31.07.2021.

Department of Computer Science, University of Lucknow, Lucknow
B.Sc (Computer Science) Eight-Semester Syllabi -2021

Year	Semester	Majore1		Credits	Majore2 Paper	credits	Minor	credits	CC/CV	credits	Total Credits	Award
		Paper Name										
1	Semester-1	P1	Computer Fundamentals	4	P1	4	P1	4	CC1	4	24	Certificate
		P2	System Analysis and Design	4	P2	4						
	Semester-2	P3	Programming in C	4	P3	4	P2	4	VC1	4	24	
		P4 (Lab)	Practical (C Language, Ms-Office)	4	P4	4						
2	Semester-3	P5	Data Structure Using C++	4	P5	4	P3	4	CC2	4	24	Diploma
		P6 (Lab)	Practical (Data Structure using C++, Python)	4	P6	4						
	Semester-4	P7	Operating System	4	P7	4	P4	4	VC2	4	24	
		P8	Management Information system	4	P8	4						
3	Semester-5	P9	Software Engineering	4	P9	4			Internship / Assignment	4	24	B.Sc. Degree
		P10	Computer Architecture and Microprocessor	4	P10	4						
		P11 P11x (Optional)	Cloud Computing									
		P11y (Optional)	Database Technologies	4								
	Semestre-6	P12	Application Development using HTML and JavaScript	4	P11	4			Minor Project	4	24	
		P13	Data Communication and Computer Network	4	P12	4						
		P14 P14x (Lab) (Optional)	Practical (Web-page creation using HTML and JavaScript)	4								
		P14y (Lab) (Optional)	Practical (Database)									
4	Semester-7	P15	Cybersecurity	4					Research Methodology	4	24	B.Sc. Research
		P16	Quality and Reliability Engineering	4								
		P17	Internet of Things	4								
		P18 P18x (Optional)	Machine Learning	4								
		P18y (Optional)	Data Science									
		P19 P19x (Optional)	Artificial Intelligence	4								
		P19y (Optional)	Web Technologies									
	Semester-8								Major Project	24	24	

Objective of the Program

The structure of B.Sc. (Computer Science) has been designed to meet following objectives:

- To train students to use full potential of computer and its associated devices.
- To introduce students with computer architecture and its utilization in various fields.
- To introduce students about the emergent computing technologies.
- To impart the necessary skills in students to present quick solutions of real time problems.
- To develop solid foundations for students and making them capable to pursue their post-graduate program.
- To meet the demand of IT professionals.

Program Specific Outcomes

After the successful completion of this undergraduate program, the students shall be able to:

- Develop most feasible solutions to real time problems.
- Write the quality programs to solve mathematical and analytical problems computationally.
- Develop quality and reliable software.
- Perform testing of software and remove the errors from them.
- Develop Web-pages and running them on World Wide Web environment.
- Have prerequisites qualifications, required to get admission in their higher studies.

SEMESTER-I

Title of the Paper: Computer Fundamentals		
Credit: 4		Theory
Course Outcome:	At the end of this course, the successful students will be able to: • Know the basic architecture of computer. • Grasp technologies on which computer works. • Solve Boolean problems and equations.	

Unit -I

Computer Definition, Evolution of Computers, Generation of Computers, Classification of Computers, Hardware and Software, Analog Digital and Hybrid Computers, Classification of Computers according to size, Super Computers, Mainframe Computers, Personal Computers, Different Terminals , Characteristics and Limitations of Computers.

Unit –II

Definition and Purpose of Different Programming Languages, Compiler, Interpreter, Assembler, Classification of software, Flowchart, Pseudo code, Algorithm, Number system (Decimal, Binary, Octal and Hexadecimal) and their Conversion, Binary addition, Binary Subtraction, Binary Multiplication, 1's Complement, 2's Complement.

Unit –III

Logic Gates and its application, Universal Gates, Boolean Algebra, Boolean Laws, De-Morgan's theorem based expression Problems, Simplification of expression using Boolean Laws, Karnaugh Map, SOP & POS techniques, Simplification of expression using Karnaugh Map.

Unit –IV

Computer Memory, Memory Hierarchy, classification of memory, Different types of secondary Memory, virtual memory, Graphical User Based operating system, Command line Based operating system, Disk Operating System, External and Internal Command in DOS.

Referenced Books:

[1] Pradeep K. Sinha and Priti Sinha, "Computer Fundamentals", BPB Publication, Sexth Edition.

[2] M. Morris Mano, "Degital Logic and Computer Design", PHI publication.

Suggested Readings

[1] M. Morris Mano, "Computer System Architecture", PHI publication.

[2]V. Rajaraman and Neeharika Adabala, "Fundamentals of Computers", PHI Publication.

Weblinks:

[1] https://www.cl.cam.ac.uk/teaching/1011/CompFunds/CompFunds.pdf.

[2] http://www.tmv.edu.in/pdf/Distance_education/BCA%20Books/BCA%20I%20SEM/BCA-121%20Computer%20Fundamental.pdf.

Title of the Paper: System Analysis And Design	
Credit: 4	**Theory**
Course Outcome:	At the end of this course, the successful students will be able to: • Analyze problems. • Know the basics of software design. • Understand System Development Life Cycle.	

Unit -I
System concept, Definition, System study, system analysis, System approach, Characteristics and Types of system, Elements of system analysis, System models and types of models, system environment and boundaries, system analyst, role of system analyst, qualification and responsibilities, System analyst as an agent of change, Open and Closed System, Formal and Informal Information Systems.

Unit –II
System Development Life Cycle and its various phases, Preliminary investigation, Determination of system requirements, Development of software, System testing, Implementation, evaluation and maintenance, system documentation and consideration, Data flow diagram (DFD) and its various levels, system requirement specification (SRS).

Unit –III
System Planning, Feasibility study and its report and importance, various tools and technique, Software Crisis: From programmer's point of view, from users point of view.

