1.2.1

1.2.1.1: How many new courses are introduced within the last five years: **18**

Total number of courses in the five years: **228**

1.2.1.2: Number of courses offered by the Institution across all the programmes during the last 5 years:

7.89% (CSE Dept)

	Year 1 (2021 – 22)	Year 2 (2020 – 21)	Year 3 (2019 – 20)	Year 4 (2018 – 19)	Year 5 (2017 – 18)
New Courses	**3**	**4**	**8**	**2**	**1**
Total Courses	**48**	**46**	**42**	**42**	**50**
Percentage	**6.25**	**8.69**	**19.04**	**4.76**	**2.00**

Year1	Year2	Year3	Year4	Year5
1. AI-ML 2. Internship 3. Data Science	1. Java 2. AOOP 3. Biology for Engineers 4. Cyber Law	1. ARM Processor 2. ARM Processor Lab 3. Introductory Project 4. Compiler Design and System Software 5. Computer Organization and Architecture 6. Data Structures and Applications 7. Artificial Intelligence and Machine Learning 8. Management Entrepreneurship and IPR	1. Internship 2. Distributed Systems	1. Unix System Programming

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Syllabus

18UCSL704	Internship	2 Credits

Contact Hours: 4 weeks

Course Learning Objectives (CLOs): Internship provides an opportunity to get industry exposure to real time scenarios that include professional skill development programs and adhere to the professional standards.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12) / PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Explore** the domain knowledge	1, 8, 2,12	-	-
CO-2	**Apply** the knowledge and skills in the professional career.	3,5, 8, 13,12	11, 16	6, 7
CO-3	**Prepare** a technical report	4,5, 8, 14,12	16	-
CO-4	**Demonstrate** the knowledge gained through presentation.	5, 8, 15,12	-	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	3.0	3.0	3.0	3.0	3.0	1.0	1.0	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	2.0

Prerequisites: Knowledge of both theory and practical courses learnt in all the previos semesters and relevant value-added information.

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18UCSE808	Data Science	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course is a 3 credit undergraduate course focusing on the data and types, data preprocessing. The details of R language are discussed to enable the students to perform data analytics. It also discusses the supervised and unsupervised learning.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Explain** the flow process for processing data science problems and the data types.	-	1, 2	13
CO-2	**Apply** the preprocessing methods to the raw data to make it available for analysis.	1, 2	-	-
CO-3	**Use** the R language to perform the data visualization and the analysis using fundamental statistical technques.	3	-	12
CO-4	Explain the machine learning technques.	-	1, 2	13
CO-5	Explain the unsupervised learning technques.	-	1, 2	13

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.3	2.3	3.0	-	-	-	-	-	-	-	-	1.0	1.0	-	-	-

Pre-requisites: Knowledge of Statistics

Contents:

Unit-I

Introduction: Evolution, Roles, Stages in Data Science Project, Applications, Data Security and Privacy Issues

Data: Data types - Structured and Unstructured, Challenges with Unstructured data, Social media data, Multi modal data, Data Storage and Presentation **7 Hrs**

Unit-II

Data Preprocessing: Cleaning, Integration, Transformation, Reduction, Discretization.

Techniques: Correlation, Regression. Exploratory Analysis. **7 Hrs**

Unit-III

R Language: Basics, Control structures, Functions, Impoting Data.
Graphics and Data Visualization: Installing gglot2, Loading the data, Plotting the Data.
Statistics and Machine Learning: Basic Statistics, Regression, Clustering **9 Hrs**

Unit-IV

Machine Learning: Introduction, Regression, Classification, Gradient Descent. **8 Hrs**

Unit-V

Unsupervised Learning: Introduction, Agglomerative Clustering, Reinforcement Learning **8 Hrs**

Reference Books:

1) Chirag Shah, "A Hands on Introduction to Data Science", Cambridge University Press, 2020
2) Laura Igual and Santi Segui, "Introduction to Data Science", Springer International Publications, 2017
3) Richord Cotton "Learning R", O'Reilly Publications, 2013.

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18UCSE508 Advanced Object Oriented Programming (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course focuses on core and advanced Java language features that are part of JDK 8 and above.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12) / PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Build** graphical user interface using JavaFX for a given problem.	13,14,15	-	1, 2,3, 5, 9,16
CO-2	**Develop** applications that involve parallel programming abilities using concurrent utility feature.	13,14,15	-	1, 2,3, 5, 9,16
CO-3	**Write** programs to solve a given problem using generics and collection Frameworks.	13,14,15	-	1, 2,3, 5, 9,16
CO-4	**Use** Java networking features to **write** applications that involve client / server interactions.	13,14,15	-	1, 2,3, 5, 9,16
CO-5	**Develop** an application that use appropriate driver classes to connect databases and **perform** database operations required as per problem specification.	13,14,15	-	1, 2,3, 5, 9,16
CO-6	**Develop** web-based applications using J2EE features like Servlets and JSP.	13,14,15	-	1, 2,3, 5, 9,16
CO-7	**Write** program using lambda expressions to solve given problem scenario.	13,14,15	-	1, 2,3, 5, 9,16
CO-8	**Write** program using stream APIs to solve given problem scenario.	13,14,15	-	1, 2,3, 5, 9,16

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.0	1.0	1.0	-	1.0	-	-	-	1.0	-	-	-	3.0	3.0	3.0	1.0

Pre-requisites: Knowledge of

- Basic features of Java
- Object oriented programming paradigm, its concepts and practices

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Contents:

Unit-I

GUI programming with JavaFX: Introducing JavaFX GUI programming – JavaFX basic concepts, JavaFX application skeleton, the Application thread; Exploring JavaFX controls – ToggleButton, RadioButton, CheckBox, ListView, TextField, TreeView, disabling a control; Introducing JavaFX menus – menu basics, overview of MenuBar, Menu and MenuItem, create main menu, add mnemonics and accelerators to menu items, use RadioMenuItem and CheckMenuItem, create ContextMenu and Toolbar **7 Hrs**

Unit-II

Concurrent Utilities: concurrent API packages, using synchronization objects, phaser, using an executer, TimeUnit enumeration, concurrent collections, locks, atomic operations, parallel programming via Fork/Join framework.

