

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**CHOICE BASED CREDIT SYSTEM (CBCS)**  
**SCHEME OF TEACHING AND EXAMINATION 2015-2016**

**B.E. Computer Science & Engineering/ B.E. Information Science & Engineering**

**III SEMESTER**

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination			Credits	
			Theory	Practical/ Drawing	Duration	Theory/ Practical Marks	I.A. Marks		Total Marks
1	15MAT31	Engineering Mathematics - III	04	--	03	80	20	100	4
2	15CS32	Analog and Digital Electronics	04	--	03	80	20	100	4
3	15CS33	Data Structures and Applications	04	--	03	80	20	100	4
4	15CS34	Computer Organization	04	--	03	80	20	100	4
5	15CS35	Unix and Shell Programming	04	--	03	80	20	100	4
6	15CS36	Discrete Mathematical Structures	04	--	03	80	20	100	4
7	15CSL37	Analog and Digital Electronics Laboratory	--	1I+2P	03	80	20	100	2
8	15CSL38	Data Structures Laboratory	--	1I+2P	03	80	20	100	2
<b>TOTAL</b>			<b>24</b>	<b>6</b>	<b>24</b>	<b>640</b>	<b>160</b>	<b>800</b>	<b>28</b>

Note: 'I' Stands for Instruction Hours and 'P' for practical Hours

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**IV SEMESTER**

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination			Credits	
			Theory	Practical/ Drawing	Duration	Theory/ Practical Marks	I.A. Marks		Total Marks
1	15MAT41	Engineering Mathematics - IV	04	--	03	80	20	100	4
2	15CS 42	Software Engineering	04	--	03	80	20	100	4
3	15CS43	Design and Analysis of Algorithms	04	--	03	80	20	100	4
4	15CS 44	Microprocessors and Microcontrollers	04	--	03	80	20	100	4
5	15CS45	Object Oriented Concepts	04	--	03	80	20	100	4
6	15CS46	Data Communication	04	--	03	80	20	100	4
7	15CSL47	Design and Analysis of Algorithm Laboratory	--	1I+2P	03	80	20	100	2
8	15CSL48	Microprocessors Laboratory	--	1I+2P	03	80	20	100	2
<b>TOTAL</b>			<b>24</b>	<b>06</b>	<b>24</b>	<b>640</b>	<b>160</b>	<b>800</b>	<b>28</b>

Note: 'I' Stands for Instruction Hours and 'P' for practical Hours

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**V SEMESTER**

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination			Credits	
			Theory	Practical/ Drawing	Duration	Theory/ Practical Marks	I.A. Marks		Total Marks
1	15CS51	Management and Entrepreneurship for IT Industry	04	--	03	80	20	100	4
2	15CS52	Computer Networks	04	--	03	80	20	100	4
3	15CS53	Database Management System	04	--	03	80	20	100	4
4	15CS54	Automata theory and Computability	04	--	03	80	20	100	4
5	15CS55x	Professional Elective 1	03	--	03	80	20	100	3
6	15CS56x	Open Elective 1	03	--	03	80	20	100	3
7	15CSL57	Computer Network Laboratory	--	1I+2P	03	80	20	100	2
8	15CSL58	DBMS Laboratory with mini project	--	1I+2P	03	80	20	100	2
<b>TOTAL</b>			<b>22</b>	<b>6</b>	<b>24</b>	<b>640</b>	<b>160</b>	<b>800</b>	<b>26</b>

<b>Professional Elective 1</b>	
15CS551	Object Oriented Modeling and Design
15CS552	Introduction to Software Testing
15CS553	Advanced JAVA and J2EE
15CS554	Advanced Algorithms

1. **Professional Elective:** Electives relevant to chosen specialization / branch
2. **Open Elective:** Electives from other technical and/or emerging subject areas (Announced separately)

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**VI SEMESTER**

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination			Credits	
			Theory	Practical/ Drawing	Duration	Theory/ Practical Marks	I.A. Marks		Total Marks
1	15CS61	Cryptography, Network Security and Cyber Law	04	--	03	80	20	100	4
2	15CS62	Computer Graphics and Visualization	04	--	03	80	20	100	4
3	15CS63	System Software and Compiler Design	04	--	03	80	20	100	4
4	15CS64	Operating Systems	04	--	03	80	20	100	4
5	15CS65x	Professional Elective 2	03	--	03	80	20	100	3
6	15CS66x	Open Elective 2	03	--	03	80	20	100	3
7	15CSL67	System Software and Operating System Laboratory	--	1I+2P	03	80	20	100	2
8	15CSL68	Computer Graphics Laboratory with mini project	--	1I+2P	03	80	20	100	2
<b>TOTAL</b>			<b>22</b>	<b>6</b>	<b>24</b>	<b>640</b>	<b>160</b>	<b>800</b>	<b>26</b>

<b>Professional Elective 2</b>	
15CS651	Data Mining and Data Warehousing
15CS652	Software Architecture and Design Patterns
15CS653	Operations research
15CS654	Distributed Computing system

1. **Professional Elective: Electives relevant to chosen specialization / branch**
2. **Open Elective: Electives from other technical and/or emerging subject areas (Announced separately)**

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VII SEMESTER

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination			Credits	
			Theory	Practical/ Drawing	Duration	I.A. Marks	Theory/ Practical Marks		Total Marks
1	15CS71	Web Technology and its applications	04	--	03	20	80	100	4
2	15CS72	Advanced Computer Architectures	04	--	03	20	80	100	4
3	15CS73	Machine Learning	04	--	03	20	80	100	4
4	15CS74x	Professional Elective 3	03	--	03	20	80	100	3
5	15CS75x	Professional Elective 4	03	--	03	20	80	100	3
6	15CSL76	Machine Learning Laboratory	--	1I+2P	03	20	80	100	2
7	15CSL77	Web Technology Laboratory with mini project	--	1I+2P	03	20	80	100	2
8	15CSP78	Project Phase 1 + Seminar	--	--	--	100	--	100	2
<b>TOTAL</b>			18	6	21	240	560	800	24

Professional Elective 3		Professional Elective 4	
15CS741	Natural Language Processing	15CS751	Soft and Evolutionary Computing
15CS742	Cloud Computing and its Applications	15CS752	Computer Vision and Robotics
15CS743	Information and Network Security	15CS753	Digital Image Processing
15CS744	Unix System Programming	15CS754	Storage Area Networks