Unit –IV
System design and modeling, state of system design, process modeling, logical and physical design, system flow chart and structured charts, data flow diagrams, file organization and data base design, system testing and quantity assurance implementation and software maintenance.

Referenced Books:

[1] Brijendra Singh, "System Analysis and Design", New Age International Publishers.

[2] Elias M. Awad, "System Analysis and Design", Galgotia publications.

Suggested Readings:

[1] Goyal Arunesh, "Systems Analysis and Design", PHI.

[2] V. Rajaraman, "Analysis and Design of Information Systems", PHI

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] http://www.ddegjust.ac.in/studymaterial/pgdca/ms-04.pdf.

SEMESTER-II

Title of the Paper: Programming in C		
Credit: 4	At the end of this course, the successful students will be able to:	Theory
Course Outcome:	• Use various C statements. • Know structure of C Program. • Write C Program.	

Unit –I
History of C, Structure of a C program, The C character set, Constants, Variables, keywords, Data types, arithmetic instructions, Integer and float conversions, Type conversion, Operators in C, Hierarchy of operators, control instructions, Input-Output statements in C (Formatted and Unformatted), Comment statements.

Unit –II
Decision control structures, Logical operators, conditional operator and relational operators, Loop control structures –while, do-while, for loop, Break statement, Continue statement, switch-case control structure, goto statement Bitwise operators,.

Unit –III
One dimensional and multidimensional array, declaration, initialization and array Manipulations, sorting (Bubble sort) Strings – Basic Concepts, Library Functions, Definition, function definition and prototyping, types of functions, type of arguments, Recursion, passing arrays to functions, storage class in C-automatic, register, external and static variables.

Unit –IV
Pointers Definition, notation, pointers of arrays, array of pointers and functions – call by value and Call by reference, Definition, declaration, accessing structure elements, Array of structure, Pointers and structures,

Referenced Books:

[1] Brian W. Kernighan, Dennis M. Ritchie , "The C Programming Language", Prentice Hall software series, Second Edition.

[2] S.K. Srivastava and Deepali Srivastava, "C in Depth", BPB Publications.

[3]Suresh Prasad Kannojia, "Programming in C: Learn with Examples: A Practical Approach", LAP LAMBERT Academic Publishing.

Suggested Readings:

[1] Yashavant Kanetkar , "Let us C", BPB publication, 15th edition.

[2] Gottfried, "Programming With C",McGraw Hill.

Weblinks

[1] http://heecontent.upsdc.gov.in/

[2] https://www.unf.edu/~wkloster/2220/ppts/cprogramming_tutorial.pdf

Title of the Paper: C Programming & MS-Office		
Credit: 4		Practical
Course Outcome:	At the end of this course, the successful students will be able to: • Use C constructs • Write basic C Programs • Work with MS-Office	

List of Exercise based on C Programming & MS-Office:

C Programming:

1. Exercise on different operators used in C Language-Arithmetic/Logical/ Relational/Bit wise/Increment-Decrement/Ternary/ Special operators.
2. Data types/variable implementation.
3. Formatted and unformatted I/O function implementation.
4. Branching Statement-if, if-else, nested if-else, Else if ladder, Switch-case.
5. Looping Statement-while, do while, for.
6. Array implementation-single and multidimensional.
7. Structure & Union implementation.
8. Pointer implementation, types-void pointer.
9. Enum and storage classes implementation.
10. Pre-processor Directive, file handling through various functions.

MS Office:

1. Creating, Opening, Saving a Document. (Shortcut keys)
2. Formatting a document — setting paragraph, headings, font size and colour, line spacing, indentation, alignment of Document.
3. Mail-merge- envelops labels and documents.
4. Protection of document- Adding Password and Digital Signature. Inspecting and managing a document.
5. Table operations in MS Word.
6. Hyperlinking and linking documents internally and externally.
7. Formatting operations in MS-Word.
8. Spread Sheet formatting.
9. Referencing cell in spreadsheet.

Referenced Books:

[1]Suresh Prasad Kannojia, "Programming in C: Learn with Examples: A Practical Approach", LAP LAMBERT Academic Publishing.

[2] S.K. Srivastava and Deepali Srivastava, "C in Depth", BPB Publications.

[3]Cox, "Step by Step office professional 2010", Prentice-Hall of India

Suggested Readings:

[1] Yashavant Kanetkar , "Let us C", BPB publication, 15th edition.

[2] Gottfried, "Programming With C",McGraw Hill.

Weblinks

[1] http://heecontent.upsdc.gov.in/

[2] https://www.unf.edu/~wkloster/2220/ppts/cprogramming_tutorial.pdf

SEMESTER-III

Title of the Paper: Data Structure Using C++		
Credit: 4 **Course Outcome:**	At the end of this course, the successful students will be able to: • Use computer memory effectively. • Access data efficiently. • Understand Object Oriented Programming Concepts.	**Theory**
Unit –I		
OOPs concept, Procedural vs OOP programming, OOP terminology and features, Tokens, Character set, Keywords, Data-types, Data Types declarations, Constants and variables, expressions, Standard Library and header files, Classes and Objects,		
Unit –II		
Operator and Expressions: Arithmetic Operator, Increment/Decrement Operator, Relational Operator, Logical Operator and conditional operators, While, Do-while, For statements nested loops. If-else, switch, break, continue and Go to statements, Classes and Objects: Need for Classes, Declaration of Classes.		
Unit –III		
Data Structure definition and its classification, objective to study data structure, Algorithms and their complexity related issues, Stack definition, application and Implementation, Queue definition, application and Implementation, Doubly Ended queue, Circular Queue, Linked list, Single Linked list and Doubly Linked List, Disadvantages of Queue and Stacks, Advantages of Linked list over Queue and Stacks.		
Unit –IV		
Searching, linear and non-linear searching, Binary searching, sorting, Internal Sorting Vs External Sorting, Insertion sort, selection sort, bubble sort, Hashing and Collision Resolution techniques, Graph, Basic Terminology, Graph Traversal, Minimal Spanning Tree, Binary Trees, AVL tree.		

