UNIVERSITY OF KERALA

Syllabus For B.Tech INFORMATION TECHNOLOGY

2020 SCHEME

SEMESTER V

SEMESTER V

SLOT	Course No.	COURSES	L-T-P	Hours	Credit
A	ITT301	WEB APPLICATION DEVELOPMENT	3-1-0	4	4
B	ITT303	OPERATING SYSTEM CONCEPTS	3-1-0	4	4
C	ITT305	DATA COMMUNICATION AND NETWORKING	3-1-0	4	4
D	ITT307	FORMAL LANGUAGES AND AUTOMATA THEORY	3-1-0	4	4
E	ITT309	MANAGEMENT FOR SOFTWARE ENGINEERS	3-0-0	3	3
F	MCN301	DISASTER MANAGEMENT	2-0-0	2	-
S	ITL331	OPERATING SYSTEM AND NETWORK PROGRAMMING LAB	0-0-3	3	2
T	ITL333	WEB APPLICATION DEVELOPMENT LAB	0-0-3	3	2
R\M/H	VAC	Remedial/Minor/Honors course	3-1-0	4*	4
	TOTAL			**31**	**23/27**

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT301	WEB APPLICATION DEVELOPMENT	PCC	3	1	0	4

Preamble: Web Application Development course is intended to deliver the elementary concepts of Web Application Development with HTML, CSS, JavaScript, JQuery, Node JS and MongoDB thereby equipping them to develop real time web applications.

Prerequisite: Basics of programming

Course Outcome (CO): After completion of the course, the student will be able to

CO No.	Course Outcomes	Bloom's Category
CO1	Identify HTML5 elements in webpages	Level 2: Understand
CO2	Implement Cascading Stylesheet to add style in HTML pages	Level 3: Apply
CO3	Apply JavaScript to add functionality to web pages	Level 3: Apply
CO4	Use Ajax & JQuery to enhance the functioning of web pages	Level 3: Apply
CO5	Develop web applications with HTML, CSS, JavaScript, Node JS and MongoDB	Level 3:Apply

Mapping of Course Outcomes with Program Outcomes 3/2/1: High/Medium/Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2		2							
CO2	1	2	2		2							
CO3	2	2	1		2							
CO4	2	2	1		3							1
CO5	2	3	1	1	3							2

The COs and CO-PO map shall be considered as suggestive only.

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Semester Examination (Marks)
	1	2	
Remember			
Understand	30	20	40
Apply	20	30	60
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

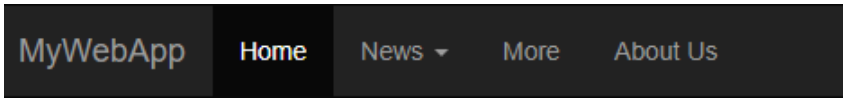
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

CO1: Differentiate ordered list and unordered list with example.

CO2: Create a navigation bar in the format shown below using Cascading Stylesheet and HTML:



CO3: Demonstrate insertion of new list item in an HTML page utilizing DOM methods.

CO4: Use Ajax & JQuery to enhance the functioning of web pages

CO5: Create a web application for library with HTML, CSS, JavaScript and Node.
The features needed in the website are:

1. Insert Book
2. Delete Book
3. Checkout Book

Model Question Paper

Course Code: ITT301

Course Name: WEB APPLICATION DEVELOPMENT

Max.Marks:100 Duration: 3 Hours

PART A **(10*3=30)**

(Each question carries 3 marks)

1. What is the use of href? Give example.
2. Illustrate the usage of alt attribute in an image tag.
3. What are Cascading Style Sheets?
4. Differentiate block and inline elements.
5. What is Document Object Model?
6. Illustrate how JavaScript makes webpages more interactive.
7. Differentiate let, var and const in JavaScript.
8. Illustrate how ajax works?
9. What are the different operations involved in accessing a web page?
10. Explain different features of node.js.

PART B **(5*14=70)**

11. Explain table tag and create the following table using table tag in HTML:

Branch	CGPA/Percentage		Salary
	UG	PG	
IT	105	12	500000
Others	200	225	400000

OR

12. Explain various concerns and operations involved in web design starting from ideation to hosting of a website.

13. Differentiate the concepts of inline, internal and external style sheets with examples.

OR

14. Illustrate layout and positioning elements in CSS with example.

15. Explain JavaScript: Objects: Math, String, Date, and document Object with example.

OR

16. What is events and explain event handling with example.

17. Explain callbacks, promise and async/await with example.

OR

18. What is Ajax, and explain loading JSON with Ajax.

19. Discuss CRUD operation with node express.

OR

20. Explain steps involved in building a node express app with MongoDB.

Syllabus

MODULE 1: INTRODUCTION TO WEB DESIGNING	**8 Hrs**
Web Design Basics: Who is the Site For?, Why People Visit your Website?, What Information Your Visitors Need?, Site maps, wireframes, Getting your message across using design, Visual hierarchy, grouping and similarity, Designing Navigation, Search Engine Optimization (SEO), Analytics, Domain Names & Hosting, Ftp & Third party tools **HTML5:** Introduction to HTML5, Basic Structure for HTML, Basic HTML tags-Headings, Linking, Images, Special Characters and Horizontal Rules, Lists, Tables, Forms, Internal Linking, meta elements, New HTML5 Form input Types, input and data list elements, autocomplete Attribute, Page-Structure Elements	
MODULE 2: STYLE WITH CSS	**9 Hrs**
Introduction to CSS: Introduction to CSS, Block and Inline Elements, Inline Styles, using internal CSS, using external CSS, How CSS rules cascade, inheritance, why use external style sheets? **CSS3 Basics:** CSS selectors, *color:* foreground color, background color, contrast, opacity; *text:* Typeface terminology, Specifying Typefaces, font-size, font-weight, font-style, text-transform, text-decoration, line-height, letter-spacing, word-spacing, text-align, vertical-align, text-indent, text-shadow; responding to users; *box:* box dimensions, limiting width, limiting height, overflow; *border margin and padding*, centering content, change inline/blocks, hiding boxes, box shadows, rounded corners; *list tables and forms:* list-style, table properties, styling forms, styling text input **Layout and positioning:** *layout:* key concepts in positioning elements, *controlling the position of elements:* relative positioning, absolute positioning, fixed positioning, z-index, float, clear, creating multi column layout with float, fixed width layout, liquid layout, layout grids, *Images:* controlling size of images in CSS, aligning images using CSS, centering	

images using CSS, background images, gradients, Media Queries

MODULE 3: INTRODUCTION TO JAVASCRIPT **9 Hrs**

JavaScript: How JavaScript makes the webpages more interactive, examples of JavaScript in browser, *Basic JavaScript instructions:* statements, comments, variable, data types, arrays, expressions, operators; *functions methods and objects:* function, anonymous function, variable scope, object, this, arrays are objects, browser object model, document object model, *Global objects:* string, number, math, date.

Decision making and Loops: *decision making:* if statement, if…else statement, switch statement, *loops:*key loop concepts, for loops, while loops, do while loops;

DOM: Document Object Model (DOM), the DOM tree as a model of a web page, working with DOM tree, accessing elements, nodelists, selecting elements: using class attribute, tag name, CSS selectors; repeating actions for an entire nodelist, looping through a nodelist, traversing the DOM, adding or removing html content, update text and markup, adding/removing elements

Event handling: different event types and ways to bind an event to an element: using DOM event handlers, using event listeners, using parameters with event listeners; the event object, event delegation, user interface events, event bubbling

Module 4: JAVASCRIPT ADVANCED **10 Hrs**

ECMA Script: ECMA Script versions, ES5 Features, ES6 introduction, Var Declarations and Hoisting, let declaration, Constant declaration, function with default parameter values, default parameter expressions, unnamed parameters, the spread operator, arrow functions, object destructuring, array destructuring, sets and maps, Array.find(), Array.findIndex(), template strings, Javascript classes, callbacks, promises, async/await

AJAX: What is Ajax? , Why use Ajax?, How Ajax works?, Handling Ajax request and response, data formats: XML, JSON; Working with JSON data, Loading HTML with Ajax, Loading XML with Ajax, Loading JSON with Ajax, working with data from other servers

JQuery : What is JQuery ?, A basic JQuery example, Why use JQuery ?, finding elements, JQuery selection, getting element content, updating elements, changing content, inserting elements, adding new content, getting and setting attributes, getting and setting CSS properties, using .each(), events, event object, effects, animating CSS properties, using animation, traversing the DOM, working with forms, JavaScript libraries, JQuery and

Ajax
Module 5: BACK END DEVELOPMENT **9 Hrs**
Web Servers: Introduction, HTTP Transactions, Multitier Application Architecture, Client-Side Scripting versus Server-Side Scripting, Accessing Web Servers. **Server Side Scripting with Node.js:** Getting to know node, node.js changed JavaScript forever, features of node, when to use and not use node, asynchronous callbacks, the NoSql movement, node and MongoDB in the wild, Hello World in Node, package.json, modules, *Built-in Modules:* FS Module, HTTP Module, Events; Node Package Manager(npm), web server using http, node.js with express, middleware, routing in express, CRUD operations in express, web server using express, making it live on Heroku **Node.js with MongoDB**: basics of MongoDB, MongoDB CRUD Operations, Building a data model with MongoDB and Mongoose, Defining simple mongoose schemas, build node express app with MongoDB

Text Books

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, “Internet and World Wide Web How To Program”, 5/E, Pearson Education, 2012.

2. Jon Duckett , “HTML and CSS: Design and Build Websites”, Wiley

3. Jon Duckett , “JavaScript and JQuery : Interactive Front–End Web Development”, Wiley

4. Nicholas C. Zakas, “Understanding ECMAScript 6: The Definitive Guide for JavaScript Developers”

Reference Books

1. Alex Young, Marc Harter, “Node js in practice”, Manning.

2. Json Krol , “Web Development with MongoDB and node js”, Packt

3. Krishna Rungta , “Node JS: learn in one day

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures (in hours)
1	**Introduction to web designing**	**8**
1.1	**Web Design Basics:** Who is the Site For?, Why People Visit your Website, What Information Your Visitors Need?, Site maps, wireframes, Getting your message across using design, Visual hierarchy, grouping and similarity, Designing Navigation, Search Engine Optimization (SEO), Analytics, Domain Names & Hosting, Ftp & Third party tools	2
1.2	**HTML5:** Introduction to HTML5, Basic Structure for HTML, Basic HTML tags-Headings, Linking, Images, Special Characters and Horizontal Rules	2
1.3	Lists, Tables, Forms, Internal Linking, meta elements, New HTML5 Form input Types	2
1.4	input and data list elements, autocomplete Attribute, Page-Structure Elements	2
2	**Style with CSS**	**9**
2.1	**Introduction To CSS:** Introduction to CSS, Block and Inline Elements, Inline Styles, Using internal CSS, Using external CSS, How CSS rules cascade, inheritance, why use external style sheets?	2
2.2	**CSS3 Basics:** CSS selectors, *color:* foreground color, background color, contrast, opacity; *text:* Typeface terminology, Specifying Typefaces, font-size, font-weight, font-style, text-transform, text-decoration, line-height, letter-spacing, word-spacing, text-align, vertical-align, text-indent, text-shadow; responding to users; *box:* box dimensions, limiting width, limiting height, overflow; *border margin and padding*, centering content, change inline/blocks, hiding boxes, box shadows, rounded corners	2
2.3	*list tables and forms:* list-style, table properties, styling forms, styling text input	1
2.4	**Layout and positioning:** *layout:* key concepts in positioning elements, *controlling the position of elements:* relative positioning, absolute positioning, fixed positioning, z-index, float, clear, creating multi column layout with float, fixed width layout, liquid layout, layout grids,	2

2.5	*Images:* controlling size of images in CSS, aligning images using CSS, centering images using CSS, background images, gradients, Media Queries	2
3	**Introduction To JavaScript**	**9**
3.1	**JavaScript:** How JavaScript makes the webpages more interactive, examples of JavaScript in browser, *Basic JavaScript instructions:* statements, comments, variable, data types, arrays, expressions, operators; *functions methods and objects:* function, anonymous function, variable scope, object, this, arrays are objects, browser object model, document object model, *Global objects:* string, number, math, date;	2
3.2	**Decision making and Loops:** *decision making:* if statement, if…else statement, switch statement, *loops:* key loop concepts, for loops, while loops, do while loops;	2
3.3	**DOM:** Document Object Model (DOM), the DOM tree as a model of a web page, working with DOM tree, accessing elements, nodelists, selecting elements: using class attribute, tag name, CSS selectors; repeating actions for an entire nodelist, looping through a nodelist,	2
3.4	traversing the DOM, adding or removing html content, update text and markup, adding/removing elements	1
3.5	**Event handling:** different event types, three ways to bind an event to an element, using DOM event handlers, using event listeners, using parameters with event listeners, the event object, event delegation, user interface events, event bubbling	2
4	**JavaScript Advanced**	**10**
4.1	**ECMA Script:** ECMA Script versions, ES5 Features, ES6 introduction, Var Declarations and Hoisting, let declaration, Constant declaration, function with default parameter values, default parameter expressions, unnamed parameters, the spread operator, arrow functions, object destructuring, array destructuring, sets and maps, Array.find, Array.findIndex, template strings	2
4.2	JavaScript classes, callbacks, promises, async/await	1
4.2	**AJAX:** What is Ajax?, Why use Ajax?, How Ajax works?, Handling Ajax request and response, data formats: XML, JSON; Working with JSON data, Loading HTML with Ajax,	2

4.3	Loading XML with Ajax, Loading JSON with Ajax, working with data from other servers	1
4.4	**JQUERY :** What is JQuery ?, A basic JQuery example, Why use JQuery ?, finding elements, JQuery selection, getting element content, updating elements, changing content, inserting elements, adding new content, getting and setting attributes	2
4.5	getting and setting CSS properties, using .each(), events, event object, effects, animating CSS properties, using animation, traversing the DOM, working with forms, JavaScript libraries, JQuery and Ajax	2
5	**Back End Development**	**9**
5.1	**Web Servers:** Introduction, HTTP Transactions, Multitier Application Architecture, Client-Side Scripting versus Server-Side Scripting, Accessing Web Servers.	2
5.2	**Server Side Scripting with Node.js:** Getting to know node, node.js changed JavaScript forever, features of node, when to use and not use node, asynchronous callbacks, the NoSql movement, node and MongoDB in the wild, Hello World in Node, package.json, modules,	2
5.3	*Built-in Modules:* FS Module, HTTP Module, Events; Node Package Manager(npm), web server using http, node.js with express, middleware, routing in express, CRUD operations in express, web server using express, making it live on Heroku	2
5.4	**Node.js with MongoDB**: basics of MongoDB, MongoDB CRUD Operations, Building a data model with MongoDB and Mongoose	2
5.5	Defining simple mongoose schemas, build node express app with MongoDB	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT303	OPERATING SYSTEM CONCEPTS	PCC	3	1	0	4

Preamble: Operating System Concepts is a graduate-level introductory course in operating systems. This course teaches the basic operating system functions, abstractions, mechanisms, and their implementations. The course is split into five modules: (1) Introduction to OS, (2) Process Management, (3) Process Synchronization, (4) Memory Management and (5) Storage Management.

Prerequisite: ITT204 Computer Organization

C**ourse Outcomes:** After the completion of the course the student will be able to

CO No.	Course Outcome (CO)	Bloom's Category
CO 1	Explain the concepts and functionality of operating systems.	Level 2: Understand
CO 2	Describe the concepts of process management and process synchronization and apply them to solve problems.	Level 3: Apply
CO 3	Illustrate deadlock and deadlock – prevention and avoidance techniques.	Level 3: Apply
CO 4	Illustrate the memory management techniques.	Level 3: Apply
CO 5	Explain the file system and its implementation	Level 2: Understand
CO 6	Use the disk scheduling algorithms to solve problems.	Level 3: Apply

Mapping of course outcomes with program outcomes 3/2/1: High/Medium/Low

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1									2
CO 2	3	3	3	2	1							2
CO 3	3	3	3	2	1							2
CO 4	3	3	3	2	1							2
CO 5	3	2	2	1								2
CO 6	3	3	3	2	1							2

The COs and CO-PO map shall be considered as suggestive only.

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	20	20	40
Apply	25	25	50
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14marks.

Course Level Assessment Questions
Course Outcome 1 (CO1):
1. Describe the basic functions of operating system.