1. Professional Elective: Electives relevant to chosen specialization / branch
2. Project Phase 1 + Seminar : Literature Survey, Problem Identification, Objectives and Methodology, Submission of Synopsis and Seminar

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B.E. Computer Science & Engineering  
 VIII SEMESTER

Sl. No	Subject Code	Title	Teaching Hours /Week		Examination			Credits	
			Theory	Practical/ Drawing	Duration	I.A. Marks	Theory/ Practical Marks		Total Marks
1	15CS81	Internet of Things and Applications	4	--	3	20	80	100	4
2	15CS82	Big Data Analytics	4	--	3	20	80	100	4
3	15CS83x	Professional Elective 5	3	--	3	20	80	100	3
4	15CS84	Internship / Professional Practice	Industry Oriented		3	50	50	100	2
5	15CSP85	Project work phase II	--	6	3	100	100	200	5
6	15CSS86	Seminar	--	4	--	100	--	100	2
<b>TOTAL</b>			11	10	15	310	390	700	20

Professional Elective 5	
15CS831	High Performance Computing
15CS832	User Interface Design
15CS833	Network management
15CS834	System Modeling and Simulation

1. Professional Elective: Electives relevant to chosen specialization / branch
2. Internship / Professional Practice: To be carried out between 6<sup>th</sup> and 7<sup>th</sup> semester vacation or 7<sup>th</sup> and 8<sup>th</sup> semester vacation period

<b>PROGRAMMING IN JAVA</b> <b>[As per Choice Based Credit System (CBCS) scheme]</b> <b>(Effective from the academic year 2016 -2017)</b> <b>SEMESTER – V</b>			
Subject Code	15CS561	IA Marks	20
Number of Lecture Hours/Week	3	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
<b>CREDITS – 03</b>			
<b>Course objectives:</b> This course will enable students to			
<ul style="list-style-type: none"> <li>• Learn fundamental features of object oriented language and JAVA</li> <li>• Set up Java JDK environment to create, debug and run simple Java programs.</li> <li>• Learn object oriented concepts using programming examples.</li> <li>• Study the concepts of importing of packages and exception handling mechanism.</li> <li>• Discuss the String Handling examples with Object Oriented concepts.</li> </ul>			
<b>Module – 1</b>			<b>Teaching Hours</b>
An Overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries, Data Types, Variables, and Arrays: Java Is a Strongly Typed Language, The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, A Closer Look at Literals, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, A Few Words About Strings <b>Text book 1: Ch 2, Ch 3</b>			<b>8 Hours</b>
<b>Module – 2</b>			
Operators: Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses, Control Statements: Java’s Selection Statements, Iteration Statements, Jump Statements. <b>Text book 1: Ch 4, Ch 5</b>			<b>8 Hours</b>
<b>Module – 3</b>			
Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection, The finalize( ) Method, A Stack Class, A Closer Look at Methods and Classes: Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Recursion, Introducing Access Control, Understanding static, Introducing final, Arrays Revisited, Inheritance: Inheritance, Using super, Creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, The Object Class. <b>Text book 1: Ch 6, Ch 7.1-7.9, Ch 8.</b>			<b>8 Hours</b>
<b>Module – 4</b>			
Packages and Interfaces: Packages, Access Protection, Importing Packages, Interfaces, Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java’s Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Using Exceptions. <b>Text book 1: Ch 9, Ch 10</b>			<b>8 Hours</b>

<b>Module – 5</b>	
Enumerations, Type Wrappers, I/O, Applets, and Other Topics: I/O Basics, Reading Console Input, Writing Console Output, The PrintWriter Class, Reading and Writing Files, Applet Fundamentals, The transient and volatile Modifiers, Using instanceof, strictfp, Native Methods, Using assert, Static Import, Invoking Overloaded Constructors Through this( ), String Handling: The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf( ), Changing the Case of Characters Within a String , Additional String Methods, StringBuffer, StringBuilder.	<b>8 Hours</b>
<b>Text book 1: Ch 12.1,12.2, Ch 13, Ch 15</b>	
<b>Course outcomes:</b> The students should be able to:	
<ul style="list-style-type: none"> <li>• Explain the object-oriented concepts and JAVA.</li> <li>• Develop computer programs to solve real world problems in Java.</li> <li>• Develop simple GUI interfaces for a computer program to interact with users</li> </ul>	
<b>Question paper pattern:</b>	
The question paper will have TEN questions. There will be TWO questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer FIVE full questions, selecting ONE full question from each module.	
<b>Text Books:</b>	
1. Herbert Schildt, Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007. (Chapters 2, 3, 4, 5, 6,7, 8, 9,10, 12,13,15)	
<b>Reference Books:</b>	
<ol style="list-style-type: none"> <li>1. Mahesh Bhavne and Sunil Patekar, "Programming with Java", First Edition, Pearson Education,2008, ISBN:9788131720806.</li> <li>2. Rajkumar Buyya,S Thamarasi selvi, xingchen chu, Object oriented Programming with java, Tata McGraw Hill education private limited.</li> <li>3. E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies.</li> <li>4. Anita Seth and B L Juneja, JAVA One step Ahead, Oxford University Press, 2017.</li> </ol>	



<b>ARTIFICIAL INTELLIGENCE</b> <b>[As per Choice Based Credit System (CBCS) scheme]</b> <b>(Effective from the academic year 2016 -2017)</b> <b>SEMESTER – V</b>			
Subject Code	15CS562	IA Marks	20
Number of Lecture Hours/Week	3	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
<b>CREDITS – 03</b>			
<b>Course objectives:</b> This course will enable students to			
<ul style="list-style-type: none"> <li>• Identify the problems where AI is required and the different methods available</li> <li>• Compare and contrast different AI techniques available.</li> <li>• Define and explain learning algorithms</li> </ul>			
<b>Module – 1</b>			<b>Teaching Hours</b>
What is artificial intelligence?, Problems, Problem Spaces and search, Heuristic search technique <b>TextBook1: Ch 1, 2 and 3</b>			<b>8 Hours</b>
<b>Module – 2</b>			
<b>Knowledge Representation Issues, Using Predicate Logic, Representing knowledge using Rules,</b> <b>TextBook1: Ch 4, 5 and 6.</b>			<b>8 Hours</b>
<b>Module – 3</b>			
Symbolic Reasoning under Uncertainty, Statistical reasoning, Weak Slot and Filter Structures. <b>TextBook1: Ch 7, 8 and 9.</b>			<b>8 Hours</b>
<b>Module – 4</b>			
Strong slot-and-filler structures, Game Playing. <b>TextBook1: Ch 10 and 12</b>			<b>8 Hours</b>
<b>Module – 5</b>			
Natural Language Processing, Learning, Expert Systems. <b>TextBook1: Ch 15,17 and 20</b>			<b>8 Hours</b>
<b>Course outcomes:</b> The students should be able to:			
<ul style="list-style-type: none"> <li>• Identify the AI based problems</li> <li>• Apply techniques to solve the AI problems</li> <li>• Define learning and explain various learning techniques</li> <li>• Discuss on expert systems</li> </ul>			
<b>Question paper pattern:</b>			
The question paper will have TEN questions. There will be TWO questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer FIVE full questions, selecting ONE full question from each module.			
<b>Text Books:</b>			
1. E. Rich , K. Knight & S. B. Nair - Artificial Intelligence, 3/e, McGraw Hill.			
<b>Reference Books:</b>			
1. Artificial Intelligence: A Modern Approach, Stuart Rusell, Peter Norving, Pearson Education 2nd Edition.			

1. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems – Prentice Hal of India.
2. G. Luger, “Artificial Intelligence: Structures and Strategies for complex problem Solving”, Fourth Edition, Pearson Education, 2002.
3. Artificial Intelligence and Expert Systems Development by D W Rolston-Mc Graw hill.
4. N.P. Padhy “Artificial Intelligence and Intelligent Systems” , Oxford University Press-2015

<b>EMBEDDED SYSTEMS</b> <b>[As per Choice Based Credit System (CBCS) scheme]</b> <b>(Effective from the academic year 2016 -2017)</b> <b>SEMESTER – V</b>			
Subject Code	15CS563	IA Marks	20
Number of Lecture Hours/Week	3	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
<b>CREDITS – 03</b>			
<b>Course objectives:</b> This course will enable students to			
<ul style="list-style-type: none"> <li>• Provide a general overview of Embedded Systems</li> <li>• Show current statistics of Embedded Systems</li> <li>• Design, code, compile, and test real-time software</li> <li>• Integrate a fully functional system including hardware and software.</li> </ul>			
<b>Module – 1</b>			<b>Teaching Hours</b>
<b>Introduction to embedded systems:</b> Embedded systems, Processor embedded into a system, Embedded hardware units and device in a system, Embedded software in a system, Examples of embedded systems, Design process in embedded system, Formalization of system design, Design process and design examples, Classification of embedded systems, skills required for an embedded system designer.			<b>8 Hours</b>
<b>Module – 2</b>			
<b>Devices and communication buses for devices network:</b> IO types and example, Serial communication devices, Parallel device ports, Sophisticated interfacing features in device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, Networked embedded systems, Serial bus communication protocols, Parallel bus device protocols-parallel communication internet using ISA, PCI, PCI-X and advanced buses, Internet enabled systems-network protocols, Wireless and mobile system protocols.			<b>8 Hours</b>
<b>Module – 3</b>			
<b>Device drivers and interrupts and service mechanism:</b> Programming-I/O busy-wait approach without interrupt service mechanism, ISR concept, Interrupt sources, Interrupt servicing (Handling) Mechanism, Multiple interrupts, Context and the periods for context switching, interrupt latency and deadline, Classification of processors interrupt service mechanism from Context-saving angle, Direct memory access, Device driver programming.			<b>8 Hours</b>
<b>Module – 4</b>			
<b>Inter process communication and synchronization of processes, Threads and tasks:</b> Multiple process in an application, Multiple threads in an application, Tasks, Task states, Task and Data, Clear-cut distinction between functions. ISRS and tasks by their characteristics, concept and semaphores, Shared data, Inter-process communication, Signal function, Semaphore functions, Message Queue functions, Mailbox functions, Pipe functions, Socket functions, RPC functions.			<b>8 Hours</b>
<b>Module – 5</b>			
<b>Real-time operating systems:</b> OS Services, Process management, Timer functions, Event functions, Memory management, Device, file and IO subsystems management, Interrupt routines in RTOS environment and handling of interrupt source calls, Real-time operating systems, Basic design using an RTOS, RTOS task scheduling models, interrupt latency and response of the tasks			<b>8 Hours</b>

as performance metrics, OS security issues. Introduction to embedded software development process and tools, Host and target machines, Linking and location software.	
<b>Course outcomes:</b> The students should be able to:	
<ul style="list-style-type: none"> <li>• Distinguish the characteristics of embedded computer systems.</li> <li>• Examine the various vulnerabilities of embedded computer systems.</li> <li>• Design and develop modules using RTOS.</li> <li>• Implement RPC, threads and tasks</li> </ul>	
<p><b>Question paper pattern:</b>  The question paper will have TEN questions.  There will be TWO questions from each module.  Each question will have questions covering all the topics under a module.  The students will have to answer FIVE full questions, selecting ONE full question from each module.</p>	
<b>Text Books:</b>	
<ol style="list-style-type: none"> <li>1. Raj Kamal, “Embedded Systems: Architecture, Programming, and Design” 2<sup>nd</sup> / 3<sup>rd</sup> edition , Tata McGraw hill-2013.</li> </ol>	
<b>Reference Books:</b>	
<ol style="list-style-type: none"> <li>1. Marilyn Wolf, “Computer as Components, Principles of Embedded Computing System Design” 3<sup>rd</sup> edition, Elsevier-2014.</li> </ol>	