Referenced Books:

[1] Bjarne Stroustrup, "A Tour of C++", C++ in Depth Series.

[2] E. Balagurusamy, "Object Oriented Programming with C++", Mcgraw Hill publication.

Suggested Readings:

[1] Barbara Johnston, "C++ Programming Today", Pearson Education.

[2] R B Patel, "Expert Data Structure with C", Khanna Publication, Fourth Edition.

Weblinks:

[1] http://heecontent.upsdc.gov.in/.

[2] https://www-personal.acfr.usyd.edu.au/tbailey/ctext/ctext.pdf.

Title of the Paper: Data Structure Using C++, Python		
Credit: 4		**Practical**
Course Outcome:	At the end of this course, the successful students will be able to: • Learn Data organization. • Know data sorting and access techniques • Write programs in Python	

List of Exercise based on Data Structure using C++, Python:

Data Structure using C++:
1. Implementation of dynamic memory allocation
2. Implementation of single dimensional and multidimensional arrays
3. Structure implementation
4. Stack Implementation with all operations
5. Stack Implementation as abstract data type
6. Stack application for In-fix, Post-fix and Pre-fix polish expression.
7. Implementation of Recursion
8. Queue Implementation with insertion and deletions of elements.
9. De-queue Implementation
10. Circular Queue Implementation
11. Priority Queue Implementation
12. Single linked Creation with all kind of operations in all conditions
13. Implementation of pointers
14. Stack Implementation using linked list
15. Queue Implementation using Linked list
16. Doubly Linked list creation with all kind of operations in all possible conditions.
17. Circular Linked list creation with all kind of operations in all possible conditions.
18. Creation of tree and performing insertion and deletion of nodes.
19. Creation of Binary tree.
20. Traversal of Binary tree (In Order, Pre Order, Post Order)
21. Implementation of sequential search.

Python:
1. Implementation of Standard input and output statement
2. Implementation of variables and operators
3. Implementation of conditional and decision making statement
4. Implementation of control and looping structure
5. Implementation of strings and text
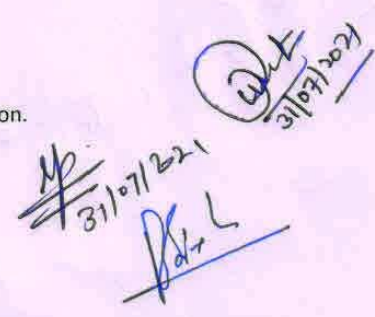
Referenced Books:

[1] E. Balagurusamy, "Object Oriented Programming with C++", Mcgraw Hill publication.

[2] Jason Rees, "Python Programming: A Practical Introduction To Python Programming For Total Beginners", McGraw Hill.

Suggested Readings:

[1] Barbara Johnston, "C++ Programming Today", Pearson Education.

[2] R B Patel, "Expert Data Structure with C", Khanna Publication, Fourth Edition.

Weblinks:

[1] http://heecontent.upsdc.gov.in/.

[2] https://www-personal.acfr.usyd.edu.au/tbailey/ctext/ctext.pdf.

SEMESTER-IV

Title of the Paper: Operating System		
Credit: 4 **Course Outcome:**	At the end of this course, the successful students will be able to: • Manage Processes. • Understand various scheduling algorithms. • Understand various memory organization techniques. Detect Deadlocks.	**Theory**
Unit –I		
Definition of operating system (OS), History of OS, Different types of OS, GUI Vs CLI Interface, Kernel and Shells architecture, Simple Batch Systems, Multiprogramming Vs Multitasking operating system, Multi-programmed Batched Systems, Time-Sharing Systems, Distributed Systems and Real-Time Systems, Operating System Structures-Command Interpreter System, Operating System Services, System Calls, System Programs, Process Concept, Process control Block, process Scheduling,		
Unit –II		
CPU scheduling-Basic Concepts, Scheduling Criteria, Shortest Job First (SJF) Scheduling, First-Come First-Serve Scheduling (FCFS), Priority Scheduling , Round Robin Scheduling, Multilevel Queue Scheduling.		
Unit –III		
Memory Partitioning Basic Concepts, Logical and Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation, Virtual Memory, Demand Paging, Paging Replacement, Fragmentation and its types, Thrashing and Demand Segmentation, File Concept, Access Methods, Directory Structure, Protection, File System Structure, Allocation methods, Free Space Management.		
Unit –IV		
Deadlock, Deadlock Characterizations, method for Handling Deadlocks, Deadlock prevention, Avoidance, Detection, recovery from Deadlock, Safe state.		

Referenced Books:

[1] Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", WILEY Publication, Ninth Edition.

[2] Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Prentice Hall, Third Edition

Suggested Readings:

[1] Dhamdhere, "Operating Systems", McGraw Hill.

[2] Tanenbaum and Andrew S, "Modern Operating Systems", Prentice Hall India.

Weblinks:

[1] http://heecontent.upsdc.gov.in/.

[2] https://www.cl.cam.ac.uk/teaching/1011/OpSystems/os1a-slides.pdf

	Title of the Paper: Management Information System	
Credit: 4 Course Outcome:	At the end of this course, the successful students will be able to: - Assure information flow across the system. - Interact with different components of system. - Produce quality product.	Theory

Unit –I
Information concepts, classification of information, methods of data and information collection, value of information, information: A quality product, General model of a human as information processor, Knowledge, MIS: Concept, Definition, Role of the MIS, Impact of MIS, MIS and the user, Management as a control system, MIS support to the management, Management effectiveness and MIS, Organization as system.

Unit –II
Information system, Major areas of information system, Component of Information system, Information system resource, Fundamental roles of Information system in Business, Trends in information system, Role of e-Business in Business, Classification of Information system, Managerial challenges in information technology, success and failure with information technology.

