Academic Council Meeting No. and Date: 09 / July 02, 2024

Agenda Number : 03 Resolution Number : 41, 42 / 3.1 & 3.3

Vidya Prasarak Mandal's
B. N. Bandodkar College of
Science (Autonomous), Thane

Syllabus for

Programme Code: BUCS

Programme : Bachelor of Science

Specific Programme : Computer Science

[S.Y.B.Sc. (Computer Science)]

Level 5.0

Revised under NEP

From academic year 2024 - 2025

Preamble

The aim of the BSc Computer Science Syllabus is to lay the theoretical foundations of software and hardware equally supplemented by the practical techniques. With this foundation of computer science along with core subjects like Mathematics, Statistics etc, the computer science students are expected to contribute efficient solutions for the various problems that are given to them.

Over this period of time, computer science students have proved this fact and have done well in Industries (mainly software) which have offered plenty of opportunities to them. With the advancement in software industry and technological innovations, the industry demands from graduate and postgraduate students are changing. The syllabus is been designed to meet the industry expectations, to inspire the students to take-up higher education as well as research, to attract student over other courses and finally to fulfill the expectations of Credit system.

The syllabus will be designed keeping these challenges in mind. The syllabus aims to cover core concepts of Computer Science and also to cover the latest technologies which can be accommodated at BSc level. One such step is that we would like to promote Open Source Technologies as much as possible.

Abhijeet A. Kale
Chairman
Board of Studies in Computer Science

PROGRAMME OUTCOMES (PO)

The Undergraduate Programmes of Science are intended to cater quality education and attain holistic development of learners through the following programme outcomes:

- **BACHELOR OF SCIENCE (B.Sc.)**

PO1 - Disciplinary Knowledge
Lay strong foundation of conceptual learning in science. Instil ability to apply science in professional, social and personal life.

PO2 - Inculcation of Research Aptitude
Ignite spirit of inquiry, critical thinking, analytical skills and problem-solving approach which will help learner to grasp concepts related to research methodology and execute budding research ideas.

PO3 - Digital Literacy
Enhance ability to access, select and use a variety of relevant information e-resources for curricular, co-curricular and extracurricular learning process.

PO4 - Sensitization towards Environment
Build cohesive bond with nature by respecting natural resources, encouraging eco-friendly practices and creating awareness about sustainable development.

PO5 - Individuality and Team work
Encourage learner to work independently or in collaboration for achieving effective results through practical experiments, project work and research activities.

PO6 - Social and Ethical Awareness
Foster ethical principles which will help in developing rational thinking and becoming socially aware citizens. Build attitude of unbiased, truthful actions and avoid unethical behaviour in all aspects of life.

Program Specific Outcomes

- Prepare the students ready for industry usage by providing required training in cutting edge technologies. (Level 4)
- Design and develop optimized computing mechanisms by integrating core computing concepts and advanced optimization techniques. (Level 6)
- Evaluate ethical, social, and professional challenges and justify appropriate communication and entrepreneurial decisions. (Level 5)
- Demonstrate basic knowledge of computer applications and apply standard practices in software project development. (Level 3)
- Understand Analyze and Develop computer programs for efficient design of computer-based systems of varying complexity. (Level 2)
- Understand various concepts of Computing, Statistics, Mathematics and Electronics appropriately to the discipline. (Level 2).

VPM's B.N.Bandodkar College of Science (Autonomous), Thane
S.Y.B.Sc. (Computer Science) Revised under NEP
Structure of Programme

Semester III

	Course Code	Course Title		No. of lectures	Credits
Major	24BUCS3T01	Core Java		**30**	**2**
	24BUCS3T02	Computer Network – I		**30**	**2**
	24BUCS3T03	Introduction to PL/SQL		**30**	**2**
	24BUCS3P01	Practical Based on 24BUCS3T01		**60**	**2**
	24BUCS3P02	Practical Based on 24BUCS3T03		**60**	**2**
Minor	24BUCS3T04	Theory of Computation		**30**	**2**
OE	24BUCS3T05	Virtualization		**30**	**2**
AEC	24BU3AEC05	Software Engineering – I		**30**	**2**
VSC	24BU3VSC05	Google Workspace		**30**	**2**
SEC	24BU3SEC08	Public Administration		**30**	**2**
CC*	23BU3CESC6	23BU3CC601	N.S.S.		**2**
		23BU3CC602	N.C.C.		
		23BU3CC603	D.L.L.E.		
		23BU3CC604	Sports		
		23BU3CC605	Cultural Activities		
		23BU3CC607	Yoga for Total Health		
		23BU3CC608	Cyber Security		

* For Syllabus of CC course, check the website / contact to concern authority.

Semester IV

	Course Code	Course Title		No. of lectures	Credits
Major	24BUCS4T01	Advanced JAVA		**30**	**2**
	24BUCS4T02	Computer Network – II		**30**	**2**
	24BUCS4T03	.NET Technologies		**30**	**2**
	24BUCS4P01	Practical Based on 24BUCS4T01		**60**	**2**
	24BUCS4P02	Practical Based on 24BUCS4T03		**60**	**2**
Minor	24BUCS4T04	Web Technologies		**30**	**2**
OE	24BUCS4T05	Modern Cloud Computing		**30**	**2**
AEC	24BU4AEC05	Software Engineering – II		**30**	**2**
VSC	24BU4VSC03	Introduction to Android Programming		**30**	**2**
FP	24BUCS4P03	Mini Project and Documentation		**30**	**2**
CC*	23BU4CESC6	23BU4CC601	N.S.S.	**2**	**2**
		23BU4CC602	N.C.C.		
		23BU4CC603	D.L.L.E.		
		23BU4CC604	Sports		
		23BU4CC605	Cultural Activities		
		23BU4CC607	Yoga for Total Health		
		23BU4CC608	Cyber Security		

***** For Syllabus of CC course, check the website / contact to concern authority

Semester III

Course Code	Course Title	Credits	No. of lectures
24BUCS3T01	**Major: Core Java**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Explain the fundamentals of Java programming, including Java features, syntax, data types, typecasting, arrays, and program structure, and apply these concepts to write basic Java programs.	L5
CO2	Apply Object-Oriented Programming concepts such as classes, objects, inheritance, polymorphism, encapsulation, constructors, and keywords (this, super, static) to design and implement modular Java programs.	L3
CO3	Apply exception handling and multithreading techniques, including try-catch, throw, throws, synchronization, wait/notify methods, to develop robust and concurrent Java applications.	L3
CO4	Implement networking and wrapper classes in Java, client-server communication using sockets and using wrapper classes for data type conversions to solve real-world programming problems.	L3

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	-	1	1
CO2	3	2	2	-	2	1
CO3	3	3	2	-	2	1
CO4	3	3	3	-	2	1

Unit I	**The Java Language:** Features of Java, Java programming format, Java Tokens, Java Statements, Java Data Types, Typecasting, Arrays **OOPS**: Introduction, Class, Object, Static Keywords, Constructors, this Key Word, Inheritance, super Key Word, Polymorphism (overloading and overriding), Encapsulation **String Manipulations**: String, String Buffer, String Tokenizer **Packages:** Introduction to predefined packages (java.lang, java.util, java.io, java.sql, java.swing), User Defined Packages, Access specifiers	15 [CO1, CO2, CO3]
Unit II	**Exception Handling:** Introduction, Pre-Defined Exceptions, Try-Catch-Finally, Throws, throw, User Defined Exception examples **Multithreading:** Thread Creations, Thread Life Cycle, Life Cycle Methods, Synchronization, Wait() notify() notify all() methods **Networking:** Introduction, Socket, Server socket, Client –Server Communication **Wrapper Classes:** Introduction, Byte, Short, Integer, Long, Float, Double, Character, Boolean classes	15 [CO2, CO3, CO4]

References:

1) Herbert Schildt, Java The Complete Reference, Ninth Edition, McGraw-Hill Education, 2014
2) E. Balagurusamy, Programming with Java, Tata McGraw-Hill Education India, 2014
3) Programming in JAVA, 2nd Ed, Sachin Malhotra & Saurabh Choudhary, Oxford Press
4) The Java Tutorials: http://docs.oracle.com/javase/tutorial/

Course Code	Course Title	Credits	No. of lectures
24BUCS3T02	**Major: Computer Network – I**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Explain the fundamentals of data communication and computer networks, including network types, components, switching techniques, and Internet standards, and analyze their roles in modern communication systems.	L2
CO2	Describe network models and protocol layering, including TCP/IP and OSI architectures, addressing, multiplexing, and demultiplexing, and apply these concepts to design basic network solutions.	L1
CO3	Explain data & signal concepts, including analog and digital signals, bit rate, transmission impairments, digital-to-digital, digital-to-analog, and analog-to-analog conversion, line coding schemes, modulation techniques, multiplexing, its impact on network communication quality.	L5
CO4	Evaluate transmission media, switching methods, guided media, fiber optics, circuit-switched and packet-switched networks, to select suitable networking solutions for different scenarios.	L5

