Vivekanand Education Society's

Institute of Technology

(An Autonomous College Affiliated to University of Mumbai, Approved by AICTE & Recognized by Govt. of Maharashtra)

Department of Electronics and Computer Science

Syllabus (Autonomy Scheme)

Semester -V

w.e.f. A.Y. 2024-25

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Semester V Scheme								
Course Code	**Course Name**	**Teaching scheme (Contact Hours)**			**Credits Assigned**			
		Th	**Pr**	**Tut**	**Th**	**Pr**	**Tut**	**Total**
ECC 501	Communication Engineering	3	-	-	3	-	-	3
ECC 502	Computer Organization and Architecture	3	-	-	3	-	-	3
ECC 503	Software Engineering	3	-	-	3	-	-	3
ECC 504	Web Technologies	3	-	-	3	-	-	3
ECC DO51	Department Optional (Course - I)	3	-	-	3	-	-	3
ECL501	Communication Engineering Lab	-	2			1		1
ECL502	Software Engineering and Web Technologies Lab	-	2	-	-	1	-	1
ECL503	Department Optional Course (Lab)	-	2	-	-	1	-	1
ECL504	Professional Communication an Ethics-II	1	2	-	1	1	-	2
ECM501	Mini project - 2A	-	4$	-	-	2	-	2
Total								**22**

Semester V Marks Scheme							
Course Code	**Course Name**	**TH**	**MT**	**CA**	**TW**	**PR/ OR**	**Total**
ECC 501	Communication Engineering	60	20	20	-	-	100
ECC 502	Computer Organization and Architecture	60	20	20	-	-	100
ECC 503	Software Engineering	60	20	20	-	-	100
ECC 504	Web Technologies	60	20	20	-	-	100
ECC DO501	Department Level Optional Course - I	60	20	20	-	-	100
ECL501	Communication Engineering Lab	-	-	-	25	25	50
ECL502	Software Engineering and Web Technologies lab	-	-	-	25	25	50
ECL503	Department Optional Course -I lab	-	-	-	25	25	50
ECL504	Professional Communication and Ethics-II	-	-	-	25	25	50
ECM501	Mini project - 2A	-	-	-	25	25	50
Total							**750**

Department Level Optional Course - I (DO 501):	
Sr.No.	**Name of Subject**
1	Software Testing and Quality Assurance
2	ASIC Verification
3	Information Theory and Coding
4	Sensors and Applications

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Semester V
Syllabus

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Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
ECC 501	Communication Engineering	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	PR/OR	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
ECC 501	Communication Engineering	20	20	60	---	---	100

Course Prerequisite:	
1	Applied Mathematics-III
2	Applied Mathematics-IV
3	Digital Electronics
4	Electronic Devices
Course Objectives:	
1	To understand basic communication system and various types of noises and impacts
2	To understand and analyse the need for various analog modulation techniques
3	To analyse the characteristics of the receivers
4	To understand pulse modulation methods
5	To analyse various line codes, concept of ISI ,equalizers, correlative coding
6	To compare the performance of various digital modulation techniques
Course Outcomes: After successful completion of the course students will be able to:	
1	Analyse the impact of various types of noises in the process of communication.
2	Compare the performance of various analog modulation techniques in terms of bandwidth and quality of signal received.
3	Compare the performance of analog and FM receivers and various parameters that can be taken care of to improve their performances.
4	Differentiate various pulse modulation techniques and various multiplexing techniques for sending data.
5	Analyse various line codes, concept of ISI, bit error rate, equalizers, correlative coding.
6	Understand the significance of digital modulation techniques and compare their performance.

Module	Contents	Hrs
1	**Introduction to Electronic Communication**	**04**
1.1	Electromagnetic Spectrum	
1.2	Block diagram of Analog communication system	
1.3	Need for modulation	
1.4	Types of Noise, Signal-to-noise ratio, Noise factor, Noise Figure, Noise Temperature	
2	**Analog Modulation Systems**	**12**
2.1	Principle of Amplitude Modulation (AM): Representation of AM wave (Mathematical & Graphical), Frequency spectrum of AM wave, AM Power Distribution, AM for a Complex Modulating Signal	
2.2	Types of AM: Generation of DSB-SC using diode based balanced modulator, Generation of SSB using phase shift method	
2.3	Principles of Angle Modulation: Theory of Frequency Modulation (FM) & Phase Modulation (PM) - Basic Concepts, Spectrum Analysis of FM Wave, Noise triangle, Pre-emphasis, De-emphasis	
2.4	Comparison of AM, FM and PM	
3	**Radio Transmitters and Receivers**	**04**
3.1	Radio Transmitters: Block diagram of AM & FM transmitters	
3.2	Radio receivers: Receiver Characteristics, Superheterodyne Receiver, diode detector, Automatic gain control (AGC), Automatic frequency control (AFC)	
4	**Pulse Modulation**	**05**
4.1	Sampling theorem and quantization of signals	
4.2	Generation and Detection of Pulse Amplitude Modulation (PAM)	
4.3	Pulse Code Modulation (PCM), and Delta Modulation (DM)	
4.4	Multiplexing Techniques: Time Division Multiplexing (TDM): T1 carrier system, Frequency Division Multiplexing (FDM)	
5	**Pulse Shaping for Optimum Transmission**	**04**
5.1	Line codes and their desirable properties	
5.2	Concept of Inter symbol interference (ISI), Eye diagram: Quality Factor and BER, Nyquist Bandwidth	
5.3	Types of equalizers: Linear equalizer	
5.4	Correlative coding: Duo-binary encoding and modified duo-binary encoding	
6	**Digital Modulation Techniques**	**10**
6.1	Advantages of Digital Modulation.	
6.2	Generation, detection, signal space diagram, power spectral density and spectrum efficiency analysis of: Binary Phase Shift Keying (BPSK), Quaternary Phase Shift Keying (QPSK), M-ary PSK, Binary Amplitude Shift Keying (BASK), Quadrature Amplitude Modulation (QAM), Binary	

	Frequency Shift Keying (BFSK), Minimum Shift Keying (MSK).	
Total		**39**

Textbooks:	
1	Simon Haykin, "*Communication System*", John Wiley And Sons ,4th Edition.
2	Taub Schilling & Saha, "*Principles Of Communication Systems*", Tata Mc-Graw Hill, Third Edition.
3	Kennedy and Davis "Electronics Communication System", Tata McGraw Hill
4	T. L. Singal, "Analog and Digital Communication," Tata Mc-Graw Hill, New Delhi, First Edition, 2012.
5	Sklar B, and Ray P. K., "Digital Communication: Fundamentals and Applications," Pearson, Dorling Kindersley (India), Delhi, Second Edition, 2009.
Reference books:	
1	Bernad Sklar, - "Digital communication", Pearson Education, 2nd Edition.
2	Simon Haykin, "Digital communication", John Wiley and sons.
3	Wayne Tomasi, "Electronics Communication Systems" Pearson Education, Third Edition, 2001.
4	R P Singh &S. Sapre, "Analog and Digital Communication", Tata McGraw Hill 2nd Edition.
5	Haykin Simon, "Digital Communication Systems," John Wiley and Sons, New Delhi, Fourth Edition, 2014.
6	Proakis & Salehi, "Communication System Engineering", Pearson Education.

Internal Assessment:	
1	Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2	Mid Term test is to be conducted when approx. 50% syllabus is completed.
3	Duration of the midterm test shall be one hour.