2. Illustrate the various types of operating system.

3. Explain the types of System Calls.

Course Outcome 2 (CO2):

1. Describe the process state with suitable diagram.

2. Consider the following set of processes with CPU burst given in seconds.

Process	CPU Burst
P1	20
P2	4
P3	6
P4	4

i. Draw the Gantt chart for FCFS and Round Robin (Time quantum=4s).

ii. What is the average waiting time for each of the scheduling algorithm?

3. Explain the fields in a process control block. What is the use of PCB in context switching?

Course Outcome 3 (CO3):

1. Explain deadlocks detection techniques.

2. Describe deadlock and necessary conditions for deadlocks.

3. Develop the program for Banker's algorithm.

4. Does a cycle in a resource allocation graph indicate a deadlock situation? Justify your answer.

5. Demonstrate the use of Peterson's solution to the critical section problem.

Course Outcome 4 (CO4):

1. Explain internal fragmentation and external fragmentation with suitable diagrams.

2. Illustrate paging and segmentation with suitable diagram.

3. Consider the following page reference string: 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6. How many page faults would occur for the following replacement algorithms, assuming three frames? What happens when four frames are used? All frames are initially empty, so your first pages will all cost one fault each (i) LRU replacement (ii)FIFO.

Course Outcome 5 (CO5):

1. Illustrate the File Attributes & File Operations.

2. Identify the different File Access methods.

3. Illustrate the various Directory structures.

Course Outcome 6 (CO6):

1. Explain the various Disk scheduling algorithms.

2. Consider a disk containing 200 cylinders. At a certain point of time the disk head is at cylinder 55 and the disk queue contains request for I/O to blocks on cylinders 58, 39, 150, 180, 65, 75, 88, 110, 100,130. Find out the total head movement with respect to FCFS, SSTF, SCAN, C-SCAN and LOOK scheduling.

3. How would you select a disk scheduling algorithm?

Model Question paper

Course Code: ITT303
Course Name: Operating System Concepts

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. What is an operating system? State and explain the basic functions of operating system?
2. Differentiate between hard real-time systems and soft real-time systems. Give 2 examples of each.
3. Explain five state process models with a neat diagram.
4. Compare long term scheduling and short term scheduling.
5. What is a deadlock? What are the necessary conditions for a deadlock to occur?

6. Explain the concept of safe and unsafe state in the context of deadlock avoidance.

7. Differentiate between external fragmentation and internal fragmentation.

8. What is Translation Look Aside Buffer (Associative Memory)? What is the need for TLB?

9. List out the different operations that can be performed by a file system.

10. What is Direct memory access technique and how it is advantageous in performing I/O?

(10x3=30)

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. (a) Explain the various types of system calls with an example for each. (10)

(b) Explain the execution of a system call. (4)

OR

12. (a) Explain in detail about the OS structure. (10)

(b)What are shells? Give examples. (4)

13. (a) What is context switching? What are all the factors affecting context switching time? (6)

(b) Explain any two preemptive CPU scheduling algorithms with example. (8)

OR

14. (a) What are the functions of a dispatcher? (6)

(b) Explain the structure of PCB. (8)

15. (a) What are the strategies for recovering from deadlock? Write the merits and demerits of each. (10)

(b) Explain how dead lock can be prevented in a system. (4)

OR

16. (a) Explain how resource allocation graphs can be used to detect deadlock. (6)

(b) Explain Bankers algorithm for dead lock avoidance with multiple resources of each type. (8)

17. (a) Describe the following memory allocation algorithms. (6)

i) First-fit
ii) Best–fit
iii) Worst –fit

(b) Explain paging memory management techniques. (8)

OR

18. (a) Explain how segmentation with paging is implemented. (8)

(b) What is virtual memory? How is it implemented? (6)

19. (a) How directories are implemented? (6)

(b) Explain the different types of directory structures. (8)

OR

20. (a) Describe various file access methods. (4)

(b) Illustrate the disk scheduling algorithms. (10)

(14x5=70)

Syllabus

Module 1 (7 hours)
Operating Systems: Introduction, Functions of OS, Types of OS (Batch, Multi programmed, Time-sharing and Real time systems) –System calls – System Programs — System structure (Simple structure, Layered approach, Microkernel system structure, Modules)– Kernel, Shell.
Module 2 (11 hours)
Process Management: Process concept, Process State, PCB, Operations on processes, Multithreading-Benefits. **Process Scheduling:** Basic concepts, Preemptive Scheduling, Dispatcher, Scheduling criteria, Scheduling Algorithms (FCFS, SJF, Priority scheduling, Round Robin Scheduling, Multi level queue scheduling, Multi level feedback queue scheduling). **Inter process communication** (Shared memory, message passing, pipes and socket).
Module 3 (11 hours)
Process Synchronization: Race Conditions - Critical Sections – Mutual Exclusion - Busy Waiting - Sleep and Wakeup - Semaphores – Monitors (Introduction). **Deadlocks**: Deadlock characteristics - conditions for deadlock - prevention – avoidance (Safe state, Resource –Allocation Graph**,** Banker's algorithm) - deadlock detection – recovery from dead lock.
Module 4 (10 hours)
Memory Management: Basics - Swapping -Memory Allocation (fixed partitions, variable partitions) Fragmentation - Paging - Segmentation - Virtual memory concepts – Demand paging - Page replacement algorithms (FIFO, Optimal, LRU) – Allocation of frames - Thrashing.
Module 5 (6 hours)
Storage Management: File System: Introduction, File concept – File Attributes, File Operations, File Types, File structure-File access methods (Sequential Access, Direct Access, Indexed Access)– File allocation methods (Contiguous, linked and indexed allocation), Directory structure (Single-Level, Two-Level, Tree-Structured, Acyclic Graph, General Graph)– Directory implementation (Linear list, Hash table). Disk Management: Introduction, Disk Scheduling algorithms (FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK)

Text Books

1. Andrew S. Tanenbaum and Herbert Bos, Modern Operating Systems, 4th edition, Pearson, 2015
2. A. Silberschatz, G.Gagne and P.Galvin, Operating System Concepts, 7th edition, AddisonWesley, 2004.

Reference Books

1. D M Dhamdhere, "*Operating Systems A Concept-based Approach"*, Tata McGraw Hill, New Delhi, 2nd Edition, 2010.
2. William Stallings, Operating Systems, 6th Edition, Pearson, 2009.
3. Garry Nutt, "Operating Systems – A Modern perspective", Third Edition, Pearson Education

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Operating Systems**	**(7 hours)**
1.1	Introduction, Functions of OS	1 hour
1.2	Types of OS	2 hours
1.3	System calls	1 hour
1.4	System Programs	1 hour
1.5	System structure	1 hour
1.6	Kernel & Shell.	1 hour
2	**Process Management**	**(11 hours**)
2.1	Process concept, Process State, PCB	2 hours
2.2	Operations on processes	1 hour
2.3	Multithreading-Benefits.	1 hour
2.4	**Process Scheduling:** Basic concepts	1 hour
2.5	Pre-emptive Scheduling, Dispatcher	1 hour
2.6	Scheduling criteria	1 hour
2.7	Scheduling Algorithms	3 hours
2.8	Inter process Communication	1 hours
3	**Process Synchronization**	**(11 hours**)
3.1	Race Conditions - Critical Sections	1 hour
3.2	Mutual exclusion with busy waiting	2 hours
3.3	Sleep and Wakeup	1 hour
3.4	Semaphores, Monitors(introduction)	2 hours
3.5	**Deadlocks**: Deadlock characteristics, conditions for deadlock	1 hour
3.6	Deadlock prevention	1 hour
3.7	Deadlock avoidance	2 hours

3.8	Deadlock detection & recovery from dead lock.	1 hour
4	**Memory Management**	**(10 hours)**
4.1	Basics - swapping	1 hour
4.2	Memory Allocation (fixed partitions, variable partitions), Fragmentation	1 hour
4.3	Paging	2 hours
4.4	Segmentation	1 hour
4.5	Virtual memory concepts & demand paging	1 hour
4.6	Page replacement algorithms (FIFO, Optimal, LRU).	2 hours
4.7	Allocation of frames, Thrashing	2 hours
5	**Storage Management**	**(6 hours)**
5.1	Introduction , File concept – File Attributes– File Operations, File Types, File structure	1 hours
5.2	File access methods, File allocation methods	1 hour
5.3	Directory structure, Directory implementation	2 hours
5.4	Disk management: Introduction, Disk scheduling algorithms	2 hours

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT305	DATA COMMUNICATION AND NETWORKING	PCC	3	1	0	4

Preamble: The syllabus is prepared with a view to equip the Engineering Graduates to learn basic concepts in data communication and computer networking, and to fine-tune performance parameters used in data transmission.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able to

CO No.	Course Outcome (CO)	Bloom's Category Level
CO 1	Discuss the basic concepts used in data communication and computer networking	Level 2 :Understand
CO 2	Identify the concepts of data transmission and apply signal encoding techniques in data transmission.	Level 3 : Apply
CO 3	Compare different transmission mode, multiplexing, and Spread Spectrum techniques.	Level 2 :Understand
CO 4	Describe the design issues and protocols in data link layer.	Level 2 :Understand
CO 5	Summarize the routing algorithms and congestion control techniques in network layer.	Level 2 :Understand

Mapping of Course Outcomes with Program Outcomes 3/2/1: High/Medium/Low

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	-	-	-	-	-	-	-	-	2
CO 2	3	3	2	1	2	-	-	-	-	-	-	2
CO 3	2	3	1	2	2	-	-	-	-	-	-	2
CO 4	2	3	3	2	1	-	-	-	-	-	-	2
CO 5	2	2	2	1	1	-	-	-	-	-	-	2

The COs and CO-PO map shall be considered as suggestive only.

Assessment Pattern

Bloom's Category Levels	Continuous Assessment Tests		End Semester Examination
	1	2	
BL 2: Understand	30	30	60
BL 3: Apply	20	20	40
BL 4: Analyse			
BL 5: Evaluate			
BL 6: Create			

Mark distribution

Total Marks	Continuous Internal Evaluation (CIE)	End Semester Examination (ESE)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be *two* parts; **Part A** and **Part B**. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer *all* questions. Part B contains 2 questions from each module of which student should answer *any one*. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

Course Outcome 1 (CO 1):

1. List the various layers of the OSI reference model.
2. What are the types of topologies used in a network?
3. Mention the various devices used in different layers of the TCP/IP reference model.
4. Define a Protocol Data Unit (PDU).
5. Compare the features of different guided media used in data transmission.
6. Give a comparative analysis of different kinds of satellite communication.
7. Compare and contrast the functionalities of hubs, bridges and switches.

Course Outcome 2 (CO 2):

1. Explain the impairments in data transmission.
2. What is Nyquist criteria for channel bandwidth?
3. Differentiate between analog and digital signals used in transmission.
4. Explain the process of Delta Modulation?

Course Outcome 3 (CO 3):

1. Explain Spread Spectrum Techniques used in networks.
2. Compare and contrast FDM and WDM.
3. Explain CDMA with the help of an example
4. Differentiate statistical TDM and synchronous TDM
5. Discuss synchronous transmission. How is synchronization provided for synchronous transmission?

Course Outcome 4 (CO 4):

1. Assess the suitability of various error correcting codes to deal with single-bit and burst errors in data transmission.
2. Derive a Hamming code for single bit error correction (For a data of length 7 Bit).
3. How are errors detected using parity checking? What are the limitations of parity checking?
4. What are the services offered by the Data Link Layer? Mention the protocols also.
5. With the help of a diagram, explain the format of an Ethernet frame.

Course Outcome 5 (CO 5):

1. What are the functionalities of network layer?
2. Compare distance vector routing and link state routing?
3. What is count-to-infinity problem? How can it be solved?
4. Explain how congestion control is performed in network layer
5. Explain congestion control in virtual circuit subnet

Model Question Paper

Course Code: ITT305

Course Name: Data Communication and Networking

Max.Marks:100 Duration: 3Hours

Part A

Answer all questions. Each question carries 3 marks. (10 * 3 = 30 Marks)

1. What are the features of WAN.
2. Explain the role of routers in Networks.
3. Explain Data rate, Noise and Bandwidth with respect to a channel.
4. If a periodic signal is decomposed into five sine waves with frequencies of 100, 300, 500, 700, and 900 Hz, what is its bandwidth? Draw the spectrum, assuming all components have maximum amplitude of 10 V.
5. Draw the constellation diagrams for ASK, BPSK, and QPSK signals.
6. Define scrambling and give its purpose.
7. Using an example, explain two-dimensional parity checks.
8. Write a short note on CDMA.
9. Explain the significance of QoS in communication
10. Explain the importance of the age field in link state messages

Part B

Answer all questions. Each question carries 14 marks. (5 * 14 = 70 Marks)

11 List and explain the main features of all the seven layers of the ISO/OSI reference model and compare it with TCP/IP Model. 14

OR

12 a. Explain the features of any two guided transmission media 9

b. Describe the use of satellites in communication 5

13	a.	Explain the features of NRZ, AMI, and Manchester encoding schemes. Encode the given digital data 10110010 using NRZ-L, NRZ-I, AMI, Manchester and differential Manchester encoding schemes?	10
	b.	A telephone line normally has a bandwidth of 3000 Hz (300 to 3300 Hz) assigned for data communications. The signal-to-noise ratio is usually 3162. Find the channel capacity.	4
		OR	
14	a.	What are the transmission impairments happening in data communication?	10
	b.	Consider a channel with a 1-MHz bandwidth. The SNR for this channel is 63. What are the appropriate bit rate and signal level?	4
15	a.	Explain Multiplexing in detail.	10
	b.	List the features of frequency hopping spread spectrum.	4
		OR	
16	a.	Describe direct sequence spread spectrum in detail	10
	b.	Explain in detail about synchronous communication	4
17	a.	List and explain the sliding window protocols used in data link layer	10
	b.	Derive the saturation throughput of pure ALOHA	4
		OR	
18	a.	Describe about CRC encoding and decoding with data word 1010 with $G(x) = x^3+x+1$	10
	b.	What is CSMA/CA?	4
19	a.	Explain distance vector routing in detail	10
	b.	What is flooding?	4
		OR	
20	a	Explain in detail about the congestion control mechanisms used by datagram subnets	10
	b.	What are the services provided by the transport layer?	4

Syllabus

Module 1: Overview of Data Communication and Networks (8 Hours)
Introduction: - Types of Computer Networks, Network Software - Protocol Hierarchies, Connection oriented and Connection less hierarchies, Reference Models - ISO-OSI Reference Model, TCP/IP Reference Model – Comparison of OSI and TCP/IP reference models. Physical Layer: - Guided Transmission Media– Twisted Pair, Coaxial and Fiber Optics, Wireless Transmission- Radio and Microwave transmission, Communication Satellites – GEO, MEO, LEO. Comparison of Network hardware - Repeaters, Routers, Bridges, Gateways, and Hub.
Module 2: Data Transmission and Encoding Techniques (10 Hours)
Data and signals, Analog Signals, Digital Signals - Transmission Impairments,Data Rate Limits: Channel Capacity, Nyquist Bit Rate, Shannon Capacity, Performance parameters - Bandwidth, Throughput, Delay & Jitter. Digital-To-Digital Conversion: Line Coding Schemes: Unipolar, Polar, Bipolar - Block Coding, Scrambling, Analog-To-Digital Conversion: Pulse Code Modulation, Delta Modulation - Digital-To-Analog Conversion: ASK, FSK, PSK.
Module 3: Digital Transmission (7 Hours)
Transmission Modes: Parallel and Serial Transmission, Asynchronous, Synchronous, Isochronous Transmission Multiplexing - TDM, FDM, WDM - Spread spectrum-The concept of spread spectrum – frequency hopping spread spectrum – direct sequence spread spectrum – code division multiple access
Module 4:Link Layer Communication (10 Hours)
Data Link Layer – design issues - Error Detection: Parity Check, Checksum, CRC, Error Correction: Hamming code - Flow Control: Stop-and-Wait, Go-Back-N, and Selective-Repeat - Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA, Controlled Access: Reservation, Polling, Token Passing, Ethernet- Ethernet Cabling, Encoding, Frame Format, Binary Exponential Back Off Algorithm.
Module 5: Network Layer (10 Hours)
Network Layer Design Issues, Routing Algorithm – Optimality principle - Flooding - Distance vector routing – Link state routing –Multicast Routing - Congestion Control Algorithms – General principles – Congestion prevention policies – Choke packets – Random Early Detection- Quality of Service requirements- Buffering, Traffic shaping – Leaky bucket algorithm. Basic functions of Transport layer and Application layer (Basic understanding only).