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	-	2	-
CO2	3	3	2	-	3	-
CO3	3	2	3	-	2	-
CO4	3	3	2	-	3	2

Unit I	**Introduction Network Models:** Introduction to data communication, Components, Data Representation, Data Flow, Networks, Network Criteria, Physical Structures, Network types, Local Area Network, Wide Area Network, Switching, The Internet, Accessing the Internet, standards and administration Internet Standards. Network Models, Protocol layering, Scenarios, Principles of Protocol Layering, Logical Connections, TCP/IP Protocol Suite, Layered Architecture, Layers in the TCP/IP Protocol Suite, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing. Detailed introduction to Physical Layer, Detailed introduction to Data-Link Layer, Detailed introduction to Network Layer, Detailed introduction to Transport Layer, Detailed introduction to Application Layer.	15 [OC1, OC2]
Unit II	Data and Signals, Analog and Digital Data, Analog and Digital Signals, Sine Wave Phase, Wavelength, Time and Frequency Domains, Composite Signals, Bandwidth, Digital Signal, Bit Rate, Bit Length, Transmission of Digital Signals, Transmission Impairments, Attenuation, Distortion, Noise, Data Rate Limits, Performance, Bandwidth, Throughput, Latency (Delay) **Introduction to Physical Layer :** Digital Transmission digital-to-digital conversion, Line Coding, Line Coding Schemes, analog-to-digital conversion, Pulse Code Modulation (PCM), Transmission Modes, Parallel Transmission, Serial Transmission. Analog Transmission, digital-to-analog Conversion, Aspects of Digital-to-Analog Conversion, Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, analog-to-analog Conversion, Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM), Multiplexing, Frequency-Division Multiplexing, Wavelength-Division Multiplexing, Time-Division Multiplexing. Transmission Media, Guided Media, Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable. Switching, Three Methods of Switching , Circuit Switched Networks, Packet Switching,	15 [OC3, OC4]

References:

1) Data Communications and Networking, Behrouz A. Forouzan, Fifth Edition, TMH, 2013.
2) Computer Network, Andrew S. Tanenbaum, David J. Wetherall, 5th Edition, Pearson Edu,2011.
3) Computer Network, Bhushan Trivedi, Oxford University Press
4) Data and Computer Communication, William Stallings, PHI

Course Code	Course Title	Credits	No. of lectures
24BUC3T03	**Major: Introduction to PL/SQL**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Explain the basic components of PL/SQL.	L2
CO2	Use SQL and PL/SQL to create and modify database applications.	L3
CO3	Implement PL/SQL Control structures and command functions in writing practical code.	L3
CO4	Explain the importance of procedures, triggers, functions in database	L2

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	-	-	-
CO2	3	3	3	-	2	1
CO3	3	3	3	-	2	1
CO4	3	2	2	-	1	2

Unit I	Understanding the differences and integration between SQL and PL/SQL, Fundamentals of PL/SQL, Advantages of PL/SQL, Datatypes in PL/SQL, Program structure of PL/SQL, Using Variables in PL/SQL, Writing PL/SQL Executable Statements, Handling Exceptions, SQL in PL/SQL, implementing control structures, such as IF-THEN-ELSE and FOR loops, to control program flow	15 [OC1, OC2, OC3]
Unit II	Creating and Using Cursors, Creation Of Stored Procedures, Creating and Using Functions, Packages, Triggers	12 [OC4]

References:

1. Database System and Concepts, A Silberschatz, H Korth, S Sudarshan, McGraw-Hill, 5th Ed.
2. Database Systems, RobCoronelm, Cengage Learning, Twelfth Edition
3. Programming with PL/SQL for Beginners, H.Dand, R.Patil, T. Sambare, X –Team, 1st Ed, 2011
4. Introduction to Database System, C.J.Date, Pearson, First Edition, 2003

Course Code	Course Title	Credits	No. of lectures
24BUCS3P01	**Practical Based on 24BUCS3T01 and 24BUCS3T02**	**02**	**60**

Upon Completing the Course, Students will able to		
CO1	Identify classes, objects, members of a class and the relationships among them for a Specific problem	L1
CO2	Understand JAVA inheritance, multithreading and other OOPs concepts	L2
CO3	Analyze the performance of various network protocols using simulation tools.	L4
CO4	Compare the performance of different transport layer protocols	L4

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	-	2	1
CO2	3	2	3	-	2	-
CO3	3	3	3	-	2	-
CO4	3	3	2	-	2	-

Practical 1	i) Write a Java program that takes a number as input and prints its multiplication table upto 10. ii) find the average and sum of the N numbers iii) test the Prime number. iv) calculate the Simple Interest and Input by the user. v) find the factorial of a given number
Practical 2	i) Accept integer values for a, b and c which are coefficients of quadratic equation. Find the solution of quadratic equation ii) calculate the Simple Interest
Practical 3	Write a JAVA code to create a Simple class to find out the Area and perimeter of rectangle and box using super and this keyword
Practical 4	Write a JAVA code to create two binary numbers.
Practical 5	Write a JAVA code to create reverse a string
Practical 6	Write a JAVA code to create accept two n x m matrices. Write a Java program to find addition of these matrices
Practical 7	Write a JAVA code to create convert a decimal number to binary number and vice versa
Practical 8	Write a JAVA code to create find the smallest and largest element from the array
Practical 9	Write a JAVA code to create accept n strings & sort them in ascending/descending order
Practical 10	Write a JAVA code to create count the letters, spaces, numbers and other characters of an input string
Practical 11	Write a JAVA code to create demonstrates the use of constructor and destructor.
Practical 12	Write a JAVA code to create demonstrate Java inheritance using extends keyword.
Practical 13	Write a JAVA code to create implement single level inheritance.
Practical 14	Write a JAVA code to create implement multiple inheritance
Practical 15	Write a JAVA code to create method overloading and method overriding
Practical 16	Write a JAVA code to create to demonstrate your own exception in Java
Practical 17	Write a JAVA code to create print the factorial for an input value.
Practical 18	Write a JAVA code to create implement thread life cycle
Practical 19	Write a JAVA code to create implement multithreading

Practical 20	Study of Network devices in detail and connect the computers in Local Area Network
Practical 21	Use of ping and tracert / trace route, ipconfig / ifconfig, route and arp utilities.
Practical 22	Configure IP static routing.
Practical 23	Configure IP routing using RIP.
Practical 24	Configuring Simple OSPF.
Practical 25	Configuring DHCP server and client.
Practical 26	Configuring DNS Server and client.
Practical 27	Configuring OSPF with multiple areas.
Practical 28	To write a client-server application for chat using TCP
Practical 29	To Perform File Transfer in Client & Server Using TCP/IP
Practical 30	**IPv4AddressingandSubnetting** a) Given an IP address and network mask, determine other information about the IP address such as: • Network address • Network broad cast address • Total number of host bits • Number of hosts b) Given an IP address and network mask, determine other information about the IP address such as: • The subnet address of this subnet • The broad cast address of this subnet • The range of host addresses for this subnet • The maximum number of subnets for this subnet mask • The number of hosts for each subnet • The number of subnet bits • The number ofthissubnet

Course Code	Course Title	Credits	No. of lectures
24BUCS3P02	**Practical Based on 24BUCS3T03**	**02**	**60**

Upon Completing the Course, Students will able to		
CO1	Understand importance of PL/SQL basics	L2
CO2	Analyze the working of PL/SQL blocks.	L4
CO3	Implement functions and procedures using PL/SQL	L3
CO4	Understand the importance of triggers in database	L2

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	-	1	1
CO2	3	2	2	-	1	1
CO3	3	2	3	-	2	1
CO4	3	3	2	-	2	2

Practical 1	Understand the PL/SQL blocks and its use.
Practical 2	Write a PL/SQL code to enter any two numbers and find out their sum, difference, product, quotient and remainder
Practical 3	Write a PL/SQL code to find out the greatest of any three numbers
Practical 4	Write a PL/SQL code to enter any number and find out whether it's positive or negative or zero
Practical 5	Write a PL/SQL code to input any number and check whether it's even or odd.
Practical 6	Write a PL/SQL code to find the factorial of any number
Practical 7	Write a PL/SQL code to insert a new row in EMP table.
Practical 8	Write a PL/SQL code to demonstrate %ROWCOUNT
Practical 9	Write a PL/SQL code to accept the monthly salary of any employee and find the bonus of 12% on annual salary if experience is more than 3 years and otherwise the bonus is Rs. 1000. After all calculate the total salary received by the employ on that month along with the bonus amount
Practical 10	Write a PL/SQL code to increase the sal of employees by 1000 rs of deptno=10.
Practical 11	Write a PL/SQL code to insert the datas of the clerks from emp table to another table
Practical 12	Take the salary of an employee into a variable and check if his or her salary is less than 3000. If ist is less than 3000 then update the EMP table with 3000
Practical 13	Write a Procedure debit_account that accepts a account number and amount to update the account.
Practical 14	Write a Procedure to raise salary of an employee. The procedure accepts two parameters employee code, amount increased.
Practical 15	Write a function that checks if salary is in range or not. The procedure accepts two parameters employeeno, designation. Call it from a procedure that accepts only employee code. You have to write the procedure also.
Practical 16	Write a function that returns the balance of an account. The function accepts only one parameter account no. call it from procedure that accepts only one account no. you have to write the procedure also.
Practical 17	Write a PL/SQL block to handle the exception when a division by zero occurs.
Practical 18	Handle the INVALID_NUMBER exception when converting a non-numeric value to a number.
Practical 19	Handle the VALUE_ERROR exception when assigning an incompatible value to a variable
Practical 20	Write a PL/SQL block of code using parameterized Cursor that will merge the data availablein the newly created table N_RollCall with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped.