Continuous Assessment:
Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8	Multiple Choice Questions (Quiz)	05 marks
9	Peer Review and Participation	05 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five needs to be solved.

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Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
ECC 502	Computer Organization and Architecture	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
ECC 502	Computer Organization and Architecture	20	20	60	---	---	100

Course Prerequisite:	
1	Digital Electronics
2	Fundamental concepts of processing
3	Data structures
Course Objectives:	
1	To introduce the learner to the design aspects which can lead to maximized performance of a Computer.
2	To introduce basic concepts and functions of operating systems.
3	To understand the concepts of process synchronization and deadlock.
4	To understand various Memory, I/O and File management techniques.
5	To introduce the learner to various concepts related to Parallel Processing.
6	To highlight the various architectural enhancements in modern processors.
Course Outcomes: After successful completion of the course students will be able to:	
1	Define the performance metrics of a computer.
2	Explain the design considerations of Processor, Memory and I/O in Computer systems.
3	Interpret the objectives and functions of an Operating System.
4	Analyze the concept of process management and evaluate performance of process scheduling algorithms.
5	Evaluate the advantages and limitations of Parallelism in systems.
6	Discuss the various architectural enhancements in modern processors.

Module	Contents	Hrs
1	**Introduction to Computer Organization**	**04**
1.1	Fundamental Units of a Computer, Basic Measures of Computer Performance - Clock Speed, CPI, MIPs and MFlops	
1.2	Number Representation methods- IEEE 754, Booth's Algorithm for multiplication, Restoring and non-restoring methods for division.	
2	**Processor Organization and Architecture**	**04**
2.1	CPU Architecture, Register Organization, Instruction cycle, Instruction Formats	
2.2	Control Unit Design- Hardwired and Micro-programmed Control: Vertical and Horizontal Micro-Instructions.	
2.3	Comparison between CISC and RISC architectures	
3	**Memory and I/O Organization**	**09**
3.1	Classification of Memories-Primary and Secondary Memories, ROM and RAM	
3.2	Memory Hierarchy, Cache Memory Concepts, Mapping Techniques, Write Policies, Cache Coherency	
3.3	Virtual Memory Management-Concept, Segmentation, Paging, Page Replacement policies	
3.4	Types of I/O devices and Access methods, Types of Buses, Bus Arbitration	
4	**Operating System concepts**	**14**
4.1	Concept of a Process, Process States, Process Description, Process Control Block	
4.2	Process scheduling -Pre-emptive and Non-pre-emptive scheduling algorithms (FCFS, Priority, SJF), Concept of Multi-Threading	
4.3	File Management -File Organization and Access	
4.4	I/O Management and Disk Scheduling: FCFS, SSTF	
5	**Parallelism**	**04**
5.1	Introduction to Parallel Processing Concepts, Flynn's classification, Amdahl's law	
5.2	Pipelining - Concept, Speedup, Efficiency, Throughput, Types of Pipeline hazards and solutions	
6	**Architectural Enhancements**	**04**
6.1	Superscalar Architectures, Out-of-Order Execution, Multi-core processors	
Total		**39**

Textbooks:	
1	William Stallings, "*Computer Organization and Architecture: Designing for Performance*", Eighth Edition, Pearson.
2	C. Hamacher, Z. Vranesic and S. Zaky, "Computer Organization", McGraw Hill,2002.
3	William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition
4	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley &Sons, Inc., 9th Edition.
Reference books:	
1	P. Hayes, "Computer Architecture and Organization", McGraw-Hill,1998.
2	B. Govindarajulu, "*Computer Architecture and Organization: Design Principles and Applications*", Second Edition, Tata McGraw-Hill.
3	D. A. Patterson and J. L. Hennessy, "Computer Organization and Design - The Hardware/Software Interface", MorganKaufmann,1998.
4	Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rd Edition
5	Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rd Edition

Internal Assessment:	
1	Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
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Continuous Assessment:
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7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8	Multiple Choice Questions (Quiz)	05 marks
9	Peer Review and Participation	05 marks

End Semester Theory Examination:	
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Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
ECC 503	Software Engineering	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
ECC 503	Software Engineering	20	20	60	---	---	100

Course Prerequisite:	
1	Knowledge of Software Application Domains, Software Engineering Practices.
2	Knowledge of any Programming Language
Course Objectives:	
1	To learn the basics of software engineering and software development process models, agile software development and other agile practices.
2	To Identify, Specify, analyse Software Requirements and prepare model.
3	To understand concepts and principles of software design and Development.
4	To learn about Project Scheduling concept and Software Cost Estimation Techniques.
5	To understand concept of software quality assurance and Risk Management.
6	To learn different software testing strategies and tactics.
Course Outcomes: After successful completion of the course students will be able to:	
1	Apply software engineering concept and choose process models for a software project development.
2	Analyse and specify software requirement specification (SRS) for software system.
3	Convert requirement model into the design model and demonstrate the use of software and user-interface design principles.
4	Generate the project schedule and estimate the cost of software system.
5	Identify risks and prepare RMMM plan for quality software system.
6	Apply testing strategies and tactics for software system.

Module	Contents	Hrs
1	**Introduction to Software Engineering and Process Models**	**07**
1.1	Nature of Software, Software Process framework	
1.2	Prescriptive Models: Waterfall Model, Incremental, RAD Models Evolutionary Process Models: Prototyping, Spiral and Concurrent Development Model. Specialized Models: Component based	
1.3	Agile process, Agility Principles, Extreme Programming (XP), Scrum.	
2	**Requirement Engineering and Modelling**	**08**
2.1	Feasibility Study Types of Requirements, Requirement Engineering Task, Software Requirement Specification (SRS), Developing Use Cases (UML)	
2.2	Requirement Model: Scenario-based model, Class-based model, Behavioural model.	
3	**Design Engineering**	**06**
3.1	Design Concepts, Design Principles	
3.2	Architecture Design, System Level Design, User Interface Design.	
4	**Project scheduling & Cost Estimation**	**06**
4.1	Project Scheduling, defining a Task Set for the Software Project, Gantt charts, Program Evaluation Review Techniques (PERT), Tracking the Schedule	
4.2	Software Project Estimation, Decomposition Techniques, LOC based, FP based and Use case-based estimations, Empirical estimation Models. COCOMO II Model.	
5	**Software Risk &Quality Management**	**06**
5.1	Software Risk, Types of Risk, Risk Identification, Risk Assessment, Risk Projection, RMMM.	
5.2	Software Quality Assurance Task and Plan, McCall's Quality Factors, Software Reliability, Formal Technical Review (FTR).	
6	**Software Testing Strategies and Tactics**	**06**
6.1	Software Testing Fundamentals, Testing strategies for conventional and Object-Oriented architectures, Unit testing, Integration testing, System Testing, Validation and System Testing.	
6.2	Testing Tactics: White-Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing.	
Total		**39**

Textbooks:	
1	Roger S Pressman "Software Engineering: A Practitioner's Approach" 8th Edition McGraw- Hill, ISBN:978-0-07-802212-8
2	Pankaj Jalote, "An integrated approach to Software Engineering", Springer/Narosa
Reference books:	
1	Ian Sommerville, "Software Engineering", Pearson Education (9th edition)
2	Jibitesh Mishra and Ashok Mohanty, "Software Engineering", Pearson edition
3	Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India
4	Hans Van Vilet, "Software Engineering Principles and Practice" 3rd edition Wiley

Internal Assessment:	
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Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
ECC504	Web Technologies	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
ECC504	Web Technologies	20	20	60	---	---	100

Course Prerequisite: Basics of programming languages, basic knowledge of HTML.	
Course Objectives:	
1	To design and create web pages using HTML5 and CSS3.
2	To implement client-side scripting to static web pages.
3	To create dynamic web pages using server-side scripting.
4	To use MVC framework for web application development.
Course Outcomes: After successful completion of the course students will be able to:	
1	Design static web pages using HTML5.
2	Design the layout of web pages using CSS3.
3	Apply the concepts of client-side validation and scripts to static web pages using JavaScript and JQuery
4	Build responsive web pages using front-end framework Bootstrap.
5	Build dynamic web pages using server -side scripting.
6	Develop a web application using appropriate web development framework.