<b>DOT NET FRAMEWORK FOR APPLICATION DEVELOPMENT</b> <b>[As per Choice Based Credit System (CBCS) scheme]</b> <b>(Effective from the academic year 2016 -2017)</b> <b>SEMESTER – V</b>			
Subject Code	15CS564	IA Marks	20
Number of Lecture Hours/Week	3	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
<b>CREDITS – 03</b>			
<b>Course objectives:</b> This course will enable students to			
<ul style="list-style-type: none"> <li>• Inspect Visual Studio programming environment and toolset designed to build applications for Microsoft Windows</li> <li>• Understand Object Oriented Programming concepts in C# programming language.</li> <li>• Interpret Interfaces and define custom interfaces for application.</li> <li>• Build custom collections and generics in C#</li> <li>• Construct events and query data using query expressions</li> </ul>			
<b>Module – 1</b>			<b>Teaching Hours</b>
<b>Introducing Microsoft Visual C# and Microsoft Visual Studio 2015:</b> Welcome to C#, Working with variables, operators and expressions, Writing methods and applying scope, Using decision statements, Using compound assignment and iteration statements, Managing errors and exceptions <b>T1: Chapter 1 – Chapter 6</b>			<b>8 Hours</b>
<b>Module – 2</b>			
<b>Understanding the C# object model:</b> Creating and Managing classes and objects, Understanding values and references, Creating value types with enumerations and structures, Using arrays <b>Textbook 1: Ch 7 to 10</b>			<b>8 Hours</b>
<b>Module – 3</b>			
Understanding parameter arrays, Working with inheritance, Creating interfaces and defining abstract classes, Using garbage collection and resource management <b>Textbook 1: Ch 11 to 14</b>			<b>8 Hours</b>
<b>Module – 4</b>			
<b>Defining Extensible Types with C#:</b> Implementing properties to access fields, Using indexers, Introducing generics, Using collections <b>Textbook 1: Ch 15 to 18</b>			<b>8 Hours</b>
<b>Module – 5</b>			
Enumerating Collections, Decoupling application logic and handling events, Querying in-memory data by using query expressions, Operator overloading <b>Textbook 1: Ch 19 to 22</b>			<b>8 Hours</b>
<b>Course outcomes:</b> The students should be able to:			
<ul style="list-style-type: none"> <li>• Build applications on Visual Studio .NET platform by understanding the syntax and semantics of C#</li> <li>• Demonstrate Object Oriented Programming concepts in C# programming language</li> <li>• Design custom interfaces for applications and leverage the available built-in interfaces in building complex applications.</li> <li>• Illustrate the use of generics and collections in C#</li> <li>• Compose queries to query in-memory data and define own operator behaviour</li> </ul>			
<b>Question paper pattern:</b>			

The question paper will have TEN questions.  
There will be TWO questions from each module.  
Each question will have questions covering all the topics under a module.  
The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. John Sharp, Microsoft Visual C# Step by Step, 8<sup>th</sup> Edition, PHI Learning Pvt. Ltd. 2016

**Reference Books:**

1. Christian Nagel, "C# 6 and .NET Core 1.0", 1st Edition, Wiley India Pvt Ltd, 2016.  
Andrew Stellman and Jennifer Greene, "Head First C#", 3rd Edition, O'Reilly Publications, 2013.
2. Mark Michaelis, "Essential C# 6.0", 5th Edition, Pearson Education India, 2016.
3. Andrew Troelsen, "Prof C# 5.0 and the .NET 4.5 Framework", 6th Edition, Apress and Dreamtech Press, 2012.

<b>CLOUD COMPUTING</b> <b>[As per Choice Based Credit System (CBCS) scheme]</b> <b>(Effective from the academic year 2016 -2017)</b> <b>SEMESTER – V</b>			
Subject Code	15CS565	IA Marks	20
Number of Lecture Hours/Week	3	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
<b>CREDITS – 03</b>			
<b>Course objectives:</b> This course will enable students to			
<ul style="list-style-type: none"> <li>• Explain the technology and principles involved in building a cloud environment.</li> <li>• Contrast various programming models used in cloud computing</li> <li>• Choose appropriate cloud model for a given application</li> </ul>			
<b>Module – 1</b>			<b>Teaching Hours</b>
Introduction ,Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments, Distributed Systems, Virtualization, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka Virtualization, Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology			<b>8 Hours</b>
<b>Module – 2</b>			<b>8 Hours</b>
Cloud Computing Architecture, Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Definition, Cloud Interoperability and Standards Scalability and Fault Tolerance Security, Trust, and Privacy Organizational Aspects Aneka: Cloud Application Platform, Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid Cloud Deployment Mode, Cloud Programming and Management, Aneka SDK, Management Tools			
<b>Module – 3</b>			<b>8 Hours</b>
Concurrent Computing: Thread Programming, Introducing Parallelism for Single Machine Computation, Programming Applications with Threads, What is a Thread?, Thread APIs, Techniques for Parallel Computation with Threads, Multithreading with Aneka, Introducing the Thread Programming Model, Aneka Thread vs. Common Threads, Programming Applications with Aneka Threads, Aneka Threads Application Model, Domain Decomposition: Matrix Multiplication, Functional Decomposition: Sine, Cosine, and Tangent. High-Throughput Computing: Task Programming, Task Computing,			

Characterizing a Task, Computing Categories, Frameworks for Task Computing, Task-based Application Models, Embarrassingly Parallel Applications, Parameter Sweep Applications, MPI Applications, Workflow Applications with Task Dependencies, Aneka Task-Based Programming, Task Programming Model, Developing Applications with the Task Model, Developing Parameter Sweep Application, Managing Workflows.	
<b>Module – 4</b>	
Data Intensive Computing: Map-Reduce Programming, What is Data-Intensive Computing?, Characterizing Data-Intensive Computations, Challenges Ahead, Historical Perspective, Technologies for Data-Intensive Computing, Storage Systems, Programming Platforms, Aneka MapReduce Programming, Introducing the MapReduce Programming Model, Example Application	<b>8 Hours</b>
<b>Module – 5</b>	
Cloud Platforms in Industry, Amazon Web Services, Compute Services, Storage Services, Communication Services, Additional Services, Google AppEngine, Architecture and Core Concepts, Application Life-Cycle, Cost Model, Observations, Microsoft Azure, Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance. Cloud Applications Scientific Applications, Healthcare: ECG Analysis in the Cloud, , Social Networking, Media Applications, Multiplayer Online Gaming.	<b>8 Hours</b>
<b>Course outcomes:</b> The students should be able to:	
<ul style="list-style-type: none"> <li>• Explain the concepts and terminologies of cloud computing</li> <li>• Demonstrate cloud frameworks and technologies</li> <li>• Define data intensive computing</li> <li>• Demonstrate cloud applications</li> </ul>	
<p><b>Question paper pattern:</b>  The question paper will have ten questions.  There will be 2 questions from each module.  Each question will have questions covering all the topics under a module.  The students will have to answer 5 full questions, selecting one full question from each module.</p>	
<p><b>Text Books:</b>  1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi Mastering Cloud. Computing McGraw Hill Education</p>	
<b>Reference Books:</b>	
NIL	