Generics and Collections Framework: Generics - what are generics, a simple generics example, a generic class with two type parameters, general form of general class, bounded types, using wildcard arguments, creating a generic method; Collections Framework – collections overview, the collection interfaces, the collection classes, accessing a collection via an iterator, for-each alternative to iterators, spliterators, storing user-defined classes in collections. **9 Hrs**

Unit-III

Networking and RMI: networking basics, the networking classes and interfaces, InetAddress class, TCP/IP client sockets, HttpURLConnection class, TCP/IP server sockets, Datagrams; Remote Method Invocation (RMI) – A simple client/server application using RMI

J2EE Databases: the concept of JDBC, JDBC driver types, a brief overview of JDBC process, database connection, Statement objects, ResultSet class, ResultSetMetaData class **7 Hrs**

Unit-IV

Java Servlets: Introduction,benefits of Java servlets, a simple java servlet, anatomy of a Java servlet, deployment descriptor, reading data from a client, reading/writing HTTP request/response headers; working with cookies, tracking sessions

Java ServerPages: Introduction,JSP tags, Request string, User sessions, cookies, session objects **9 Hrs**

Unit-V

Extended features of Java: Lambda Expressions – introducing lambda expressions, block lambda expressions, passing lambda expressions as arguments, lambda expressions and exceptions, lambda expressions and variable capture, method references; The Stream API – stream basics, reduction operations, using parallel streams, mapping, collecting, iterators and streams. **7 Hrs**

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Reference Books:

1) Herbert Schildt, "Java: The Complete Reference", 10th edition, McGraw-Hill, 2017
2) Jim Keogh, "J2EE: The Complete Reference", McGraw-Hill, 2011
3) Gregory Brill, "CodeNotes for J2EE: EJB, JDBC, JSP, and Servlets", Random House Publishing Group, 2002.
4) John Hunt & Chris Loftus, "Guide to J2EE: Enterprise Java", Springer Publications, 2012.

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21UAEE100	Biology for Engineers	(2-0-0) 2

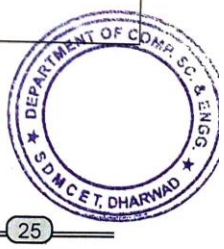
Contact Hours: 26 CIE: 50 Marks SEE: 50 Marks Exam Duration: 2 Hrs.

Course Learning Objective (CLO):

To enable learners to understand the basic organization and functioning of living organisms from an engineering perspective.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1,12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Describe the fundamentals of living things.	-	-	1
CO-2	Apply the concept of plant, animal and microbial systems and growth in real life systems.	-	2	1
CO-3	Analyze the cause of symptoms, and treatment of common diseases.	-	2	1
CO-4	Comprehend on genetic and the immune system	-	2	1
CO-5	Illustrate the application of biology system in relative industries.	1,2	3	



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POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	1.4	2.25	2	-	-	-	-	-	-	2.6	-	-

Prerequisites: A course on Biology Preferred

Contents:

Unit-I

Introduction to Cell Biology: Need to study biology, Cell, structure types, function of prokaryote and eukaryote, cell organization cell differentiation, cell theory etc. Microbiological fundamentals (yeast, bacteria and virus) **06 Hrs.**

Unit-II

Biomolecules: Structure, classification and functions of lipid and fats proteins, enzymes, nucleic acids, vitamins, carbohydrates etc. **05 Hrs.**

Unit-III

Physiology and Human Diseases: Excretory, circulatory, respiratory, digestive and nervous system, immunology. Jaundice, cancer, diabetes, COVID-19. **05 Hrs.**

Unit-IV

Cell and Tissue Engineering: Recombinant DNA technology, stem cells genetically modified organisms, biosensors, applications. **04 Hrs.**

Unit-V

Industrial Biology: Cycles of life: Nitrogen, oxygen, carbon etc. Culture media, sterilization etc. microbes in food products, Basics of Biochips, Biofertilizer, Biofuels. **06 Hrs.**

Question Paper Pattern:

1. Each question will carry 10 marks with maximum of three sub divisions
2. Each unit will consists of two full questions
3. Students have to answer one full question from each unit and total five questions to be answered.
4. The question paper will have built in choice in the unit.

Reference Books:

1. S. Thyaga Rajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M. K. Jaganathan, "*Biology for Engineers*," Tata McGraw-Hill, New Delhi, 2012.
2. Wiley, "Biology for Engineers" Wiley India Ltd.

3. Jeremy M. Berg, John L. Tymoczko and LubertStryer, "*Biochemistry*," W.H. Freeman and Co. Ltd., 6th Ed., 2006.
4. Robert Weaver, "*Molecular Biology*," MCGraw-Hill, 5th Edition, 2012.
5. Jon Cooper, "*Biosensors A Practical Approach*" Bellwether Books, 2004.
6. Martin Alexander, "*Biodegradation and Bioremediation,*" Academic Press, 1994.
7. Kenneth Murphy, "*Janeway's Immunobiology*," Garland Science; 8th edition, 2011.
8. Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, "Principles of Neural Science, McGraw-Hill, 5th Edition, 2012.

21UAEE200	Cyber Law	(2-0-0) 2

Contact Hours: 26 CIE: 50 Marks SEE: 50 Marks Exam Duration: 2 Hrs.

Course Learning Objectives (CLOs): This course will cover the basics of cyber-crimes & spread awareness of this field to help the students understand the importance of security and related laws.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1,12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain the meaning of cyber-crime and its implications. [usage] [BL-3]	-	1, 2, 3, 5	-
CO-2	Identify and Elaborate the taxonomy and classifications of cyber-crimes. **[Familiarity] [BL-2]**	2	1	-
CO-3	Identify the scope and applicability of IT Act-2000; [Familiarity] [BL-2]	-	3	1, 2
CO-4	Explore the Legal Protection against Cyber Crimes. [Familiarity]	2	4, 5, 6	-
CO-5	Study recent trends in cyber law and development. [Familiarity] [BL-3]	2	4, 5, 6	

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level	1.66	2	2	2	2	2	-	-	-	-	-	-

Prerequisites: NIL

Contents:

Unit I

Introduction:

Cyber Crime: Meaning and Definition, Meaning of Crime, Meaning of Cyber Crime. **04 Hrs.**

Unit II

Classification of Cyber Crimes:

Taxonomy of Cyber Crime, Classifications of Cyber Crimes, Cyber Crimes against Persons, Crimes against Persons' Property, Cybercrimes Against Government, Cybercrimes Against Society at large, Causes of Cyber Crime, Impact and Effects of Cyber Crimes, Cyber Crime: Some Landmark Occurrence. **06 Hrs.**

Unit III

Information Technology Law:

A Bird's Eye View, Cyber World vis-a-vis need of Legal Protection, Information Technology Act, 2000: A Beginning, Objectives of Information Technology Act, 2000, Scope of Information Technology Act, 2000, Applicability of Information Technology Act, 2000, Information Technology Act, 2000: A Snapshot, Information Technology (Amendment) Act, 2008, Recompense of Information Technology Law, Limitation of Information Technology Law. **06 Hrs.**

Unit IV

Legal Protection against Cyber Crimes:

Criminal Liabilities under Information Technology Act, 2000 Common Cyber Crimes and Applicable Legal Provisions: A Snapshot, Civil Liabilities under Information Technology Act, 2000, Civil Liability for Corporate: Cyber Crimes under IPC and Special Laws, The Indian Penal Code, 1860, Cyber Crimes under the Special Acts. **06 Hrs.**

Unit V

Cyber Laws – Recent Trends

Different types of cyber law trends and developments of India. **04 Hrs.**

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Question Paper Pattern:

1. Each question will carry 10 marks with maximum of two sub divisions.
2. Each unit will consists of two full questions
3. Students have to answer one full question from each unit and total five questions to be answered.
4. The question paper will have built in choice in the unit.