Module	Contents	Hrs
1	**Introduction to HTML5**	**04**
1.1	Basic structure of an HTML5 document, Creating an HTML5 document, Mark up Tags, Heading-Paragraphs, line Breaks HTML5 Tags - Introduction to elements of HTML, Working with Text, Lists, Tables and Frames, Hyperlinks, Images and Multimedia, Forms and other HTML5 controls.	
1.2	Self-Learning: HTML5 based game development	
2	**Static Web Page Design**	**04**
2.1	Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling (Background, Text Format, Controlling Fonts), Working with block elements and objects, Lists and Tables, CSS Id and Class, Box Model (Introduction, Border properties, Padding Properties, Margin properties). CSS Advanced: (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector)	
2.2	Self-Learning: Creating page Layout and Site Designs	
3	**Client-side scripting**	**06**
3.1	**Java Script:** Introduction to JavaScript, Lexical Structure, Types, Values, Variables, Expressions and Operators, Statements, Objects, Arrays, Functions, Pattern matching with regular expressions, JavaScript in Web Browsers, The Window object, Scripting Documents, Scripting CSS, Handling Events	
3.2	**jQuery:** jQuery Basics, jQuery Getters and Setters, Altering Document Structure, Handling events with jQuery, Animated Effects, Utility functions, jQuery Selectors and Selection Methods, Extending jQuery with Plug-ins, The jQuery UI Library	
3.3	Self-Learning: JavaScript Framework -AngularJS	
4	**Bootstrap**	**10**
4.1	Introduction to Bootstrap, downloading and installing Bootstrap. **The Grid System**: Introducing the Grid, Offsetting and Nesting, Responsive Features, Utility Classes, and Supported Devices. **CSS Foundations**: Typography in Bootstrap, Styling Tables, Styling Forms, Styling Buttons, Images, icons, and Thumbnails. **Navigation Systems**: Tabs, Pills, and Lists, Breadcrumbs and Pagination, Navigation Bar, Making the Navigation Bar Responsive. **JavaScript Effects**: Drop-downs, Modal Windows, Tooltips and Popovers, Navigation Aids: Tabs, Collapse, Affix, Carousel.	
4.2	Self-Learning: Bootstrap Customization: Combining Elements in Bootstrap, Customizing by Components, Plugins, and Variables	

5	**Server side-scripting**	**10**
5.1	Introduction to PHP, PHP Tags, Adding Dynamic content, accessing form variables, Identifiers, user-declared variables, Datatypes, Constants, Operators, Control structures, Conditionals, Iteration constructs, using arrays, string manipulation and regular expressions, reusing code and writing functions, Designing and creating your web database, Accessing MySQL database from the Web with PHP, Session Control in PHP.	
5.2	Self-Learning: PHP-NoSQL Database connectivity e.g. PHP-MongoDB connectivity	
6	**Web Development Framework**	**05**
6.1	Server side-scripting – Laravel Framework Managing Your Project Controllers, Layout, Views, and Other Assets, Talking to the Database, Model Relations, Scopes, and Other Advanced Features, Integrating Web Forms, Authenticating and Managing Your Users, Deploying, Optimizing and Maintaining Your Application	
6.2	Self-learning: Django Framework, Interactive web sites, web-based information system, blogs, social networking sites,	
Total		**39**

Textbooks:	
1	Ralph Moseley, M.T. Savliya , "Developing Web Applications", Willy India, Second Edition,
2	"Web Technology Black Book", Dreamtech Press, First Edition, 978-7722-997
3	Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition,O'REILLY,2014.(
4	Professional Rich Internet Applications: AJAX and Beyond, Dana Moore, Raymond Budd, Edward Benson, Wiley publications. https://ebooks-it.org/0470082801-ebook.htm
5	Jennifer Kyrnin, "SAMS Teach Yourself Bootstrap in 24 hours", 1st edition, Pearson Education.
6	Martin Bean, "Laravel 5 Essentials", PACKT Publishing Ltd
Reference books:	
1	Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web - How To Program", Fifth Edition, Pearson Education, 2011.
2	Achyut S Godbole and Atul Kahate, "Web Technologies", Second Edition, Tata McGraw Hill, 2012.
3	Thomas A Powell, Fritz Schneider, "JavaScript: The Complete Reference", Third Edition, Tata McGraw Hill, 2013.
4	David Flanagan, "JavaScript: The Definitive Guide, Sixth Edition", O'Reilly Media, 2011

5	Steven Holzner, "The Complete Reference – PHP", Tata McGraw Hill, 2008
6	Mike Mcgrath, "PHP & MySQL in easy Steps", Tata McGraw Hill, 2012.
7	J. Millman and A. Grabel, "Head First HTML and CSS", 2nd edition, O" Reilly.
8	Ben Frain, "Responsive Web design with HTML5 and CSS3", PACKT Publishing Ltd.
9	L. Welling and L. Thomson, "PHP and MySQL Web Development", 4th edition, Adison Wesley Professional.
Digital Materials:	
1	www.nptelvideos.in
2	www.w3schools.com
3	http://spoken-tutorial.org

Internal Assessment:	
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Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
ECCDO 501	Software Testing & Quality Assurance	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
ECCDO 501	Software Testing & Quality Assurance	20	20	60	---	---	100

Course Prerequisite: Programming Language (C++, Java), Software Engineering.	
Course Objectives:	
1	To provide students with knowledge in Software Testing techniques.
2	To provide knowledge of Black Box and White Box testing techniques.
3	To provide skills to design test case plans for testing software.
4	To prepare test plans and schedules for testing projects.
5	To understand how testing methods can be used in a specialized environment.
6	To understand how testing methods can be used as an effective tool in providing quality assurance concerning software.
Course Outcomes: After successful completion of the course students will be able to:	
1	Investigate the reason for bugs and analyse the principles in software testing to prevent and remove bugs.
2	Understand various software testing methods and strategies.
3	Design test planning.
4	Manage the test process.
5	Apply the software testing techniques in the commercial environment.
6	Use practical knowledge of a variety of ways to test software and quality attributes