Practical 21	Write a database trigger on Library table. The System should keep track of the records that are being updated or deleted. The old value of updated or deleted records should be added in Library_Audit table.
Practical 22	Write a Stored Procedure namely proc_Grade for the categorization of student. If marks scoredby students in examination is <=1500 and marks>=990 then student will be placed in distinction category if marks scored are between 989 and 900 category is first class, if marks 899 and 825 category is Higher Second Class.
Practical 23	Write a program in PL/SQL to show the uses of implicit cursor Write a program in PL/SQL to show the uses of SQL%FOUND and SQL%NOTFOUND
Practical 24	Write a program in PL/SQL to retrieve the records from the employees table and display them using cursors
Practical 25	Write a code in PL/SQL to implement a trigger that records user activity (inserts, updates, deletes) in an audit log for a given set of tables
Practical 26	Write a PL/SQL package that contains a procedure to update the salary of an employee based on their performance rating
Practical 27	Write a code in PL/SQL to design a trigger that captures changes made to specific columns and logs them in an audit table
Practical 28	Write a PL/SQL code to develop a package that includes procedures and functions to perform various string manipulations, such as reversing a string and counting the occurrence of a substring
Practical 29	Write a PL/SQL code to create a package that includes a procedure to calculate the factorial of a number and a function to check if a number is prime.
Practical 30	Write a PL/SQL package that contains a function to retrieve the total number of employees in a specific job title.

Course Code	Course Title	Credits	No. of lectures
24BUCS3T04	**Minor: Theory of Computation**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Explain the fundamental concepts of automata theory and formal languages, including finite automata, grammar types, and formal language classifications.	L5
CO2	Construct and analyze deterministic and nondeterministic finite automata, Mealy and Moore machines, and pushdown automata to recognize and accept given languages	L6
CO3	Examine the equivalence of DFA & NDFA, minimize finite automata, and apply pumping lemmas to prove the properties and limitations of regular and context-free languages	L4
CO4	Design regular expressions, context-free grammars, and pushdown automata to generate or accept specific languages, demonstrating the ability to translate between grammars, automata, and language representations.	L6

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	2	1
CO2	3	3	2	-	2	-
CO3	3	3	2	-	2	-
CO4	3	3	2	-	2	-

Unit I	**Automata Theory:** Defining Automaton, Finite Automaton, Transitions and Its properties, Acceptability by Finite Automaton, Nondeterministic Finite State Machines, DFA and NDFA equivalence, Mealy and Moore Machines, Minimizing Automata. **Formal Languages:** Defining Grammar, Derivations, Languages generated by Grammar, Comsky Classification of Grammar and Languages, Recursive Enumerable Sets, Operations on Languages, Languages and Automata	15 [OC1, OC2]
Unit II	**Regular Sets and Regular Grammar:** Regular Grammar, Regular Expressions, Finite automata and Regular Expressions, Pumping Lemma and its Applications, Closure Properties, Regular Sets and Regular Grammar **Context Free Languages:** Context-free Languages, Derivation Tree, Ambiguity of Grammar, CFG simplification, Normal Forms, Pumping Lemma for CFG **Pushdown Automata:** Definitions, Acceptance by PDA, PDA and CFG	15 [OC2, OC3, OC4]

References:

1) Theory of Computer Science, K. L. P Mishra, Chandrasekharan, PHI,3rd Edition
2) Introduction to Computer Theory, Daniel Cohen, Wiley,2nd Edition
3) Introductory Theory of Computer Science, E.V. Krishnamurthy,Affiliated East-West Press.
4) Theory of Computation, Kavi Mahesh, Wiley India
5) Elements of The Theory of Computation, Lewis, Papadimitriou, PHI
6) Introduction to Languages and the Theory of Computation, John E Martin, McGraw-Hill Education
7) Introduction to Theory of Computation, Michel Sipser, Thomson

Course Code	Course Title	Credits	No. of lectures
24BUCS3T05	**OE: Virtualization**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Describe the fundamental concepts of virtualization, including its types, applications, and advantages in modern computing systems.	L1
CO2	Explain and differentiate between various virtualization types such as desktop, network, server, storage, and system-level virtualization	L5
CO3	Analyze the architecture and taxonomy of virtual machines, including process and system virtual machines, and evaluate their roles in computing environments	L4
CO4	Demonstrate the use of hypervisors to create and manage virtual machines, applying virtualization techniques to solve real-world computing problems.	L3

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	-	2	1
CO2	3	2	3	-	2	-
CO3	3	3	2	-	2	-
CO4	3	3	3	-	3	-

Unit I	Overview of virtualization: Basics of Virtualization, Virtualization Types: Desktop Virtualization, Network Virtualization, Server and Machine Virtualization, Storage Virtualization, System level or Operating Virtualization.	15 [OC1, OC2]
Unit II	Applications of Virtualization, Virtualization Advantages, Virtual Machine Basics, Taxonomy of Virtual machines, Process Virtual Machines, System Virtual Machines, Hypervisor	15 [OC3, OC4]

Reference Books

- Mastering_VMware_vSphere_5.5, Sybex Publication
- Configuring Windows Server Virtualization, Microsoft Press
- Citrix.XenServer.6.0.Administration.Essential.Guide, Feb.2007, Packtpub.
- Blade Servers and Virtualization, Wiley.
- Virtualization: A Beginner's Guide, Professional Xen Virtualization William von Hagen, January, 2008, Wrox Publications
- Virtualization: From the Desktop to the Enterprise, Chris Wolf , Erick M. Halter, 2005, A Press
- VMware and Microsoft Platform in the Virtual Data, Center, 2006, Auerbach
- Network virtualization, Kumar Reddy, Victor Moreno, July, 2006, Cisco Press

Course Code	Course Title	Credits	No. of lectures
24BU3AEC05	**AEC: Software Engineering – I**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Explain the fundamentals of software engineering, including software development life cycle (SDLC), software processes, and critical socio-technical systems	L4
CO2	Describe software requirements, including functional, non-functional, user, system, and interface requirements	L1
CO3	Apply and analyze different software development process models, including Waterfall, Prototyping, Iterative, RAD, RUP, Agile, and Extreme Programming, to select suitable models for real-world projects.	L3
CO4	Apply system modeling and architectural design principles, including context, behavioral, data, object models, modular decomposition, control styles, and reference architectures, to design structured and maintainable software systems.	L3

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	-	2	2
CO2	3	2	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	3	2

Unit I	**Introduction:** What is software engineering? Software Development Life Cycle, Requirements Analysis, Software Design, Coding, Testing, Maintenance etc. **Software Requirements:** Functional and Non-functional requirements, User Requirements, System Requirements, Interface Specification, Documentation of the software requirements. **Software Processes:** Process and Project, Component Software Processes. **Software Development Process Models.** • Waterfall Model. • Prototyping. • Iterative Development. • Rational Unified Process. • The RAD Model • Time boxing Model. **Agile software development**: Agile methods, Plan-driven and agile development, Extreme programming, Agile project management, Scaling agile methods.	**15** [OC1, OC2, OC3]
Unit II	**Socio-technical system:**Essential characteristics of socio technical systems, Emergent System Properties, Systems Engineering, Components of system such as organization, people and computers, Dealing Legacy Systems. **Critical system:** Types of critical system, A simple safety critical system, Dependability of a system, Availability and Reliability, Safety and Security of Software systems. **Requirements Engineering Processes:** Feasibility study, Requirementselicitation and analysis, Requirements Validations, Requirements Management. **System Models:** Models and its types, Context Models, Behavioural Models, Data Models, Object Models, Structured Methods. **Architectural Design:** Architectural Design Decisions, System Organisation, Modular Decomposition Styles, Control Styles, Reference Architectures. **User Interface Design:** Need of UI design, Design issues, The UI design Process, User analysis, User Interface Prototyping, Interface Evaluation.	**15** [OC3, OC4]