Text Books

1. Andrew S. Tanenbaum, Computer Networks, Prentice Hall, 4th Edition, 2003
2. Behrouz A. Forouzan, Data Communications and Networking, 5/e, Tata McGraw Hill, 2017.
3. William Stallings, 'Data and Computer Communications', 8/e Pearson, 2007.

Reference Books

1. William Stallings, Computer Networking with Internet Protocols, Prentice-Hall, 2004.
2. Fred Halsall, Computer Networking and the Internet, 5/e.
3. F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach Featuring Internet, 6/e, Pearson Education, 2012.
4. L. L. Peterson and B. S. Davie, Computer Networks, A systems approach, 5/e, Morgan Kaufmann, 2011.

Course Contents and Lecture Schedule

Sl. No.	Topic	No. of Lectures
1	**Overview of Data Communication and Networks**	**8 Hours**
1.1	Introduction: - Types of Computer Networks, Network Software - Protocol Hierarchies, Connection oriented and Connection less hierarchies	2
1.2	Reference Models - ISO-OSI Reference Model, TCP/IP Reference Model – Comparison of OSI and TCP/IP reference models	3
1.3	Physical Layer: - Guided Transmission Media– Twisted Pair, Coaxial and Fiber Optics, Wireless Transmission- Radio and Microwave transmission, Communication Satellites – GEO, MEO, LEO. Comparison of Network hardware - Repeaters, Routers, Bridges, Gateways, and Hub.	3
2	**Data Transmission and Encoding Techniques**	**10 Hours**
2.1	Data and signals, Analog Signals, Digital Signals - Transmission Impairments,Data Rate Limits: Channel Capacity, Nyquist Bit Rate, Shannon Capacity, Performance parameters - Bandwidth, Throughput, Delay & Jitter.	4
2.2	Digital-To-Digital Conversion: Line Coding Schemes: Unipolar, Polar, Bipolar - Block Coding, Scrambling,	3
2.3	Analog-To-Digital Conversion: Pulse Code Modulation, Delta Modulation - Digital-To-Analog Conversion: ASK, FSK, PSK.	3
3	**Digital Transmission**	**7 Hours**
3.1	Transmission Modes: Parallel and Serial Transmission, Asynchronous, Synchronous, Isochronous Transmission	2
3.2	Multiplexing - TDM, FDM, WDM	2
3.3	Spread spectrum-The concept of spread spectrum – frequency hopping spread spectrum – direct sequence spread spectrum – code division multiple access	3
4	**Link Layer Communication**	**10 Hours**
4.1	Data Link Layer – design issues	2
4.2	Error Detection: Parity Check, Checksum, CRC, Error Correction: Hamming code	3

4.3	Flow Control: Stop-and-Wait, Go-Back-N, and Selective-Repeat	2
4.4	Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA, Controlled Access: Reservation, Polling, Token Passing, Ethernet- Ethernet Cabling, Encoding, Frame Format, Binary Exponential Back Off Algorithm.	3
5	**Network Layer**	**10 Hours**
5.1	Network Layer Design Issues, Routing Algorithm – Optimality principle - Flooding	2
5.2	Distance vector routing, Link state routing	2
5.3	Multicast Routing	1
5.4	Congestion Control Algorithms – General principles	1
5.5	Congestion prevention policies – Choke packets – Random Early Detection	2
5.6	Quality of Service requirements- Buffering, Traffic shaping – Leaky bucket algorithm.	1
5.7	Basic functions of Transport layer and Application layer	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT307	FORMAL LANGUAGES AND AUTOMATA THEORY	PCC	3	1	0	4

Preamble: The course is considered as a core subject in the area of computer science. This course introduces the formal languages and automata theory which includes various formal languages, strings, finite automaton, grammar, regular expression, pushdown automaton; Linear bounded automata and variants of Turing machine. Not only do they form basic models of computation, they are also the foundation of many branches of computer science, e.g. compilers, NLP, Program verification, Complexity theory. The properties of various automata will be studied and various rigorous techniques for analyzing and comparing them will be discussed, by using both formalism and examples.

Prerequisite: The students are expected to have basic knowledge in Set theory, Functions and Relations.

Course Outcomes: After the completion of the course the student will be able to

CO No.	Course Outcomes (CO)	Bloom's Category Level
CO 1	Understand the formal language hierarchy and its applications in the field of computation.	Level 2: Understand
CO 2	Construct automaton for any given regular language and find its equivalent regular expressions.	Level 3: Apply
CO 3	Design a context free grammar for any given context free language.	Level 3: Apply
CO 4	Construct Turing machines and understand their capability.	Level 3: Apply
CO 5	Analyze P,NP class and various undecidable problems.	Level 4: Analyze

Mapping of course outcomes with program outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2										2
CO 2	3	1										3
CO 3	1		3		2							1
CO 4	3	2			1							2
CO 5	3	3										3

3/2/1: High/Medium/Low

The COs and CO-PO map shall be considered as suggestive only.

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
BL 1: Remember	10	10	20
BL 2: Understand	30	30	60
BL 3: Apply	10	5	15
BL 4: Analyse		5	5
BL 5: Evaluate			
BL 6: Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Define grammar. How can we represent grammar in terms of an expression?
2. Check whether the given grammar is ambiguous or not.
3. Give a brief note on chomsky hierarchy for language classification

Course Outcome 2 (CO2):

1. Construct a DFA for the given regular language.
2. Consider the language for the NFA, strings ending with 'ab' over $\Sigma = \{a , b\}$. Convert the NFA into equivalent DFA.
3. Prove that the following languages are regular or not (Ex: $L = \{a^n \mid n >= 0\}$

Course Outcome 3(CO3):

1. Construct context free grammar for the regular expression:

   L = (a + b)* (aa + bb) (a+b)*

2. Which Normal form representation of CFG will you prefer in converting CFG to NPDA? Why?
3. Can we construct a deterministic PDA for the language ww^R . Justify your answer and also design a NPDA machine for the above language.

Course Outcome 4 (CO4):

1. Write a note on recursively enumerable language.
2. " For every language in the universe, there exists a TM". Justify your answer with a suitable example.
3. Discuss briefly about the halting problem of TM.

Course Outcome 5 (CO5):

1. Discuss on tractable problems.
2. Give a brief note on Universal Turing Machine(UTM).
3. Compare and contrast decidable problems and undecidable problems.

Model Question paper

Course Code: **ITT307**

Course Name: Formal Languages and Automata Theory

Max.Marks:100 Duration: 3 Hours

PART A

(10*3=30)

(Each Question carries 3 Marks)

1. Explain a) Language of DFA b) Extended transition function.
2. Design a DFA, which accepts the strings with even number of 0's and even number of 1's over {0,1}.
3. Construct the finite automaton equivalent to the regular expression i) R.S , ii) R*.
4. Design a Moore machine that takes a set of all strings over {a,b} as input and prints 1 as output for every occurrence of baa as a substring.
5. If a DFA D constructed from NFA N by the subset construction, then L(D) = L(N). Prove it.

6. Design ε -NFA for the set of strings consisting of zero or more a's followed by zero or more b's followed by zero or more c's. Try to use ε transitions to simplify your design.
7. Show that the language L={ 0 i 1 i | i is an integer and i>=1} is not regular using Pumping Lemma.
8. Explain Closure properties of CFL.
9. Define CFG. Give CFG generating the set of palindromes over alphabet {a,b}.
10. Define PushDown Automata.

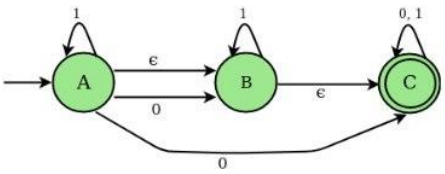
PART B **(5*14=70)**

11. State and prove the equivalence theorem between DFA and NFA.

OR

12. Construct a Moore machine that takes a set of all strings over { a, b } as input and prints '1' as output for every occurrence of ' ab ' as a substring.

13. Convert the following NFA- ∈ to its equivalent DFA.



OR

14. State and prove myhill nerode theorem. Also minimize a dfa for any regular language.

15. Obtain CFG for the language " Set of all palindromes". Discuss it.

OR

16. Can we construct a deterministic PDA for the language ww^R . Justify your answer. Also design a NPDA machine for the above language.

17. Simplify the following grammar:

S->AB / a

A-> BC / b

B-> aC / B

C->aB/ C

OR

18. Discuss about Turing Machine Halting Problem with a suitable example.

19. With a neat sketch explain about Universal Turing Machine.

OR

20. Design a Turing Machine, which can compute the second complement of a given binary number.

Syllabus

Module 1 – Finite automata (9 hours)
Family of formal languages - Finite automata – Type 3 formalism - Deterministic finite automata (DFA) – Language acceptance - Non-deterministic finite automata (NFA) – Finite automata with epsilon transitions – Applications - Finite automata with output - NFA to DFA conversions - Equivalence theorem between DFA and NFA -Minimization of DFA.
Module 2 - Regular languages & Regular expressions (10 hours)
Regular languages and Regular expressions: Myhill-Nerode theorem - Conversion of DFA's to Regular expressions by eliminating states - Conversion of Regular expressions to Automata – Closure properties of Regular languages – Pumping lemma for Regular languages - Applications of the Pumping lemma.
Module 3 – Type 2 formalism & Push Down Automata (10 hours)
Type 2 formalism: Context free grammars (CFG) and languages – Parse trees – Ambiguity in grammars – Pushdown automata (PDA) – Acceptance by final state and empty stack – Equivalence of PDA's and CFG's – Deterministic push down automata (DPDA) – Simplification of CFG - Pumping lemma for CFG's – Chomsky normal form – Greibach normal form.
Module 4 – Type 1 formalism(9 hours)
Closure properties of context free languages – Decision properties of CFL's - Type 1 formalism: Context sensitive grammar – Linear bounded automata .Type 0 formalism: Turing machine (TM) - Recursively enumerable language (REL) – Multitape TM – Non-deterministic TM – Properties of TM.
Module 5 - Undecidability and Universal Turing Machine (7 hours)
Halting problem of TM – Recursive languages - Unrestricted grammars - Universal Turing Machine (UTM) – Tractability - Undecidable problems - Introduction to P and NP class problems.

Text Books

1. J.E.Hopcroft, R.Motwani and J.D.Ullman , "Introduction to Automata Theory Languages and computation",3rd edition Pearson, 2008.
2. Michael Sipser, “Introduction to the Theory of Computation”, 3rd edition (or 1st edition),Course Technology Inc, 2013.

Reference Books

1. Harry R. Lewis, Christos H. Papadimitriou, “ Elements of the Theory of Computation”, Prentice-hall Publisher, 2nd edition, 1998.
2. K.Krithivasan and R.Rama; Introduction to Formal Languages, Automata Theory and Computation ,Pearson Education, 2009.
3. John C . Martin, “Introduction to Languages and the Theory of Computation”, McGraw-Hill Publisher, 4th edition, 2010.
4. Dexter C. Kozen, “Automata and Computability”, Springer.1997.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Finite automata (9 hours)**	
1.1	Family of formal languages	1
1.2	Deterministic finite automata	2
1.3	Non-deterministic finite automata	2
1.4	Finite automata with epsilon transitions	1
1.5	Finite automata with output	1
1.6	Equivalence between DFA and NFA	1
1.7	Minimization of DFA	1
2	**Regular languages & Regular expressions (10 hours)**	
2.1	Regular languages	1
2.2	Regular expressions	1
2.3	Myhill-Nerode theorem	1
2.4	Conversion of DFA’s to Regular expressions by state elimination	2
2.5	Conversion of Regular expressions to Automata	1
2.6	Closure properties of Regular languages	1
2.7	Pumping lemma for Regular languages	2
2.8	Applications of the Pumping lemma.	1
3	**Type 2 formalism & Push Down Automata (10 hours)**	
3.1	Context free grammars	1
3.2	Ambiguity in grammars	1
3.3	Push down automata(PDA)	2
3.4	String Acceptance by final state and empty stack	1
3.5	Equivalence of PDA’s and CFG’s	1
3.6	Deterministic push down automata (DPDA)	1

3.7	Simplification of CFG	1
3.8	Pumping lemma for CFG's	1
3.9	CNF and GNF	1
4	**Type 1 formalism(9 hours)**	
4.1	Closure properties of context free languages	1
4.2	Context sensitive grammar	1
4.3	Linear bounded automata	1
4.4	Turing machine	2
4.5	Recursively enumerable languages , Properties	1
4.6	Non-deterministic TM	2
4.7	Properties of TM	1
5	**Undecidability and Universal Turing Machine (7 hours)**	
5.1	Halting problem of TM	1
5.2	Recursive languages	1
5.3	Unrestricted grammars	1
5.4	Universal Turing machine	1
5.5	Tractability,Undecidable problems	1
5.6	P, NP class problems	2

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CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT309	MANAGEMENT FOR SOFTWARE ENGINEERS	PCC	3	0	0	3

Preamble: This course aims on providing the concepts of Software Engineering, Software Development Life Cycle and the key aspects of managing a software project like project evaluation, planning, monitoring along with management of people and quality.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO No.	Course Outcome (CO)	Bloom's Category
CO 1	Understand about the basics of software process, software development life cycle and process models.	Level 2 : Understand
CO 2	Interpret the concepts of managing software projects.	Level 2 : Understand
CO 3	Make use of project evaluation techniques and choose software estimation approaches for effort and cost.	Level 3: Apply
CO 4	Explain on planning the project activities and describe the concepts of risk management and resource allocation.	Level 2 : Understand
CO 5	Understand project monitoring and control, organize people and teams and describe the techniques for ensuring software quality.	Level 2 : Understand

Mapping of course outcomes with program outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2								1	1	2
CO 2	2	2								1	1	2
CO 3	2	1								1	1	2
CO 4	2	1								1	1	2
CO 5	2	2						1	2	1	2	2

3/2/1: high/medium/low

The COs and CO-PO map shall be considered as suggestive only.

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	80
Apply	20	20	10
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What is Software Engineering?
2. Explain about Software Process.
3. Explain about any one process model.

Course Outcome 2 (CO2)

1. Explain any one aspect of software project management spectrum.
2. Explain the importance of software project management over other types of projects.

3. What are the activities involved in project management?

Course Outcome 3(CO3):

1. How evaluation of individual projects is done?
2. What are steps in project planning?
3. Explain any one effort estimation technique.
4. Suppose a project was estimated to be 400 KLOC. Calculate the effort and development time for each of the three model i.e., organic, semi-detached & embedded.
5. Explain on cost estimation.

Course Outcome 4 (CO4):

1. Explain any one scheduling technique.
2. Explain on risk assessment.
3. How are resources identified for a project?

Course Outcome 5 (CO5):

1. How data collection is done for project monitoring?
2. What are the factors for selecting a right person for a project?
3. What is a quality plan?