Module	Contents	Hrs
1	**Testing Methodology**	**08**
1.1	Introduction to Software Testing: Introduction, Goals of Software Testing, Software Testing Definitions, Model for Software Testing, Effective Software Testing vs Exhaustive Software Testing, Software Failure Case Studies.	
1.2	Software TestingTerminology and Methodology: Software Testing Terminology, Software Testing Life Cycle (STLC), Software Testing methodology.	
1.3	Verification and Validation: Verification, Verification requirements, Validation.	
2	**Testing Techniques**	**09**
2.1	Black Box testing: boundary value analysis, equivalence class testing, state table-based testing, cause-effect graphing based testing, error guessing.	
2.2	White box Testing Techniques: need, logic coverage criteria, basis path testing, graph matrices, loop testing, data flow testing, mutation testing, Static Testing.	
2.3	Validation Activities: Unit validation, Integration, Function, System, Acceptance Testing.	
2.4	Regression Testing: Progressive vs. Regressive	
3	**Managing the Test Process**	**07**
3.1	Test Management: test organization, structure and of testing group, test planning, detailed test design and test specification.	
3.2	Software Metrics: need, definition and classification of software matrices.	
3.3	Efficient Test Suite Management: minimizing the test suite and its benefits	
4	**Test Automation**	**04**
4.1	Automation and Testing Tools: need, categorization, selection and cost in testing tool,	
4.2	Guidelines for testing tools.	
5	**Testing for specialized environment**	**05**
5.1	Agile Testing, Agile Testing Life Cycle, Challenges in Agile Testing	
5.2	Testing Object-Oriented Software: OOT Basics, Object-oriented Testing	
6	**Quality Management**	**06**
6.1	Software Quality Management, McCall's quality factors and Criteria	
Total		**39**

Textbooks:	
1	Software Testing Principles and Practices, Naresh Chauhan, Oxford Higher Education.
2	Software Testing and quality assurance theory and practice, Kshirasagar Naik, Priyadarshi Tripathy, Wiley Publication
Reference books:	
1	Effective Methods for Software Testing, Willam E. Perry, Wiley Publication, third edition.
2	Software Testing Concepts and Tools, Nageswara Rao Pusuluri, Dreamtech press.

Internal Assessment:	
1	Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2	Mid Term test is to be conducted when approx. 50% syllabus is completed.
3	Duration of the midterm test shall be one hour.

Continuous Assessment:
Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
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3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8	Multiple Choice Questions (Quiz)	05 marks
9	Peer Review and Participation	05 marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	Any three questions out of five needs to be solved.

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
ECC DO501	ASIC Verification	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
ECC DO501	ASIC Verification	20	20	60	---	---	100

Course Prerequisite: Digital Electronics	
Course Objectives:	
1	To introduce the learner System Verilog concepts for verification.
2	To provide understanding of System Verilog and SVA for verification, and understand the improvements in verification efficiency.
3	To introduce the learner advanced verification features such as practical use of classes, randomization, checking and coverage.
4	To highlight the significance of verification in VLSI industry.
Course Outcomes: After successful completion of the course students will be able to:	
1	Demonstrate an understanding of programmable devices and verification methodologies.
2	Exploit new constructs in System Verilog.
3	Summarize ASIC verification techniques such as Randomization, assertions, coverage etc.
4	Create layered test benches for digital designs in system Verilog.
5	Carry out verification of design successfully using simulators.

Module	Contents	Hrs
1	**Verification Basics**	**07**
1.1	Introduction, Verification Process, Verification Plan, Verification Methodology options, Basic Testbench Functionality, Directed Testing, Constrained-Random Stimulus, Functional Coverage, Testbench Components, Layered Testbench, Technology challenges test, Verification languages, Verification IP reuse, Verification approaches.	
2	**Data types, Procedural statements, Connecting the Test bench and Design**	**08**
2.1	Data Types: Built-in Data Types, Logic Data type, Fixed-Size Arrays (Packed and Unpacked arrays), Dynamic Arrays, Queues, associative array, array methods – Reduction, Locator & ordering, Creating New Types with typedef, Creating User-Defined Structures, Enumerated Types, Constants, Strings, Expression width.	
2.2	**Procedural statements:** Procedural Statements, Tasks, Functions, and Void Functions, routine arguments, returning from a routine, Time values.	
2.3	**Connecting the Test bench and Design:** Separating the test-bench and design, The Interface construct, Grouping Signals in an Interface using Modports, Creating Interface Monitor, Stimulus timing with Clocking Block, Test-bench design Race Condition, Program Block, Connecting it all together, Top level Scope, Program-Module interactions.	
3	**Basic Object -Oriented Programming**	**06**
3.1	**OOP**: Class, creating new objects, Where to Define a Class, OOP Terminology, Understanding Dynamic objects, Object Deallocation, using objects, Static vs Global Variables, Class methods, defining methods outside class, scoping rules, Using one class inside another, Understanding Dynamic objects, Copying objects, public vs. local, Building a test-bench	
4	**Randomization**	**07**
4.1	Randomization in system Verilog, Constraint details, Solution probabilities, controlling multiple constraint blocks, Valid constraints, In-line constraints, the pre-randomize and post-randomize functions, Random number functions, Constraints tips and techniques.	
5	**System Verilog Assertions and Functional Coverage**	**07**
5.1	**System Verilog Assertions**: Types of Assertions and examples, Immediate Assertions, Concurrent Assertions, SVA Property and Sequences, Implication (Overlapped & Non-Overlapped) Operator and Repetition Operator, System Verilog Assertion built-in methods ($rose, $fell, $stable, $past)	
5.2	**Functional Coverage**: Coverage Types, Functional Coverage Strategies, Simple Functional Coverage Example, anatomy of a cover group, triggering a	

	cover group, data sampling, cross coverage, generic cover groups, Coverage Options, Parameterized Cover Groups, Analysing Coverage Data, Measuring Coverage Statistics During Simulation.	
6	**System Verilog Test-bench Case studies**	**04**
6.1	A complete System Verilog Layered Test-Bench for the simple design of ADDER and Memory module- Test-Bench Architecture, Transaction Class, Generator Class, Interface, Driver Class, Monitor, Scoreboard, Environment.	
Total		**39**

Textbooks:	
1	Chris Spear, "System Verilog for Verification: A guide to learning the testbench language features", Springer, 3rd Edition.
2	Janick Bergeron, "Writing Testbenches Using System Verilog", Springer 2006.
3	Stuart Sutherland, Simon Davidmann, and Peter Flake, "System Verilog for Design: A guide to using system verilog for hardware design and modeling", Springer, 2nd Edition.
Reference books:	
1	Ben Cohen, Srinivasan Venkataramanan, Ajeetha Kumari and Lisa Piper, "System Verilog Assertions Handbook", Vhdl Cohen Publishing, 3rd edition
2	S Prakash Rashinkar, Peter Paterson and Leena Singh, "System on Chip Verification Methodologies and Techniques", Kluwer Academic, 1st Edition.
3	System Verilog Language Reference manual.
4	Samir Palnitkar, "Verilog HDL: A guide to Digital Design and Synthesis" second edition, Pearson – IEEE 1364-2001 compliant.
5	Spartan and Virtex family user manuals from Xilinx.
6	Verilog Language Reference manual.

Internal Assessment:	
1	Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
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Continuous Assessment:

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9	Peer Review and Participation	05 marks

End Semester Theory Examination:	
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2	Question paper will have a total of five questions.
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Vivekanand Education Society's

Institute of Technology

(An Autonomous College Affiliated to University of Mumbai, Approved by AICTE & Recognized by Govt. of Maharashtra)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
ECC DO501	Information Theory and Coding	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
ECC DO501	Information Theory and Coding	20	20	60	---	---	100

Course Prerequisite: Engineering Mathematics - IV ECC 401	
Course Objectives:	
1	To learn the principles and applications of information theory in communication systems.
2	To study various data compression methods.
3	To model the continuous and discrete communication channels.
4	To understand the theoretical framework upon which error-control codes are designed.
Course Outcomes: After successful completion of the course students will be able to:	
1	Comprehend the significance of this quantitative measure of information in the communication systems.
2	Explain entropy, joint entropy, relative entropy, conditional entropy, and channel capacity of a system.
3	Obtain knowledge in designing various source codes and channel codes.
4	Differentiate between lossy and lossless compression techniques.
5	Analyze an efficient data compression scheme for a given information source.
6	Apply the concepts of multimedia communication.