<b>MOBILE APPLICATION DEVELOPMENT</b> <b>[As per Choice Based Credit System (CBCS) scheme]</b> <b>(Effective from the academic year 2016 -2017)</b> <b>SEMESTER – VI</b>			
Subject Code	15CS661	IA Marks	20
Number of Lecture Hours/Week	3	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
<b>CREDITS – 03</b>			
<b>Course objectives:</b> This course will enable students to			
<ul style="list-style-type: none"> <li>• Learn to setup Android application development environment</li> <li>• Illustrate user interfaces for interacting with apps and triggering actions</li> <li>• Interpret tasks used in handling multiple activities</li> <li>• Identify options to save persistent application data</li> <li>• Appraise the role of security and performance in Android applications</li> </ul>			
<b>Module – 1</b>			<b>Teaching Hours</b>
Get started, Build your first app, Activities, Testing, debugging and using support libraries			<b>8 Hours</b>
<b>Module – 2</b>			
User Interaction, Delightful user experience, Testing your UI			<b>8 Hours</b>
<b>Module – 3</b>			
Background Tasks, Triggering, scheduling and optimizing background tasks			<b>8 Hours</b>
<b>Module – 4</b>			
All about data, Preferences and Settings, Storing data using SQLite, Sharing data with content providers, Loading data using Loaders			<b>8 Hours</b>
<b>Module – 5</b>			
Permissions, Performance and Security, Firebase and AdMob, Publish			<b>8 Hours</b>
<b>Course outcomes:</b> The students should be able to:			
<ul style="list-style-type: none"> <li>• Create, test and debug Android application by setting up Android development environment</li> <li>• Implement adaptive, responsive user interfaces that work across a wide range of devices.</li> <li>• Infer long running tasks and background work in Android applications</li> <li>• Demonstrate methods in storing, sharing and retrieving data in Android applications</li> <li>• Analyze performance of android applications and understand the role of permissions and security</li> <li>• Describe the steps involved in publishing Android application to share with the world</li> </ul>			
<b>Question paper pattern:</b>			
The question paper will have TEN questions.			
There will be TWO questions from each module.			
Each question will have questions covering all the topics under a module.			
The students will have to answer FIVE full questions, selecting ONE full question from each module.			
<b>Text Books:</b>			
1. Google Developer Training, "Android Developer Fundamentals Course – Concept Reference", Google Developer Training Team, 2017. <a href="https://www.gitbook.com/book/google-developer-training/android-developer-fundamentals-course-concepts/details">https://www.gitbook.com/book/google-developer-training/android-developer-fundamentals-course-concepts/details</a> (Download pdf file from the above link)			

**Reference Books:**

1. Erik Hellman, “Android Programming – Pushing the Limits”, 1<sup>st</sup> Edition, Wiley India Pvt Ltd, 2014.
2. Dawn Griffiths and David Griffiths, “Head First Android Development”, 1<sup>st</sup> Edition, O’Reilly SPD Publishers, 2015.
3. J F DiMarzio, “Beginning Android Programming with Android Studio”, 4<sup>th</sup> Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580
4. Anubhav Pradhan, Anil V Deshpande, “ Composing Mobile Apps” using Android, Wiley 2014, ISBN: 978-81-265-4660-2

<b>BIG DATA ANALYTICS</b> <b>[As per Choice Based Credit System (CBCS) scheme]</b> <b>(Effective from the academic year 2016 -2017)</b> <b>SEMESTER – VI</b>			
Subject Code	15CS662	IA Marks	20
Number of Lecture Hours/Week	4	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
<b>CREDITS – 03</b>			
<b>Course objectives:</b> This course will enable students to			
<ul style="list-style-type: none"> <li>• Interpret the data in the context of the business.</li> <li>• Identify an appropriate method to analyze the data</li> <li>• Show analytical model of a system</li> </ul>			
<b>Module – 1</b>			<b>Teaching Hours</b>
<b>Introduction to Data Analytics and Decision Making:</b> Introduction, Overview of the Book, The Methods, The Software, Modeling and Models, Graphical Models, Algebraic Models, Spreadsheet Models, Seven-Step Modeling Process. <b>Describing the Distribution of a Single Variable:</b> Introduction,Basic Concepts, Populations and Samples, Data Sets,Variables,and Observations, Types of Data, Descriptive Measures for Categorical Variables, Descriptive Measures for Numerical Variables, Numerical Summary Measures, Numerical Summary Measures with StatTools,Charts for Numerical Variables, Time Series Data, Outliers and Missing Values,Outliers,Missing Values, Excel Tables for Filtering,Sorting,and Summarizing. <b>Finding Relationships among Variables:</b> Introduction, Relationships among Categorical Variables, Relationships among Categorical Variables and a Numerical Variable, Stacked and Unstacked Formats, Relationships among Numerical Variables, Scatterplots, Correlation and Covariance, Pivot Tables.			<b>08 Hours</b>
<b>Module – 2</b>			
<b>Probability and Probability Distributions:</b> Introduction,Probability Essentials, Rule of Complements, Addition Rule, Conditional Probability and the Multiplication Rule, Probabilistic Independence, Equally Likely Events, Subjective Versus Objective Probabilities, Probability Distribution of a Single Random Variable, Summary Measures of a Probability Distribution, Conditional Mean and Variance, Introduction to Simulation. <b>Normal,Binormal,Poisson,and Exponential Distributions:</b> Introduction,The Normal Distribution, Continuous Distributions and Density Functions, The Normal Density,Standardizing:Z-Values,Normal Tables and Z-Values, Normal Calculations in Excel, Empirical Rules Revisited, Weighted Sums of Normal Random Variables, Applications of the Normal Random Distribution, The Binomial Distribution, Mean and Standard Deviation of the Binomial Distribution, The Binomial Distribution in the Context of Sampling, The Normal Approximation to the Binomial, Applications of the Binomial Distribution, The Poisson and Exponential Distributions, The Poisson Distribution, The Exponential Distribution.			<b>08 Hours</b>
<b>Module – 3</b>			
<b>Decision Making under Uncertainty:</b> Introduction,Elements of Decision Analysis, Payoff Tables, Possible Decision Criteria, Expected Monetary			<b>08 Hours</b>