Unit –III
MIS: Organization effectiveness, Concept of corporate planning, Essentiality of strategic planning, Development of the business strategies, Type of strategies, short-range planning, tools of planning, MIS: strategic business planning.

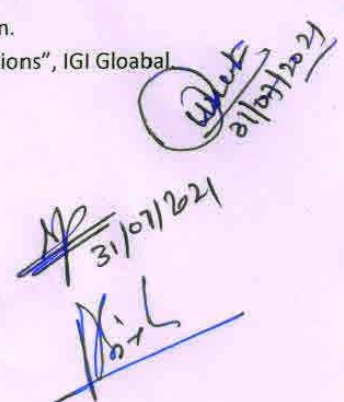| Unit –IV |
|---|
| Competitive Strategy Concepts, Strategic Uses of Information technology, Value chain and strategic Information system, Agility and its major types, Creating a virtual company, knowledge management system |

Referenced Books:

[1] James A O'Brien, George M Marakas "Management Information System", McGrawHill, Tenth Edition.

[2] Leonard Jessup, Joseph Valacich, "Information System TODAY", PHI Publication.

Suggested Readings:

[1] Kenneth C. Laudon, Jane P. Laudon, "Management Information Systems", pearson.

[2] Adamantios Koumpis, "Management Information Systems for Enterprise Applications", IGI Gloabal.

Weblinks:

[1] http://heecontent.upsdc.gov.in/.

[2] https://www.sctevtservices.nic.in/docs/website/pdf/140339.pdf

SEMESTER-V

Title of the Paper: Software Engineering	
Credit: 4 **Course Outcome:**	At the end of this course, the successful students will be able to: Theory

Credit: 4 Course Outcome:	At the end of this course, the successful students will be able to: • Know steps required to follow before writing software. • Write quality software. • Validate software. • Test software to identify vulnerabilities.	Theory

Unit –I

Software Engineering Definition, Cost, schedule and quality, Software quality attributes, Software Development Process Models, Waterfall Model, Prototyping Model, and Iterative Development.

Unit –II

Software Qualities, External qualities, internal qualities, Correctness, Reliability, Robustness, Usability, verifiability, Maintainability, reusability, Portability, interoperability, interoperability, Software Requirement Specification (SRS), Characteristics of SRS, Components of SRS.

Unit –III

Risk analysis, Spiral model, COCOMO Model, errors, fault and failure in software, Top-down approach and Bottom up approach for software design.

Unit –IV

Software Testing –System testing, Component testing, Integration testing, Black Box testing, White Box testing, alpha testing, Beta testing, Validation Vs Verification, Software errors and their causes of occurrence, Software quality definition, Cohesion and its types, Coupling and its major types.

Referenced Books:

[1] Pankaj Jalote, "Software Engineering: A Precise Approch", Wiley Publication.

[2] Rajib Mall, "Fundamentals of Software Engineering", PHI, Fifth Edition.

Suggested Readings:

[1] Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, "Fundamentals of Software Engineering", PHI.

[2] K K Agarwal, yogesh Singh, "Software Engineering", New Age international.

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] http://web.firat.edu.tr/mbaykara/softwareengineering.pdf

Title of the Paper: Computer Architecture and Microprocessor		
Credit: 4 Course Outcome:	At the end of this course, the successful students will be able to: • Know various components of microprocessor. • Understand registers organization in Microprocessor • Develop assembly language program. • Understand DMA Controller.	Theory
Unit –I		
Sequential circuit, Combinational Circuit, Flip-Flops (RS, Clocked RS, T, D, JK, Master Slave), Counters and its types, Registers, Encoder and Decoder, Half Adder, Full Adder, Half Sub-tractor, Multiplexer, De-Multiplexer.		
Unit –II		
Introduction of Microprocessor: Evolution of microprocessor, Embedded microprocessor, Bit-Slice Processor, RISC and CISC Processor, Vector Processor Array processor, Intel 8086 Microprocessor: Pin description of Intel 8086, operating model of 8086, Register organization of 8086, Bus Interface and Execution Unit (BIU and EU), Interrupts 8086 Read and write Bus Cycle.		
Unit –III		
8086 Instruction Group: Data transfer Instruction , Arithmetic Instruction, Logical Instruction processor Control Instructing, string Instructions, Interrupts instructions, Addressing modes of 8086 Micro–Processor		
Unit –IV		
Synchronous Data Transfer, Asynchronous Data Transfer, Interrupt Driven Data Transfer DMA Controller Address space partitioning – Memory mapped I/O scheme, I/O mapped I/O scheme.		

Referenced Books:

[1] V. Rajaraman and T. Radhakrishnan, "Digital Logic and Computer Organization", PHI Publication, Fourth Edition.

[2] B. Ram, "Fundamentals of Microprocessor and Microcomputers", Dhanpat Rai Publications, Sixth Edition.

Suggested Readings:

[3] M. Morris Mano, "Computer System Architecture", PHI publication, Third Edition.

[4] Gaonkar, Ramesh S, "Microprocessor Architecture, Programming and Application with 8085", Penram International Publication.

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] https://udrc.lkouniv.ac.in/Department/DepartmentDetail/StudyMaterial?dept=34

Title of the Paper: Cloud Computing		
Credit: 4 Course Outcome:	At the end of this course, the successful students will be able to: • Understand Cloud Computing concepts. • Avail global services of cloud computing. • Use different service models	Theory

Unit –I
Cloud Computing, Characteristics of Cloud Computing, inherent risks with cloud computing, Service models, Deployment Models, Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Benefits and challenges in cloud computing.

Unit –II
Cloud Service Models, Software-as-a-service, Platform-as-a-service, Infrastructure-as-a-service, Benefits and Characteristics of SaaS, PaaS and IaaS, Cloud based services and Applications, Virtualization, Hypervisor, Guest OS.

Unit –III
Explanations about Full Virtualization, Para-virtualization, Hardware-Virtualization, Load Balancing, Scalability and Elasticity, Deployment, Replication and its types, Cloud Application Development life-cycle, Software Defined Networking (SDN).