Reference Books:

1) CYBER CRIME LAW AND PRACTICE, Published by: THE INSTITUTE OF COMPANY SECRETARIES OF INDIA, 2016
2) https://cybercrimelawyer.wordpress.com/category/66cpunishment-for-identity theft /
3) www.cyberlawsindia.net
4) http://www.enotes.com/research-starters/social-impactscyber-crime

21UHUC101/201	Society, Environment and Engineering	(2-0-0) 2
Contact Hours: 26	**CIE: 50 Mark SEE: 50 Marks Exam Duration: 02 Hrs.**	

Course Learning Objectives (CLOs):

The student is expected to learn the societal structure, development processes, concern towards environment, appropriate technology and role of Engineers in providing engineering solutions for societal comfort.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1,12)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Analyse the social structure and development needs	6,7		8
CO-2	Create awareness about the need of balanced ecosystems and identify the reasons for environment degradation.	6,7		8
CO-3	Apply mitigation techniques for conservation of environment	6,7		8
CO-4	Evaluate the need and impact of technology on social system and climate	6,7		8

CO-5	Recite his/her role as a facilitator for sustainable development	6,7		8

POs	1	2	3	4	5	6	7	8	9	10	11	12
Mapping Level						3	3	1				

Prerequisites: Nil

Contents:

Unit I

Societal Structures and Dynamics: An analysis of basic sociology concepts and their applications to contemporary society; cultural heritage, occupation mobility and income distribution, social tensions and their causes; societal responsibility and social institutions.

Transformation of industrial society into information society, Development processes: parameters for development of interrelationship between social economic and scientific factors. Role of science and technology in development planning; its objectives and assessment. **06 Hrs.**

Unit II

Ecosystems: Natural ecosystems, Principles of eco-balance, Biosphere cycle, carbon dioxide cycle, causes of eco-imbalance - its effects and remedies.

Environmental Degradation: Causes of degradation– its effects, Control of air, water, soil, and pollutions, Solid waste management, Protection of ozone layer. **05 Hrs.**

Unit III

Conservation of environment: Optimum utilization of natural resources, Renew able and non renewable resources, Conflict of resources, Global environmental issues, Climate change as a threat to human civilization and Mitigation measures. **05 Hrs.**

Unit IV

Technology: Definition, Impact of technology on environment & society, Benefits of technology due to new inventions, Conflict of technology, technology creation for societal change, Appropriate technology, Intermediate technology, labor based and labor intensive technology, Shifts in employment due to technological advancement, Role of technology to unmask social problems, Impact of technology on culture, tradition and social values. **05 Hrs.**

Unit V

Technology for Sustainable development: Definition and concept, Technology for sustainable energy and materials. Agricultural age, industrial age and information age, Characteristics of information society, Information as power and wealth. Community management, Engineers role as facilitator. **05 Hrs.**

Question Paper Pattern:

1) Each question will carry 10 marks with maximum of two sub divisions
2) Each unit will consists of two full questions
3) Students have to answer one full question from each unit and total five questions to be answered.
4) The question paper will have built in choice in the unit.

Reference Books:

1. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Environmental Engineering", 16th Edition, Laxmi Publications (P) Ltd., New Delhi, 2016
2. H.G. Wells, "Brief History of Civilization",
3. J. Neharu, "Glimps of World History", 2004

18UCSC400	ARM Processor	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course focuses on the following learning perspectives:

- Understand the internal architecture, instruction set of ARM7 microcontroller, assembling process & implement small programs.
- Design & develop Assembly Language Program /& C program for a given real time application.
- Understand the use of interrupts & other advanced concepts related to ARM7
- Demonstrate working knowledge of the necessary steps and methods used to interface ARM7 to devices such as motors, LCD, ADC, and DAC etc.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs/PSOs		
		Substantial	Moderate	Low
CO-1	**Explain** the features of embedded systems, architecture of ARM7 and applications.	-	1	-
CO-2	**Write** a program using the instruction set of ARM and THUMB state to solve the engineering problems.	-	2,5	13
CO-3	**Explain** the exception, interrupts and interrupt handling schemes and **write** program to solve simple problems.	-	3	-
CO-4	**Explain** the architectural features of LPC2148 microcontrollers.	-	1,2	13,15
CO-5	**Write** a program to interface hardware to LPC2148 microcontrollers.	-	5	3,12

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.0	2.0	1.5	-	2.0	-	-	-	-	-	-	1.0	1.0	-	1.0	-

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Course Contents:

1. **ARM Embedded Systems and ARM Processor Fundamentals:** Evolution of Microcontroller and Microprocessor, The RISC design philosophy, ARM design philosophy, embedded system hardware- AMBA bus protocol, embedded system software- applications. ARM core data flow model, Registers, CPSR-Processor modes, Banked registers. Pipeline- Characteristics. **9 Hrs**
2. **ARM Instruction Set :** Fundamentals of ARM instructions, Barrel shifter, Classification and explanation of instructions with examples-Data processing, Branch, Load-store, SWI and Program Status **7 Hrs**
3. **Introduction to THUMB and ARM Programming :** Introduction to THUMB, Differences between ARM and THUMB, Register usage in Thumb, ARM Thumb Interworking. General Structure of ARM assembly module, Assembler directives. Simple ALP programs on Arithmetic & logical operations, Factorial, string operation, sorting, searching, and Scan **8 Hrs**
4. **Exception and Interrupt handling schemes:** Exception handling- ARM processor exceptions and modes, vector table, exception priorities, link register offsets. Interrupts- assigning interrupts, interrupt latency, IRQ and FIQ exceptions with example- code for enabling and disabling IRQ and FIQ exceptions, Comparison between exception and interrupts. Interrupt handling schemes- nested interrupt handler, non-nested interrupt handler. Basic interrupt stack design. **7 Hrs**
5. **LPC2148 ARM CPU:** Salient features, applications, block diagram, memory mapping. Functional features of Interrupt controller, RTC, USB, UART, I2C, SPI, SSP controllers, watch dog timers and other system control units. **4 Hrs**
6. **Peripherals - GPIO, PLL & Timers:** Features, Register description with example and Applications. **4 Hrs**

Reference Books:

1. Andrew N. Sloss, ARM System Developer's guide, ELSEVIER Publications, 2016
2. William Hohl, ARM Assembly Language, CRC Press.
3. Steve Furber, ARM System-on-chip Architecture by, Pearson Education, 2012
4. James K. Peckol, Embedded Systems: A Contemporary Design Tool, 2008
5. Jonathan W. Valvano, Brookes / Cole, Embedded Microcomputer Systems, Real Time Interfacing, 1999
6. LPC 2148 USER MANUAL.