Text book:

1.Software Engineering, edition, Ian Somerville, Pearson Education, Ninth Edition
2.Software Engineering, Pankaj Jalote, Narosa Publication
3.Software engineering, a practitioner's approach, Roger Pressman, Tata Mcgraw-hill, 7th Edition

Course Code	Course Title	Credits	No. of lectures
24BU3VSC05	**VSC: Google Workspace**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Evaluate and optimize email communication strategies using Gmail to ensure effective, professional, and secure correspondence	L5
CO2	Analyze and coordinate meetings, events, and communications using Google Calendar, Google Meet, and Google Chat to ensure effective collaboration and workflow management.	L4
CO3	Apply Google Drive to save, organize, and share files efficiently for effective collaboration	L3
CO4	Evaluate and improve collaborative documents, spreadsheets, and presentations to ensure accuracy, clarity, and effectiveness in shared projects.	L5

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	-	2	2
CO2	2	2	3	-	3	2
CO3	2	1	3	-	3	2
CO4	2	2	3	-	3	2

Unit I	**1. Google Workspace & Mastering email communication with Gmail:** Overview of Google Workspace, Setting up a Google account andaccessing Google Workspace, Set Profile information and Photo,Send and Receive emails, Organize emails using labels, filters, andstars for easy retrieval and management, Utilize Gmail's advancedfeatures like scheduling emails, snoozing emails, and setting reminders.a. Create a Gmail account. Write a brief email to your friends invitingthem to a meeting to discuss a possible industrial visit. Attach adocument file with the many options for places to visit. **2. Google Calendar , Meet and Chat :** Create a new calendar, Create anevent in Google Calendar, Set remainders and alarms , Share aCalendar with Other People ,Integrate with Gmail and other apps.Scheduling and managing Google Meet events, Features in GoogleMeet like screen sharing, chat, annotations and recording, Creatingpublic and private Google Chat rooms ,Inviting and managingparticipants in Google Chat rooms, Utilizing Chat room features likesharing files, links, and multimedia, pinning messages, and polls.a. Create a new event in Google Calendar for an event happening ona specific date and time. Set a reminder to alert you one day prior tothe event. Share your Google Calendar with a specific email address and grant them view-only access. b. Set up a meeting with your project partners, choose the suggestedsecurity configurations, and send a meeting invite to the participantsvia email. Begin the meeting by letting everyone into the meetingroom. To demonstrate to them the project's progress, share yourscreen. Use chats to send brief messages and share relevantdocuments. **3. Google Drive:**Managing files and folders in Google Drive, Sharing filesand folders with collaborators and setting access permissions. a. Create a project folder in Google drive. Add a PowerPointpresentation detailing project milestones and a Word document withproject guidelines to the folder. Share the folder and allow the projectteam members to edit it. **4. Google Docs:** Document creation with Google Docs, Apply BasicFormatting to Text , Inserting Images, Creating tables, Format	**15** **[OC1, OC2]**

	adocument with styles, Using Find and Replace, Using RegularExpressions for Advanced Searching, Sharing and Collaborating onfiles. a. Create a one page document which best describes you. Add thedocument's heading and page numbers. Make a list of your hobbiesusing bullet points. Employ formats and typefaces to give thedocument an elegant look. To highlight your skills, use hyperlinks toother documents in the folder. Include a picture of yourself on thepage as well. Add a table with your educational background in it. Write about your positive college experiences by voice typing. Afterthat, translate the document's content into a different language ofyour choice. **5. Google Sheets :**Insert, delete and manage sheets , Insert a Function, Format Spreadsheets, Cells, and Ranges, Apply Number Formatting and Conditional Formatting, Insert and View Notes, ChooseSpreadsheet Settings, Merge Cells, Wrap and Rotate Cell Contents,Inserting Objects in Google Sheets, Sort and Filter Data, Apply DataValidation to Your Sheets, Protect Ranges in a Sheet, Protect a Sheet,Create and Manage Macros. a. Create a Personal budget sheet, list all your expenses and incomesof the month in the sheet. Use sum function to total the income andexpenses. Use IF function to find if the budget is in deficit or not.	
Unit II	**1. Google Slides:** Add a Slide to a Presentation, Import Slides from anExisting Presentation, Understanding and Using Views, Work with Text, Boxes, Add Audio and Video to a Slide, Insert Shapes and Word Art,Add a Transition and Animations, Edit a Slide Master, Organize theSlides in a Presentation a. Open a new Google Slides presentation titled “Project Presentation”.Add slides to provide a summary of your project. Use themes andtransitions to make the slide experience better. **2. Google Forms:** Create a Form, Choose Settings for a Form, AddQuestions to a Form, Add Images to a Question, Add a Video to aQuestion, Import Questions from an Existing Form, Create a Form withMultiple Sections, Control Progression Based on Answers, AddCollaborators to a Form, Preview and Test a Form, Send a Form to ItsRespondents, View the Responses to a Form, Analyse form responsesand generate reports. a. Create a Google Form to accept participation entries for the variousevents your department is organizing on the annual day. Mention thedetails of event in the form description. Include a dropdown menu toselect the events they wish to participate in. Insert relevantmultimedia to make the Google Form attractive. b. Create an online evaluation quiz using Google Form. Include avariety of question formats, such as ones with pictures, videos, etc.Assign points to the questions. Share the link with your friends andcheck out the the summary of the responses. **3. Google Classroom:** Create and set up a Google Classroom, AddStudents and Co-Teachers, Using Google Classroom to shareresources, Create assignment, Set due dates and points, Use rubricsfor grading, Integrate quizzes created using Google Form with GoogleClassroom. a. Create a Google Classroom for a certain subject that includes arange of topics, resources, and activities. Include resources for eachtopic, such as Word docs, PowerPoints, and YouTube links. Includeelements that encourage participation and interaction, such asassignments and discussions. **4. Google Maps:**Search on Maps, Different Map Views (Satellite, Terrain,Street View), Customizing Maps, Get to your destination, Sharing	**15** **[OC3, OC4]**

	Mapswith Others. a. Use google maps to explore local landmarks in your area. Finddirections from your current location to a nearby restaurant. UseMaps to check the places you have visited on a particular day.5. Google Sites: Creating and building simple websites using GoogleSites, Adding content, images, and widgets to websites. a. Assume you runs a small business. Create a visually appealingwebsite which includes the following pages: Home page , About thebusiness, Products page, Announcement of discounts.	

References:

- 1. Hart-Davis, G. (2021). Teach Yourself Visually Google Workspace Visual.
- 2. https://support.google.com/a/users#topic=9247638
- 3. https://support.google.com/edu/classroom#topic=10298088
- 4. https://support.google.com/maps/?hl=en#topic=9729258
- 1. Team, Z. (2017). The Ultimate Guide to G-Suite. Lean Pub G-Suite.
- 2. Iyer, b. (2022). Google workspace user guide: a practical guide tousing google apps efficiently while integrating them with yourdata.

Course Code	Course Title	Credits	No. of lectures
24BU3SEC08	**SEC: Public Administration**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Explain the evolution and constitutional context of Indian administration and analyze the changing role of the District Collector since independence.	L5
CO2	Explain the role of Public Service Commissions at Union and State levels and analyze their functions in recruitment, examinations, and maintaining administrative efficiency.	L5
CO3	Analyze the financial administration process, including budgetary procedures, role of Parliamentary Committees, Comptroller and Auditor General to evaluate financial accountability mechanisms	L4
CO4	Examine contemporary issues in Indian administration, Citizens' Charter, citizen-administration interaction and evaluate their effectiveness in promoting transparent governance	L4

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	1	3
CO2	3	2	1	-	1	3
CO3	3	3	1	-	1	3
CO4	3	3	2	-	2	3

Unit I	**Introduction to Indian Administration :** Evolution and Constitutional Context, Salient features, District Administration since Independence: Changing role of District Collector **Personnel Administration :** Recruitment: All India Services, Central Services, State Services Public Service Commission: Union Public Service Commission and Maharashtra Public Service Commission Training: All- India Services, Central Services, State Services (Maharashtra)	**15** [OC1, OC2]
Unit II	**Financial Administration:** Budgetary Process, Parliamentary Committees: Public Accounts Committee, Estimates Committee, Committee on Public Undertakings, Comptroller and Auditor General **Contemporary Issues in Indian Administration:** Integrity in Administration:Lokpal, Lokyukta, CVC, Citizen and Administration, Citizens' Charter	**15** [OC3, OC4]

References:

- Bava,.Noorjahan.Public Administration in the 21stCentury, Kanishka Publishers New Delhi, 2010.
- Avasthi, Maheshwari, Public Administration, Laxmi Narayan Agarwal Publications, Agra, 2006
- onlinelibrary.wiley.com
- Patil, B. B., Lokaprashasan,PhadkePrakashan, Kolhapur, 2009.
- Bora, Shirsat, Lokaprashasanshastra,Vidya Books Publishers, Aurangabad, 2013