Unit –IV
SDN architecture, SDN layers, elements of Software Defined Networking, Network Function Virtualization, NFV architecture, Cloud reference Model, Cloud Services, Cloud Stack architecture, Azure platform, Hadoop Schedulers.

Referenced Books:

[1] Arshdeep Bahga and Vijay Madisetti, "Cloud Computing: A Hands on Approach", University Press.

[2] Ray J Rafaels, "Cloud Computing: from beginning to end", McGraw Hill.

Suggested Reading:

[1] Jagannath Kallakurchi and Kailash Jayaswal, "Cloud Computing Black Book", Dreamtech Publication.

[2] Mehul Mahrishi, Kamal Kant Hiran, Ruchi Doshi, Fagbol, "Cloud Computing", BPB Publication.

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] https://www.sanog.org/resources/sanog26/SANOG26_Tutorial%20-%20Introduction_Cloud_Computing_Sreenath.pdf

Title of the Paper: Database Technologies		
Credit: 4 Course Outcome:	At the end of this course, the successful students will be able to: • Know basic concepts of Database. • Organize and Clustering Data • Normalize stored data	Theory
Unit –I		
Data Modeling for a Database, Entities and their attributes, relationship, Record and files, Abstraction and Data Integration, The three level architecture proposal for a DBMS, Components of Database, Classification of DBMS Users, Role of Database Administrator.		
Unit –II		
Data Definition Languages, Data Manipulation Languages, DBMS facilities, Structure of DBMS, Advantages and Disadvantages of DBMS, Database association, Entities, Attributes, Data Models Classification, Entity-relationship model.		
Unit –III		
Normalization, first Normal form, Second Normal form, third Normal form, BCNF. Database Schema, Primary keys, super key, simple key, composite key, foreign key, candidate key. Relational Data Model, Network Data Model.		
Unit –IV		
Hierarchical Model, Attributes and Domains, Tuples, Database Design, Design process, Entity relationship model, Entity-relationship design issues, Relational Database design, Features of Good Relational Design, Deadlock.		

Referenced Books:

[1] Bipin C Desai, "An Introduction to Database Systems", Galgotia Publication.

[2] Abraham Silberschatz, Henry F. Korth, S. Sudarshan "Database System Concepts", McGraw Hill.

Suggested Readings:

[1] C J Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", Pearson

[2] P. joseph, "Introduction to Database Systems", ITL Education Solutions Limited

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] http://www.ddegjust.ac.in/studymaterial/mca-3/ms-11.pdf

Title of the Paper: Internship/Assignment		
Credit: 4	At the end of this course, the successful students will learn:	Theory
Course Outcome:	• To identify problems. • To Dataflow diagrams. • To establish relations among entities	

In internship/Assignment the students are expected to learn project management. Students will have to do following tasks in their fifth semester:
1. Choosing a real time problem.
2. Defining the area of coverage in problem statement.
3. Identifying Entities and relationships among them.
4. Constructing E-R diagram
5. Constructing the data Flow among the entities.
6. Identification of primary key, foreign key and composite key.
7. Identifying the number of tables required across the project.

*** Student should remember that the Title of their Internship project/Assignment taken in fifth semester will get converted into Minor project (same title) and shall be continue till end of six semester. In the fifth semester exam, the marks shall be given to the students on the basis of above seven points performed in semester.

SEMESTER-VI

Title of the Paper: Application Development using HTML and JavaScript		
Credit: 4		Theory
Course Outcome:	At the end of this course, the successful students will be able to: • Write HTML coding. • Establish navigations among HTML pages. • Incorporate JavaScript in HTML pages to enhance quality	
Unit –I		
Program, Software, Web-Application, Window Application, Local server, Web Server, Uploading files on Web Server, The Role of Configuration file on Web-Server, Web Development tools, Static Web Page, Dynamic Web Page, Navigations across the Web-Pages.		
Unit –II		
Developing and Attaching CSS files to web-page, Basic fundamentals to Application design, feasibility analysis of web-Application, Requirement Analysis of Web-Application, Creation of internal CSS file and Creation of External CSS file.		
Unit –III		
JavaScript Definition and utilization, JavaScript Placement in web-page, Client-Side JavaScript, Server-side JavaScript, Data Types in JavaScript, Variable in JavaScript and its scope, Strings, Arrays.		
Unit –IV		
Web-Page Design with <TD> and <TR> tags, Web-Page Design with <Div> tags, The implementation of FORM tags, Text formatting, Adding Graphics, flash and Multimedia to Web-Application.		

Referenced Books:

[1] Ivan Bayross, "Web Enabled Commercial Applications Development Using HTML, JavaScript, DHTML and PHP", BPB Publication, Fourth Edition.

[2] Thomas Powell, "HTML & CSS: The Complete Reference", McGraw Hill, Fifth Edition.

Suggested Reading:

[1] Steven Holzner, "HTML Black Book", dreamtech publication.

[2] Craig Grannel, "The Essential Guide to CSS and HTML Web Design", friendsof publication.

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] https://wtf.tw/ref/duckett.pdf

Title of the Paper: Data Communication and Computer Network		
Credit: 4		Theory
Course Outcome:	At the end of this course, the successful students will be able to: - Know different network topologies. - Know networking devices and their organization. - Protect data from malicious attacks. - Know various networking models and key standards.	

Unit –I

Data, Information, Data Vs Information, Data Communication and its Component, Communication Media, Data transmission Modes, Modem and its major types, Computer network and its advantages, World Wide Web, Internet, LAN, MAN, WAN, Bridge, router, Switch, Repeater.

Unit –II

OSI reference Model, TCP/IP Model, OSI Model Vs TCP/IP Model, Network topologies, IEEE Standards for Local Area Networks, IEEE 802.3 Ethernet Technologies, IEEE 802.4 Token Bus, IEEE 802.5 Token Ring, IEEE 802.6 Distributed, Queue Dual Bus, FDDI.