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18UCSL406 **ARM Processor Laboratory** **(0-0-3) 1.5**

Contact Hours: 36

Course Learning Objectives (CLOs): This course focuses on the following learning perspectives:

- Understand the internal architecture, instruction set of ARM7 microcontroller, assembling process & implement small programs.
- Design & develop Assembly Language Program /& C program for a given real time application.
- Understand the use of interrupts & other advanced concepts related to ARM7
- Demonstrate working knowledge of the necessary steps and methods used to interface ARM7 to devices such as motors, LCD, ADC, and DAC etc.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs/PSOs		
		Substantial	Moderate	Low
CO-1	**Execute** assembly level codes for a given specific problem using ARM processor.	-	2, 4	3,15
CO-2	**Execute** embedded C programs for a given specific problem using ARM processor.	-	4,14	15,16
CO-3	**Implement** programs for interfacing with real world devices such as LCD's Keyboards, DAC, ADC, Relays Motors etc.	13	4,5,16	3,12

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	-	2.0	1.0	2.0	2.0	-	-	-	-	-	-	1.0	3.0	2.0	1.0	1.5

Course Contents:

PART A: Conduct the following experiments to learn ALP using ARM:

- Arithmetic and logical operations
- Interrupts related operations
- Timer related applications.

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PART B: Conduct interfacing experiments to learn embedded C for ARM:

- LCD- interfacing
- Stepper Motor Interfacing
- Real time sensors Interfacing
- 7-segment LED interface

Reference Books:

1. Andrew N. Sloss, ARM System Developer's guide, ELSEVIER Publications, 2016
2. William Hohl, ARM Assembly Language, CRC Press.
3. Steve Furber, ARM System-on-chip Architecture by, Pearson Education, 2012
4. James K. Peckol, Embedded Systems: A Contemporary Design Tool, 2008
5. Jonathan W. Valvano, Brookes / Cole, Embedded Microcomputer Systems, Real Time Interfacing, 1999
6. LPC 2148 USER MANUAL.

18UCSL407	Introductory Project	(0-0-2) 1

Contact Hours: 13

Course Learning Objectives (CLOs): This course enables the student to identify the community expectations in terms of possible engineering solutions and prepare project proposal.

Course Outcomes (COs):

CO	Description of the course outcome At the end of the course student should be able to:	Mapping to POs/PSOs		
		Substantial	Moderate	Low
CO-1	**Identify** the societal problems	-	-	2,6,7,9,12,13
CO-2	**Analyze** real environment **and Formulate** the problem statement.	-	-	9,12,13
CO-3	**Conduct** exhaustive literature survey	-	-	9,12,13
CO-4	**Propose** sustainable engineering solutions	-	-	7,5,12,13
CO-5	**Prepare** the report and communicate effectively through presentation.	-	-	9,10,12,13
CO-6	**Manage** the project in terms of various resources in a particular discipline or in a multi-disciplinary domain.	-	-	11

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	-	1.0	-	-	1.0	1.0	1.0	-	1.0	-	1.0	1.0	1.0	-	-	-

Guidelines for conduction:

1. Team consists of 4-5 students.
2. Students have to choose a guide among the faculty members who are teaching their semester.
3. In consultation with guide, the team should carry out their project work.
4. Final evaluation is based on seminar and report submission.
5. This requires designated committee to monitor the process of conduction

18UCSC303	Computer Organization and Architecture	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This course focuses on the following learning perspectives:

- Basics of sub systems of a computer, their organization, structure and operation.
- Basic concept of programs as sequences of machine instructions.
- Operational aspects of I/O devices and standard I/O interfaces.
- Memory hierarchy and concept of virtual memory.
- Arithmetic and logical operations with integer and floating-point operands.
- Organization of a simple processor, pipelined processor and other computing systems.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs/PSOs		
		Substantial	Moderate	Low
CO-1	**Explain** the basic working principles of various sub-systems of a computer system.	-	-	1, 2, 8
CO-2	**Explain** the working principles of different sub systems, such as processor, Input/output, and memory.	-	3,8	1, 2, 4, 6
CO-3	**Design** the required memory bank using basic memory units.	-	3	-
CO-4	**Explain** hardwired control and micro programmed control, pipelining, embedded and other computing systems.	3,4	1	2
CO-5	**Design** simple arithmetic and logical units for a given operational features.	4, 8	1, 2, 3	-

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.5	1.3	2.3	2.3	-	1.0	-	2.0	-	-	-	-	-	-	-	-

DEPARTMENT OF COMP. SCIENCE SDMCET, DHARWAD

KURAKUNDI RAGHAVENDRARAO GOPINATH

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Prerequisites: Knowledge of: Digital Electronics and Programming language.

Course Contents:

1. **Basic Structure and Machine Instructions:** Basic Operational Concepts, Bus Structures, Performance - Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. **8 Hrs**
   Machine Instructions and Programs: Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions, Encoding of Machine Instructions.
2. **Input / Output Organization:** Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Exceptions, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces – PCIBus, SCSI Bus, USB. **8 Hrs**
3. **Memory System:** Basic Concepts, Semiconductor RAM and ROM Memories, Speed, Size and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, Performance Considerations. **8 Hrs**
4. **Arithmetic:** Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed Operand Multiplication, Fast Multiplication, Integer Division, Floating-point Numbers and Operations. **8 Hrs**
5. **Basic Processing Unit:** Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hard-wired Control, Micro programmed Control. Pipelining, Embedded Systems and Large Computer Systems: Basic Concepts of pipelining, Examples of Embedded Systems, Processor chips for embedded applications, Simple Microcontroller. **7 Hrs**

Reference Books:

1) Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5/E, TMH, 2011.
2) William Stallings, Computer Organization & Architecture, 9/E, PHI, 2012.
3) Vincent P. Heuring & Harry F. Jordan, Computer Systems Design and Architecture, 2/E, Pearson education, 2004.