Model Question paper

Course Code: ITT309

Course Name: MANAGEMENT FOR SOFTWARE ENGINEERS

Max Marks:100 Duration: 3hr

PART A

Answer all questions, each carries 3 marks

1. Explain the Generic process framework for Software engineering.

2. Briefly explain about Scrum.

3. How can a Project manager avoid the problems in a project which may lead to project failure?

4. Compare Traditional and Modern project management practices.

5. What is Cost-benefit analysis?

6. Explain the Bottom-up approach of estimation.

7. What are activity-on-arrow networks?

8. How are Risks identified?

9. What are the activities that are carried out as a part of the project termination review process?

10. Explain CMMI. (10*3=30)

PART B

Answer all questions, each carries 14 marks

11. a) What are the advantages and disadvantages of Waterfall model? How can an Agile model overcome the disadvantages of Waterfall model? (8)

b) What is Agile Modeling? Explain. (6)

OR

12. a) Explain prototyping model in detail. (9)

b) What is Pair programming? What are the advantages of Pair Programming? (5)

13. a) Explain about Agile Teams. (5)

b) How are Software projects categorized? (9)

OR

14. a) Explain the Product aspect of Software management spectrum. (8)

b) Explain the major activities carried out by a software project manager and the order in which these are carried out. (6)

15. Explain in detail the Steps in Project planning. (14)

OR

16. a) What is Benefits management? Explain. (5)

b) Explain the COCOMO II approach for effort estimation. (9)

17. a) Explain on the Forward pass and Backward pass analysis in CPM. (8)

b) How are resources scheduled over the duration of the project? (6)

OR

18. a) What is an Activity? Explain the approaches for identifying the activities that make up a project. (7)

b) Explain any one techniques used for evaluating risks in the project schedule. (7)

19. a) Explain Software Configuration Management. (9)

b) What is leadership? What are the various styles of Leadership? (6)

OR

20. a) Explain in detail about Earned Value Analysis. (10)

b) Explain the difference between Verification and Validation. (4)

Syllabus

Module 1 (8 Hours)
Introduction: Software engineering, Software process, Software engineering practice **Process models**: Prescriptive process models- Specialised process models, The unified process, Personal and Team process models. **Agile development:** Agility, Agile process. Extreme programming- XP Values, The XP Process, Industrial XP, The XP Debate. Other Agile development models- Adaptive Software Development (ASD), Scrum, Dynamic Systems Development Method (DSDM), Crystal, Feature Driven Development (FDD), Lean Software Development (LSD), Agile Modeling (AM), Agile Unified Process (AUP). Selection of an appropriate Project Approach- Choice of process Models.
Module 2 (5 Hours)
Managing software projects: Project Management Concepts –The Management Spectrum- People- Product- Process- Project. **Software Project Management** - Importance – Software projects VS other types of project – Categorizing Software projects- Stakeholders – Setting Objectives –The Business Case- Project success and failure. **Management** –Activities- Management Control- Traditional VS modern project management.
Module 3 (8 Hours)
Project Evaluation: Project portfolio management- Evaluation of individual projects- Cost benefit evaluation techniques- Risk evaluation- Programme Management- Creating a Programme- Aids to Programme Management- Benefits Management. **Project Planning**: Step wise Project Planning **Software Estimation:** Basis for software estimation- Software Effort estimation techniques- Bottom-up and Top-down estimation- Function Point Analysis- COCOMO II. Cost Estimation- Staffing Pattern- Schedule compression.

Module 4 (7 Hours)
Activity Planning: Objectives- Project Schedules- Projects and Activities- Sequencing and Scheduling Activities- Network Planning Models- Forward Pass- Backward pass- Identifying Critical Path and Critical Activities- Activity-on-arrow networks. **Risk Management:** Risk- Categories of Risk- Risk Identification- Risk Assessment- Risk Planning- Risk management- Risk Evaluation- PERT, Monte Carlo Simulation, Critical Chain. **Resource Allocation:** Nature of Resources- Identifying and Scheduling Resources- Creating Critical Paths- Cost Schedule- Scheduling sequence.
Module 5 (7 Hours)
Monitoring and Control: Creating the framework- Collecting data- Review- Project Termination Review- Visualizing Progress- Gantt Chart, Slip Chart, Timeline. Cost Monitoring- Earned Value Analysis- Getting the project back to target- Change control- Software Configuration Management- Contract management. **Managing People:** Organizational Behaviour- Selecting the right Person- Motivation- Stress- Working in Teams- Becoming a Team- Decision Making- Organization and Team Structures- Communication- Leadership. **Software Quality:** Quality Management Systems- Process Capability Models- CMMI, Six Sigma. Techniques for Enhancing Software Quality- Testing- Software Reliability- Quality Plans.

Text Books

1. Roger S Pressman, Software Engineering: A Practitioner's Approach, Seventh edition, Tata McGraw Hill.
2. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill

Reference Books

1. Pankaj Jalote, Software Project Management in Practice, Pearson Education
2. Walker Royce, Software Project Management- Addison-Wesley, 1998.
3. Sunitha E.V, Sarath K.S, Software Project Management, Jyothis Publishers 2019

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction**	**8 Hours**
1.1	Software engineering, Software process, Software engineering practice	1
1.2	**Process models**: Prescriptive process models- Specialised process models, The unified process, Personal and Team process models.	3
1.3	**Agile development:** Agility, Agile process. Extreme programming- XP Values, The XP Process, Industrial XP, The XP Debate. Other Agile development models- Adaptive Software Development (ASD), Scrum, Dynamic Systems Development Method (DSDM), Crystal, Feature Driven Development (FDD), Lean Software Development (LSD), Agile Modeling (AM), Agile Unified Process (AUP). Selection of an appropriate Project Approach- Choice of process Models.	4
2	**Managing software projects**	**5 Hours**
2.1	Project Management Concepts –The Management Spectrum- People- Product- Process- Project.	1
2.2	**Software Project Management** - Importance – Software projects VS other types of project – Categorizing Software projects- Stakeholders – Setting Objectives –The Business Case- Project success and failure.	3
2.3	**Management** –Activities- Management Control- Traditional VS modern project management.	1
3	**Evaluation, Planning and Estimation**	**8 Hours**
3.1	**Project Evaluation:** Project portfolio management- Evaluation of individual projects- Cost benefit evaluation techniques- Risk evaluation- Programme Management- Creating a Programme- Aids to Programme Management- Benefits Management.	3
3.2	**Project Planning**: Step wise Project Planning	2
3.3	**Software Estimation:** Basis for software estimation- Software Effort estimation techniques- Bottom-up and Top-down estimation- Function Point Analysis- COCOMO II. Cost Estimation- Staffing Pattern- Schedule compression.	3
4	**Activity Planning, Risk management and Resource allocation**	**7 Hours**
4.1	**Activity Planning:** Objectives- Project Schedules- Projects and Activities- Sequencing and Scheduling Activities- Network	3

	Planning Models- Forward Pass- Backward pass- Identifying Critical Path and Critical Activities- Activity-on-arrow networks.	
4.2	**Risk Management:** Risk- Categories of Risk- Risk Identification- Risk Assessment- Risk Planning- Risk management- Risk Evaluation- PERT, Monte Carlo Simulation, Critical Chain.	2
4.3	**Resource Allocation:** Nature of Resources- Identifying and Scheduling Resources- Creating Critical Paths- Cost Schedule- Scheduling sequence	2
5	**Monitoring, People management, Quality**	**7 Hours**
5.1	**Monitoring and Control:** Creating the framework- Collecting data- Review- Project Termination Review- Visualizing Progress- Gantt Chart, Slip Chart, Timeline. Cost Monitoring- Earned Value Analysis- Getting the project back to target- Change control- Software Configuration Management- Contract management.	3
5.2	**Managing People:** Organizational Behaviour- Selecting the right Person- Motivation- Stress- Working in Teams- Becoming a Team- Decision Making- Organization and Team Structures- Communication- Leadership.	2
5.3	**Software Quality:** Quality Management Systems- Process Capability Models- CMMI, Six Sigma. Techniques for Enhancing Software Quality- Testing- Software Reliability- Quality Plans.	2

MCN 301	DISASTER MANAGEMENT	Category	L	T	P	CREDIT	YEAR OF INTRODUCTION
		Non - Credit	2	0	0	Nil	2020

Preamble: The objective of this course is to introduce the fundamental concepts of hazards and disaster management.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Define and use various terminologies in use in disaster management parlance and organise each of these terms in relation to the disaster management cycle (Cognitive knowledge level: **Understand**).
CO2	Distinguish between different hazard types and vulnerability types and do vulnerability assessment (Cognitive knowledge level: **Understand**).
CO3	Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk (Cognitive knowledge level: **Understand**).
CO4	Explain the core elements and phases of Disaster Risk Management and develop possible measures to reduce disaster risks across sector and community (Cognitive knowledge level: **Apply**)
CO5	Identify factors that determine the nature of disaster response and discuss the various disaster response actions (Cognitive knowledge level: **Understand**).
CO6	Explain the various legislations and best practices for disaster management and risk reduction at national and international level (Cognitive knowledge level: **Understand**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO1 1	PO1 2
CO1		2				2				2		2
CO2	2	3	2		2	2	3			3		2
CO3	2	3	2	2	2	2	3			3		2
CO4	3	3	3		2	2	3					2
CO5	3	3			2	2	3					2
CO6	3					2	3	3				2

The COs and CO-PO map shall be considered as suggestive only.

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	**10**	**10**	**20**
Understand	**25**	**25**	**50**
Apply	**15**	**15**	**30**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A.

Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

MCN 301 Disaster Management

Module 1

Systems of earth

Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland water bodies; biosphere

Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.

Module 2

Hazard types and hazard mapping; Vulnerability types and their assessment- physical, social, economic and environmental vulnerability.

Disaster risk assessment –approaches, procedures

Module 3

Disaster risk management -Core elements and phases of Disaster Risk Management

Measures for Disaster Risk Reduction – prevention, mitigation, and preparedness.

Disaster response- objectives, requirements; response planning; types of responses.

Relief; international relief organizations.

Module 4

Participatory stakeholder engagement; Disaster communication- importance, methods, barriers; Crisis counselling

Capacity Building: Concept – Structural and Non-structural Measures, Capacity Assessment; Strengthening Capacity for Reducing Risk

Module 5

Common disaster types in India; Legislations in India on disaster management; National disaster management policy; Institutional arrangements for disaster management in India.

The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles

Reference Text Book

1. R. Subramanian, Disaster Management, Vikas Publishing House, 2018
2. M. M. Sulphey, Disaster Management, PHI Learning, 2016
3. UNDP, Disaster Risk Management Training Manual, 2016
4. United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. Explain the different types of cyclones and the mechanism of their formation
4. Explain with examples, the difference between hazard and risk in the context of disaster management
5. Explain the following terms in the context of disaster management (a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

Course Outcome 2 (CO2):

1. What is hazard mapping? What are its objectives?
2. What is participatory hazard mapping? How is it conducted? What are its advantages?
3. Explain the applications of hazard maps
4. Explain the types of vulnerabilities and the approaches to assess them

Course Outcome 3 (CO3):

1. Explain briefly the concept of ‘disaster risk’

2. List the strategies for disaster risk management ‘before’, ‘during’ and ‘after’a disaster
3. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy

Course Outcome 4 (CO4):

1. What is disaster prevention? Distinguish it from disaster mitigation giving examples
2. What are the steps to effective disaster communication? What are the barriers to communication?
3. Explain capacity building in the context of disaster management

Course Outcome 5 (CO5):

1. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
2. Explain the importance of communication in disaster management
3. Explain the benefits and costs of stakeholder participation in disaster management
4. How are stakeholders in disaster management identified?

Course Outcome 6 (CO6):

1. Explain the salient features of the National Policy on Disaster Management in India
2. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction
3. What are Tsunamis? How are they caused?
4. Explain the earthquake zonation of India

Model Question paper

QP CODE: **PAGES:3**

Reg No:_____ **Name :_____**

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MCN 301

Course Name: Disaster Management

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. What is hazard mapping? What are its objectives?
4. Explain briefly the concept of 'disaster risk'
5. List the strategies for disaster risk management 'before', 'during' and 'after'a disaster
6. What is disaster prevention? Distinguish it from disaster mitigation giving examples
7. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
8. Explain the importance of communication in disaster management
9. What are Tsunamis? How are they caused?
10. Explain the earthquake zonation of India

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. a. Explain the different types of cyclones and the mechanism of their formation [10]

b. Explain with examples, the difference between hazard and risk in the context of disaster management
[4]

OR

12. Explain the following terms in the context of disaster management [14]

(a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

13. a. What is participatory hazard mapping? How is it conducted? What are its advantages? [8]

b. Explain the applications of hazard maps [6]

OR

14. Explain the types of vulnerabilities and the approaches to assess them [14]

15. a. Explain the core elements of disaster risk management [8]

b. Explain the factors that decide the nature of disaster response [6]

OR

16. a. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy [6]

b. Explain the different disaster response actions [8]

17. a. Explain the benefits and costs of stakeholder participation in disaster management [10]

b. How are stakeholders in disaster management identified? [4]

OR

18. a. What are the steps to effective disaster communication? What are the barriers to communication? [7]

b. Explain capacity building in the context of disaster management [7]

19. Explain the salient features of the National Policy on Disaster Management in India [14]

OR

20. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction [14]

Teaching Plan

	Module 1	**5 Hours**
1.1	Introduction about various Systems of earth, Lithosphere-composition, rocks, Soils; Atmosphere-layers, ozone layer, greenhouse effect, weather	1 Hour
1.2	Cyclones, atmospheric circulations, Indian Monsoon; hydrosphere-Oceans, inland water bodies; biosphere	1 Hour
1.3	Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard,	1 Hour
1.4	Exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, Disaster risk management, early warning systems	1 Hour
1.5	Disaster preparedness, disaster prevention, disaster, Mitigation, disaster response, damage assessment, crisis counselling, needs assessment.	1 Hour
	Module 2	**5 Hours**
2.1	Various Hazard types, Hazard mapping; Different types of Vulnerability types and their assessment	1 Hour
2.2	Vulnerability assessment and types, Physical and social vulnerability	1 Hour
2.3	Economic and environmental vulnerability, Core elements of disaster risk assessment	1 Hour
2.4	Components of a comprehensive disaster preparedness strategy approaches, procedures	1 Hour
2.5	Different disaster response actions	1 Hour
	Module 3	**5 Hours**
3.1	Introduction to Disaster risk management, Core elements of Disaster Risk Management	1 Hour
3.2	Phases of Disaster Risk Management, Measures for Disaster Risk Reduction	1 Hour
3.3	Measures for Disaster prevention, mitigation, and preparedness.	1 Hour

3.4	Disaster response- objectives, requirements. Disaster response planning; types of responses.	1 Hour
3.5	Introduction- Disaster Relief, Relief; international relief organizations.	1 Hour
	Module 4	**5 Hours**
4.1	Participatory stakeholder engagement	1 Hour
4.2	Importance of disaster communication.	1 Hour
4.3	Disaster communication- methods, barriers. Crisis counselling	1 Hour
4.4	Introduction to Capacity Building. Concept – Structural Measures, Non-structural Measures.	1 Hour
4.5	Introduction to Capacity Assessment, Capacity Assessment; Strengthening, Capacity for Reducing Risk	1 Hour
	Module 5	**5 Hours**
5.1	Introduction-Common disaster types in India.	1 Hour
5.2	Common disaster legislations in India on disaster management	1 Hour
5.3	National disaster management policy, Institutional arrangements for disaster management in India.	1 Hour
5.4	The Sendai Framework for Disaster Risk Reduction and targets	1 Hour
5.5	The Sendai Framework for Disaster Risk Reduction-priorities for action, guiding principles	1 Hour

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITL331	OPERATING SYSTEM AND NETWORK PROGRAMMING LAB	PCC	0	0	3	2

Preamble: Operating System and Network Programming Lab aims at giving an in depth idea of operating system and networking concepts. Students will understand the basic commands and the implementation of process scheduling, inter process communication, semaphores etc. and also aim to implement network programming in Java.

Prerequisite: Concepts of Operating Systems and Networking, and Programming knowledge in C and JAVA

Course Outcomes:

After the completion of the course the student will be able to

CO. No.	Course Outcomes	Bloom's Taxonomy
CO 1	Analyse CPU Scheduling Algorithms like FCFS, Round Robin, SJF and Priority.	Level 4: Analyse
CO 2	Implement inter process communication and process synchronization problems.	Level 3: Apply
CO 3	Implement memory management schemes - first fit, best fit and worst fit.	Level 3: Apply
CO 4	Implement client server communication using sockets.	Level 3: Apply
CO 5	Implement MAC protocols.	Level 3: Apply
CO 6	Familiarization of network simulation tool.	Level 2: Understand

Mapping of course outcomes with program outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	-	-	-	-	1	-	3
CO 2	3	3	3	2	1	-	-	-	-	1	-	3
CO 3	3	3	3	2	1	-	-	-	-	1	-	3
CO 4	3	3	3	2	2	-	-	-	-	1	-	3
CO 5	3	3	3	2	2	-	-	-	-	1	-	3
CO 6	2	2	2	2	3	-	-	-	-	1	-	3

3/2/1: High/Medium/Low

The COs and CO-PO map shall be considered as suggestive only.

Assessment Pattern:

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks
Continuous Assessment : 30 marks
Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks
(b) Implementing the work/Conducting the experiment : 10 Marks
(c) Performance, result and inference (usage of equipments and trouble shooting) : 25 Marks
(d) Viva voce : 20 marks
(e) Record : 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. Write a program to implement FCFS and Round Robin process scheduling algorithms for the following scenario.