Semester IV

Course Code	Course Title	Credits	No. of lectures
24BUCS4T01	**Major: Advanced JAVA**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Explain the fundamental concepts of Java GUI programming using AWT and Swing, including components, layouts, event handling, and differences between AWT and Swing.	L5
CO2	Develop interactive Java applications by implementing AWT and Swing components, handling events, and creating user-friendly interfaces.	L6
CO3	Analyze and manage database connectivity in Java applications using JDBC, including executing SQL queries, handling different types of ResultSets, and working with BLOB and CLOB data.	L4
CO4	Design and implement dynamic web applications using Servlets, JSP, and JavaBeans, incorporating session management, communication mechanisms, and reusable components for scalable web solutions.	L6

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	-	2	1
CO2	3	3	3	-	3	2
CO3	3	3	3	-	2	2
CO4	3	3	3	-	3	2

Unit I	**AWT:** Introduction, Components, Event-Delegation-Model, Listeners, Layouts, Individual components Label, Button, CheckBox, Radio Button, Choice, List, Menu, Text Field, Text Area **Swing:** Need for swing components, Difference between AWT and swing, Components hierarchy, Panes, Swing components: Jlabel, JTextField and JPasswordField, JTextAres, JButton, JCheckBox, JRadioButton, JComboBox and JList **JDBC:** Introduction, JDBC Architecture, Types of Drivers, Statement, ResultSet, Updatable ResultSet, Forward Only ResultSet, Scrollable ResultSet, PreparedStatement, BLOB & CLOB	**15** **[OC1, OC2, OC3]**
Unit II	**Servlets:** Introduction, Web application Architecture, Http Protocol & Http Methods, Web Server & Web Container, Servlet Interface, GenericServlet, HttpServlet, Servlet Life Cycle, ServletConfig, ServletContext, Servlet Communication, Session Tracking Mechanisms **JSP:** Introduction, JSP LifeCycle, JSP Implicit Objects & Scopes, JSP Directives, JSP Scripting Elements, JSP Actions: Standard actions and customized actions, **Java Beans:** Introduction, JavaBeans Properties, Examples	**15** **[OC1, OC2, OC4]**

References:

1) Cay S. Horstmann, Gary Cornell, Core Java™ 2: Volume II–Advanced Features Prentice Hall PTR,9th Edition
2) Herbert Schildt, Java2: The Complete Reference, Tata McGraw-Hill,5th Edition
3) Joe Wigglesworth and Paula McMillan, Java Programming: Advanced Topics, Thomson Course Technology (SPD) ,3rd Edition
4) Advanced Java Programming, Uttam K. Roy, Oxford University Press
5) *The Java Tutorials: http://docs.oracle.com/javase/tutorial/)*
6) The Java Tutorials of Sun Microsystems Inc

Course Code	Course Title	Credits	No. of lectures
24BUCS4T02	**Major: Computer Network – II**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Recognize basic elements of computer network and Transmission Media.	L1
CO2	Explain the Working of Data Link Layer, Network Layer and Transport Layer.	L2
CO3	Use protocols used in Data Link Layer, Network Layer and Transport Layer to configure network operations.	L3
CO4	Use fundamental underlying principles of computer networking	L3

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	-	-	-
CO2	3	2	2	-	-	-
CO3	3	3	3	-	2	-
CO4	3	2	2	-	1	-

Unit I	**Introduction to Data-Link Layer:** Introduction to Data-Link Layer, Nodes and Links, Services, Two Sub-layers, Three Types of addresses, Address Resolution Protocol (ARP). Error Detection and Correction, introduction, Types of Errors, Redundancy, Detection versus Correction,	**15** **[OC1, OC2, OC3]**
Unit II	**Network layer, Transport Layer** Media Access Control (MAC), random access, CSMA, CSMA/CD, CSMA/CA, controlled access, Reservation, Polling, Token Passing, channelization, FDMA, TDMA, CDMA. Connecting Devices and Virtual LANs, connecting devices, Hubs, Link-Layer, Switches, Routers, Introduction to Network Layer, network layer services, Packetizing, Routing and Forwarding, Other Services, IPv4 addresses, Address Space, Classful Addressing. Unicast Routing, General Idea, Least-Cost Routing, Routing Algorithms, Distance-Vector Routing, Link-State Routing, Path-Vector Routing, Introduction to Transport Layer, Transport-Layer Services, Connectionless and Connection-Oriented Protocols. Transport-Layer Protocols, Service, Port Numbers, User Datagram Protocol, User Datagram, UDP Services, UDP Applications, Transmission Control Protocol, TCP Services, TCP Features, Segment.	**15** **[OC2, OC3, OC4]**

References:

1) Data Communications and Networking, Behrouz A. Forouzan, Fifth Edition, TMH, 2013.
2) Computer Network, Andrew S. Tanenbaum, David J. Wetherall, 5th Ed, Pearson Education,2011.
3) Computer Network, Bhushan Trivedi, Oxford University Press
4) Data and Computer Communication, William Stallings, PHI

Course Code	Course Title	Credits	No. of lectures
24BUCS4T03	**Major: .NET Technologies**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Explain the fundamentals of .NET framework, C# programming and the architecture of ASP.NET web applications, including pages, controls, and application structure.	L5
CO2	Develop interactive & dynamic web applications using ASP.NET, implementing HTML server controls, web controls, state management techniques and validation mechanisms.	L6
CO3	Analyze & manage web application behavior through session management, view state, cross-page posting, site navigation techniques to ensure efficient & secure user interaction.	L4
CO4	Design and implement professional web applications using advanced ASP.NET features such as master pages, themes, rich controls, site maps, and URL routing for scalable and maintainable solutions.	L6

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	-	2	1
CO2	3	3	3	-	3	2
CO3	3	3	3	-	2	2
CO4	3	3	3	-	3	2

Unit I	**The .NET Framework:**.NET Languages, Common Language Runtime, .NET Class Library **C# Language Basics:** Comments, Variables and Data Types, Variable Operations, Object-Based Manipulation, Conditional Logic, Loops, Methods, Classes, Value Types and Reference Types, Namespaces and Assemblies, Inheritance, Static Members, Casting Objects, Partial Classes **ASP.NET:** Creating Websites, Anatomy of a Web Form - Page Directive, Doctype, Writing Code - Code-Behind Class, Adding Event Handlers, Anatomy of an ASP.NET Application - ASP.NET File Types, ASP.NET Web Folders, **HTML Server Controls** - View State, HTML Control Classes, HTML Control Events, HtmlControl Base Class, HtmlContainerControl Class, HtmlInputControl Class, Page Class, global.asax File, web.config File	**15** **[OC1, OC2, OC3]**
Unit II	**Web Controls:** Web Control Classes, WebControl Base Class, List Controls, Table Controls, Web Control Events and AutoPostBack, Page Life Cycle **State Management:** ViewState, Cross-Page Posting, Query String, Cookies, Session State, Configuring Session State, Application State **Validation:** Validation Controls, Server-Side Validation, Client-Side Validation, HTML5 Validation, Manual Validation, Validation with Regular Expressions **Rich Controls:** Calendar Control, AdRotator Control, MultiView Control **Themes and Master Pages:** How Themes Work, Applying a Simple Theme, Handling Theme Conflicts, Simple Master Page and Content Page, Connecting Master pages and Content Pages, Master Page with Multiple Content Regions, Master Pages and Relative Paths **Website Navigation:** Site Maps, URL Mapping and Routing, SiteMapPath Control, TreeView Control, Menu Control	**15** **[OC3, OC4]**

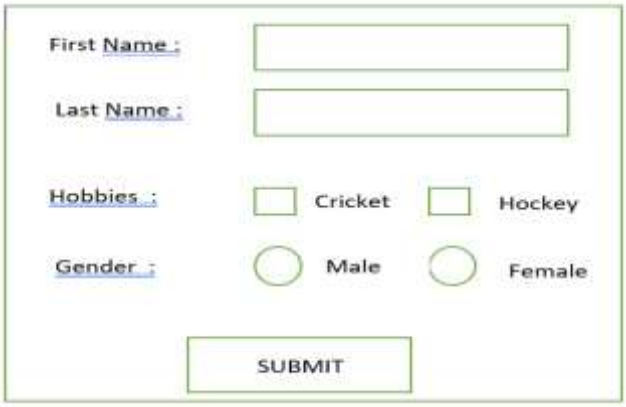
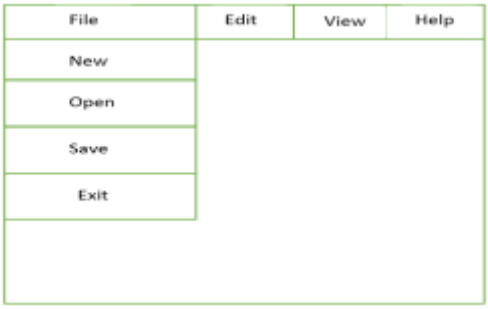
Reference Books:

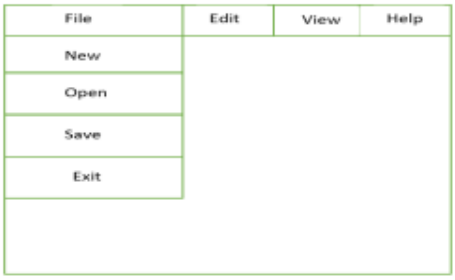
1) Beginning ASP.NET 4.5 in C#, Matthew MacDonald, Apress(2012)
2) The Complete Reference ASP .NET, MacDonald, Tata McGraw Hill
3) Beginning ASP.NET 4 in C# and VB ImarSpanajaars, WROX

Course Code	Course Title	Credits	No. of lectures
24BUCS4P01	**Practical Based on 24BUCS4T01**	**02**	**60**

Upon Completing the Course, Students will able to		
CO1	Develop Java-based GUI applications using AWT and Swing, implementing components, layouts, event handling, and basic logic for user interaction.	L6
CO2	Design and implement interactive desktop applications such as calculators, validation programs, and data-entry forms using Swing and AWT.	L6
CO3	Create dynamic web applications using JSP, utilizing intrinsic objects, validations, page navigation, and server-side scripting elements.	L6
CO4	Integrate database connectivity using JDBC in Servlets and JSP to perform data storage, retrieval, authentication, and registration functionalities.	L6

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	-	2	-
CO2	3	2	3	-	3	-
CO3	3	2	3	-	2	1
CO4	3	3	3	-	2	2

Practical 1	Write a Java AWT Program to Create following output. 
Practical 2	Write a Java AWT Program to Create following output. 
Practical 3	Write a AWT Program to Find Entered Number is Even or Odd.
Practical 4	Design a calculator based on AWT application.
Practical 5	Write AWT Program to create 3 Buttons “Red”, ”Green” and “Blue” Which when clicked Background color of window should get changed with respective color.
Practical 6	Design a Swing program to print the factorial for an input value.
Practical 7	Design a calculator based on Swing application.

Practical 8	Write a Java Swing Program to Create following output. 
Practical 9	Write a Java Swing Program to Create following output. 
Practical 10	Design an Swing application that contains the interface to add student information and display the same.
Practical 11	Write a JAVA Swing Program to Find Entered Number is Prime Number or Not?
Practical 12	Create a simple calculator application using servlet.
Practical 13	Create a servlet for a login page. If the username and password are correct then it says message “Hello <username>” else a message “login failed”
Practical 14	Create a simple servlet application to find entered value is Even or Odd.
Practical 15	Write a servlet to determine whether the entered name from the HTML form is palindrome or not.
Practical 16	Write a Servlet program to print all the even numbers between the two entered numbers by the user, let say user enters 5 and 500 , so print the even numbers between 5 and 500
Practical 17	Write a servlet program to redirect the request to another servlet which requires a String as the parameter and the other servlet converts the string to lower case.
Practical 18	Design suitable database for Library Management System.
Practical 19	Create a registration servlet in Java using JDBC. Accept the details such as Username, Password, Email, and Country from the user using HTML Form and store theregistration details in the database.
Practical 20	Develop Simple Servlet Question Answer (Quiz) Application.
Practical 21	Using Request Dispatcher Interface create a Servlet which will validate the passwordentered by the user, if the user has entered "Servlet" as password, then he will be forwarded to Welcome Servlet else the user will stay on the index.html page and anerror message will be displayed.
Practical 22	Create a simple calculator application using JSP.
Practical 23	Write a JSP Program to accept a String and determine whether the String‟s length is greater than 6.
Practical 24	Develop a simple JSP application to display values obtained from the use of intrinsic objects of various types.
Practical 25	Design a JSP program to print the factorial for an input value.
Practical 26	Create a registration JSP application to register the userusing JDBC.
Practical 27	Create a login JSP application to authenticate the user based on username and password using JDBC.
Practical 28	Develop a simple JSP application to pass values from one page to another with validations. (Name-txt, age-txt, hobbies-checkbox, email-txt, gender-radio button).
Practical 29	Create a Currency Converter application using EJB.
Practical 30	Develop a Simple Room Reservation System Application Using EJB.

Course Code	Course Title	Credits	No. of lectures
24BUCS4P02	**Practical Based on 24BUCS4T03**	**02**	**60**

Upon Completing the Course, Students will able to		
CO1	Explain the fundamentals of .NET framework, C# programming and the architecture of ASP.NET web applications, including pages, controls, and application structure.	L5
CO2	Develop interactive & dynamic web applications using ASP.NET, implementing HTML server controls, web controls, state management techniques and validation mechanisms.	L6
CO3	Analyze & manage web application behavior through session management, view state, cross-page posting, site navigation techniques to ensure efficient & secure user interaction.	L4
CO4	Design and implement professional web applications using advanced ASP.NET features such as master pages, themes, rich controls, site maps, and URL routing for scalable and maintainable solutions.	L6

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	-	2	1
CO2	3	3	3	-	3	2
CO3	3	3	3	-	2	2
CO4	3	3	3	-	3	2

Practical 1	Write C# programs for understanding C# basics involving a. Variables and Data Types b. Object-Based Manipulation
Practical 2	Create an application that obtains four int values from the user and displays the product.
Practical 3	Write C# programs for understanding C# basics involving Loops
Practical 4	Write C# programs for understanding C# basics involving Conditional Logic
Practical 5	Create an application that receives the (Student Id, Student Name, Course Name, Date of Birth) information from a set of students. The application should also display the information of all the students once the data entered.
Practical 6	Create an application to demonstrate following operations i. Test for vowels. ii.Reverse a number and find sum of digits of a number.
Practical 7	Create an application to demonstrate following operations i. Generate Fibonacci series. ii. Test for prime numbers.
Practical 8	Create an application to demonstrate following operations i. Number Even or odd. ii. Value is Palindrome or not
Practical 9	Create an application to demonstrate string operations.
Practical 10	Write C# programs for understanding C# basics involving various Methods
Practical 11	Demonstrate the use of Calendar control to perform following operations. a) Display messages in a calendar control b) Display vacation in a calendar control c) Selected day in a calendar control using style d) Difference between two calendar dates
Practical 12	Create simple application to perform operation: Money Conversion
Practical 13	Create simple application to perform operation: Finding factorial Value
Practical 14	Create simple application to perform operation: Temperature Conversion
Practical 15	Create simple application to perform operation: Quadratic Equation
Practical 16	Write C# programs for Object oriented concepts of C# such as: a. Program using classes b .Constructor and Function Overloading
Practical 17	Write C# programs for Object oriented concepts of C# such as: a. Inheritance b. Namespaces
Practical 18	Create simple application to demonstrate use of following concepts i. Inheritance (all types) ii. Interfaces
Practical 19	Create simple application to demonstrate use of following concept i. Using Delegates and events
Practical 20	Create simple application to demonstrate use of following concept i. Exception handling

Practical 21	Design ASP.NET Pages with various Server controls.
Practical 22	Design ASP.NET Pages with Web controls and demonstrate the use of AutoPostBack.
Practical 23	Design ASP.NET Pages with Rich Controls (Calendar / Ad Rotator)
Practical 24	Design ASP.NET page and perform validation using various Validation Controls
Practical 25	Design ASP.NET Pages for State Management using a. Cookies b. Session State c. Application State
Practical 26	Demonstrate the use of Treeview control perform following operations. a) Treeview control and datalist b) Treeview operations
Practical 27	Design an APS.NET master web page and use it other (at least 2-3) content pages.
Practical 28	Create a Registration form to demonstrate use of various Validation controls.
Practical 29	Create Web Form to demonstrate use of Website Navigation controls and Site Map.
Practical 30	Create a web application to demonstrate various states of ASP.NET Pages.