<p>Value(EMY),Sensitivity Analysis, Decision Trees, Risk Profiles, The Precision Tree Add-In,Bayes' Rule, Multistage Decision Problems and the Value of Information, The Value of Information, Risk Aversion and Expected Utility, Utility Functions, Exponential Utility, Certainty Equivalents, Is Expected Utility Maximization Used?</p> <p><b>Sampling and Sampling Distributions:</b> Introduction, Sampling Terminology, Methods for Selecting Random Samples, Simple Random Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling, Multistage Sampling Schemes, Introduction to Estimation, Sources of Estimation Error, Key Terms in Sampling, Sampling Distribution of the Sample Mean, The Central Limit Theorem, Sample Size Selection, Summary of Key Ideas for Simple Random Sampling.</p>	
<p><b>Module – 4</b></p>	
<p><b>Confidence Interval Estimation:</b> Introduction, Sampling Distributions, The t Distribution, Other Sampling Distributions, Confidence Interval for a Mean, Confidence Interval for a Total, Confidence Interval for a Proportion, Confidence Interval for a Standard Deviation, Confidence Interval for the Difference between Means, Independent Samples, Paired Samples, Confidence Interval for the Difference between Proportions, Sample Size Selection, Sample Size Selection for Estimation of the Mean, Sample Size Selection for Estimation of Other Parameters.</p> <p><b>Hypothesis Testing:</b>Introduction,Concepts in Hypothesis Testing, Null and Alternative Hypothesis, One-Tailed Versus Two-Tailed Tests, Types of Errors, Significance Level and Rejection Region, Significance from p-values, Type II Errors and Power, Hypothesis Tests and Confidence Intervals, Practical versus Statistical Significance, Hypothesis Tests for a Population Mean, Hypothesis Tests for Other Parameters, Hypothesis Tests for a Population Proportion, Hypothesis Tests for Differences between Population Means, Hypothesis Test for Equal Population Variances, Hypothesis Tests for Difference between Population Proportions, Tests for Normality, Chi-Square Test for Independence.</p>	<p><b>08 Hours</b></p>
<p><b>Module – 5</b></p>	
<p><b>Regression Analysis:</b> Estimating Relationships: Introduction, Scatterplots : Graphing Relationships, Linear versus Nonlinear Relationships,Outliers,Unequal Variance, No Relationship,Correlations:Indications of Linear Relationships, Simple Linear Regression, Least Squares Estimation, Standard Error of Estimate, The Percentage of Variation Explained:R-Square,Multiple Regression, Interpretation of Regression Coefficients, Interpretation of Standard Error of Estimate and R-Square, Modeling Possibilities, Dummy Variables, Interaction Variables, Nonlinear Transformations, Validation of the Fit.</p> <p><b>Regression Analysis:</b> Statistical Inference:Introduction,The Statistical Model, Inferences About the Regression Coefficients, Sampling Distribution of the Regression Coefficients, Hypothesis Tests for the Regression Coefficients and p-Values, A Test for the Overall Fit: The ANOVA Table,Multicollinearity,Include/Exclude Decisions, Stepwise Regression,Outliers,Violations of Regression Assumptions,Nonconstant Error Variance,Nonnormality of Residuals,Autocorrelated Residuals ,Prediction.</p>	<p><b>08 Hours</b></p>
<p><b>Course outcomes:</b> The students should be able to:</p>	
<ul style="list-style-type: none"> <li>• Explain the importance of data and data analysis</li> <li>• Interpret the probabilistic models for data</li> <li>• Define hypothesis, uncertainty principle</li> </ul>	

- Evaluate regression analysis

**Question paper pattern:**

The question paper will have ten questions.

There will be 2 questions from each module.

Each question will have questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. S C Albright and W L Winston, Business analytics: data analysis and decision making, 5/e Cenage Learning

**Reference Books:**

<b>WIRELESS NETWORKS AND MOBILE COMPUTING</b> <b>[As per Choice Based Credit System (CBCS) scheme]</b> <b>(Effective from the academic year 2016 -2017)</b> <b>SEMESTER – VI</b>			
Subject Code	15CS663	IA Marks	20
Number of Lecture Hours/Week	3	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
<b>CREDITS – 03</b>			
<b>Course objectives:</b> This course will enable students to			
<ul style="list-style-type: none"> <li>• Describe the wireless communication.</li> <li>• Illustrate operations involved in Mobile IP.</li> <li>• Discover the concepts of mobile computing and databases.</li> </ul>			
<b>Module – 1</b>			<b>Teaching Hours</b>
Mobile Communication, Mobile Computing, Mobile Computing Architecture, Mobile Devices Mobile System Networks, Data Dissemination, Mobility Management, Security Cellular Networks and Frequency Reuse, Mobile Smartphone, Smart Mobiles, and Systems Handheld Pocket Computers, Handheld Devices, Smart Systems, Limitations of Mobile Devices Automotive Systems			<b>8 Hours</b>
<b>Module – 2</b>			<b>8 Hours</b>
GSM-Services and System Architecture, Radio Interfaces of GSM, Protocols of GSM Localization, Call Handling Handover, Security, New Data Services, General Packet Radio Service High-speed Circuit Switched Data, DECT, Modulation, Multiplexing, Controlling the Medium Access Spread Spectrum, Frequency Hopping Spread Spectrum (FHSS), Coding Methods, Code Division Multiple Access, IMT-2000 3G Wireless Communication Standards, WCDMA 3G Communications Standards ,CDMMA2000 3G Communication Standards, I-mode, OFDM, High Speed Packet Access (HSPA) 3G Network Long-term Evolution, WiMax Rel 1.0 IEEE 802.16e, Broadband Wireless Access, 4G Networks, Mobile Satellite Communication Networks			<b>8 Hours</b>
<b>Module – 3</b>			<b>8 Hours</b>
IP and Mobile IP Network Layers, Packet Delivery and Handover Management Location Management, Registration, Tunnelling and Encapsulation, Route Optimization Dynamic Host Configuration Protocol, VoIP, IPsec Conventional TCP/IP Transport Layer Protocols, Indirect TCP, Snooping TCP Mobile TCP, Other Methods of Mobile TCP-layer Transmission ,TCP over 2.5G/3G Mobile Networks			<b>8 Hours</b>
<b>Module – 4</b>			<b>8 Hours</b>
Data Organization, Database Transactional Models – ACID Rules, Query Processing Data Recovery Process, Database Hoarding Techniques , Data Caching, Client-Server Computing for Mobile Computing and Adaptation Adaptation Software for Mobile Computing, Power-Aware Mobile Computing, Context-aware Mobile Computing			<b>8 Hours</b>
<b>Module – 5</b>			<b>8 Hours</b>
Communication Asymmetry, Classification of Data-delivery Mechanisms, Data Dissemination Broadcast Models, Selective Tuning and Indexing techniques, Digital Audio Broadcasting (DAB), Digital Video Broadcasting			<b>8 Hours</b>