Processes	Arrival time	Burst time
P0	0	7
P1	2	4
P2	4	1
P3	5	4

Assume quantum time for RR is 2

(i) What is the Average Turn-around time for each of these scheduling algorithms?

(ii) What is the Total Waiting time for each of these scheduling algorithms?

Course Outcome 2 (CO2):

1. Program to implement Inter Process Communication using shared memory.
2. Program to implement Dining Philosophers problem using semaphores.

Course Outcome 3 (CO3):

1. Implement first fit, best fit and worst fit memory management schemes.

Course Outcome 4 (CO4):

1. Program to implement client server communication using sockets.
2. Program to implement chat application.

Course Outcome 5 (CO5):

1. Program to implement Go Back N protocol.

Course Outcome 6 (CO6):

1. Simulate Bus topology using NS-3.

LIST OF EXPERIMENTS

(All the listed experiments are mandatory)

OPERATING SYSTEM

(Experiments are to be implemented using C programming language)

1. Familiarization of system calls (fork, exec, getpid, exit, wait, close, stat etc) in operating system.
2. Implement process scheduling algorithms (FCFS, SJF, Round-Robin, Priority) and compute average waiting time and average turn-around time.
3. Inter-process communication using mail boxes, pipes, message queues and shared memory.
4. Implementation of dining philosophers problem using threads, semaphores and shared memory.
5. Implementation of banker’s algorithm.
6. Implement memory management schemes (first fit, best fit and worst fit).

NETWORK PROGRAMMING

(Experiments are to be implemented using JAVA programming language)

7. Familiarisation of Network Programming API in Java.
8. Implementation of Medium Access Control protocols – 1) Go Back N. 2) Selective Repeat and 3) Sliding Window.
9. Implementation of an echo server.
10. Implement Client-Server communication using sockets.
11. Implementation of chat application
12. Install network simulator NS-3 in Linux operating system and simulate wired and wireless scenarios. (Familiarization only)

References:

1. Abraham Silberschatz, Peter B Galvin, Greg Gagne, Operating System Concepts, 9/e, Wiley India, 2015.
2. Behrouz A Forouzan, Data Communications & Networking –Mc Graw Hill,2008.
3. Herbert Schildt, “The Java 2 : Complete Reference” Tenth Edition - Mc Graw Hill.
4. https://www.nsnam.org/docs/tutorial/html/

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITL333	WEB APPLICATION DEVELOPMENT LAB	PCC	0	0	3	2

Preamble: Web Application Development Lab is intended to deliver hands-on experience of Web Application Development with HTML, CSS, JavaScript, JQuery, Node JS and Mongo DB thereby equipping them to develop real time web applications.
Prerequisites: Basics of Programming, ITT301 Web Application Development

Course Outcomes: After the completion of the course the student will be able to

CO.No.	Course Outcomes
CO1	Infer the structure of HTML elements in a webpage
CO2	Build Webpages using HTML and CSS
CO3	Utilize JavaScript to add functionality to webpages
CO4	Implement different Ajax & JQuery functionalities in Web development.
CO5	Develop a web applications using Node JS and MongoDB

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	2	-	-	-	-	-	-	-	-
CO2	1	2	-	2	-	-	-	-	-	-	-	-
CO3	2	2	-	2	-	-	-	-	-	-	-	-
CO4	2	2	-	3	-	-	-	-	-	-	-	-
CO5	2	3	1	3	-	-	-	-	-	-	-	2

3/2/1: High/Medium/Low

The COs and CO-PO map shall be considered as suggestive only.

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30 marks

End Semester Examination Pattern:

The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipment and troubleshooting)	: 25 Marks
(d) Viva voce	: 20 Marks
(e) Record	: 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Develop a website (HTML) for College Library having pages:
    a) Home Page:
        - Navbar
        - Banner image
        - Contents
        - Footer
    b) Books Management
        - Add/Remove Book
        - Book Details
    c) About Us

2. Create a website which demonstrates the usage of following HTML tags:
    - Headings
    - Paragraphs
    - Image
    - Lists
    - Anchor
    - Forms
3. Develop a website for Online Bus Ticket Booking having pages:
    a) Home Page:
        - Navbar

-Banner image
- Contents
- Footer

b) Ticket Booking
- Book Ticket
- Booking Details

c) About Us

Course Outcome 2 (CO2)

1. Develop a website for College Library having pages:
   a) Home Page:
      - Navbar
      - Banner image
      - Contents
      - Footer
   b) Books Management
      - Add/Remove Book
      - Book Details
   c) About Us

2. Develop a Responsive website for Online Bus Ticket Booking

3. Develop an Online shopping website using HTML and Bootstrap

Course Outcome 3(CO3):

1. Write javascript code to calculate grades of students and average grade of a class(use prompt to get input)

2. Develop “Craps dice game” with javascript.

3. Develop a to do list app with HTML, CSS and Javascript (use AJAX with JSON)

Course Outcome 4 (CO4):

1. Develop Craps dice game with jquery

2. Develop a to do list app with HTML, CSS and JQuery(use AJAX with JSON)

3. Develop an online shopping website with HTML, CSS and JQuery (use JQuery Animations and plugins)

Course Outcome 5 (CO5):

1. Develop a website for College Library using Node JS with MongoDB.

2. Develop a Responsive website for Online Bus Ticket Booking using Node JS with MongoDB

3. Develop an Online shopping website using Node JS with MongoDB

LIST OF EXPERIMENTS

(All the listed experiments are mandatory)

1. Install, setup Integrated Development Environment (IDE) for web development.
2. Create a web page with all possible elements of HTML5
3. Create a web page with all types of Cascading style sheets
4. Create a Responsive Web page with HTML and CSS
5. Create Responsive web page with Bootstrap
6. Programs to demonstrate JavaScript array, object and functions
7. Client Side Scripts for Form Validation using JavaScript
8. Programs to familiarise ES6 concepts
9. Programs to demonstrate DOM and event handling.
10. Programs using AJAX with HTML, XML and JSON data
11. Programs to familiarise JQuery.
12. Create a website with HTML, CSS and Javascript (implement Ajax)
13. Programs to familiarise Server Side Scripting using Node JS
14. Programs using MongoDB database with Node JS
15. Develop a web site with HTML, CSS, Javascript/JQuery, Node JS and MongoDB

Reference Books

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, “Internet and World Wide Web How To Program”, 5/E, Pearson Education, 2012.
2. Jon Duckett , “HTML and CSS: Design and Build Websites”, Wiley
3. Jon Duckett , “JavaScript and JQuery: Interactive Front–End Web Development”, Wiley
4. Nicholas C. Zakas, “Understanding ECMAScript 6: The Definitive Guide for JavaScript Developers”
5. Alex Young, Marc Harter, “Node js in practice”, Manning
6. Json Krol , “Web Development with mongodb and node js”, Packt
7. Krishna Rungta , “Node JS: learn in one day”

SEMESTER V

MINOR

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT381	WEB APPLICATION DEVELOPMENT	VAC	3	1	0	4

Preamble: This course is intended to make the students capable of understanding the important components of HTML5 documents and use HTML5,CSS to create web pages.The course is intended to help he students to develop dynamic web pages PHP, Java Servlets and Java Server Pages

Prerequisite: ITT281 JAVA programming, ITT282 Database Management

Course Outcomes: After the completion of the course the student will be able to

CO No.	Course Outcomes	Bloom's Category
CO1	Discuss the important components of HTML5 documents and use HTML5 to create web pages	Level 2: Understand
CO2	Apply styles in web pages using cascading style sheets	Level 3: Apply
CO3	Develop dynamic web pages using PHP.	Level 3: Apply
CO4	Develop server based programs using Java Servlets	Level 3: Apply
CO5	Develop dynamic web pages using Java Server Pages	Level 3: Apply

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	3	-	2	-	-	-	-	-	-	3
CO 2	2	-	3	-	2	-	-	-	-	-	-	3
CO 3	3	-	3	-	2	-	-	-	-	-	-	3
CO 4	3	-	3	-	2	-	-	-	-	-	-	3
CO 5	3	-	3	-	2	-	-	-	-	-	-	3

3/2/1: high/medium/low

The COs and CO-PO map shall be considered as suggestive only.

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	20	20	30

Apply	25	25	60
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Create an HTML5 document containing an ordered list of three items—ice cream, pizza and soft drinks. Each ordered list should contain a nested, unordered list of your favourite flavours. Provide three flavours in each unordered list.

2. What do you meant by MIME? Explain its uses? Provide any FIVE examples.

3. Create a web page using HTML5 to accomplish a feedback on a cafeteria.

Course Outcome 2 (CO2):

1. Using CSS create a sophisticated drop down menu for a set of web page addresses

2. Explain conflicting styles with examples. What happens when conflicting occurs? How can you remove the conflicts?

3. Write a CSS rule that changes the colour of all elements containing attribute class = "red_colour" to red.

.

Course Outcome 3(CO3):

1. With a PHP code snippet illustrate the use of "foreach" loop in PHP.
2. Design and Develop a mail registration form using PHP.
3. Develop a student management system using PHP.

Course Outcome 4(CO4):

1. Design and Develop a Servlet based web application to update the basic salary of all employees belonging to the department of sales by 5%, assuming there exists an employee table with field(e_id,e_dept,e_name,b_sal,n_sal)?
2. Explain the methods used to implement the life cycle of Servlets
3. List out the benefits of Servlets

Course Outcome 5(CO5):

1. How to pass control from one JSP page to another?
2. Explain the importance of data sharing among JSP Pages. Design and Develop a JSP based web application to display the values which is being entered by the user in a registration form
3. How does Error handling is done in JSP

Model Question paper

Course Code: ITT381

Course Name: WEB APPLICATION DEVELOPMENT

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. What is Internal Linking? How can it be achieved?
2. List out any 5 page structure elements
3. List any 4 media types available in CSS?
4. How can you insert CSS codes in your HTML page? Provide one example for each methods
5. In PHP how can you search a string using regular expressions
6. Discuss the differences between server side programming and client side programming
7. Compare and Contrast doGet and doPost service methods of Servlets

8. Explain the use of Servlets in MVC architecture

9. How to pass control from one JSP page to another?

10. Explain the role of JSP in MVC design

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. a) Suppose your HTML page contains a text input element for inputting months of a year. How can you provide a drop-down list of pre-defined options of months for that text element? (7Marks)

b) Using HTML5 scripting create the below given table (CO1)

Sl. No	Department	No of Students	
		Boys	Girls
1	IT	110	135
2	ME	220	18
3	EC	160	180
4	CE	200	120

(7 Marks)

12. a) Create an HTML5 document containing an ordered list of animals of three kinds—Carnivorous, Herbivorous and Omnivorous. Each ordered list should contain a nested, unordered list of your favourite animals. Provide atleast three of them in each unordered list (8 Marks)

b) Provide HTML tags for inserting the following:

i) >
ii) ©
iii) ®
iv) 1/4
v) Horizontal Rule
vi) &. (6 Marks)

13. a) Illustrate different flavours of positioning elements available in CSS with examples. (7 Marks)

b) Provide CSS rules to set background image of a page. Make it tiled.

(7 Marks)

14.a) Explain conflicting styles with examples. What happens when conflicting occurs? How can you remove the conflicts?
(8 marks)

b) Which all are the media types available in CSS? Explain the uses of atleast two types with an example. (6 Marks)

15. a) Implement a database based online student management system using PHP. The system should have the following features:

i. Provision to input the student details such as stud_name, stud_rollno, stud_age, stud_branch, stud_gender
ii. Provision to search a student using stud_rollno
iii. Provision to delete a student using stud_rollno
iv. Provision to display the details of all students available in the database.

(10 marks)

b) List out the methods to access a web server (4 Marks)

16. a) How can you make data type conversions in PHP? (4 marks)

b) Describe the steps involved in PHP to access a database. (10 Marks)

17. a) Describe the use of Servlet Container with a neat diagram (6 marks)

b) Develop a Servlets based online student management system with the following features:

(i) Student registration (ii) Student search using stud_ID

(iii) Student deletion using stud_ID (8 Marks)

18. a) With a neat diagram explain the Servlets life cycle. (7 marks)

b) Implement a simple mail registration application using Java Servlets. (7 Marks)

19. a) With a JSP program explain the method of sharing control among different pages.

(8 Marks)

b) Develop a registration and login form for an e-mail application using JSP and required database. (6 marks)

20. a) With neat diagrams explain the architecture of JSP applications. (8 Marks)

b) How does error handling done in JSP using Exception objects? Explain with an example. (6 marks)

Syllabus

Module 1	**No. of Lectures**
Introduction to Computers and the Internet- Web Basics, Introduction to HTML5 - W3C HTML5 Validation Service, Headings, Linking, Images, Special Characters and Horizontal Rules, Lists, Tables, Forms, Internal Linking, meta elements, New HTML5 Form input Types, input and data list elements and auto complete Attribute, Page-Structure Elements.	8 hours
Module 2	
Introduction to Cascading Style Sheets -Inline Styles, Embedded Style Sheets, Conflicting Styles, Linking External Style Sheets, Positioning Elements - Absolute Positioning, z-index, Relative Positioning, span, Backgrounds, Element Dimensions, Box Model and Text Flow, Media Types, Drop-Down Menus	8 hours
Module 3	
Web Servers: Introduction, HTTP Transactions, Multitier Application Architecture, Client-Side Scripting versus Server-Side Scripting, Accessing Web Servers. Server Side Programming with PHP - Introduction, converting Between Data Types, Arithmetic Operators, Form Processing and Business Logic, Using PHP to Process HTML5 Forms, Accessing MySQL Database with PHP	10 hours
Module 4	
Servlets: Introduction to Servlets, Benefits of Servlets, servlets as controller in MVC, basic HTTP, servlet container, servlet lifecycle,Servlets with JDBC	9 hours
Module 5	
Java Server Pages: Generating Dynamic Content, Using Scripting Elements, Implicit JSP Objects. Error Handling and Debugging, Passing Control and Data between Pages – Sharing Session and Application Data – Application Models - MVC Design	10 hours

Text Books

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, “Internet and World Wide Web How To Program”, 5/E, Pearson Education, 2012.

2. Hans Bergsten , Java Server Pages, O’Reilly, 2003

3. Jason Hunter, William Crawford, Java Servlet Programming, Second Edition, , O'Reilly Media.

Reference Books

1. Robert W. Sebesta, "Programming the World Wide Web", 8/E, Pearson Education, 2012.

2. Chris Bates, "Web Programming – Building Intranet applications", Wiley Publications, 3rd Edition, 2009..

3. Joseph J. Bambara, Paul R. Allen, Mark Ashnault, Ziyad Dean, Thomas Garben, Sherry Smith J2EE UNLEASHED — SAMS Techmedia

4. Roman, Scott Ambler, Tyler Jewell (ed.), Mastering EJB(2nd Edition) – Ed– John Wiley Publications, 2003.

5. Stepahnie Bodoff, Dale Green, Kim Hasse, Eric Jendrock, Monica Pawlan, Beth Stearns , The J2EE Tutorial, Pearson Education , Asia.

6. www.w3schools.com

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to Computers and the Internet**	**8 hours**
1.1	Introduction to Computers and the Internet- Web Basics	1 hour
1.2	Introduction to HTML5 - W3C HTML5 Validation Service, Headings, Linking, Images, Special Characters and Horizontal Rules	2 hours
1.3	Lists, Tables	1 hour
1.4	Forms, Internal Linking, meta elements	1 hour
1.5	New HTML5 Form input Types, input and data list elements and auto complete Attribute,	2 hours
1.6	Page-Structure Elements.	1 hour
2	**Introduction to Cascading Style Sheets**	**8 hours**
2.1	Inline Styles, Embedded Style Sheets	2 hours
2.2	Conflicting Styles, Linking External Style Sheets	2 hours
2.3	Positioning Elements - Absolute Positioning, z-index, Relative Positioning, span, Backgrounds, Element Dimensions	2 hours
2.4	Box Model and Text Flow, Media Types, Drop-Down Menus	2 hours
3	**Web Servers**	**10 hours**
3.1	Introduction, HTTP Transactions, Multitier Application Architecture, Client-Side Scripting versus Server-Side Scripting, Accessing Web Servers.	2 hours
3.2	Server Side Programming with PHP - Introduction, converting	2 hours

	Between Data Types, Arithmetic Operators	
3.3	Form Processing and Business Logic	2 hours
3.4	Using PHP to Process HTML5 Forms	2 hours
3.5	Accessing MySQL Database with PHP	2 hours
4	**Java Servlets**	**9 hours**
4.1	Introduction to Java Servlets, Benefits of Servlets, use as controller in MVC,	2 hours
4.2	basic HTTP, servlet container,	2 hours
4.3	Servlet lifecycle	1 hour
4.4	Servlets with JDBC	4 hours
5	**Java Server Pages**	**10 hours**
5.1	Generating Dynamic Content, Using Scripting Elements,	2 hours
5.2	Implicit JSP Objects.	1 hour
5.3	Error Handling and Debugging	2 hours
5.4	Passing Control and Data between Pages	2 hours
5.5	Sharing Session and Application Data	2 hours
5.6	Application Models - MVC Design	1 hour

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT383	INTERNET TECHNOLOGY	VAC	3	1	0	4

Preamble: This subject provides an overview on the principles on which the Internet and other distributed systems are based; their architecture, algorithms and design. It covers the important topic of middleware, examining different approaches to supporting distributed applications including distributed objects and components, and web services.The two dominant modern network architectures are cloud computing and the Internet of things (IoT) is also introduced here. The subject then covers the well-established topics of security.