Unit –III

Sliding Window Protocols, Point-to-Point Protocol (PPP), Multiple Access Protocols, Error Detection and Error Correction, IPV6, IPV4, FTP, SMTP.

Unit –IV

Network Security and AIC triad (availability, integrity and confidentiality),Cryptography: Notion of Plain Text, Encryption, Key, Cipher Text, Decryption and cryptanalysis, Public Key Encryption, digital Signatures and Authentication.

Referenced Books:

[1] Brijendra Singh, "Data Communication and Computer Networks", PHI Publication, Fourth Edition.

[2] Brijendra Singh, "Network Security and Management", PHI Publication, Third Edition.

Suggested Readings:

[1] Behrouz A Forouzan, "Data Communication and Networking", McGraw Hill Publication, Fifth Edition.

[2] Andrew S. Tanenbaum, "Computer Networks", PHI

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] https://www.ece.uvic.ca/~itraore/elec567-13/notes/dist-03-4.pdf

Title of the Paper: Web-Page Creation Using HTML and JavaScript		
Credit: 4		Practical
Course Outcome:	At the end of this course, the successful students will be able to: • Use different HTML tags. • Design Static Web-pages. • Use CSS to make web-page attractive. • Use JavaScript to add variety of dynamic features to pages.	

1. Implementation of single and paired tags
2. Implementation of tables and frames
3. Implementation of cell spacing and cell padding
4. Implementation of marquee
5. Implementation of row span and column span
6. Implementation of javaScript with HTML
7. CSS attachment and Implementation
8. Adding visitor clock to a web-Page JavaScript
9. Dynamic menu creation using javaScript.
10. Graphics Implementation using JavaScript.
11. Interlinking of web-pages
12. Creation of Web-forms.
13. Adding calendar to web-page with JavaScript.
14. Adding rollover effects to images.
15. Fetching images through CSS in a Web-Page.

Referenced Books:

[1] Ivan Bayross, "Web Enabled Commercial Applications Development Using HTML, JavaScript, DHTML and PHP", BPB Publication, Fourth Edition.

[2] Thomas Powell, "HTML & CSS: The Complete Reference", McGraw Hill, Fifth Edition.

Suggested Reading:

[1] Steven Holzner, "HTML Black Book", dreamtech publication.

[2] Craig Grannel, "The Essential Guide to CSS and HTML Web Design", friendsof publication.

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] https://wtf.tw/ref/duckett.pdf

Title of the Paper: Database		
Credit: 4		Practical
Course Outcome:	At the end of this course, the successful students will be able to: • Create and structure database as per needs. • Organize records in database. • Retrieve data from database. • Remove duplication of data.	

1. Table Creation.
2. Table alteration.
3. Data Insertion
4. Data Deletion.
5. Data Retrieval
6. Data alteration.
7. Schema alteration.
8. Implementation of Primary keys.
9. Implementation of Candidate key.
10. Implementation of foreign key.
11. Implementation of Composite key.
12. Implementation of DDL command
13. Implementation of DML command
14. Implementation of 1st Normal form.
15. Implementation of 2nd Normal form.

Referenced Books:

[1] Bipin C Desai, "An Introduction to Database Systems", Galgotia Publication.

[2] Abraham Silberschatz, Henry F. Korth, S. Sudarshan "Database System Concepts", McGraw Hill.

Suggested Readings:

[1] C J Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", Pearson

[2] P. joseph, "Introduction to Database Systems", ITL Education Solutions Limited

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] http://www.ddegjust.ac.in/studymaterial/mca-3/ms-11.pdf

Title of the Paper: Minor Project		
		Project
Credit: 4 Course Outcome:	At the end of this course, the successful students will learn: • To use framework and languages to complete project. • To manage admin section of computable solution. • To deal with server end.	

In the six semester, the student shall convert their fifth semester problem in minor project for six semester/ new project. In this semester the student shall perform following tasks:

1. Setting up system with essential software, database and server.
2. Coding the project in appropriate language.
3. Designing Graphical User Interface.
4. Connecting database to GUI.
5. Feeding data to database.
6. Retrieving data from database.
7. Bringing the project in their final shape.
8. Preparing technical report about their project in about 60 pages.

SEMESTER-VII

Title of the Paper : Cybersecurity

Credit: 4 Course Outcome:	At the end of this course, the successful students will be able to: • Know risks inherent in Cyberspace. • Know precautions used to tackle with cybercriminals. • Know different forms of Cybercrime.	Theory

Unit –I
Data, Information, Data Vs Information, characteristics of information, W3 Consortium, Function of W3C, Networking, W3 and internet relationship, Information security, World Wide Web Security, Network security, Cybersecurity Definition and importance.

Unit –II
Cybersecurity: As international Problem, Cybersecurity: Common and shared responsibility, Cyberspace basics, Cybercrime basics, Vicious architecture of Cybercrime, Motivations behind cybercrimes.

Unit –III
Cyber Attacks, Threat, and Malware, Cyberterrorism, Information security to cybersecurity, Role of risk analysis in cybersecurity, Cybercrime: as a Profession, Cost of Cybercrime, Cyber Stalking, Intellectual property theft, Salami attack,

Unit –IV
e-mailbombing, Phishing, Identity theft, Spoofing, Worms, Trojan Horses, Virus, Denial-of-Service (DoS), Distributed Denial-of-Service (DDoS), Defacement attack, Ransomeware, Challenges in Cybersecurity.

Referenced Books:

[1] Rajesh Kumar Goutam, "Cybersecurity Fundamentals", BPB Publication, First Edition.

[2] Nina Godbole, Sunit Belapure, "Cybersecurity", Wiley Publication,

Suggested Readings:.

[1} William Gibson, "*Neuromancer*", Ace Science Fiction Books.