Synchronization, Synchronization Software for Mobile Devices, Synchronization Software for Mobile Devices SyncML-Synchronization Language for Mobile Computing, Sync4J (Funambol), Synchronized Multimedia Markup Language (SMIL)	
<b>Course outcomes:</b> The students should be able to:	
<ul style="list-style-type: none"> <li>• Summarize various mobile communication systems.</li> <li>• Describe various multiplexing systems used in mobile computing.</li> <li>• Indicate the use and importance of data synchronization in mobile computing</li> </ul>	
<b>Question paper pattern:</b>	
<p>The question paper will have TEN questions.  There will be TWO questions from each module.  Each question will have questions covering all the topics under a module.  The students will have to answer FIVE full questions, selecting ONE full question from each module.</p>	
<b>Text Books:</b>	
<ol style="list-style-type: none"> <li>1. Raj kamal: Mobile Computing, 2<sup>ND</sup> EDITION, Oxford University Press, 2007/2012</li> <li>2. Martyn Mallik: Mobile and Wireless Design Essentials, Wiley India, 2003</li> </ol>	
<b>Reference Books:</b>	
<ol style="list-style-type: none"> <li>1. Ashok Talukder, Roopa Yavagal, Hasan Ahmed: Mobile Computing, Technology, Applications and Service Creation, 2nd Edition, Tata McGraw Hill, 2010.</li> <li>2. Iti Saha Misra: Wireless Communications and Networks, 3G and Beyond, Tata McGraw Hill, 2009.</li> </ol>	

**PYTHON APPLICATION PROGRAMMING**  
**[As per Choice Based Credit System (CBCS) scheme]**  
**(Effective from the academic year 2016 -2017)**  
**SEMESTER – VI**

Subject Code	15CS664	IA Marks	20
Number of Lecture Hours/Week	3	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

**CREDITS – 03**

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

- Learn Syntax and Semantics and create Functions in Python.
- Handle Strings and Files in Python.
- Understand Lists, Dictionaries and Regular expressions in Python.
- Implement Object Oriented Programming concepts in Python
- Build Web Services and introduction to Network and Database Programming in Python.

<b>Module – 1</b>	<b>Teaching Hours</b>
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Why should you learn to write programs, Variables, expressions and statements, Conditional execution, Functions	<b>8 Hours</b>
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<b>Module – 2</b>	
Iteration, Strings, Files	<b>8 Hours</b>

<b>Module – 3</b>	
Lists, Dictionaries, Tuples, Regular Expressions	<b>8 Hours</b>

<b>Module – 4</b>	
Classes and objects, Classes and functions, Classes and methods	<b>8 Hours</b>

<b>Module – 5</b>	
Networked programs, Using Web Services, Using databases and SQL	<b>8 Hours</b>

**Course outcomes:** The students should be able to:

- Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.
- Demonstrate proficiency in handling Strings and File Systems.
- Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
- Interpret the concepts of Object-Oriented Programming as used in Python.
- Implement exemplary applications related to Network Programming, Web Services and Databases in Python.

**Question paper pattern:**

The question paper will have TEN questions.

There will be TWO questions from each module.

Each question will have questions covering all the topics under a module.

The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. Charles R. Severance, “Python for Everybody: Exploring Data Using Python 3”, 1<sup>st</sup> Edition, CreateSpace Independent Publishing Platform, 2016. ([http://do1.dr-chuck.com/pythonlearn/EN\\_us/pythonlearn.pdf](http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf)) (Chapters 1 – 13, 15)
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2<sup>nd</sup> Edition, Green Tea Press, 2015.



(<http://greenteapress.com/thinkpython2/thinkpython2.pdf>) (Chapters 15, 16, 17)  
(Download pdf files from the above links)

**Reference Books:**

1. Charles Dierbach, "Introduction to Computer Science Using Python", 1<sup>st</sup> Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014
2. Mark Lutz, "Programming Python", 4<sup>th</sup> Edition, O'Reilly Media, 2011. ISBN-13: 978-9350232873
3. Wesley J Chun, "Core Python Applications Programming", 3<sup>rd</sup> Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365
4. Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, "Data Structures and Algorithms in Python", 1<sup>st</sup> Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126562176
5. Reema Thareja, "Python Programming using problem solving approach", Oxford university press, 2017

<b>SERVICE ORIENTED ARCHITECTURE</b> <b>[As per Choice Based Credit System (CBCS) scheme]</b> <b>(Effective from the academic year 2016 -2017)</b> <b>SEMESTER – VI</b>			
Subject Code	15CS665	IA Marks	20
Number of Lecture Hours/Week	3	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
<b>CREDITS – 03</b>			
<b>Course objectives:</b> This course will enable students to			
<ul style="list-style-type: none"> <li>• Compare various architecture for application development</li> <li>• Illustrate the importance of SOA in Application Integration</li> <li>• Learn web service and SOA related tools and governance</li> </ul>			
<b>Module – 1</b>			<b>Teaching Hours</b>
<b>SOA BASICS: Software Architecture;</b> Need for Software Architecture, Objectives of Software Architecture, Types of IT Architecture, Architecture Patterns and Styles, <b>Service oriented Architecture;</b> Service Orientation in Daily Life, Evolution of SOA, Drives for SOA, Dimension of SOA, Key components, perspective of SOA, <b>Enterprise-wide SOA;</b> Considerations for Enterprise -Wide SOA, Strawman Architecture For Enterprise-Wide-SOA-Enterprise, SOA-Layers, Application Development Process, SOA Methodology For Enterprise <b>Text 1: Ch2: 2.1 – 2.4; Ch3:3.1-3.7; Ch4: 4.1 – 4.5</b>			<b>8 Hours</b>
<b>Module – 2</b>			
<b>Enterprise Applications;</b> Architecture Considerations, Solution Architecture for enterprise application, <b>Software platforms for enterprise Applications;</b> Package Application Platforms, Enterprise Application Platforms, <b>Service-oriented-Enterprise Applications;</b> Considerations for Service-Oriented Enterprise Applications, Patterns for SOA, Pattern-Based Architecture for Service-Oriented Enterprise Application(java reference model only). Composite Applications, SOA programming models. <b>Text 1: Ch5:5.1, 5.2, 6.1, 6.2 (PageNo 74-81), 7.1 – 7.5</b>			<b>8 Hours</b>
<b>Module – 3</b>			
<b>SOA ANALYSIS AND DESIGN;</b> Need For Models, Principles of Service Design, Design of Activity Services, Design of Data services, Design of Client services and Design of business process services, <b>Technologies of SOA;</b> Technologies For Service Enablement, Technologies For Service Integration, Technologies for Service orchestration. <b>Text 1: Ch 8: 8.1 – 8.6, 9.1 – 9.3</b>			<b>8 Hours</b>
<b>Module – 4</b>			
<b>Business case for SOA;</b> Stakeholder OBJECTIVES, Benefits of SOA, Cost Savings, Return on Investment, SOA Governance, <b>Security and implementation;</b> SOA Governance, SOA Security, approach for enterprise wide SOA implementation, <b>Trends in SOA;</b> Technologies in Relation to SOA, Advances in SOA. <b>Text 1: Ch 10: 10.1 -10.4, Ch 11: 11.1 to 11.3, Ch12:12.2, 12.3</b>			<b>8 Hours</b>
<b>Module – 5</b>			
<b>SOA Technologies-PoC;</b> Loan Management System(LMS), PoC-Requirements Architectures of LMS <b>SOA based integration;</b> integrating existing application, <b>SOA best practices,</b> Basic SOA using REST. Role of WSDL,SOAP and			<b>8 Hours</b>