Prerequisite: ITT 283 Data Communication and ITT 284 Computer Networks

Course Outcomes: After the completion of the course the student will be able to

CO No.	Course Outcomes(CO)	Bloom's Category
CO 1	Describe building blocks of distributed systems.	Level2: Understand
CO 2	Explain the functions of remote invocation, operating system and webserver and understand its application on Internet.	Level2:: Understand
CO 3	Familiarize with the basic concepts, cloud services, deployment models, and architecture of cloud computing.	Level2:: Understand
CO 4	Discuss the key foundation and uses of IoT enabled devices and familiarize with the IoT architecture reference model.	Level2:: Understand
CO 5	Describe the modern networking security issues, and their solutions.	Level2:: Understand

Mapping of course outcomes with program outcomes

POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	-	-	-	-	-	-	-	-	-	2
CO 2	3	2	1	-	-	-	-	-	-	-	-	2
CO 3	3	2	1	-	1	-	-	-	-	-	-	2
CO 4	3	2	1	-	-	-	-	-	-	-	-	2
CO 5	3	2	1	-	2	-	-	-	-	-	-	2

3/2/1: high/medium/low

The COs and CO-PO map shall be considered as suggestive only.

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1(Marks)	Test 2(Marks)	
Remember	10	10	20
Understand	40	40	80
Apply			
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are the features of distributed systems?
2. What is interprocess communication?

Course Outcome 2 (CO2)

1. What is request reply protocol?
2. What are the differences between process and threads?

Course Outcome 3(CO3):

1. What are the features of cloud computing?
2. Explain ITU-T Cloud Computing Functional Reference Architecture

Course Outcome 4 (CO4):

1. Explain in detail about types of sensors
2. Explain the elements of RFID systems

Course Outcome 5 (CO5):

1. Discuss the importance of encryption in communication
2. Explain wireless network security

Model Question Paper

Course Code: ITT383
Course Name: INTERNET TECHNOLOGY

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks. (10 * 3 = 30 Marks)

1. Give examples for distributed system
2. What is HTML?
3. What is middleware?
4. What is a thread?
5. What are the characteristics of cloud computing?
6. What is Infrastructure as a service?
7. What is an actuator?
8. What is RFID?
9. What is the difference between HTTP and HTTPS?
10. What is VPN?

Part B

Answer all questions. Each question carries 14 marks. (5 * 14 = 70 Marks)

11. What is a distributed system? Explain the challenges in distributed system.

OR

12. Explain in detail about overlay networks.

13. Explain in detail about remote procedure call.

OR

14. Explain about web service infrastructure and components.

15. Illustrate NIST cloud computing reference architecture.

OR

16. Describe the three basic cloud services in detail.

17. Explain the different elements in an RFID system in detail.

OR

18. Describe the ITU-T Y.2060 IoT Reference Model.

19. Explain any 5 security scams used to fool users

OR

20. Explain in detail about wireless network security

Syllabus

Module 1: Introduction to Distributed Systems (9Hours)
Characterization of Distributed Systems: Introduction, Examples of distributed systems, Trends in distributed systems, Challenges, Case Study: The World Wide Web. System Models: Introduction, Physical Models, Architectural models. Interprocess Communication: Introduction, The APIs for internet protocols, External data representation and marshalling, Network Virtualization: Overlay networks. *Text Book I – Chapter 1,2, and 4*
Module 2: Distributed Middleware Application(9 Hours)
Remote Invocation: Introduction, request-reply protocols, remote procedure call, remote method invocation. Operating system support: Introduction, The operating system layer, Processes and threads, Communication and invocation. Web Services: Introduction, Web Services, Coordination of web services, Application of web services *Text Book I – 5, 7, and 9*
Module 3: Cloud Computing (9 Hours)
Basic Concepts, Cloud Computing Elements, Cloud Service Models: SaaS, PaaS, IaaS, Other Cloud Services, Cloud Deployment Models, NIST Cloud Computing Reference Architecture, ITU-T Cloud Computing Reference Architecture, ITU-T Cloud Computing Functional Reference Architecture *Text Book II – Chapter 13*

Module 4: Internet of Things (9Hours)
The Internet of Things: Components. Scope of the Internet of Things, Components of IoT-Enabled Things: Sensors, Types of Sensors, Actuators, Embedded System, Microprocessors, Microcontrollers, Transceivers, RFID, IoT Architecture - ITU-T Y.2060 IoT Reference Model, IoT World Forum Reference Model *Text Book II – Chapter 14, 15*
Module 5: Network Security(9 Hours)
Introduction, Cybercrime And Cyber Security, Unsecure Internet, Computer Encryption, Confidential Web Browsing, Encryption Keys, Authentication: User IDs And Passwords, Two-Factor Authentication,Wireless Network Security, Network Firewall, Security Scams, Man-In-The-Middle Attacks, Email Addresses And Web Site URLs based attacks, Malware In Email Attachments, Secure Access with VPNs, VPN Technology *Text Book III – Chapter 14, 15*

Text Books

1. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, "Distributed Systems – Concepts and Design". 5/e Addison Wesley, Inc., 2012.
2. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud". 10/e Pearson Education, Inc., 2016.
3. Douglas E. Comer, "The Internet Book: Everything You Need to Know about Computer Networking and How the Internet Works", 5th edition, CRC Press, 2019.

Reference Books

1. William Stallings, "Computer Security: Principles and Practice", 3/e, Pearson Education Inc,2015
2. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", Wiley, 2013
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGrawhill, 2009
4. Douglas E. Comer, Computer Networks and Internets, 6/e,Pearson Education Inc,2018

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1: Introduction to Distributed Systems (9 Hours)**	
1.1	Characterization of Distributed Systems: Introduction, Examples of distributed systems	2Hours
1.2	Trends in distributed systems, Challenges, Case Study: The World Wide Web.	2Hours
1.3	System Models: Introduction, Physical Models, Architectural models.	2Hours
1.4	Interprocess Communication: Introduction, The APIs for internet protocols, External data representation and marshalling	2 Hours
1.5	Network Virtualization: Overlay networks	1 Hour
2	**Module 2: Distributed Middleware Application(9 Hours)**	
2.1	Remote Invocation: Introduction, request-reply protocols	2 Hours
2.2	Remote procedure call, remote method invocation.	2 Hours
2.3	Operating system support: Introduction, The operating system layer, Processes and threads, Communication and invocation.	3 Hours
2.4	Web Services: Introduction, Web Services	1 Hours
2.5	Coordination of web services, Application of web services	1 Hours
3	**Module 3: Cloud Computing (9 Hours)**	
3.1	Basic Concepts, Cloud Computing Elements, Cloud Service Models: SaaS, PaaS, IaaS, Other Cloud Services	3Hours
3.2	Cloud Deployment Models	2 Hours
3.3	NIST Cloud Computing Reference Architecture, ITU-T Cloud Computing Reference Architecture, ITU-T Cloud Computing Functional Reference Architecture	4Hours
4	**Module 4: Internet of Things (9Hours)**	
4.1	The Internet of Things: Components. Scope of the Internet of Things	3Hours
4.2	Components of IoT-Enabled Things: Sensors, Types of Sensors, Actuators, Embedded System, Microprocessors, Microcontrollers, Transceivers, RFID	3 Hours
4.3	IoT Architecture - ITU-T Y.2060 IoT Reference Model, IoT World Forum Reference Model	3 Hours
5	**Module 5: Security (9Hours)**	
5.1	Introduction, Cybercrime And Cyber Security	1Hour
5.2	Unsecure Internet, Computer Encryption, Confidential Web Browsing, Encryption Keys	1Hour
5.3	Authentication: User IDs And Passwords, Two-Factor Authentication	2Hours
5.4	Wireless Network Security, Network Firewall	2Hours

5.5	Security Scams, Man-In-The-Middle Attacks, Email Addresses And Web Site URLs based attacks, Malware In Email Attachments	2 Hours
5.6	Secure Access with VPNs, VPN Technology	1 Hour

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT385	SOFTWARE ARCHITECTURE CONCEPTS	VAC	3	1	0	4

Preamble: The syllabus is prepared with the view of preparing the Engineering Graduates capable ofunderstanding essential concept of software architecture.

Prerequisite: Basic programming knowledge

Course Outcomes: After the completion of the course the student will be able to

CO No.	Course Outcome (CO)	Bloom's Category
CO1	Summarize role of software architecture and architect	Level 2: Understand
CO2	Discuss Basic Concepts in Software Architecture	Level 2: Understand
CO3	Explain Design Patterns	Level 2: Understand
CO4	Explain the role of Architecture in SDLC	Level 2: Understand
CO5	Identify the role of Architecture in Business	Level 2: Understand
CO6	Illustrate Architecture Techniques	Level 2: Understand

Mapping of course outcomes with program outcomes

COs	PROGRAMME OUTCOMES (PO)											
	K3 PO1	4 PO2	5 PO3	5 PO4	6 PO5	3 PO6	2 PO7	3 PO8	3 PO9	3 PO10	3 PO11	3 PO12
CO1	1	-	-	-	-	-	-	3	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	3	3	-	1	-	-	1	-	-
CO4	2	-	1	-	-	-	-	-	-	-	-	-
CO5	1	-	2	-	-	-	-	1	-	-	-	1
CO6	2	-	-	-	2	-	1	-	-	-	-	-

3/2/1: high/medium/low

The COs and CO-PO map shall be considered as suggestive only.

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	20
Understand	30	30	80
Apply			
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part Acontain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List out the importance of software architecture.
2. Explain the business context of software architecture.
3. Describe the Contexts of Software Architecture.
4. Explain roles of the Software Architect.

Course Outcome 2 (CO2):

1. List out basic concepts in Software Architecture.
2. Explain the relevance of Software Design.
3. Examine the Design principles of software architecture.

Course Outcome 3 (CO3):

1. Summarize structural design patterns.

2. Illustrate Design Patterns.

Course Outcome 4 (CO4):

1. Compare and contrast waterfall model and agile model.
2. Classify architecture evaluation methods.
3. Illustrate documentation of Software Architectures with example.
4. Identify different phases in software development.

Course Outcome 5 (CO5):

1. Identify the basis for economic analysis of architecture.
2. Identify the role of Product Line Architecture.
3. Develop a strategy to improve the Architecture Competence.
4. Select the quality attributes that are relevant for the Software Industry.

Course Outcome 6 (CO6):

1. Differentiate bottom-up and top-down architecture development.
2. Write short note on architectural patterns
3. Describe Architecture Development Techniques.
4. Explain different architecture integration strategies.

Model Question paper

Course Code: **ITT385**

Course Name: Software Architecture Concepts

Max.Marks:100 Duration: 3 Hours

PART A **(10*3=30)**

(Each Question carries 3 Marks)

1. List out the importance of software architecture.
2. Explain the business context of software architecture.
3. List out basic concepts in Software Architecture.
4. Summarize structural design patterns.
5. Compare and contrast waterfall model and agile model.
6. Classify architecture evaluation methods.
7. Identify the basis for economic analysis of architecture.
8. Identify the role of Product Line Architecture.
9. Differentiate bottom-up and top-down architecture development.
10. Write short note on architectural patterns.

PART B **(5*14=70)**

(Each Question carries 14 Marks)

11. Describe the Contexts of Software Architecture.

OR

12. Explain roles of the Software Architect.
13. Analyze the relevance of Software Design.

OR

14. Examine the merits and demerits of each type ofDesign Patterns.
15. Illustrate documentation of Software Architectures with example.

OR

16. Identify different phases in software development.
17. Develop a strategy to improve the Architecture Competence.

OR

18. Select the quality attributes that are relevant for the Software Industry.
19. Describe Architecture Development Techniques.

OR

20. Explain different architecture integration strategies.

Syllabus

Module 1: Introduction to Software Architecture
Relevance of Software Architecture, Contexts of Software Architecture, Software ArchitectureApproaches, Software Architect, Roles of the Software Architect
Module 2: Basic Conceptsin Software Architecture
Basic Concepts in Software Architecture, Introduction to software design, Design principles, Design Patterns
Module 3: Architecture in SDLC
Software Development Life Cycle (SDLC) Role of Architecture in SDLC -Requirements and Design Documenting Software Architectures, Implementation, and Testing, Architecture Evaluation
Module 4: Architecture & Business
Economic Analysis of Architectures Architecture Competence- Competence of Individuals,Competence of a Software Architecture Organization Architecture and Software Product Lines- working, role, evaluation, and issues Quality Attributes
Module 5: Architecture Techniques

Architecture Development Techniques
Software Partitioning Strategies
Software Changeability and Dependency Management
Using Architectural Patterns
Integration Strategies
Bottom-Up Architecture Development, Top-Down Architecture Development

Text Books

1. Software Architecture – A practical Guide using UML, Jeff Garland, Richard Anthony, John Wiley & Sons Ltd, ISBN 0 470 84849 9 , 2003
2. Software Architecture in Practice, (3rd Edition) (SEI Series in Software Engineering), by Len Bass, Paul Clements, Rick Kazman, Publisher: Addison-Wesley, 2012.
3. Software Design: From Programming to Architecture, Eric Braude, Wiley, 2004.
4. Software Architecture: Foundations,Theory, and Practice, R. N. Taylor, N. Medvidovic, and E. M. Dashofy. , John Wiley & Sons, 2009.

Reference Books

1. Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development (3ed), Craig Larman; Printice Hall PTR (2004). ISBN 13: 978-0131489066
2. Pankaj Jalote, An integrated approach to Software Engineering, 3rd Edition, Springer/Narosa.
3. Ian Sommerville, Software Engineering, 10th Edition, Addison-Wesley

Course Contents and Lecture Schedule

Sl.No	Module 1: Introduction to Software Architecture	10hrs
1.1	Introduction to Software Architecture, importance of Software Architecture	2
1.2	Contexts of Software Architecture – Technical Context, Project Life Cycle Context, Business Context, Professional Context	2
1.3	Software Architecture Approaches - The 4+1 Views, RM-ODP viewpoints, Bass architectural structures, Hofmeister software architecture views.	2
1.4	Software Architect, Roles of the Software Architect - Relationship to other key roles in development organization, Skills and Background for the Architect,	2
1.5	Injecting Architecture Experience, Structuring the Architecture Team, Traps and Pitfalls Associated with the Role of Software Architect.	2

	Module 2: Basic Conceptsin Software Architecture	**8 hrs**
2.1	Basic Concepts in Software Architecture – Architecture, components, connector, configuration, architectural style, architectural patterns, models, processes, stakeholders.	2
2.2	Introduction to software design	1
2.3	Design principles - Correctness and Robustness, Flexibility, Reusability, and Efficiency.	2
2.4	Design Patterns - Creational Design Patterns, Structural Design Patterns, Behavioural Design Patterns.	3
	Module 3: Architecture in SDLC	**9 hrs**
3.1	**Software Development Life Cycle** (SDLC) overview – Phases in software development, Different types of SDLC – Waterfall model to Agile model.	2
3.2	**Architecture in SDLC** - Architecture and Requirements	2
3.3	**Architecture in SDLC** - Designing an Architecture	2
3.4	**Architecture in SDLC** - Documenting Software Architectures, Architecture, Implementation, and Testing, Architecture Evaluation.	3
	Module 4: Architecture & Business	**9 hrs**
4.1	**Economic Analysis of Architectures** - Decision-Making Context, The Basis for the Economic Analysis, Putting Theory into Practice: The CBAM	2
4.2	**Architecture Competence**- Competence of Individuals: Duties, Skills, and Knowledge of Architects, Competence of a Software Architecture Organization	2
4.3	**Architecture and Software Product Lines** - An Example of Product Line Variability, Working of a Software Product Line, Product Line Scope, The Quality Attribute of Variability, The Role of a Product Line Architecture, Variation Mechanisms, Evaluating a Product Line Architecture, Key Software Product Line Issues	2
4.4	**Quality Attributes** – Availability, Interoperability, Modifiability, Performance, Security, Testability, Usability	3
	Module 5: Architecture Techniques	**9 hrs**

5.1	**Architecture Development Techniques -** Commonality and variability analysis, Design for change, Generative programming techniques, Building a skeleton system, Prototyping, Interface development – Design by Contract, Architectural description languages, Architecture evaluation	2
5.2	**Software Partitioning Strategies** – Separation of Concerns - Functional decomposition, Isolate configuration data, Isolate hardware-specific components, Isolate time-critical components, Separate domain implementation model from human interface, Separate domain implementation model from implementationtechnology, Separate main function from monitoring, Separate fault recovery processing, Adaptation of external interfaces	2
5.3	**Software Changeability and Dependency Management** - The stable dependencies principle (SDP), Acyclic dependencies principle, Interface Separation Principle. **Using Architectural Patterns**	2
5.4	**Integration Strategies -** Data-only integration, Executable integration, Establishing Architecture to Support Development, Configuration and change management, Build management, Continuous integration, Anticipate multi-language development, Anticipate tactical development (scripting),	2
5.5	Bottom-Up Architecture Development, Top-Down Architecture Development	1

SEMESTER V

HONOURS

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT393	WIRELESS COMMUNICATION	VAC	3	1	0	4

Preamble: The course addresses the fundamentals of wireless communications and provides an overview of existing and emerging wireless communication technology and networks.