Course Code	Course Title	Credits	No. of lectures
24BUCS4T04	**Minor: Web Technologies**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Explain the fundamentals of the Internet, World Wide Web, web browsers, search engines, and protocols, including HTTP and DNS, and their role in web development.	L5
CO2	Develop and design web pages using HTML5, CSS, and multimedia elements, implementing structured layouts, tables, forms, and navigation for effective web applications.	L6
CO3	Analyze and apply client-side scripting using JavaScript, including operators, statements, objects, and events, to create interactive and responsive web pages.	L4
CO4	Design and implement complete web applications integrating HTML5, CSS, multimedia, and JavaScript functionalities, ensuring usability, interactivity, and accessibility for end-users.	L6

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	-	2	1
CO2	3	2	3	-	3	2
CO3	3	3	3	-	2	2
CO4	3	3	3	-	3	2

Unit I	**Internet and the World Wide Web:** What is Internet? Introduction to internet and its applications, E-mail, telnet, FTP, e-commerce, video conferencing, ebusiness. Internet service providers, domain name server, internet address, World Wide Web (WWW): World Wide Web and its evolution, uniform resource locator (URL), browsers – internet explorer, Netscape navigator, opera, Firefox, chrome, Mozilla. search engine, web saver – apache, IIS, proxy server, HTTP protocol **HTML5:** Introduction, Why HTML5? Formatting text by using tags, using lists and backgrounds, Creating hyperlinks and anchors. Style sheets, CSS formatting text using style sheets, formatting paragraphs using style sheets. **HTML5** Page layout and navigation: Creating navigational aids: planning site organization, creating text based navigation bar, creating graphics based navigation bar, creating graphical navigation bar, creating image map, redirecting to another URL, creating division based layouts: HTML5 semantic tags, creating divisions, creating HTML5 semantic layout, positioning and formatting divisions. **HTML5 Tables, Forms and Media:** Creating tables: creating simple table, specifying the size of the table, specifying the width of the column, merging table cells, using tables for page layout, formatting tables: applying table borders, applying background and foreground fills, changing cell padding, spacing and alignment, creating user forms: creating basic form, using check boxes and option buttons, creating lists, additional input types in HTML5, Incorporating sound and video: audio and video in HTML5, HTML multimedia basics, embedding video clips, incorporating audio on web page	**15** **[OC1, OC2, OC3]**
Unit II	**Java Script:** Introduction, Client-Side JavaScript, Server-Side JavaScript, JavaScript Objects, JavaScript Security, **Operators:** Assignment Operators, Comparison Operators, Arithmetic Operators, % (Modulus), ++(Increment), --(Decrement), -(Unary Negation), Logical Operators, Short-Circuit Evaluation, String Operators, Special Operators, ?: (Conditional operator), (Comma operator), delete, new, this, void **Statements:** Break, comment, continue, delete, do..while, export, for, for..in, function, if..else, import, labelled, return, switch, var, while, with. Core JavaScript (Properties and Methods of each): Array, Boolean, Date, Function, Math, Number, Object, String, regExp	**15** **[OC3, OC4]**

	Events and Event Handlers : General Information about Events, Defining Event Handlers, event, onAbort, onBlur, onChange, onClick, onDblClick, onDragDrop, onError, onFocus, onKeyDown, onKeyPress, onKeyUp, onLoad, onMouseDown, onMouseMove, onMouseOut, onMouseOver, onMouseUp, onMove, onReset, onResize, onSelect, onSubmit, onUnload	

References:

1. Web Design The Complete Reference by Thomas Powell, Tata McGraw Hill
2. HTML5 Step by Step FaitheWempen, Microsoft Press edition 2011
3. PHP 5.1 for Beginners by Ivan BayrossSharanam Shah, SPD – 2013
4. PHP Project for Beginners by SharanamShah, Vaishali Shah, SPD -2015
5. PHP 6 and MySQL Bible by Steve Suehring, Tim Converse, Joyce Park, Wiley-2009
6. Head First HTML 5 programming by Eric Freeman,O'Reilly- 2013
7. JavaScript 2.0: The Complete Reference by Thomas Powell and Fritz Schneider, Tata McGraw Hill-2 nd edition

Course Code	Course Title	Credits	No. of lectures
24BUCS4T05	**OE: Modern Cloud Computing**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Explain the fundamental concepts of cloud computing, characteristics, benefits, service models (IaaS, PaaS, SaaS), types of clouds, basic principles of distributed, parallel computing	L5
CO2	Analyze basic cloud operations using OpenStack, including CLI and API commands, tenant management, and quota configuration, to manage cloud resources effectively.	L4
CO3	Analyze cloud architecture and deployment strategies, evaluate different cloud models, and design scalable and efficient private cloud environments using OpenStack components.	L4
CO4	Design and implement a production-ready cloud environment using OpenStack, including controller, compute, networking, and storage deployment, and orchestrate applications using OpenStack Heat.	L6

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	-	-
CO2	3	2	3	-	2	1
CO3	3	3	3	1	2	1
CO4	3	3	3	1	3	2

Unit I	Introduction to Cloud Computing, Characteristics and benefits of Cloud Computing, Basic concepts of Distributed Systems, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing. Elements of Parallel Computing. Elements of Distributed Computing. Technologies for Distributed Computing. Cloud Computing Architecture. The cloud reference model. Infrastructure as a service. Platform as a service. Software as a service. Types of clouds.	15 [OC1, OC2]
Unit II	Introduction to OpenStack, OpenStack test-drive, Basic OpenStack operations, OpenStack CLI and APIs, Tenant model operations, Quotas, Private cloud building blocks, Controller deployment, Networking deployment, Block Storage deployment, Compute deployment, deploying and utilizing OpenStack in production environments, Building a production environment, Application orchestration using OpenStack Heat	15 [OC2, OC3, OC4]

References*:*

1) Mastering Cloud Computing, RajkumarBuyya, Christian Vecchiola, S ThamaraiSelvi, Tata McGraw Hill Education Private Limited, 2013

2) OpenStack in Action, V. K. CODY BUMGARDNER, Manning Publications Co, 2016

3) OpenStack Essentials, Dan Radez, PACKT Publishing, 2015

4) OpenStack Operations Guide, Tom Fifield, Diane Fleming, Anne Gentle, Lorin Hochstein, Jonathan Proulx, Everett Toews, and Joe Topjian, O'Reilly Media, Inc., 2014

5) https://www.openstack.org

Course Code	Course Title	Credits	No. of lectures
24BU4AEC05	AEC: Software Engineering – II	02	30

Upon Completing the Course, Students will able to		
CO1	Apply software development principles, concepts, and techniques to develop software	L3
CO2	Interpret the process of using theoretical and technical knowledge to develop systems	L2
CO3	Differentiate software development practices that contribute to maintainability across the lifecycle.	L4
CO4	Evaluate and justify project management strategies, including task sequencing, responsibility assignment, and schedule adaptation in response to project risks.	L5

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	-	2	1
CO2	3	2	2	-	3	1
CO3	3	3	2	-	2	2
CO4	3	3	2	-	3	2

Unit I	**Project Management** Software Project Management, Management activities, Project Planning, Project Scheduling, Risk Management. **Quality Management:** Process and Product Quality, Quality assurance and Standards, Quality Planning, Quality Control, Software Measurement and Metrics. **Verification and Validation:** Planning Verification and Validation, Software Inspections, Automated Static Analysis, Verification and Formal Methods. **Software Testing:** System Testing, Component Testing, Test Case Design, Test Automation. **Software Measurement**: Size-Oriented Metrics, Function-Oriented Metrics, Extended Function Point Metrics	15 [OC1, OC2, OC3]
Unit II	**Software Cost Estimation:**Software Productivity, Estimation Techniques, Algorithmic Cost Modelling, Project Duration and Staffing **Process Improvement:** Process and product quality, Process Classification, Process Measurement, Process Analysis and Modeling, Process Change, The CMMI Process Improvement Framework. **Service Oriented Software Engineering:** Services as reusable components, Service Engineering, Software Development with Services. **Software reuse:** The reuse landscape, Application frameworks, Software product lines, COTS product reuse. **Distributed software engineering**: Distributed systems issues, Client–server computing, Architectural patterns for distributed systems, Software as a service	15 [OC3, OC4]

References:

1.Software Engineering, edition, Ian Somerville, Pearson Education, Ninth Edition
2.Software Engineering, Pankaj Jalote, Narosa Publication
3.Software engineering, a practitioner's approach, Roger Pressman, Tata Mcgraw-hill, 7th Edition

Course Code	Course Title	Credits	No. of lectures
24BU4VSC03	**VSC: Introduction to Android Programming**	**02**	**30**

Upon Completing the Course, Students will able to		
CO1	Explain the fundamentals of Android application development, including Android architecture, components, activities, intents, and the activity lifecycle.	L5
CO2	Develop Android applications using basic and advanced UI components, layouts, menus, RecyclerView, and material design principles to create interactive and user-friendly interfaces.	L6
CO3	Analyze and implement data storage and retrieval mechanisms in Android applications using SharedPreferences, SQLite, ContentProviders, loaders, and cloud services like Firebase, ensuring performance and security.	L4
CO4	Design, implement, and publish complete Android applications incorporating background services, notifications, broadcast receivers, asynchronous tasks, and ad integration for real-world usage.	L6

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	-	-	-
CO2	3	2	3	-	2	1
CO3	3	3	3	-	2	2
CO4	3	3	3	-	3	2