JAVA/XML Mapping in SOA. <b>Text 1:Page No 245-248; ReferenceBook:Chapter3; Text 1:Page No 307-310</b> <b>Text 2: Ch 3, Ch4</b>	
<b>Course outcomes:</b> The students should be able to:	
<ul style="list-style-type: none"> <li>• Compare the different IT architecture</li> <li>• Analysis and design of SOA based applications</li> <li>• Implementation of web service and realization of SOA</li> <li>• Implementation of RESTful services</li> </ul>	
<b>Question paper pattern:</b>	
<p>The question paper will have TEN questions.  There will be TWO questions from each module.  Each question will have questions covering all the topics under a module.  The students will have to answer FIVE full questions, selecting ONE full question from each module.</p>	
<b>Text Books:</b>	
<ol style="list-style-type: none"> <li>1. Shankar Kambhampaly, “Service–Oriented Architecture for Enterprise Applications”,Wiley Second Edition, 2014.</li> <li>2. Mark D. Hansen, “SOA using Java Web Services”, Practice Hall, 2007.</li> </ol>	
<b>Reference Books:</b>	
<ol style="list-style-type: none"> <li>1. Waseem Roshen, “SOA-Based Enterprise Integration”, Tata McGraw-HILL, 2009.</li> </ol>	

**MULTI-CORE ARCHITECTURE AND PROGRAMMING**

[As per Choice Based Credit System (CBCS) scheme]

(Effective from the academic year 2016 -2017)

**SEMESTER – VI**

Subject Code	15CS666	IA Marks	20
Number of Lecture Hours/Week	3	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03

**CREDITS – 03****Course objectives:** This course will enable students to

- Explain the recent trends in the field of Computer Architecture and describe performance related parameters
- Illustrate the need for quasi-parallel processing.
- Formulate the problems related to multiprocessing
- Compare different types of multicore architectures

**Module – 1****Teaching Hours**

**Introduction to Multi-core Architecture** Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi-core Architectures from Hyper- Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms Understanding Performance, Amdahl's Law, Growing Returns: Gustafson's Law. **System Overview of Threading** : Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization.

**8 Hours****Module – 2**

**Fundamental Concepts of Parallel Programming** :Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Challenges You'll Face, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion, Other Alternatives. **Threading and Parallel Programming Constructs:** Synchronization, Critical Sections, Deadlock, Synchronization Primitives, Semaphores, Locks, Condition Variables, Messages, Flow Control- based Concepts, Fence, Barrier, Implementation-dependent Threading Features

**8 Hours****Module – 3**

**Threading APIs** :Threading APIs for Microsoft Windows, Win32/MFC Thread APIs, Threading APIs for Microsoft. NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads, Thread Synchronization, Signaling, Compilation and Linking.

**8 Hours****Module – 4**

**OpenMP: A Portable Solution for Threading** : Challenges in Threading a Loop, Loop-carried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No wait, Interleaving Single-thread and Multi-thread Execution, Data Copy-in and Copy-out, Protecting Updates of Shared

**8 Hours**

Variables, Intel Task queuing Extension to OpenMP, OpenMP Library Functions, OpenMP Environment Variables, Compilation, Debugging, performance	
<b>Module – 5</b>	
<b>Solutions to Common Parallel Programming Problems :</b> Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture, High-level Languages, Avoiding Pipeline Stalls on IA-32, Data Organization for High Performance.	<b>8 Hours</b>
<b>Course outcomes:</b> The students should be able to:	
<ul style="list-style-type: none"> <li>• Identify the issues involved in multicore architectures</li> <li>• Explain fundamental concepts of parallel programming and its design issues</li> <li>• Solve the issues related to multiprocessing and suggest solutions</li> <li>• Point out the salient features of different multicore architectures and how they exploit parallelism</li> <li>• Illustrate OpenMP and programming concept</li> </ul>	
<b>Question paper pattern:</b> The question paper will have TEN questions. There will be TWO questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer FIVE full questions, selecting ONE full question from each module.	
<b>Text Books:</b>	
1. Multicore Programming , Increased Performance through Software Multi-threading by Shameem Akhter and Jason Roberts , Intel Press , 2006	
<b>Reference Books:</b>	
<b>NIL</b>	

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**CHOICE BASED CREDIT SYSTEM (CBCS)**  
**SCHEME OF TEACHING AND EXAMINATION 2015-2016**

**B.E. Computer Science & Engineering**  
**B.E. Information Science and Engineering**

**V SEMESTER OPEN ELECTIVES**

<b>Open Elective 1</b>	
15CS561	Programming in JAVA
15CS562	Artificial Intelligence
15CS563	Embedded Systems
15CS564	Dot Net framework for application development;
15CS565	Cloud Computing

**VI SEMESTER**

<b>Open Elective 2</b>	
15CS661	Mobile Application Development
15CS662	Big Data Analytics
15CS663	Wireless Networks and Mobile computing
15CS664	Python Application Programming
15CS665	Service Oriented Architecture
15CS666	Multicore Architecture and Programming