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18UCSC302	Data Structures and Applications	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): This course focuses on the following learning perspectives:

- Working of various basic data structures and their implementation.
- Implementation issues of data structure in programming language.
- Selection of the appropriate data structure for solving a given problem.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs/PSOs		
		Substantial	Moderate	Low
CO-1	**Write** programs to solve problems using Pointers and Structures/Unions.	-	14	1,3, 15, 16
CO-2	**Write** programs to solve problems using files.	-	14	1,3, 15, 16
CO-3	**Write** programs to solve simple problems using stack and **explain** its working principles.	-	14	1,3, 15, 16
CO-4	**Write** programs to solve problems using queue and **explain** its working principles.	-	14	1,3, 15, 16
CO-5	**Write** programs to solve problems using Linked Lists and **explain** its working principles.	-	14	1,3, 15, 16
CO-6	**Write** programs to solve problems using trees and **explain** its working principles.	-	14	1,3, 15, 16
CO-7	**Write** programs to solve problems using Hashing and **explain** its working principles.	-	14	1,3, 15, 16

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.0	-	1.0	-	-	-	-	-	-	-	-	-	-	2.0	1.0	1.0

Prerequisites: Problem Solving skills and knowledge of Programming in C language.

Course Contents:

1. **Structure, unions and Pointers:** Motivation for using structures. Pointer, access data from memory through pointer, pointer to structures. Motivation for dynamic memory requirement. Realizing arrays using pointer and dynamic memory allocation. Importance of memory management during allocation and de-allocation of memory. **08 Hrs**
2. **Stack:** Realization of stack and its operations using static and dynamic structures. Application of stack in converting an expression from infix to postfix and evaluating a postfix expression. Heterogeneous stack using Unions. Applications of Stacks. **10 Hrs**
3. **Queues:** Realization of queues (FIFO, Double-ended queue, Priority queue) and its operations using static and dynamic data structures, Applications of Queues. **8 Hrs**
4. **Lists:** Constructing dynamic data structures using self-referential structure (using the same realized linked Lists), operations on lists. Doubly Linked list. Application of Lists in sorting. **10 Hrs**
5. **Trees:** Types of trees and their properties, Realization of trees using static and dynamic data structures. Operations on Binary trees and their application in searching (BST and AVL Tree), Binary heap as priority queues, Applications of Trees. **12 Hrs**
6. **Hash Table:** Realizing effective hash table with proper data stricture and hash function, its application. **4 Hrs**

Reference Books:

1. Aaron M. Tenenbaum, YedidyahLangsam and Moshe J. Augenstein: Data Structures using C and C ++, Pearson Education / PHI, 2006,
2. E. Balagurusamy: Programming in ANSI C, 7th Edition, Tata McGraw-Hill, 2016.
3. Behrouz A. Forouzan and Richard F. Gilberg: Computer Science: A Structured Programming Approach Using C, 2nd Edition, Cengage Learning, 2003.

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18UCSL306	Data Structures and Applications Laboratory	(0-0-3) 1.5

Contact Hours: 36

Course Learning Objectives (CLOs): This laboratory course focuses on the following learning perspectives:

- Realization of fundamental data structures like stacks, queues, linked lists and trees.
- Compare and contrast the benefits of dynamic and static data structure implementations.
- Selection of the appropriate data structure for solving a given problem.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course, the student will be able to:	Mapping to POs/PSOs		
		Substantial	Moderate	Low
CO-1	**Write** programs to solve problems using Pointers and Structures/Unions.	-	14	1,3, 15, 16
CO-2	**Write** programs to solve problems using files.	-	14	1,3, 15, 16
CO-3	**Write** programs to solve problems using stack.	-	14	1,3, 15, 16
CO-4	**Write** programs to solve problems using queue.	-	14	1,3, 15, 16
CO-5	**Write** programs to solve problems using Linked Lists.	-	14	1,3, 15, 16
CO-6	**Write** programs to solve problems using trees.	-	14	1,3, 15, 16
CO-7	**Write** programs to solve problems using Hashing.	-	14	1,3, 15, 16

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POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.0	-	1.0	-	-	-	-	-	-	-	-	-	-	2.0	1.0	1.0

Suggested list of term works:

The list of experiments is based on the following concepts:

1) Pointers and Structures/Unions
2) Files
3) Stack
4) Queue
5) Linked Lists
6) Trees
7) Hashing

Reference Books:

1. Aaron M. Tenenbaum, YedidyahLangsam and Moshe J. Augenstein: Data Structures using C and C ++, Pearson Education / PHI, 2006,
2. E. Balagurusamy: Programming in ANSI C, 7th Edition, Tata McGraw-Hill, 2016.
3. Behrouz A. Forouzan and Richard F. Gilberg: Computer Science: A Structured Programming Approach Using C, 2nd Edition, Cengage Learning, 2003.

18UCSC502	Compiler Design and System Software	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): This is a 3 credit course at undergraduate level enabling the students to understand structure of a compiler,representation of patterns and syntax using lexical rules and grammars respectively, working of parsers, translation schemes, code optimization and code generation, working of assemblers, loaders, linkers and macro processor.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Explain** the basic structure and working principles of phases of compiler.	-	13	1
CO-2	**Write** a parser for the given input based on the appropriate parsing technique and **validate** the design	13,14	1,2,3	15
CO-3	**Generate** an optimized intermediate code.	-	1,2,3,13	15
CO-4	**Explain** the working principles of run time environments that include stack allocation, heap management and garbage collection technique used in compiler.	-	1,2,3,13	15
CO-5	**Generate** optimized code for the given intermediate code	-	1,2,3,13	15
CO-6	**Design** Assembler for the given language specification and **validate** the design.	-	1,2,3,13,14	15
CO-7	**Design** Macroprocessor for the given language specification and **validate** the design.	-	1,2,3,13,14	15
CO-8	**Explain** the working principles of Linkers & Loaders for the given language specification.	-	1,2,3,13,14	15

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.9	2.0	2.0	-	-	-	-	-	-	-	-	-	2.1	2.3	1.0	-

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Pre-requisites: Knowledge of

- Finite Automata and Formal languages
- Programming language (any)

Contents:

Unit-I

Introduction: Different Phases of Compilers, Comparison of Compilers and Interpreters. Top-down Parsing: RDP and Predictive parsing. **7 Hrs**

Unit-II

Bottom-up Parsing: Simple LR, LALR, CLR parsers, ambiguous grammars. **8 Hrs**

Unit-III

Intermediate Code Generation and Optimizations: Syntax-directed translation; Syntax-directed translation schemes, Variants of syntax trees; Three-address code; Types and declarations; Translation of expressions; Type checking; Control flow; Various techniques of machine independent optimization. **8 Hrs**