Prerequisite: ITT292 Mathematical Foundation for Networking

Course Outcomes: After the completion of the course the student will be able to

CO No.	Course Outcome(CO)	Bloom's Category
CO 1	Discuss the fundamental concepts wireless communication	Level 2: Understand
CO 2	Illustrate large and small scale fading in mobile wireless communication	Level 3: Apply
CO 3	Familiarize and apply equalization, diversity & channel coding techniques	Level 3: Apply
CO 4	Identify the multiple access techniques in wireless systems	Level 2: Understand
CO 5	Discuss various wireless system models	Level 2: Understand

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	1	-	-	-	-	-	-	-	-	3
CO 2	1	2	2	2	-	-	-	-	-	-	-	2
CO 3	1	2	3	2	-	-	-	-	-	-	-	2
CO 4	1	2	2	1	-	-	-	-	-	-	-	2
CO 5	1	2	1	-	2	-	-	-	-	-	-	3

3/2/1: high/medium/low

The COs and CO-PO map shall be considered as suggestive only

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand	30	30	60
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Define Coherence time. How does this parameter decide the behaviour of the wireless channel?
2. If a total of 33MHz of bandwidth is allocated to a particular FDD cellular telephone system which uses two 25KHz simplex channels to provide full duplex voice and control channels, compute the number of channels available per cell if a system uses a) 4 cell re-use and b) 7-cell reuse.

Course Outcome 2 (CO2)

1. Distinguish between slow and fast fading. Explain with an example.
2. Describe the free space propagation model and derive the loss in the signal strength.

Course Outcome 3(CO3):

1. Draw and explain a simplified communication system using an adaptive equalizer at the receiver.
2. Write a brief note on categories of space diversity reception methods.

Course Outcome 4 (CO4):

1. How FDMA handles near far problem?
2. Identify the channel capacity of TDMA in cell system.

Course Outcome 5 (CO5):

1. Explain the GSM architecture in detail.
2. What is triangular routing problem? Discuss any solution.

Model Question Paper

Course Code: ITT393
Course Name: WIRELESS COMMUNICATION

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks. (10 * 3 = 30 Marks)

1. How is frequency reuse distance measured in cellular system?
2. What is meant by mobile assisted handoff?
3. What is fast fading?
4. List the various path loss models for large scale fading
5. What is time diversity?
6. What is the difference between linear and non linear equilization?
7. What is reverse channel interference?
8. What is SDMA?
9. What is care of address?
10. What are the features of mobile adhoc networks?

Part B

Answer all questions. Each question carries 14 marks. (5 * 14 = 70 Marks)

11. Explain in detail about the handoff strategies used in cellular system

OR

12. Discuss the impact of interference in a cellular system and system capacity

13. Explain in detail about the three basic propagation mechanisms

OR

14. Explain the different types of small scale fading based on multipath time delay spread

15. Describe any two diversity combining techniques stating their respective merits

OR

16. What are block codes? Explain the features of block codes

17. Compare FDMA and TDMA

OR

18. Describe in detail about CSMA/CD protocol

19. Discuss the system architecture of GSM

OR

20. What is triangular routing? How can it be avoided?

Syllabus

Module 1: INTRODUCTION TO WIRELESS COMMUNICATION **8 hours**
Introduction to wireless communication systems: Evolution of mobile radio communications, Mobile radio systems around the world. Example of wireless communication systems. Modern wireless communication systems: 2G, 3G, 4G and 5G. Wireless local loop, Wireless local area networks, Bluetooth and personal area networks. The Cellular Concept: Frequency reuse, channel assignment and handoff strategies, interference and system capacity, trunking and grade of service. Improving coverage and capacity in cellular systems.
Module 2 :MOBILE RADIO PROPAGATION **9 hours**
Large scale path loss: Introduction to radio wave propagation, free space propagation models, Three basic propagation mechanisms, reflection, Two-ray propagation model, Diffraction, Scattering. Small scale fading and multipath: Small scale multipath propagation, Types of small scale fading – flat fading, frequency selective fading, fast fading and slow fading.
Module 3: EQUALIZATION, DIVERSITY & CHANNEL CODING **9 hours**
Introduction, fundamentals of equalization, Survey of equalization techniques, Methods for Channel Diversity – Space Diversity, Polarization Diversity, Frequency Diversity , Multipath diversity, Time Diversity. Diversity Combining – Selection Combining, Scanning Combining, Equal Gain Combining, Maximal Ratio Combining Fundamentals of Channel Coding – BlockCodes, Examples
Module 4:MULTIPLE ACCESS TECHNIQUES **10 hours**
Introduction. Frequency Division Multiple Access (FDMA). Time Division Multiple Access

(TDMA). Spread Spectrum Multiple Access. Space Division Multiple Access (SDMA). Capture effects in packet Radio, CSMA/CA Capacity of Cellular Systems – fundamentals
Module 5 : WIRELESS SYSTEMS **9 hours**
Telecommunication system – GSM, Wireless LAN – IEEE 802.11,Bluetooth. Mobile Network layer – Mobile IP, Mobile ad-hoc networks.

Text Books

1. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", 2nd edition, Pearson Education India, 2014.

2. Dr Jochen Schiller, "Mobile Communications", 2nd edition, Pearson Education, 2012.

Reference Books

1. Goldsmith, A. (2005). Wireless Communications. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511841224.

2. Prof. Neal Patwari, ECE 5325/6325: Wireless Communication Systems Lecture Notes, Fall 2011

3. Cory Beard and William Stallings, "Wireless Communication Networks and Systems", Pearson

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**MODULE 1**	**8 hours**
1.1	Introduction to wireless communication systems: Evolution of mobile radio communications, Mobile radio systems around the world. Example of wireless communication systems.	1 Hr
1.2	Modern wireless communication systems: 2G, 3G, 4G and 5G. Wireless local loop, Wireless local area networks, Bluetooth and personal area networks.	1 Hr
1.3	The Cellular Concept: Frequency reuse, channel assignment and handoff strategies,	2 Hrs
1.4	Interference and system capacity, trunking and grade of service.	2 Hrs
1.5	Improving coverage and capacity in cellular systems.	2Hrs
2	**MODULE 2**	**9 hours**
2.1	LARGE SCALE PATH LOSS: Introduction to radio wave propagation, free space propagation models, Three basic propagation mechanisms, reflection, Two-ray propagation model.	3 Hrs

2.2	Diffraction, Scattering.	2 Hrs
2.3	SMALL SCALE FADING AND MULTIPATH: Small scale multipath propagation	1 Hr
2.3	Types of small scale fading – flat fading, frequency selective fading, fast fading and slow fading.	3 Hrs
3	**MODULE 3**	**9 hours**
3.1	Introduction, fundamentals of equalization, Survey of equalization techniques.	2 Hrs
3.2	Methods for Channel Diversity – Space Diversity, Polarization Diversity, Frequency Diversity, Multipath diversity, Time Diversity.	3 Hrs
3.3	Diversity Combining – Selection Combining, Scanning Combining, Equal Gain Combining, Maximal Ratio Combining	2 Hrs
3.4	Fundamentals of Channel Coding – BlockCodes, Examples	2 Hrs
4	**MODULE 4**	**10 hours**
4.1	Introduction. Frequency Division Multiple Access (FDMA).	1 Hrs
4.2	Time Division Multiple Access (TDMA).	1 Hr
4.3	Spread Spectrum Multiple Access.	2 Hrs
4.4	Space Division Multiple Access (SDMA).	2 Hrs
4.5	Capture effects in packet Radio, CSMA/CA	2 Hrs
4.6	Capacity of Cellular Systems - fundamentals	2 Hrs
5	**MODULE 5**	**9 hours**
5.1	Telecommunication system – GSM.	2 Hr
5.2	Wireless LAN – IEEE 802.11	2 Hr
5.3	Bluetooth.	1 Hrs
5.4	Mobile Network layer – Mobile IP.	2 Hrs
5.5	Mobile ad-hoc networks.	2 Hrs

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT395	SECURITY IN COMPUTING	VAC	3	1	0	4

Preamble:
The syllabus is designed with the view of preparing the students capable of understanding the principles and concepts of computer security. The students should be able to understand what it means for a system to be secure. Furthermore, the students will get to know about computing systems vulnerabilities, threats, and security controls.

Prerequisite: Basics of Operating systems**,** Database Systems and Computer Networks

Course Outcomes: After the completion of the course the student will be able to

CO No.	Course Outcome(CO)	Bloom's Category
CO 1	Outline the basic concepts and techniques of computer security	Level 2: Understand
CO 2	Explain the various aspects of program security	Level 2: Understand
CO 3	Model secure and trusted operating systems	Level 3: Apply
CO 4	Summarize the requirements and features of database security	Level 2: Understand
CO 5	Identify the security issues in network and the appropriate security measures	Level 3: Apply

Mapping of course outcomes with program outcomes

COs	PROGRAMME OUTCOMES (PO)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1			1						
CO 2	3	2	1			1						
CO 3	2	2	1		2							1
CO 4	2	2	1		2			2				2
CO 5	3	2	2		2	2		2				3

3/2/1: high/medium/low

The COs and CO-PO map shall be considered as suggestive only.

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	30	30	40
Apply	10	10	40
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Outline substitution techniques with suitable examples.
2. Distinguish between vulnerability, threat and control
3. Explain DES algorithm.

Course Outcome 2 (CO2):

1. Explain how non malicious program errors become a threat to security.
2. Explain the different methods to control program threats.
3. Explain the limitations on the amount of information leaked per second through a covert channel in multi-access computing system.

Course Outcome 3 (CO3):

1. Model the layered design of a trusted operating system.
2. Compare Simple Security Condition Preliminary version and Star Property Preliminary version in Bell-La-Padula model.
3. Write a set of rules combining the secrecy controls of the Bell-La-PAdula model with the integrity controls of Biba model**.**

Course Outcome 4 (CO4):

1. Outline the models for designing multilevel secure database.
2. Explain two phase update with an example.
3. Explain the factors that determine the sensitivity of data.

Course Outcome 5 (CO5):

1. Compare the different types of firewalls.
2. Explain the two general types of IDS.
3. Identify the security purpose for the fields, such as sequence number of an IPSec packet.

Model Question paper

Course Code: ITT395

Course Name: Security in Computing

Max.Marks:100 Duration: 3 Hours

PART A (10*3=30)

(Each Question carries 3 Marks)

1. What do you mean when you say that a system is secure?
2. Summarize the uses of encryption.
3. Differentiate the types of program security flaws.
4. Explain about virus signatures.
5. Outline how a fence register is used for relocating a user's program.
6. List few disadvantages of using physical separation in computing system.
7. Interpret the purpose of encryption in multilevel secure database management systems.
8. Explain about commutative filters.
9. Identify a counter measure for traffic flow analysis.
10. Explain the different types of Intrusion Detection Systems.

PART B (5*14=70)

11. a. Explain the major vulnerabilities that a computer system is subjected to (7)
    b. Differentiate substitution ciphers and transposition ciphers with examples (7)

OR

12. a. Explain DES algorithm. (7)
    b. Differentiate symmetric and asymmetric encryption. (7)

13. a. Explain about non malicious program errors. (7)
    b. Outline the various methods to control different program threats. (7)

OR

14. a. Explain the different kinds of malicious codes. (7)
    b. Represent three controls that could be applied to detect or prevent salami attacks. (7)

15. a. According to Bell-La Padula Model, identify the restrictions placed on two active subjects that need to send and receive signals to and from each other. Justify your answer. (7)
    b. Compare Simple Security Condition Preliminary version and Star Property Preliminary version in Bell-La-Padula model. (7)

OR

16. a. Model the layered design of a trusted operating system. (9)
    b. Explain the factors that determine the sensitivity of data. (5)

17. a. Outline the basic security requirements of database systems. (7)
    b. Show the mechanisms to implement ‘seperation’ in databases. (7)

OR

18. a. Represent the models for designing multilevel secure database. (7)
    b. Explain the disadvantages of partitioning as means of implementing multilevel security for database. (7)

19. a. Examine the significance of dual signature in secure electronic transactions? (5)
    b. Compare the different types of firewalls. (9)

OR

20. Differentiate between message confidentiality threats and message integrity threats. (7)
21. Make use of a social engineering attack to obtain a user’s password and explain the attack in detail. (7)

Syllabus

Module 1: Introduction to Security in Computing (10 Hours)
Introduction: Security Problem in Computing, Elementary Cryptography- Terminology and Background, Introduction - Substitution Ciphers, Transposition Ciphers, Encryption Algorithms, DES, AES, Public Key Encryption, Uses of Encryption.
Module 2: Program Security (9 Hours)
Secure Programs, Nonmalicious Program Errors, Viruses and other Malicious Code, Targeted Malicious Code, Controls against Program Threats.
Module 3 : Protection in General Purpose Operating System (9 Hours)
Protected Objects and Methods of Protection, Memory Address Protection, Control of Access to General Objects, File Protection Mechanisms, User Authentication, Designing Trusted Operating Systems- Security Policies, Models of Security, Trusted Operating System Design, Assurance in Trusted OS.
Module 4 : Database and Data Mining Security (9 Hours)
Introduction to Databases, Security Requirements, Reliability and Integrity, Sensitive Data, Inference, Multilevel Databases, Proposals for Multilevel Security, Data Mining.
Module 5 : Security in Networks (8 Hours)
Security in Networks- Threats in Networks, Network Security Controls, Secure Electronic Transactions, Firewalls, Intrusion Detection Systems.

Text Books

1. Charles P. Pfleeger, Shari Lawrence Pfleeger and Deven N. Shah, Security in Computing, 4th Edition.
2. William Stallings, Cryptography and Network Security Principles and Practice, Pearson Education, 4th Edition.

Reference Books

1. William Stallings, Network Security Essentials, Applications and Standards, Pearson Education.
2. Michael E. Whitman and Herbert J Mattord, Principles of Information Security, 4th Edition.