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] http://index-of.es/Varios-2/Neuromancer.pdf

Title of the Paper: Quality and Reliability Engineering		
Credit: 4 **Course Outcome:**	At the end of this course, the successful students will be able to: • Know parameters for quality software. • Write quality software. • Enhance the Reliability of Software.	**Theory**
Unit –I		
Software Quality Control, Quality Assurance System, Responsibility for quality, Company-wide Quality Control, Quality Cost Categories, Meaning of Quality of Software, Management for Quality Control and Reliability.		
Unit –II		
Software quality control and Management, Software life-cycle phases, software quality attributes, software quality assurance activities, software quality management, taguchi method for quality improvement.		
Unit –III		
Introduction to reliability, History of reliability, Reliability mathematics, Component reliability and Hazard model, Reliability of series and parallel system,		
Unit –IV		
Software Reliability, Qualitative view of reliability, quantitative view of reliability, definition of software reliability, software environment and reliability management, software reliability models.		

Referenced Books:

[1] Brijendra Singh, "Quality Control & Reliability Analysis", Khanna Publishers

[2] Daniel Galin, "Software Quality Assurance: from theory to implementation", Pearson edition.

Suggested Readings:

[1] Michael R. LYU, "Handbook of Software Reliability Engineering", McGraw Hills.

[2] John D. Musa, "Software Reliability Engineering: More Reliable Software Faster and Cheaper", 2nd Edition.

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] http://www.cse.cuhk.edu.hk/~lyu/book/reliability/

	Title of the Paper: Internet of Things	
Credit: 4 **Course Outcome:**	At the end of this course, the successful students will be able to: • Recognize IoT devices and learn their Management. • Know the role of IoT Devices in internet structure. • Understand IoT models and their utility.	**Theory**
	Unit –I	
	What is internet of Things (IoT), IoT Applications, Architecture, Devices, Wireless networks, Security and Privacy, Event-Driven Systems, IoT System Architectures, Protocol Concepts, IoT Oriented Protocols.	
	Unit –II	
	Bluetooth Stack, Databases, Time Bases, Security, IoT Devices, IoT Device Design Space, Cost of ownership and Power consumption, Duty Cycle and Power Consumption, Platform Design, IoT Network Model.	
	Unit –III	
	Events, Event as five tuple, Network, Devices and Hubs, Single hub Networks, Multi-hub Networks, Network Models and Physical Networks, IoT Event Analysis, Event Populations, Environmental Interaction Modeling.	
	Unit –IV	
	Industrial Internet of Things, Industrie 4.0, IoT, IIoT, and Industrie 4.0 relationship, IIoT Architecture, IoT reference model by ITU, IoT business models, Security property layers, Systems Security in IoT, Network Security in IoT.	

Referenced Books:

[1] Dimitrios Serpanos and Marilyn Wolf, "Internet-of-Things (IoT) Systems:Architectures, Algorithms, Methodologies", springer.

[2] David Hanes and Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press.

Suggested Readings:

[1] Cuno Pfister, "Getting Started with the Internet of Things", O'Rielly Publication.

[2] Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Wiley Publication.

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] https://www.elsevier.com/journals/internet-of-things/2542-6605?generatepdf=true

Title of the Paper: Machine Learning		
Credit: 4 Course Outcome:	At the end of this course, the successful students will be able to: • Grasp Machine Learning Concepts. • Use machine learning concepts to achieve automation. • Analyze data set for future decisions.	Theory
Unit –I		
What is machine learning, Machine Learning Applications, Learning Associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning, Wellsprings of Machine learning, Brain models.		
Unit –II		
Adoptive Control theory, Psychological Models, Evolutionary Models, Varieties of Machine Learning, Input Vectors, Training Regimes, Performance Evaluation, Boolean Representation in machine learning.		
Unit –III		
Representing Boolean Functions on Cubes, Decision Lists, Symmetric and Voting Functions, Version Spaces and mistakes bounds, Supervised learning definition, Generalization definition, Multivariate Regression, Multidimensional Scaling.		
Unit –IV		
Representing Boolean Functions on Cubes, Bayesian Decision Theory (only introduction), Boolean Representation in machine learning.		

Referenced Books:

[1] Ethem Alpaydın, "Introduction to Machine Learning", The MIT Press Cambridge, Massachusetts, London, England, Second Edition.

[2] Nils J. Nilsson, "Introduction to Machine Learning", Laboratory Department of Computer Science Stanford University Stanford.

Suggested readings:

[1] Alex Smola and S.V.N. Vishwanathan, " Introduction to Machine Learning", Cambridge University Press.

[2] Shai Shalev, Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms" Cambridge University Press.

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] https://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf

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Title of the Paper: Data Science		
Credit: 4 Course Outcome:	At the end of this course, the successful students will be able to: • Reduce data retrieval time. • Learn better organization of data. • Perform effective clustering • remove data redundancy	Theory

Unit –I
Data Definition, Data Structure, Data Science, Need of Data Science, Data Structure Versus Data Science, Types of Data: Numerical Data, Discrete Data, Continuous Data.
Unit –II
Categorical Data, Ordinal Data, Mean, Median, Mode in terms of Data Science, Data Science deviation and variance,
Unit –III
Neighbors Concept, K-nearest neighbors (KNN), KNN Application to predict rating, Dimensionality Reduction, Principal Component Analysis, ETL versus ELT.
Unit –IV
Reinforcement Learning, Q-learning, Markov Decision process, Dealing with Real World Data, Analyzing the bias/variance trade off, Data Cleaning.

Referenced Books:

[1] Frank Kane, "Hands-on-Data Science and Python Machine Learning", Packt Publication.

[2] Jake VanderPlas, "Python Data Science Handbook", Jupyter Publishing,

Suggested Readings:

[1] Igual, Laura, Seguí, Santi, "Introduction to Data Science: A Python Approach to Concepts, Techniques and Applications", Springer.

[2] Samuel Burns, "Fundamentals of Data Science: Take the first Step to Become a Data Scientist", Kendile edition.