Module	Contents	Hrs
1	**Introduction to Information Theory**	**07**
1.1	Introduction to Probability theory: Axiomatic definition of probability, Bayes Theorem.	
1.2	One random variable: Types of random variable, Discrete & Continuous, PMF, PDF and Cumulative distribution Function, Conditional Probability, Independent Event.	
1.3	Two Random Variable: Discrete and Continuous, Joint probability density function, Joint Distribution function, Marginal probabilities, joint conditional probability.	
1.4	Concept of amount of information, information units, Entropy: marginal, conditional entropies.	
1.5	Information rate.	
1.6	Introduction to Probability theory: Axiomatic definition of probability, Bayes Theorem.	
1.7	One random variable: Types of random variable, Discrete & Continuous, PMF, PDF and Cumulative distribution Function, Conditional Probability, Independent Event.	
2	**Source Coding Techniques**	**06**
2.1	Block Diagram of Digital Communication system.	
2.2	Encoding techniques, Purpose of encoding, Instantaneous codes, Construction of instantaneous codes, Kraft's inequality, Coding efficiency and redundancy.	
2.3	Source coding theorem. Construction of basic source codes: Shannon Fano coding, Huffman coding.	
3	**Information Channels**	**06**
3.1	Information Channels: Communication Channels.	
3.2	Channel Models, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies, Mutual Information, Channel Capacity.	
3.3	Discrete Memoryless channels: Binary Symmetric Channel (BSC), Channel Capacity of BSC, redundancy and efficiency of channels.	
3.4	Channel Capacity: Hartley – Shannon law.	
4	**Codes for error detection and correction**	**08**
4.1	Linear block codes, Error detecting and correcting capabilities.	
4.2	Generator and Parity check matrices, Standard array and Syndrome decoding.	
4.3	Cyclic codes: Generator polynomial, Generator and Parity check matrices, Encoding of cyclic codes.	
4.4	Syndrome computation and error detection, Decoding of cyclic codes.	

5	**Convolution Codes**	**06**
5.1	Encoding and State, Tree and Trellis diagrams.	
5.2	Maximum likelihood decoding of convolution codes, Viterbi algorithm.	
6	**Audio and Video Coding**	**06**
6.1	Linear Predictive coding, code excited LPC, Perceptual coding, MPEG audio coders, Dolby audio coders.	
Total		**39**

Textbooks:	
1	Simon Haykin, Communication Systems, 4th Edition, John Wiley and Sons.
2	Ranjan Bose, Information theory, coding and cryptography, 2nd Edition,Tata McGraw-Hill.
3	R. Togneri, C.J.S deSilva, Fundamentals of Information Theory and Coding Design, 1st Edition,Taylor and Francis.
4	Fred Halsall, Multimedia Communications, Applications Networks Protocols and Standards, Pearson Education, 1st Edition, Asia.
Reference books:	
1	Bernard Sklar, Digital Communications Fundamentals and Applications,2nd Edition, Person Education Asia.
2	Taub and Schilling, Principles of Communication Systems , 2nd Edition, Tata McGraw-Hill.
3	Glover and Grant, Digital Communication, 2ndEdition, Pearson.
4	T. M. Cover, J. A. Thomas, Elements of Information Theory, 2nd Edition,Wiley.
5	Mark Nelson, Data Compression Book, 2nd Edition, BPB Publication.
6	Watkinson J, Compression in Video and Audio, 1st Edition, Focal Press, London.
7	R. J. McEliece, The Theory of Information and Coding, 1st Edition, Cambridge University Press.

Internal Assessment:	
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Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
ECC DO501	Sensors and Applications	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
ECC DO501	Sensors and Applications	20	20	60	---	---	100

Course Prerequisite:	
1	Concept of internal characteristics of passive elements like resistor, capacitor, inductor etc.
2	Diode and transistor.
3	Working, knowledge of basic fundamentals of mechanical terms like position, strain, stress etc.
Course Objectives:	
1	To introduce the basics of sensors, their characteristics and the integration of sensors with signals and systems.
2	To learn different considerations of analog, digital & mixed circuit design.
3	To understand various sensor types and their applications across different domains such as area occupancy, motion, position, displacement, velocity, etc.
4	To understand and apply the principles of sensor materials and technologies.
5	To understand sensor technologies, their applications, and the communication protocols.
6	To implement international standards and best practices for calibrating sensors in industrial applications.
Course Outcomes: After successful completion of the course students will be able to:	
1	Understand the concept of sensors and its characteristics, applications.

2	Understand the practical approach in design of technology based on different sensors.
3	Understand the principles and mechanisms of various sensors for measuring physical parameters.
4	Learn various sensor materials and technology used in designing sensors.
5	Understand sensor technologies and industrial communication protocols essential for modern industrial applications.
6	Understand and apply international standards and best practices in sensor calibration for industrial applications.

Module	Contents	Hrs
1	**Sensors Fundamentals and Characteristics Sensors, Signals and Systems**	**06**
1.1	Sensor Classification–Physical, Mechanical, Electrical, Chemical, electro-chemical	
1.2	Functional unit of sensor: receptor and transducer; Units of Measurements	
1.3	Sensor Characteristics, Physical Principles of Sensing Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material	
2	**Interface Electronic Circuits**	**06**
2.1	Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits	
2.2	Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission.	
2.3	Introduction to Digital filters.	
3	**Sensors in Different Applications**	**08**
3.1	Area Occupancy and Motion Detectors; Position, Displacement, and Level; Velocity and Acceleration; Force, Strain, and Tactile Sensors; Pressure Sensors	
3.2	Temperature Sensors; Biosensors, Gas sensors, proximity sensor. (Correlation of output with the parameter being measured in engineering terms): Only Working principle of each type of sensors and transduction action (for example: detection of change in temperature and conversion to electrical quantity say resistance and corresponding correlation)	
3.3	Case study of Applications of sensors in Automotive, Manufacturing plants, digital devices such as mobile phone, house-hold instrument such as washing machine (name of various sensors and their usability in each of these applications).	
4	**Sensor Materials and Technologies**	**07**

4.1	MEMS-cantilever based sensorsand their types such as, accelerometer, gyroscopes: Structure, material used (polysilicon, Silicon etc), working principle, applications.	
4.2	Metal oxide semiconductor (nano-particles) based sensors such as gas sensors, biomedical sensors (Structure, material used, working principle, applications)	
5	**Smart Sensors**	**06**
5.1	4-20 mA Current Loop, Block diagram of smart sensors	
5.2	HART, Industrial buses such as Profibus, CAN bus, etc.	
6	**Industrial standards for the sensors and its calibration**	**06**
6.1	Basic knowledge about IEC 60601-1-1: Medical Electrical Equipment – Part 1-1, ISA S82.01, NEMA standards	
6.2	PCI 6.5 to SOX compliance, HIPAA compliance	
Total		**39**

Textbooks:	
1	Jacob Fraden,Handbook of Modern Sensors Physics, Designs, and Applications, Fourth Edition, Springer
2	D. Patranabis, Sensors and Transducers, 2nd Edition, PHI Publication, New Delhi.
3	Mechatronics- Ganesh S. Hegde, Published by University Science Press, 2nd Edition, An imprint of Laxmi Publication Private Limited.
4	Terry Bartelt, Process Control Systems and Instrumentation, Delmar Cengage Learning India Edition New edition.
Reference books:	
1	G. Eranna , Metal Oxide Nanostructures as Gas Sensing Devices, Publisher: CRC Press.
2	ISA S82.01 - Safety Standard for Electrical & Electronic Test, Measuring, Controlling Related Equipment.