Unit-IV

Run-Time Environments: Storage Organization; Stack allocation of space; Access to non-local data on the stack; Heap management; Introduction to garbage collection.
Code Generation: Issues in the design of Code Generator; The Target language; Addresses in the target code; Basic blocks and Flow graphs; Optimization of basic blocks; A Simple Code Generator **8 Hrs**

Unit-V

Ancillary Code Processing Techniques: Generic description of Assembler, Loader, Linker and Macro's. Assemblers: Basic Assembler Features & Functions and Design of assembler. Loaders and Linkers: Basic Loader Functions - Design of Loaders and Linkers, Macro Processor: Design of Macro Processors. **8 Hrs**

Reference Books:

1) Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman,"Compilers-Principles, Techniques and Tools", 2/E, Addison-Wesley, 2007.
2) D.M.Dhamdhere, "System Programming and Operating Systems", 2nd revised edition, Tata McGraw - Hill, 2009 reprint.
3) Leland L Beck, "System Software : An Introduction to Systems Programming" 3rd Edition Pearson Education 2007
4) John J Donovan, "System Programming", Tata McGraw-Hill 2017

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18UCSL505 Compiler Design and System Software Lab (0-0-3)1.5

Contact Hours: 36

Course Learning Objectives (CLOs): This laboratory course focuses on representation of patterns and syntax using lexical rules and grammars respectively, Implementation of parser & translation schemes, Implementation of assemblers, loaders, linkers & macro processor, Knowledge of system level APIs for implementation of IPC and system commands.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Design** and **Implement** a system to recognize a given pattern from the input stream using appropriate design tools and programming language.	13,14	1,2,3	15
CO-2	**Prepare** the grammar for the given the pattern/language constructs and **Write** a computer program using compiler writing tools to implement lexical analyzer and parser.	13,14	1,2,3	15
CO-3	**Design** and **implement** a parser and related applications.	13,14	1,2,3	15
CO-4	**Write** a computer program to implement a feature of systems level language processing tools to enable them to handle large scale systems like macro processor and assembler functions.	13,14	1,2,3	15
CO-5	**Write** a computer program to **Implement** various UNIX commands using system calls.	13,14	1,2,3	15
CO-5	**Use** IPC concepts in implementing communication protocol.	13,14	1,2,3	15

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.0	2.0	2.0	-	-	-	-	-	-	-	-	-	3.0	3.0	1.0	-

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Prerequisites: Knowledge of: Unix Operating System, Any programming language, and Finite automata and formal Languages

Contents:

1. Programs on pattern recognition using DFA concepts.
2. Programs on Lex and Yacc.
3. Implementation of parser.
4. Implementation of assembler.
5. Emulation of basic commands of UNIX using system calls.
6. Application development using Inter Process Communication.

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18UHUC500	Management, Enterprenuership, and IPR	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): This course focuses on the following learning perspectives:

- The evolution of IT managementand related aspects.
- The scope of entrepreneurship in digital firms.
- The issues and procedures related to intellectual property rights.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Study** the principles of management in a given organization.	-	2	-
CO-2	**Describe** and **analyze** the role of staffing and the need for motivation in management	-	2	-
CO-3	**Explain** the role of entrepreneur in establishing an organization.	-	2,6	-
CO-4	**Describe** the importance and provisions of institutional support in establishing an enterprise.	-	2,6	-
CO-5	**Explain** the core principles, procedures and related laws and **apply** IPR for given new idea/invention.	-	5,8,10	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	-	2.0	-	-	2.0	2.0	-	2.0	-	2.0	-	-	-	-	-	-

Pre-requisites: Knowledge of humanities course.

Contents:

Unit-I

Engineering and Management: Historical Development of Engineering and Management, Management as synthesis.

Planning, Forecasting and Decision Making: Nature of Planning, foundation of planning, some planning concepts, forecasting, nature of decision making,

management science, tools for decision **10Hrs**

Unit-II

Organizing and staffing: Nature of organizing, traditional organizational theory, technology and modern organization structures, staffing technical organization, authority and power; delegation, meeting and committees. Motivation: Motivation, leadership, motivating and leading technical professionals. Controlling: Process of control, financial and non-financial controls. **11 Hrs**

Unit-III

Foundations of Entrepreneurship: Meaning of entrepreneur, functions of entrepreneur, types of entrepreneur, concept of entrepreneurship, role of entrepreneurs in economic development& barriers of entrepreneurship. Small Scale Industry: Definition, characteristics of SSI, role of SSI in economic development, advantages of SSI, steps to start an SSI, impact of liberalization, privatization, and globalization on SSI, definition of ancillary and tiny industry. **11 Hrs**

Unit-IV

Government and Institutional Support: Nature of support from government, objectives and functions of SSI, SIDBI, DIC, single window agency, KIADB, KSSIDC, KSFC. Preparation of Project: Meaning of project identification, project report, contents and formulation, identification of business opportunities, feasibility studies, types and purpose. **10 Hrs**

Unit-V

Intellectual Property Rights: Meaning and forms of intellectual property rights, competing rationale for protection, international conventions and security. Copyright: Meaning of copyright, content of copy right, ownership and rights, period of copyright, assignment and relinquishment of copyright, license, infringement of copy right, fair use, offenses and penalties. Patents: Concept of patent, patentable inventions, procedure for obtaining patent, rights and obligations of patent holders, infringements and remedies, offenses and penalties. Industrial Designs: Definition of design, procedure for registration, rights conferred by registration, infringements, Trademark and related issues. **10 Hrs**

Reference Books:

1) Kenneth C. Laudon and Jane P. Laudon, "Management Information Systems - Managing the Digital Firm", 8th Edition, Pearson Publications, 2017.
2) Making Intellectual Property Work for Business - Handbook for Chambers of Commerce and Business Associations Setting Up Intellectual Property Services by ICC and WIPO, Paperback, 2012.

18UCSC700 Artificial Intelligence and Machine Learning (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): This course focuses on following learning perspectives:

- To introduce the basic concepts, theories and state-of-the-art techniques of artificial intelligence and machine learning.
- Enable student with knowledge enough to be a self-learner in exploring the application of machine learning /AI algorithms in the different fields of science, medicine, finance etc.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Explain** the world, behavior of agents and problem-solving aspects of agents.	-	3,4	1,2
CO-2	**Demonstrate** the representation and usage of knowledge using First order logic.	-	3,4	1,2
CO-3	**Explain** the decision-making process with incomplete, inconsistent and everchanging facts.	-	3,4	-
CO-4	**Explain** machine learning concepts and range of problems that can be handled by machine learning.	-	3,4	-
CO-5	**Apply** the concepts of and the machine learning to the real-world problems.	-	-	3,4,5

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.0	1.0	2.0	2.0	2.0	-	-	-	-	-	-	-	-	-	-	-

Pre-requisites: Knowledge of

1. Logic
2. Discrete Mathematics
3. Programming Fundamentals

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Contents:

Unit-I

Introduction: AI Problems Underlying Assumption, AI Techniques, Criteria for Success

State Space Search & Heuristic Search Techniques: Defining the Problems as A State Space Search, Production Systems, Production Characteristics, Issues in The Design Of Search Programs.