Unit I	Introduction to Android, Obtaining the required tools, creating first android app, understanding the components of screen, adapting display orientation, action bar, Activities and Intents, Activity Lifecycle and Saving State, Basic Views: TextView, Button, ImageButton, EditText, CheckBox, ToggleButton, RadioButton, and RadioGroup Views, ProgressBar View, AutoCompleteTextView, TimePicker View, DatePicker View, ListView View, Spinner View	**15** **[OC1, OC2]**
Unit II	User Input Controls, Menus, Screen Navigation, RecyclerView, Drawables, Themes and Styles, Material design, Providing resources for adaptive layouts, AsyncTask and AsyncTaskLoader, Connecting to the Internet, Broadcast receivers, Services, Notifications, Alarm managers, Transferring data efficiently Data - saving, retrieving, and loading: Overview to storing data, Shared preferences, SQLite primer, store data using SQLite database, ContentProviders, loaders to load and display data, Permissions, performance and security, Firebase and AdMob, Publish your app	**15** **[OC3, OC4]**

Reference Books:

1) "Beginning Android 4 Application Development", Wei-Meng Lee, March 2012, WROX.
2) https://developers.google.com/training/courses/android-fundamentals
3) https://www.gitbook.com/book/google-developer-training/android-developer-fundamentals-course-practicals/details

Course Code	Course Title	Credits	No. of
24BUCS4P03	**Mini Project and Documentation / Research Article**	**02**	**lectures**

Upon Completing the Course, Students will able to		
CO1	Identify the problem to solve and meet its requirements	L2
CO2	Understand concepts of Project and Project Management	L2
CO3	Examine project planning techniques applied in Industrial In-Plant training	L4
CO4	Develop interest towards research-oriented field with ability to search the literature and brief report preparation.	L6

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1	-	2	1
CO2	3	2	1	-	2	1
CO3	3	3	1	-	3	1
CO4	2	3	2	-	1	2

Annexure 1 : Project Guidelines
Annexure 2 : Research Paper/ Article Guidelines

Annexure 1 : Project Guidelines

Guidelines to Prepare-Mini-Project

This document provides guide lines for writing and evaluating the technical specifications for a B.Sc. IT Mini project.

Writing the specification

The purpose of the technical specification is to provide specific information about how the project will be carried out with details about the products that will be delivered. The technical specification should include the following sections.

FrontPage

Page1 Title page
Page2 Certificate from External Guide / Organization
Page3 Acknowledgement
Page4 Contents
Page5 Abstract

1. Introduction

Define the "Problem"
Objectives
Purpose
Scope
Advantages
Applicability

2. Survey of Technology

3. Gantt Chart, Hardware and Software Requirements

4. **System Design**

Basic Modules

Data Design (if applicable)

Logic Diagrams

- Class Diagram
- Use case Diagram
- ER Diagram

5. **Implementation and Testing**

Coding

Testing

6. **Results**
7. **Conclusion**
8. **REFERENCES/BIBLIOGRAPHY**

1. Author Name, Title of Paper/Book, Publisher's Name, Year of publication
2. Full URL Address

Typing and Binding of Research Project Report Font

1. Chapter Names - 16TIMESNEWROMAN(Bold)All Caps
2. Headings - 14TIMESNEWROMAN(Bold)All Caps
3. Subheadings - 14TIMESNEWROMAN(Bold)Title Case
4. Sub–Sub Headings- 12TIMESNEWROMAN(Bold)Title Case
5. Body of Project - 12TIMESNEWROMAN
6. Text in Diagrams - 12TIMESNEWROMAN(All Lower Case)
7. Diagrams/Table Headings/Fig.Headings-12'TIMESNEWROMANTitleCase
8. If Any Text 12'TIMESNEWROMAN(Title Case)

Spacing

1. Two(2)Line Spacing between Heading and Body Text.
2. LineSpacingInBodyTextshouldbe1.5
3. New Paragraphs Start With Single Tab.

Margins

Left1.5' Right1.0'

Top1.0' Bottom1.0'

Page Numbers

Position Bottom, Middle

1. FrontPages Small Roman Numbers

(Excluding Title Page, Certificate Page, Acknowledgement Page)

2. Body Pages 1,2,3…….

3.Annexure 1,2,3……..

(Separate For Each Annexure)

Size:A4 Paper **Color:** White

Documentation: Spiral Binding

Project Report Should Not Exceed More Than 25-to-30 Pages

Annexure 2 :
Research Paper/ Article Guidelines

Article title

Author Name[1], Author Name[2], Author Name[3]
[1]University/College Name, Department, Street Address, City, Country, Postal Code
Company Name, Street Address, City, Country, Postal Code
~~Email:~~~~xxx@xxx.xxx[1]xxx@xxx.xxx[2]xxx@xxx.xxx[2]~~

Abstract

Sample text inserted for illustration. Replace with abstract text. Your abstract should give readers a brief summary of your article. It should concisely describe the contents of your article, and include key terms. It should be informative, accessible and not only indicate the general scope of the article but also state the main results obtained and conclusions drawn. The abstract should be complete in itself; it should not contain undefined abbreviations and no table numbers, figure numbers, references or equations should be referred to. It should be suitable for direct inclusion in abstracting services and should not normally be more than 300 words.

Keywords: optics, photonics, light, lasers, templates, journals.

1. Introduction

2. Litreature Review

3. Statement of Problem (Optional)

4. Experimental Techniques / Research Methodology

5. Figures and Tables (Data analysis Or Interpretation of Data)

5.1 Figures

Figures are numbered in the order in which they are called out in the text. Figures should be embedded in the manuscript for the initial submission; individual figure files will be requested for the first revision in .tif, .eps, .png, or PDF format. We cannot accept application files (e.g., Corel Draw, Microsoft PowerPoint, etc.). All figure parts must be labeled (a), (b), etc. Each figure file should contain all parts of the figure.

6. Results and Discussions

7. Recommendation

8. Conclusion

References

1. M. Gómez and M. Lazzari, *Materials Today* **17**, 358 (2014).
2. J. S. Huang, V. Callegari, P. Geisler, and B. Hecht, *Nature Communications***1**, 150, (2010)
3. S. D. George, U. Ladiwala, J. Thomas, A. Bankapur, S. Chidangil, and D. Mathur, *Appl. Surface Sci.***305**, 375 (2014).

Evaluation and Examination Scheme

Evaluation Scheme 30:20
Internals Based on Unit 1 / Unit 2 / Unit 3/ Unit 4

Assignments/ Tutorials/Class Test	Seminar or any other activities	Active Participation & Leadership qualities	Total
10	05	05	20

Suggested Format for Mandatory Question paper

Duration: 1.30Hours **Total Marks: 30**

N. B.: 1. All the questions are compulsory
2. Figures to the right indicate full marks.
3. Answer to the same question must be written together.
4.Use of non-programmable calculator is allowed.

Q.1 **Attempt any Two** **8**
(A)
(B)
(C)
(D)

Q.2 **(A)** **Attempt any One** **4**
i)
ii)
(B) **Attempt any One** **3**
i)
ii)

Q.3 **Attempt any Two** **8**
(A)
(B)
(C)
(D)

Q.4 **(A)** **Attempt any One** **4**
i)
ii)
(B) **Attempt any One** **3**
i)
ii)

Semester End Practical Examination:
Practical examination of each paper for 50 marks will be held for 2 or 3 hours.

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VPM's B. N. Bandodkar College of Science (Autonomous), Thane

Curriculum Structure for the Undergraduate Degree Programme S.Y.B.Sc. Computer Science

	Course Code	SEMESTER–III	Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)			Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)			
		Course Title	EM	EN	SD	PE	GE	HV	ES
Major	24BUCS3T01	Core Java	√		√				
	24BUCS3T02	Computer Network – I	√	√	√				
	24BUCS3T03	Advanced Database Management System	√	√	√				
	24BUCS3P01	Practical Based on 24BUCS3T01	√	√	√				
	24BUCS3P02	Practical Based on 24BUCS3T03	√	√	√				
MN	24BUCS3T04	Theory of Computation			√				
OE	24BUCS3T05	Virtualization	√	√	√				
AEC	24BU3AEC05	Software Engineering – I	√	√	√				
VSC	24BU3VSC05	Google Workspace	√	√	√				
SEC	24BU3SEC08	Public Administration				√	√		
CC					√			√	

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		Course Title	EM	EN	SD	PE	GE	HV	ES
Major	24BUCS4T01	Advanced JAVA	√	√	√				
	24BUCS4T02	Computer Network – II	√	√	√				
	24BUCS4T03	.NET Technologies	√	√	√				
	24BUCS4P01	Practical Based on 24BUCS4T01	√	√	√				
	24BUCS4P02	Practical Based on 24BUCS4T03	√	√	√				
MN	24BUCS4T04	Web Technologies	√	√	√				
OE	24BUCS4T05	Modern Cloud Computing	√	√	√				
AEC	24BU4AEC06	Software Engineering – II	√	√	√				
VSC	24BU4VSC03	Introduction to Android Programming	√	√	√				
FP	24BUCS4P03	Mini Project and Documentation / Research Article	√	√	√	√	√		
CC					√			√	

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