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] http://math.ecnu.edu.cn/~lfzhou/seminar/[Joel_Grus]_Data_Science_from_Scratch_First_Princ.pdf

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Title of the Paper: Artificial Intelligence		
Credit: 4		**Theory**
Course Outcome:	**Outcome of Course:**	
	At the end of this course, the successful students will be able to:	
	• Analyze real time data and convert them into facts.	
	• Normalize data to perform operations.	
	• Cluster data to exclude undesired data.	

Unit –I
Artificial Intelligence Definition, Real time AI problems, Underlying assumptions, Production systems and its characteristics, AI problem characteristics, Universe Predictable Problem, State-space representation, Problem-reduction representation.

Unit –II
Four categories of production system. Simple Hill climbing, Steepest Ascent Hill Climbing, Local Maximum, Plateau, Ridge, Annealing, Mapping between Facts and Representations, Mutilated Checker Board Problem,

Unit –III
Representation of facts, Knowledge Representation, Representational Adequacy, Inferential Adequacy, Inferential efficiency, Acquisitional efficiency, Inheritable Knowledge, AI and Breadth Search Algorithm.

Unit –IV
Rule based systems, Representing knowledge as constraints, Model based reasoning, Blind state-space search, Blind AND/OR graph search.

Referenced Books:

[1] Elaine Rich, Kevin Knight, Shivashankar B Nair, "Artificial Intelligence", Third Edition, McGraw Hill.

[2] Parag Kulkarni and Prachi Joshi, "Artificial Intelligence: Building Intelligent System", PHI

Suggested Readings:

[1] Avron Barr and Edward A. Feigenbaum, "Handbook of artificial Intelligence", Department of Computer Science, Stanford University.

[2] Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", PHI

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] https://link.springer.com/journal/10462/volumes-and-issues

Title of the Paper: Web Technologies		
Credit: 4 **Course Outcome:**	At the end of this course, the successful students will be able to: • Understand the Web Server environment. • Work with Web-page designing technologies. • Work with Content Management System to meet needs	**Theory**
Unit –I		
Internet, World Wide Web, World Wide Consortium, Domain Name system, Accessing web server, Web Server, transferring of files from local server to web servers, The role of FTP in internet, Search Engine, Web Browser, Search Engine Versus Web Browser.		
Unit –II		
HTML, DHTML, Head and Body section of HTML page, Paired tags, Singular Tags, Title and footer, Text formatting, Emphasizing material in a web page, Text styles, Text effects, ordered and unordered lists, Border attribute, width and height attributes, Cell spacing and Cell Padding.		
Unit –III		
Row Spanning and Column Spanning, Working with tables, working with divisions, Links and Hyperlinks, inserting flash files in web-page, inserting media-player in web-page, Cascading Styles Sheet (CSS), CSS types, and attachments to web-pages.		
Unit –IV		
Interlinking Web-pages, Search Engine Optimization (SEO), Search Engine evaluation and criterion Enhancement of web-page ranking across search engines, Open-source software and their utility.		

Referenced Books:

[1] Ivan Bayross, "Web Enabled Commercial Applications Development Using HTML, JavaScript, DHTML and PHP", BPB Publication, Fourth Edition.

[2] Thomas Powell, "HTML & CSS: The Complete Reference", McGraw Hill, Fifth Edition.

Suggested Reading:

[1] Steven Holzner, "HTML Black Book", dreamtech publication.

[2] Craig Grannel, "The Essential Guide to CSS and HTML Web Design", friendsof publication.

Weblinks:

[1] http://heecontent.upsdc.gov.in/

[2] https://wtf.tw/ref/duckett.pdf

Title of the Paper: Research Methodology		
Credit: 4 Course Outcome:	At the end of this course, the successful students will be able to: • Choose and formulate Research Problems. • Do data analysis. • Handle small projects and write technical reports.	Theory

Unit –I
Meaning of Research, Objectives of Research, Types of Research, Research Approaches, and Significance of research, Research Methods Versus Methodology, Research and Scientific Method, Criteria of Good Research.

Unit –II
Research Problems, Research Problem formulation choosing Research Problem, Research Design, need for research design, features of Good Design, Research Hypothesis, Identification of Quality Research Papers, Research Paper Citations and their impacts in research field.

Unit –III
Data Collection, Authenticity of data, Data Collection methods: Survey and Questionnaire, Quality Questionnaire Preparation, Evaluation and Classification of data, Data Validation, Quantitative and Qualitative Data.

Unit –IV
Mean, Median, Mode, Dispersion, Skewness, Hypothesis, Report, technical report, writing Technical reports, Writing Project report.

Referenced Books:

[1] C R Kothari and Gaurav Garg, "Research Methodology: Methods and Techniques", New Age.

[2] Ranjit Kumar, "Research Methodology", person india.

Suggested Readings:

[1] Alexander M. Novikov, Dmitry A. Novikov, "Research Methodology From Philosophy of Science to Research Design", CRC Press.

[2] S.K Acharya, P. Pal, A. Biswas, "Research Methodology the Design, Process and Applilcation", SSPH Publishing.

Weblinks:

[1] https://www.cusb.ac.in/images/cusb-files/2020/el/cbs/_C_R_Kothari.pdf

[2] http://www.yanchukvladimir.com/docs/Library/202010.pdf

SEMESTER-VIII

Title of the Paper: Major Project	
Credit: 24	Project
Course Outcome: At the end of this course, the successful students will be able to: • Deal with all phases of SDLC. • Develop real time projects. • Integrate Web-designing technologies with database.	

In this semester, Student shall opt a real time project with the consult of Departmental Supervisor and perform following tasks:

1. Requirement Analysis.
2. Literature survey upon 10 research papers form SCI/Scopus indexed journals.
3. Major Players
4. Identification of problem statement to decide objective
5. Expected Outcome
6. Entity-Relation Diagrams
7. Data Flow Diagrams
8. Hardware and Software Requirement
9. Implementation
10. Results
11. Conclusion
12. Future Scope
13. References