Internal Assessment:	
1	Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
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Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
ECL 501	Communication Engineering Lab	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
ECL 501	Communication Engineering Lab	---	---	---	25	25	50

Lab Outcomes: After successful completion of the course students will be able to:	
1	Perform hardware implementation of various analog and digital modulation methods.
2	Illustrate generation and detection of various pulse modulation techniques.
3	Apply techniques to insert Inter Symbol Interference and methods to mitigate its effect.
4	Simulate various analog and digital modulation methods.
5	Demonstrate multiplexing and de-multiplexing of signals using multiplexing techniques.
6	Illustrate the effect of sampling frequency on the reconstructed signal.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr.No.	**Name of the Experiments**
1	Analog Modulation and demodulation: AM
2	Analog Modulation and demodulation: FM
3	Pre-emphasis & De-emphasis
4	Analog Pulse modulation (PAM/PWM/PPM)
5	Time division multiplexing
6	Frequency division multiplexing
7	Verification of Sampling theorem
8	Generation of Line codes
9	Binary modulation and demodulation of BASK
10	Binary modulation and demodulation of BPSK
11	Binary modulation and demodulation of BFSK
Simulation-based experiments	
12	Simulation of AM and FM
13	Simulation of PAM, PPM, PWM
14	Simulation of BPSK/BASK/MSK modulation
15	Simulation of duobinary encoder, decoder

Note: Suggested List of Experiments is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term-Work:

1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
ECL502	Software Engineering and Web Technologies Lab	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
ECL502	Software Engineering and Web Technologies Lab	---	---	---	25	25	50

Lab Outcomes: After successful completion of the course students will be able to:	
1	Identify requirements and apply process model to selected case study.
2	Analyse and design models for the selected case study using UML modelling
3	Use various Software Engineering and Project Management Tools
4	Design static web pages using HTML5, CSS3, Bootstrap.

5	Apply the concepts of Client-side validation and scripts to static web pages using JavaScript and jQuery.
6	Build dynamic web pages using Server-Side Scripting.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr.No.	**Name of the Experiments**
Software Engineering	
1	Prepare detailed statement of problem with feasibility study and identify suitable process model for the same with justification.
2	Develop Software Requirement Specification (SRS) document in IEEE format for the project.
3	Prepare schedule for the project using any project management tool
4	Prepare RMMM plan for the project.
5	Identify scenarios & develop UML Use case and Class Diagram for the project.
6	Develop Activity / State Transition diagram and Sequence diagram for the project.
7	Develop test cases for the project using white box testing.
Web Technologies	
8	a) Installation and Setting of LAMP / WAMP / XAMP.
9	b) Develop a Prototype of the selected problem statement (UI and UX).
10	Design and Implement web pages using HTML5 and CSS3 on the selected problem statement.
11	Design Form using javascript/HTML/JQuery with client-side validations on the selected problem statement.
12	Design Interactive web pages using PHP (any framework) with database connectivity to MySQL on the selected problem statement.
13	Design and Implement web pages with PHP and Ajax on the selected problem statement.
Note 1	*Practicals (Software Engineering) can be conducted using any open-source software tools like Dia, Star UML, Project Libre etc.*
Note 2	*Students are expected to pick up one Case study/Mini Project such as hospital*

	management, student management, e-shop etc., and perform all the experiments based on that.

Note: Suggested List of Experiments is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term-Work:	
1	Term work should consist of 10 experiments. **At least 10 experiments covering entire syllabus of Software Engineering and Web Technologies (50% Software Engineering and the remaining 50% Web Technologies)** should be set to have well predefined inference and conclusion.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
ECL 503	Software Testing & Quality Assurance Lab	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
ECL 503	Software Testing & Quality Assurance Lab	---	---	---	25	25	50

Lab Outcomes: After successful completion of the course students will be able to:	
1	Understand the system thoroughly (for requirement, designing and implementation).
2	Recognize failures in the system.

3	Investigate the reason for bugs.
4	Design test plan and test cases.
5	Execute the test cases manually and using automated tools.
6	Manage the testing process.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr.No.	**Name of the Experiments**
1	Write programs in C Language to demonstrate the working of the following a. constructs: i) do...while ii) while....do iii) if...else iv) switch
2	Write a program for any one function of the selected system. Introspect the causes for its failure and write down the possible reasons for its failure.
3	Study the system, requirement specifications and designing the system.
4	Write the brief test plan.
5	Select the test cases (positive and negative scenarios) for the selected system.
6	Design Test cases for the system using boundary value analysis or equivalent class partitioning.
7	Manual execution of test cases and prepare defect reports.
8	Identify regression scenarios for automation for any one/two test case.
9	Study of any testing tool (e.g. Selenium).
10	Automate the scenario in exp 8 with a testing tool. (e.g. Selenium)
11	Study of any test management tool (e.g. Qase).
12	Writing down test cases and execution using tools (e.g. Qase).
13	Study defect management (e.g. JIRA)
14	Design quality matrix for your system.
Note	*Consider one system (e.g. Library Management System, ATM system, Banking application, Library Management System) and use throughout the lab.*

Note: Suggested List of Experiments is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging experiments, (limited

to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term-Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

Course Code	**Course Name**	**Teaching Scheme (Teaching Hours)**			**Credits Assigned**			
		Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tut**	**Total**
ECL 503	**ASIC Verification**	---	**02**	---	---	**01**	---	**01**

Course Code	**Course Name**	**Examination Scheme**					
		Theory			**Term Work**	**Practical & Oral**	**Total**
		Internal Assessment		**End Sem Exam**			
		Mid-Term Test	**Continuous Assessment**				
ECL 503	**ASIC Verification**	---	---	---	**25**	**25**	**50**

Lab Outcomes: After successful completion of the course students will be able to:	
1	Create test plan and test cases to verify any digital design.
2	Apply the advanced verification techniques like Randomization on set of inputs.
3	Create a transaction class and apply object -oriented programming for Verification.
4	Carry out simulation of designs using System Verilog hardware verification language

5	Develop a complete Layered Test-bench for any digital design.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr.No.	**Name of the Experiments**
1	Write Verilog code for 4:1 MUX using all Verilog modeling styles and simulate the same.
2	Write Verilog code and test-bench for D flip flop and 4 bit counter and simulate the same.
3	Create a test plan and self-checking test-bench for the ALU.
4	Create dynamic arrays, associative arrays, and queues using System Verilog.
5	Write test bench using dynamic arrays, associative arrays with System Verilog to test a synchronous 8-bit x64K (512kBit) RAM.
6	Create an Interface for a Memory Design. Use Modport to assign direction to signal.
7	Create class and its objects and perform deep copy and shallow copy.
8	Create an Interface for a Memory Design. (without modport)
9	To understand and create Virtual interface and use it in a class.
10	Given design specifications, draw waveform and write SVA expressions.
11	Given design specifications, draw waveform and write clock based Sequences
12	Create IPCs like events, mailbox and semaphores to interact between threads.
13	Find coverage by writing cover groups for a design.
14	Implementation of parallel processes using Fork Join/ join_any/ join_none statement.
15	Create a layered test-bench for a simple design like Adder.