Course Contents and Lecture Schedule

	Module 1: Introduction to Classical and Modern cryptographic techniques	**10 hrs**
1.1	Introduction: Security problem in Computing	1
1.2	Elementary Cryptography- terminology and background	1
1.3	Substitution Ciphers	2
1.4	Transposition Ciphers	2
1.5	Encryption Algorithms- DES, AES	3

1.6	Public Key Encryption, Uses of Encryption.	1
	Module 2: Program Security	**9 hrs**
2.1	Secure Programs	1
2.2	Nonmalicious Program Errors	1
2.3	Viruses and other Malicious Code	2
2.4	Targeted Malicious Code	3
2.5	Controls against Program Threats	2
	Module 3: Protection in General Purpose Operating System	**9 hrs**
3.1	Protected Objects and Methods of Protection	1
3.2	Memory Address Protection	1
3.3	Control of Access to General Objects	1
3.4	File Protection Mechanisms	1
3.5	User Authentication	1
3.6	Designing Trusted Operating Systems- Security Policies, Models of Security	2
3.7	Trusted Operating System Design, Assurance in Trusted OS	2
	Module 4: Database and Data Mining Security	**9 hrs**
4.1	Introduction to Databases	1
4.2	Security Requirements	1
4.3	Reliability and Integrity	1
4.4	Sensitive Data, Inference	2
4.5	Multilevel Databases, Proposals for Multilevel Security	3
4.6	Data Mining	1
	Module 5: Security in Networks	**8hrs**
5.1	Network Concepts	1
5.2	Threats in Networks	2
5.3	Network Security Controls	2
5.4	Secure Electronic Transactions	1
5.5	Firewalls	1
5.6	Intrusion Detection Systems	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT397	ADVANCED COMPUTER ARCHITECTURE	VAC	3	1	0	4

Preamble: Advanced computer architecture course is intended to deliver students the advanced concepts of Computer architecture It also helps them to learn how computer performance is measured and how memory organisation and memory performance optimization is done. A detailed insight into ILP,TLP and DLP, multicore and shared memory architectures with necessary case studies are also covered in the syllabus.

Prerequisite: ITT204 Computer Organisation

Course Outcomes: After the completion of the course the student will be able to

CO No.	Course Outcome(CO)	Bloom's Category
CO 1	Measure performance of a computer by understanding the basic architectures of computers	Level 3: Apply
CO 2	Demonstrate the Memory optimization techniques.	Level 3: Apply
CO 3	Investigate pipelining techniques, ILP, multithreading and to illustrate various methods to overcome the challenges in ILP	Level 3: Apply
CO 4	Write a simple OpenMP program to execute multi threaded programs and to understand the concepts in Shared Multicore Architectures	Level 3: Apply
CO 5	Write a simple CUDA program to exploit DLP and to understand the concepts in DLP	Level 3: Apply

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	2								2
CO2	3	2	2	2	3							2
CO3	3	3	2	3	3							2
CO4	3	3	3	3	2							2
CO5	3	3	3	3	2							2

3/2/1: high/medium/low

The COs and CO-PO map shall be considered as suggestive only

Assessment Pattern

Bloom's Category	Continuous Assessment Test		End Semester Examination
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	30	30	60
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Consider two programs A and B that solves a given problem. A is running on a SPARC machine operating at 500 MHz and B is running on a DEX machine running at 750 MHz. A

contains a total instructions of 4670, out of which 19% are floating point instructions, 33% load store instructions and rest are simple instructions. B is composed of 25% floating point instructions. The number of simple instructions in B is twice the count of load store instructions. Total instruction count of B is 4100. In both DEX and SPARC floating point operation has an average CPI of 5 and simple instruction has an average CPIof 1.2. Both the architectures differ in the CPI of load store instruction. They are 2 and 2.4 for SPARC and DEX respectively.
a) Given this setup which machine solves the problem faster, and by how much?
b) Is there any other program to machine mapping that gives a better result ?

2. A new floating-point system is introduced in a system and it speeds up floating point operations by 2 times. In an application 1/5 th of the instructions are floating-point operations. What is the overall speedup? (Ignore the penalty to any other instructions) The speeding up of the floating-point unit slowed down data cache accesses resulting in a 1.5x slowdown. Data cache accesses consume 10% of the execution time. What is the overall speedup now?

Course Outcome 2 (CO2):
1. Discuss various cache optimisation techniques

2. An 8KB direct-mapped write-back cache is organized as multiple blocks, each of size 32-bytes. The processor generates 32-bit addresses. The cache controller maintains the tag information for each cache block comprising of the following. 1 Valid bit 1 Modified bit As many bits as the minimum needed to identify the memory block mapped in the cache. What is the total size of memory needed at the cache controller to store meta-data (tags) for the cache?

Course Outcome 3 (CO3):
1. Assume a MIPS pipeline with 1 integer unit (EX), 1 FP Adder for the following code.

```
Loop:   L.D F0,)(R1) ;F0=array element
        ADD.D F4,F0,F2 ;add scalar in F2
        S.D F4,0(R1) ;store result
        DAADUI R1,R1,#-8 ;decrement pointer 8 bytes(per DW)
        BNE R1,R2,Loop ; branch if R1!=R2
```

(a) What is the execution time of one loop iteration (in cycles) if operand forwarding is permitted?
(b) What is the execution time of one loop iteration (in cycles) if compiler scheduling is done within an iteration of the loop?
(c) Unroll the loop fully and then schedule the code for maximum performance. What is the best execution time you can get from this code?

2. Suppose you have the following instruction sequence to be executed

```
lw $1, 0($7)
addi $1, $1, 1
```

sw $10, 10($7)
lw $2, 0($8)
addi $2, $2, 1
sw $20, 10($8)

Rearrange the instruction sequence so that it achieves the same functionality but best performance (shortest execution time). You are only allowed to change the order of the six instructions. Do not modify or add new instructions. Calculate the execution time of the instruction sequence you rearranged.

Course Outcome 4 (CO4):

1. Discuss Cache coherence protocols
2. Create a simple OpenMP program that does the following:

A. Creates a parallel region
B. Has each thread in the parallel region obtain its thread id
C. Has each thread print "Hello World" along with its unique thread id
D. Has the master thread only, obtain and then print the total number of threads

Course Outcome 5 (CO5):

1. Assume that the processor runs at 700 MHz and has a maximum vector length of 64. The load/store unit has a start-up overhead of 15 cycles; the multiply unit, 8 cycles; and the add/subtract unit, 5 cycles. Consider the following code, which multiplies two vectors that stores single precision complex numbers in it:

```
for (i=0;i<300;i++){

    c_re[i] = a_re[i] * b_re[i] – a_im[i] * b_im[i];
    c_im[i] = a_re[i] * b_im[i] + a_im[i] * b_re[i];  }
```

(a) What is the arithmetic intensity of this kernel, if arithmetic intensity is defined as the ratio of floating point operations per byte of memory accessed?

(b) Assuming chaining and a single memory pipeline, how many chimes are required? How many clock cycles are required per complex result value, including start-up overhead? (5)

2. Write a CUDA program for matrix multiplication by exploiting DLP

Model Question Paper

Course Code: ITT397

Course Name: Advanced Computer Architecture

Max.Marks:100 Duration: 3 Hours

PART A (10*3=30)

(Each question carries 3 Marks)

1. Compare SISD and SIMD architectures.
2. Discuss Amdahl's law.
3. For a cache with capacity 32KB, how many blocks does the cache holds for block size=32 bytes, 64 bytes and 128 bytes?
4. Differentiate cache memory and TLB
5. List the limitations of ILP
6. What do you mean by hardware speculation?
7. What is multiprocessor hyperthreading
8. What is the use of Vector Mask Registers Vector architecture.
9. Write any three differences between Vector architecture and GPU.
10. Show that the following loop have a loop-carried dependency or not?

```
for (i=0;i<100;i++){
    A[i] = B[2*i+4];
    B[4*i+5] = A[i];}
```

PART B (5*14=70)

(Each full question carries 14 marks)

11. a) Explain Flynn's taxonomy of architectures specifying the application of each. (7 marks)

    b) A single processor has FIT of 100. What is the mean time to failure for this system? If it takes 2 days to get the system running again, what is the availability of the system? Suppose a cluster Lucid has 1000 processors with a FIT of 100, then what is its MTTF? Assume that it experiences a catastrophic failure only if 1/4 of the computers fail. (7 marks)

OR

12. a) Consider a code fragment A=D*(B+C)-E where A, B, C, D and E are memory locations to be executed on a processor TITAN. Write down the instruction sequence generated for this code fragment if TITAN is

    (i) Stack machine

    (ii) Accumulator machine

    (iii) Load Store machine. (6 marks)

b) A new floating-point system is introduced in a system and it speeds up floating point operations by 2 times. In an application 1/5 th of the instructions are floating-point operations. What is the overall speedup? (Ignore the penalty to any other instructions) The speeding up of the floating-point unit slowed down data cache accesses resulting in a 1.5x slowdown. Data cache accesses consume 10% of the execution time. What is the overall speedup now? (8 marks)

13. a) Explain the memory hierarchy in ARM Cortex- A8 (5 marks)

b) Discuss the cache optimisation techniques. (9 marks)

OR

14. a) Consider two cache architectures. One has a separate I and D cache of size 16KB and the other one is a unified dual ported of size 32KB. The I & D cache has instruction miss rate 0.5% and data miss rate 5%. The unified cache has aggregate miss rate 1%. Hit time is 1 cycle. Miss penalty is 50 cycles. 30% of instructions are load/store. Which one is better and what is the improvement in CPI. Assume CPI of 1 without cache misses.

(6 marks)

b) Discuss how address translation is done in Virtual memory (8 marks)

15. a) We have a program of 1000 instructions in the format of "lw, add, lw, add, "
The add instruction depends (and only depends) on the lw instruction right before it. The lw instruction depends (and only depends) on the add instruction right before it. If the program is executed on the pipelined datapath with 5 stages (IF-ID&DR-EXE-MEM-WB).

(1) What would be the actual CPI if operand forwarding is permitted?

(2) Without forwarding, what would be the actual CPI?

Format : LOAD Rdest, #constant(Rx)

ADD Rdest,Rsrc1,Rsrc2 (7 marks)

b) Perform Tomasulo's algorithm with reservation stations and Reorder Buffer and find out clock cycle in which the last instruction completes execution..

i) Assume the following information about functional units.

Functional unit type	**Cycles in Ex**
Integer Mul	2
Integer Div	10
Integer Add	1

ii) Assume the processor can issue into the reservation stations and reorder buffer only one instruction per cycle.

iii) Assume you have unlimited reservation stations, functional units, reorder buffer entries and CDB .

iv) The Functional units are not pipelined.

v) Fill in the cycle numbers in each pipeline stage for each instruction. For each instruction indicate where its source operands' are read from (use RF for register file, CDB for common data bus and ROB for Reorder Buffer).

vi) Also for simplicity when an operand is waiting for an execution unit's result just indicated as waiting on CDB, instead of the number of the execution unit.

vii) An instruction waiting for data on CDB can move to its EX stage in the cycle after the CDB broadcast.

viii) Assume that integer instructions also follow Tomasulo's algorithm so the result from the integer functional unit is also broadcast on CDB and forwarded to dependent instructions through CDB.

(7 marks)

OR

16. a) Discuss dynamic scheduling in Intel core i7 (9 marks)
b) A non pipelined system takes 50 ns to process a task. The same task can be processed in a six segment pipeline with a clock cycle of 10ns. Determine the speedup ratio of the pipeline for 100 tasks. What is the maximum speed up that can be achieved. ? (5 marks)
17. a) Explain shared memory multiprocessor systems (8 marks)
b) Write an OpenMP program for matrix multiplication (6 marks)

OR

18. a) Discuss Directory based cache coherency protocol (7 marks)
b) Discuss Intel Skylake processor (7 marks)
19 a) Discuss Graphical Processing Units (8 marks)
b) Write a CUDA program for adding two vectors (6 marks)

OR

20 a) Discuss Loop level parallelism with examples (8 marks)
b) Discuss DLP in Nvidia Maxwell (6 marks)

Syllabus

Module 1:(6 hours)
Introduction: Defining Computer Architecture, Flynn's Classification of Computers, Metrics for Performance Measurement-CPU performance, Memory/ Cache performance.
Module 2:(10 hours)
Memory Hierarchy Introduction, Advanced Optimizations of Cache Performance, Memory Technology and Optimizations, Virtual Memory and Virtual Machines, The Design of Memory Hierarchy, Simple program analysis using PIN (A binary instrumentation tool) Case Study: Memory Hierarchies in Intel Core i7 and ARM Cortex-A8.
Module 3:(10 hours)
Instruction Level Parallelism and Thread Level Parallelism: Introduction, Concepts and Challenges, Basic Compiler Techniques for Exposing ILP, Reducing Branch Costs with Advanced Branch Prediction, Dynamic Scheduling, Advanced Techniques for Instruction Delivery and Speculation, Limitations of ILP, Multithreading: Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput, Simple thread programs and synchronization using OpenMP, Case Study: Dynamic Scheduling in Intel Core i7 and ARM Cortex-A8
Module 4:(10 hours)
Multicore systems and Shared Memory Architectures - Introduction, Shared-Memory Multicore Systems, Performance Metrics for Shared-Memory Multicore Systems, Cache Coherence Protocols, Synchronization, Memory Consistency, Multithreaded Programming using OpenMP, Case Study:

Intel Skylake and IBM Power8.
Module 5:(9 hours)
Data Level Parallelism Introduction, Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, GPU Memory Hierarchy, Detecting and Enhancing Loop-Level Parallelism, Introduction to CUDA programming and simple programs using CUDA, Case Study: Nvidia Maxwell.

Text Books

1. J.L. Hennessy and D.A. Patterson. Computer Architecture: A Quantitative Approach. 5th Edition, Morgan Kauffmann Publishers, 2012.
2. J.P. Shen and M.H. Lipasti. Modern Processor Design: Fundamentals of Superscalar Processors. McGraw-Hill Publishers, 2005.

References

1. D.B. Kirk and W.W. Hwu. Programming Massively Parallel Processors. 2nd Edition, Morgan Kauffmann Publishers, 2012.
2. Pin tool – A Dynamic Binary Instrumentation Tool http://software.intel.com/en-us/articles/pin-a-dynamic-binary-instrumentation-tool
3. OpenMP. http://www.openmp.org/
4. CUDA. https://developer.nvidia.com/cuda-zone

Course Content and Course Schedule

Module 1:Introduction:		**6 hours**
1.1	Defining Computer Architecture	2 hours
1.2	Flynn's Classification of Computers	1 hour
1.3	Metrics for Performance Measurement	1 hour
1.4	Processor performance	1 hour
1.5	Memory Performance	1 hour
Module 2: Memory Hierarchy		**10 hours**
2.1	Introduction to Memory hierarchy	1 hour
2.2	Advanced Optimizations of Cache Performance	2 hours
2.3	Memory Technology and Optimizations	2 hours

2.4	Virtual Memory and Virtual Machines	1 hour
2.5	The Design of Memory Hierarchy	1 hour
2.6	Simple program analysis using PIN (A binary instrumentation tool)	1 hour
2.7	Case Study: Memory Hierarchies in Intel Core i7 and ARM Cortex-A8.	2 hours
Module 3:Instruction Level Parallelism and Thread Level Parallelism		**10 hours**
3.1	Instruction-level Parallelism: Concepts and Challenges	1 hour
3.2	Basic Compiler Techniques for Exposing ILP	1 hour
3.3	Reducing Branch Costs with Advanced Branch Prediction	1 hour
3.4	Dynamic Scheduling	1 hour
3.5	Advanced Techniques for Instruction Delivery and Speculation	1 hour
3.6	Limitations of ILP	1 hour
3.7	Multithreading, Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput	1 hour
3.8	Simple thread programs and synchronization using OpenMP	1 hour
3.9	Case Study: Dynamic Scheduling in Intel Core i7 and ARM Cortex-A8	2 hours
Module 4: Multicore systems and Shared Memory Architectures		**10 hours**
4.1	Introduction to TLP	1 hour
4.2	Shared-Memory Multicore Systems	1 hour
4.3	Performance Metrics for Shared-Memory Multicore Systems	1 hour
4.4	Cache Coherence Protocols	3 hours
4.5	Synchronization, Memory Consistency	1 hour
4.6	Multithreaded Programming using OpenMP	1 hour
4.7	Case Study: Intel Skylake and IBM Power8.	2 hours

Module 5: Data Level Parallelism		**9 hours**
5.1	Introduction to DLP	1 hour
5.2	Vector Architecture	1 hour
5.3	SIMD Instruction Set Extensions for Multimedia,	1 hour
5.4	Graphics Processing Units, GPU Memory Hierarchy	2 hours
5.5	Detecting and Enhancing Loop- Level Parallelism	1 hour
5.6	Introduction to CUDA programming and simple programs using CUDA	2 hours
5.7	Case Study: Nvidia Maxwell.	1 hour