Note: Suggested List of Experiments is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging experiments, (limited

to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term-Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

Course Code	**Course Name**	**Teaching Scheme (Teaching Hours)**			**Credits Assigned**			
		Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tut**	**Total**
ECL 503	**Information Theory and Coding**	---	**02**	---	---	**01**	---	**01**

Course Code	**Course Name**	**Examination Scheme**					
		Theory			**Term Work**	**Practical & Oral**	**Total**
		Internal Assessment		**End Sem Exam**			
		Mid-Term Test	**Continuous Assessment**				
ECL 503	**Information Theory and Coding**	---	---	---	**25**	**25**	**50**

Lab Outcomes: After successful completion of the course students will be able to:	
1	Understand the basics of information theory, source coding techniques and calculate Entropy of source.
2	Implement Shannon-Hartley equation to find the upper limit on the Channel Capacity.

3	Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of communication system.
4	Apply the knowledge of digital electronics and describe the error control codes like block code, cyclic code and convolutional codes.
5	Implement audio and video compression techniques

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr.No.	**Name of the Experiments**
1	Write a program for determination of entropy and mutual information of a given channel: Noise free channel.
2	Write a program for determination of entropy and mutual information of a given channel: Binary symmetric channel.
3	Write a program for Shannon-Hartley equation to find the upper limit on the Channel Capacity
4	Write a program for generation and evaluation of variable length source coding Shannon – Fano Coding and decoding.
5	Write a program for generation and evaluation of variable length source coding Huffman Coding and decoding.
6	Write a program for generation and evaluation of variable length source coding LZW Coding and decoding.
7	Write a program for Forward error correction system with a given Linear block code.
8	Write a Program for coding & decoding of Linear block codes.
9	Write a Program for coding & decoding of Cyclic codes.
10	Write a program for coding and decoding of Convolutional codes.
11	Write a program for computing the LPC coefficients.
12	Write a program for video compression.

Note: Suggested List of Experiments is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging experiments, (limited

to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term-Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

Course Code	**Course Name**	**Teaching Scheme (Teaching Hours)**			**Credits Assigned**			
		Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tut**	**Total**
ECL503	**Sensors and Applications**	---	**02**	---	---	**01**	---	**01**

Course Code	**Course Name**	**Examination Scheme**					
		Theory			**Term Work**	**Practical & Oral**	**Total**
		Internal Assessment		**End Sem Exam**			
		Mid-Term Test	**Continuous Assessment**				
ECL503	**Sensors and Applications**	---	---	---	**25**	**25**	**50**

Lab Outcomes: After successful completion of the course students will be able to:	
1	Choose proper sensor with its thorough understanding of the characteristics.
2	Design suitable signal conditioning circuit for the chosen sensors
3	Perform characterization of sensor materials and technology used in different sensors
4	Implement a prototype for demonstrating the application of the sensors
5	Demonstrate problem solving & troubleshooting skills in sensor applications

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr.No.	**Name of the Experiments**
1	Characteristics of temperature sensors
2	Characteristics of optical Sensors
3	I to V and V to I converter
4	Frequency to voltage converter using OpAmp
5	Inverting and non-inverting amplifier using OpAmp
6	LVDT Sensor construction and characteristics
7	Instrumentation Amplifier Design
8	Filter Design (Analog)
9	Filter Design (Digital Simulation)
10	Case study on any house hold appliance
11	4-20mA Current Loop
12	Interface with Real word using A/D converters
13	Simulations of Micro-sensors
14	Simulations of micro-actuators such as micro-heater/ micro-motors

Case study: Make a detailed report on industrial applications of sensor: Automotive, mobile phone, consumer products or household equipment such as fridge, washing machine (anyone, all students in a batch should take up different problem statement). The case study should include:

1. Name of equipment
2. Application of selected equipment
3. Sensors used in that equipment, working principle of each type of sensor
4. Draw the complete block diagram of equipment and explain the working of each block.
5. Summary
6. References

Note: Suggested List of Experiments is indicative. However, flexibilities lie with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term-Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
ECL504	Professional Communication and Ethics-II	---	2 * + 2 Hours (Batch-wise)	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
ECL504	Professional Communication and Ethics-II	---	---	---	25	25	50

Theory class to be conducted for full class.

Course Objectives:	
1	Discern and develop an effective style of writing important technical/business documents.
2	Investigate possible resources and plan a successful job campaign.
3	Understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement.
4	Develop creative and impactful presentation skills.
5	Analyse personal traits, interests, values, aptitude and skills.

6	Understand the importance of integrity and develop a personal code of ethics
Course Outcomes: After successful completion of the course students will be able to:	
1	Plan and prepare effective business/ technical documents which will in turn provide solid foundation for their future managerial roles.
2	Strategize their personal and professional skills to build a professional image and meet the demands of the industry.
3	Emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations.
4	Deliver persuasive and professional presentations.
5	Develop creative thinking and interpersonal skills required for effective professional communication.
6	Apply codes of ethical conduct, personal integrity and norms of organizational behavior.

Module	Contents	Hrs
1	**ADVANCED TECHNICAL WRITING: PROJECT/PROBLEM BASED LEARNING (PBL)**	**06**
1.1	**Purpose and Classification of Reports** Classification on the basis of: Subject Matter (Technology, Accounting, Finance, Marketing, etc.), Time Interval (Periodic, One-time, Special), Function (Informational, Analytical, etc.), Physical Factors (Memorandum, Letter, Short & Long)	
1.2	**Parts of a Long Formal Report** Prefatory Parts (Front Matter), Report Proper (Main Body), Appended Parts (Back Matter)	
1.3	**Language and Style of Reports** Tense, Person & Voice of Reports, Numbering Style of Chapters, Sections, Figures, Tables and Equations, Referencing Styles in APA & MLA Format, Proof-reading through Plagiarism Checkers	
1.4	**Definition, Purpose & Types of Proposals** Solicited (in conformance with RFP) & Unsolicited Proposals, Types (Short and Long proposals)	
1.5	**Parts of a Proposal** Elements, Scope and Limitations, Conclusion	
1.6	**Technical Paper Writing** Parts of a Technical Paper (Abstract, Introduction, Research Methods, Findings and Analysis, Discussion, Limitations, Future Scope and References), Language and Formatting, Referencing in IEEE Format	
2	**EMPLOYMENT SKILLS**	**06**
2.1	**Cover Letter & Resume**	

	Parts and Content of a Cover Letter, Difference between Bio-data, Resume & CV, Essential Parts of a Resume, Types of Resume (Chronological, Functional & Combination)	
2.2	**Statement of Purpose** Importance of SOP, Tips for Writing an Effective SOP	
2.3	**Verbal Aptitude Test** Modelled on CAT, GRE, GMAT exams	
2.4	**Group Discussions** Purpose of a GD, Parameters of Evaluating a GD, Types of GDs (Normal, Casebased & Role Plays), GD Etiquette	
2.5	**Personal Interviews** Planning and Preparation, Types of Questions, Types of Interviews (Structured, Stress, Behavioral, Problem Solving & Case-based), Modes of Interviews: Face-toface (One-to one and Panel) Telephonic, Virtual	
3	**BUSINESS MEETINGS**	**02**
3.1	**Conducting Business Meetings** Types of Meetings, Roles and Responsibilities of Chairperson, Secretary and Members, Meeting Etiquette	
3.2	**Documentation** Notice, Agenda, Minutes	
4	**TECHNICAL/ BUSINESS PRESENTATIONS**	**02**
4.1	**Effective Presentation Strategies** Defining Purpose, Analyzing Audience, Location and Event, Gathering, Selecting &Arranging Material, structuring a Presentation, Making Effective Slides, Types of Presentations Aids, Closing a Presentation, Platform Skills	
4.2	**Group Presentations** Sharing Responsibility in a Team, Building the contents and visuals together, Transition Phases	
5	**INTERPERSONAL SKILLS**	**08**
5.1	**Interpersonal Skills** Emotional Intelligence, Leadership & Motivation, Conflict Management & Negotiation, Time Management, Assertiveness, Decision Making	
5.2	**Start-up Skills** Financial Literacy, Risk Assessment, Data Analysis (e.g. Consumer Behavior, Market Trends, etc.)	
6	**CORPORATE ETHICS**	**02**
6.1	**Intellectual Property Rights**	

	Copyrights, Trademarks, Patents, Industrial Designs, Geographical Indications Integrated Circuits, Trade Secrets (Undisclosed Information)	
6.2	**Case Studies** Cases related to Business/ Corporate Ethics	
Total		**26**

Textbooks:	
1	Arms, V. M. (2005). Humanities for the engineering curriculum: With selected chapters from Olsen/Huckin: Technical writing and professional communication, second edition. Boston, MA: McGraw-Hill.
2	Bovée, C. L., &Thill, J. V. (2021). Business communication today. Upper Saddle River, NJ: Pearson.
3	Butterfield, J. (2017). Verbal communication: Soft skills for a digital workplace. Boston, MA: Cengage Learning.
4	Masters, L. A., Wallace, H. R., & Harwood, L. (2011), Personal development for life and work. Mason: South-Western Cengage Learning.
Reference books:	
1	Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). *Organizational behaviour*. Harlow, England: Pearson.
2	Meenakshi Raman, Sangeeta Sharma (2004) Technical Communication, Principles and Practice. Oxford University Press
3	Archana Ram (2018) Place Mentor, Tests of Aptitude For Placement Readiness. Oxford University Press
4	Sanjay Kumar &Pushp Lata (2018). Communication Skills a workbook, New Delhi: Oxford University Press.

LIST OF ASSIGNMENTS FOR TERMWORK: **(In the form of Short Notes, Questionnaire/ MCQ Test, Role Play, Case Study, Quiz, etc.)**	
Sr.No.	**Contents**
1	Cover Letter and Resume
2	Short Proposal

3	Meeting Documentation
4	Writing a Technical Paper/ Analyzing a Published Technical Paper
5	Writing a SOP
6	IPR
7	Interpersonal Skills
8	Aptitude test (Verbal Ability)

Note:

- The Main Body of the project/book report should contain minimum 25 pages (excluding Front and Back matter).
- The group size for the final report presentation should not be less than 5 students or exceed 7 students.
- There will be an end–semester presentation based on the book report.

GUIDELINES FOR INTERNAL ASSESSMENT	
Term-Work: Term work shall consist of minimum 8 experiments. The distribution of marks for term work shall be as follows:	
1	**Assignments: 10 Marks**
2	**Attendance: 05 Marks**
3	**Presentation slides: 05 Marks**
4	**Book Report (hard copy): 05 Marks**
The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.	

INTERNAL ORAL:	
Oral Examination will be based on a GD & the Project/Book Report presentation.	
1	**Group Discussion: 10 Marks**
2	**Project Presentation: 05 Marks**
3	**Group Dynamics: 05 Marks**

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
ECM501	Mini project - 2A	---	4$	---	---	02	---	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
ECM501	Mini project - 2A	---	---	---	25	25	50

$ indicate workload of learner not faculty

Course Objectives:	
1	To acquaint with the process of identifying the needs and converting it into the problem.
2	To familiarize the process of solving the problem in a group.

3	To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4	To inculcate the process of self-learning and research.
Course Outcomes: After successful completion of the course students will be able to:	
1	Identify problems based on societal /research needs.
2	Apply knowledge and skill to solve societal problems in a group.
3	Develop interpersonal skills to work as member of a group or leader.
4	Draw the proper inferences from available results through theoretical/experimental/simulations.
5	Analyze the impact of solutions in societal and environmental context for sustainable development.
6	Use standard norms of engineering practices.
7	Excel in written and oral communication.
8	Demonstrate capabilities of self-learning in a group, which leads to life-long learning.
9	Demonstrate project management principles during project work

Guidelines for Mini Project:	
1	Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity
2	Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3	Major focus of Mini-project 2 shall be towards exploration and applicability of knowledge acquired in the domain areas of DLOs available for the year.
4	Student shall give special consideration to identify and provide solutions to the burning societal and/or environmental issues which may affect the mankind to larger extend.
5	Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.

A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.

Log book:	
1	Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self- learning.
2	Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/supervisor.
3	Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
4	The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.

5	With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
6	However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case-tocase basis

Guidelines for Assessment of Mini Project:

The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester. In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions. Distribution of Term work marks for both semesters shall be as below;

Distribution of Term work marks for both semesters shall be as below;

Marks awarded by guide/supervisor based on logbook	**10**
Marks awarded by review committee	**10**
Quality of Project report	**5**

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

In **first semester** entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.

1	First on identification and finalization of problem
2	Second on proposed solution for the problem.

In **second semester** expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.

1	First review shall base on readiness of building working prototype.
2	Second review shall be based on poster presentation-cum-demonstration of working model in last month of the said semester.

Half-year project:

In this case students' group shall complete project in all aspects, in a semester, including;

Identification of need/problem
Proposed acceptable solution for the identified problem
Procurement of components/systems, if any
Building a working prototype and testing

The group shall be evaluated twice during the semester by review committee, mainly look for the progress as;

First review focus shall be towards identification & selection of problem and probable solution proposal.
Second review shall be for implementation and testing of solution. (Innovative/out of box solution)

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria:

1	Quality of survey/ need identification.
2	Clarity of Problem definition based on need.
3	Innovativeness in solutions
4	Feasibility of proposed problem solutions and selection of best solution
5	Innovativeness and out of box thinking
6	Cost effectiveness and Societal impact
7	Functional working model as per stated requirements
8	Effective use of skillsets acquired through curriculum including DLOs
9	Effective use of standard engineering practices & norms
10	Contribution of an individual as team member/Leader
11	Feasibility to deploy the solution on large scale
12	Clarity in written and oral communication

In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in Mini project.
In case of **half year project** all criteria in generic may be considered for performance evaluation of students in mini-project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

Report should be prepared as per the guidelines issued by the University of Mumbai. Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations, having experience of more than five years approved by head of the Institute

Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed by team of external & internal examiner at the end of semester/year. Performance shall be evaluated based on;

1	Quality of problem and Clarity
2	Innovativeness in solutions
3	Cost effectiveness and Societal impact
4	Implementation of working model
5	Effective use of diversified skill-set
6	Effective use of standard engineering practices & norms
7	Contribution of an individuals as a member/Leader
8	Clarity in written and oral communication