Generate And-Test: Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, and Means-ends Analysis. **11 Hrs**

Unit-II

Knowledge Representation: Issues, Representations and Mappings, Approaches to Knowledge Representation.

Using Predicate Logic: Representation Simple Facts in Logic, Representing, Computable Functions and Predicates, Resolution. Representing Knowledge Using Rules, Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning. **11 Hrs**

Unit-III

Statistical Reasoning, Probability and Uncertainty: Bayes' Theorem, Full joint probabilistic distribution, Bayesian Networks and Probabilistic inferences, Dumpster Shafer Theory.

Forms of learning: Issues in designing a learning system. Assumptions of Common Machine Learning Models. **10 Hrs**

Unit-IV

Linear Regression: Multivariate Regression, Logistic regression, Polynomial Regression.

Linear Models for Classification: Decision Trees, Regression Trees, K-nearest neighbors (KNN) algorithm. Bias Variance Trade off. **10 Hrs**

Unit-V

Perceptron: Neural Networks - Introduction, Early Models, Perceptron Learning, Backpropagation, Initialization, Training & Validation, Support Vector Machines, Introduction, Early Models, Unsupervised learning and clustering – k-means clustering, hierarchical clustering. **10 Hrs**

Reference Books:

1) Elaine Rich and Kevin Knight "Artificial Intelligence", 2nd Edition, Tata Mcgraw-Hill, 2005.
2) Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall, 2009.
3) Trevor Hastie, Robert Tibshirani, and Jerome H. Friedman "The Elements of Statistical Learning".
4) Christopher Bishop, "Pattern Recognition and Machine Learning"
5) Mitchell Tom "Machine Learning", McGraw Hill, 1997.

18UCSL702	Artificial Intelligence and Machine Learning Laboratory	(0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs): This course is in line with the theory course Artificial Intelligence & Machine Learning (18UCSC700). It focuses on hands on experience on creation of data models, database design, programming using appropriate technology.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course, the student will be able to:		Mapping to POs(1-12) / PSOs(13-16)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Represent** the Knowledge for the given scenario using appropriate tools techniques and language.	-	3,4,5	-
CO-2	**Identify** data preprocessing requirement of a given data set for the learning algorithms.	-	3,4,5	-
CO-3	**Demonstrate** of the strengths and weaknesses of regression and classification approaches in machine learning.	-	3,4,5	-
CO-4	**Demonstrate** unsupervised algorithms for clustering requirement on a data set from the real world using python.	-	3,4,5	-
CO-5	**Represent** the Knowledge for the given scenario using appropriate tools techniques and language.	-	3,4,5	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	-	-	2.0	2.0	2.0	-	-	-	-	-	-	-	-	-	-	-

Pre-requisites: Knowledge of

1. Logic
2. Discrete Mathematics
3. Programming Fundamentals

Course Contents

This course is in line with the theory course Artificial Intelligence & Machine Learning (18UCSC700). There will be one problem with the **Knowledge**

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Representation and four problems on **Machine Learning** (Linear Regression, Multilinear regression, Polynomial regression, Decision Tree, K-means clustering). The problems to be composed by the faculty are announced to the students. The student will analyze the problem, justify the requirement of AI Approach for the solution, choose the platform or technology for implementations and demonstrate all the steps involved like pre-processing the dataset, importing the dataset, Spitting the dataset into the training set and test set, training the model on the training dataset, predicting the test set results, Visualising the Training set results, Visualising the test set results, etc where ever applicable. The students will submit implementation, conduction and observation write up for each problem. An internal examination and 5 problems work will be used to grade the student's performance in this course.

Associated Lab Works (Sample)

1. Represent facts and relationships of any famous epic of your choice using first order logic, implement and demonstrate some queries.
2. Build a decision tree for the case of SDMCET students' performance based on the IA-1, IA-2, IA-3, CTA, Attendance, SEE marks (optional) and classifying them into one of the Grade S, A, B, C, D, E & F. Study of precision of classification by including the 10th, 12th and CET/COMED-K into consideration.
3. Given the features of an email like , Sender's email ID, Number of typos in the email, Occurrence of words like "offer", "prize", "free Gift", classify the email as Spam or not. Use the feature vector to train a Logistic classifier which emits a score in the range 0 to 1. If the score is more than 0.5, we label the email as spam. Otherwise, we don't label it as spam. (https://magoosh.com/).
4. Linear or polynomial regression to predict the salary of a person given the designation, no of years of experience, location of work, previous financial years profit etc.
5. A Hospital Care chain wants to open a series of Emergency-Care wards within a region. We assume that the hospital knows the location of all the maximum accident-prone areas in the region. They have to decide the number of the Emergency Units to be opened and the location of these Emergency Units, so that all the accident-prone areas are covered in the vicinity of these Emergency Units. The challenge is to decide the location of these Emergency Units so that the whole region is covered. Here is when K-means Clustering comes to rescue! (https://www.edureka.co/blog/k-means-clustering/)

15UCSC800	Distributed Systems	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): This course focuses on the following learning perspectives:

- To know the design principles of distributed systems, architectures and
- To prepare design solutions using latest industry relevant technology at basic level.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs/PSOs		
		Substantial	Moderate	Slight
CO-1	**Explain** the functional characteristics of various components of distributed system architecture.	-	13	-
CO-2	**Explain** the functioning of various communication protocols and **Write a program** using appropriate technology/protocol to build sub systems that makes a distributed system.	13,14	-	15
CO-3	**Explain** the need and principles of various synchronization strategies used in distributed system.	-	1,2,13	-
CO-4	**Explain** the need and principles of various consistency strategies and replication necessary for a distributed system.	-	1,2,13	-
CO-5	**Explain** the need and principles of various fault tolerance strategies necessary for a distributed system.	-	1,2,13	-
CO-6	**Explain** the functional characteristics of various components of an industry relevant product used in building distributed file system and **write programs** to perform storage and retrieval operations.	-	2,3,5,13,14	15
CO-7	**Explain** the architectural patterns and **use** it for developing distributed system.	-	13	-

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	2.0	2.0	2.0	-	2.0	-	-	-	-	-	-	-	2.1	2.5	1.0	-

Pre-requisites: Knowledge of Computer Networks and Operating Systems

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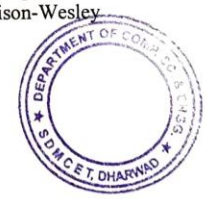
Course Contents:

1. **Introduction:** Need for distributed system and applications, process and communication model (in terms of IPCs RPCs, RMIs and software agents), architecture & design patterns — **06 Hrs.**
2. **Naming:** Terminologies and different types of naming services — **02 Hrs.**
3. **Synchronization :** Clock Synchronization, Logical Clocks, Mutual Exclusion, Global Positioning of Nodes, Election Algorithms — **12 Hrs.**
4. **Consistency and Replication:** Introduction, Data-centric Consistency Models, Client-centric Consistency Models, Replica Management, Consistency Protocols — **12 Hrs.**
5. **Fault Tolerance& Security:** Introduction, Process Resilience, Reliable Client-Server Communication, Reliable Group Communication, Distributed Commit, Recovery; Introduction to Security, Security in Distributed Systems — **08 Hrs.**
6. **A case study on distributed file system**used in latest industry relevant technology/platform — **06 Hrs.**
7. **A case study on** industry relevant technology based on Proxy &Broker Architecture — **06 Hrs.**

Suggested Implementation based activities: Simple programs on various communication protocols.

Reference Books:

1. Andrew S Tanenbaum & Maarten van Steen, "Distributed Systems Principles and Paradigms", Second Edition, 2007, Pearson Prentice Hall.
2. Tom White, "Hadoop: The Definitive Guide", Fourth Edition, 2015, O'Reilly
3. George Coulouris, Jean Dollimore, Tim Kindberg & Gordon Blair, "Distributed Systems Concepts and Design", Fifth Edition, 2012, Addison-Wesley.



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15UCSC504	Unix System Programming	(4 - 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs): This course facilitates the students to get familiarity with UNIX kernel structure, system calls and the use of standards like ANSI, POSIX and X/Open through programming.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs/PSOs		
		Substantial	Moderate	Low
CO-1	**Explain** the various standards used in Unix systems programming and **Write** programs to use the standards.	13, 14	-	-
CO-2	**Write** programs related to file management and **Explain** the organization of Unix file system.	13, 14	-	-
CO-3	**Write** programs to do various process management activities and **Explain** the underlying working principles.	13, 14	-	-
CO-4	**Write** programs to demonstrate the use of signals and **Explain** the underlying working principles.	13, 14	-	-
CO-5	**Explain** the need of daemons in Unix OS and **Write** simple programs to demonstrate the creation/usage of daemons in Unix environment.	13, 14	-	-
CO-6	**Write** programs to demonstrate inter process communication in solving simple problems and **Explain** the underlying working principles of various IPCs.	13, 14	-	-

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	-	-	-	-	-	-	-	-	-	-	-	-	3.0	3.0	-	-

Pre-requisites: Knowledge of Computer Networks and Operating Systems

Course Contents:

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1.	**Introduction:** UNIX and ANSI Standards: The ANSI C Standard, the ANSI/ISO C++ Standards, Difference between ANSI C and C++, the POSIX Standards, the POSIX.1 FIPS Standard, the X/Open Standards. UNIX and POSIX APIs: The POSIX APIs, the UNIX and POSIX Development Environment, API Common Characteristics	**4 Hrs**
2.	**Unix Files:** File Types, The UNIX and POSIX File System, The UNIX and POSIX File Attributes, Inodes in UNIX System V, Application Program Interface to Files, UNIX Kernel Support for Files, Relationship of C Stream Pointers and File Descriptors, Directory Files, Hard and Symbolic Links	**5 Hrs**
3.	**Unix File APIs:** General File APIs, File and Record Locking, Directory File APIs, Device File APIs, FIFO File APIs, Symbolic Link File APIs, General File Class, regfile Class for Regular Files, dirfile Class for Directory Files, FIFO File Class	**5 Hrs**
4.	**Unix Processes :** The Environment of a UNIX Process: Introduction, main function, Process Termination, Command-Line Arguments, Environment List, Memory Layout of a C Program, Shared Libraries, Memory Allocation, Environment Variables, setjmp and longjmp Functions, getrlimit, setrlimit Functions, UNIX Kernel Support for Processes	**7 Hrs**
5.	**Process Control:** Introduction, Process Identifiers, fork, vfork, exit, wait, waitpid, waited, wait3, wait4 Functions, Race Conditions, exec Functions, Changing User IDs and Group IDs, Interpreter Files, system Function, Process Accounting, User Identification, Process Times. Process Relationships: Introduction, Terminal Logins, Network Logins, Process Groups, Sessions, Controlling Terminal, tcgetpgrp, tcsetpgrp, and tcgetsid Functions, Job Control, Shell Execution of Programs, Orphaned Process Groups	**8 Hrs**
6.	**Signals and Daemon Processes:** Signals: The UNIX Kernel Support for Signals, signal, Signal Mask, sigaction, The SIGCHLD Signaland the waitpid Function, The sigsetjmp and siglongjmp Functions, Kill, Alarm, Interval Timers, POSIX.lb Timers. Daemon Processes: Introduction, Daemon Characteristics, Coding Rules, Error Logging, Single-instance daemons; Daemon conventions; Client-Server Model	**7 Hrs**
7.	**Interprocess Communication:** Introduction; IPC using Pipes, FIFOs, Message Queues, Semaphores and Sockets	**16 Hrs**

Reference Books:

1. Terrence Chan, "Unix System Programming Using C++", Prentice Hall India, 2009
2. Stephen A. Rago&W.Richard Stevens, "Advanced Programming in the UNIX Environment", 2nd Edition, Pearson Education / PHI, 2005
3. Marc J. Rochkind, "Advanced Unix Programming", 2nd Edition, Pearson Education, 2004.
4. Maurice.J.Bach, "The Design of the UNIX Operating System",Pearson Education / PHI, 1987

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Post Graduate:

Name of the Course	Course Code	Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development	Year of introduction (during the last five years)	Link to the relevant document
Software defined network	20PCSEE326	Skill Development	21-22	
Software project management	20PCSEE327	Skill Development	21-22	
Human computer interface	20PCSEE329	Skill Development	21-22	
Applied cryptography	20PCSEE330	Skill Development	21-22	
Research Methodology & IPR	20PRMIC100	Skill Development	20-21	
Mathematical foundations of Computer Science	20PMCSC100	Skill Development	20-21	
Aritifical Intelligence and Machine Learning	20PCSEC102	Employability/Skill Development	20-21	
Block chain technology	20PCSEE126	Employability/Skill Development	20-21	
Deep learning	20PCSEE226	Skill Development	20-21	
Research Methodology & IPR	18PCSEE125	Skill Development	18-19	
Advanced computer architecture	16PCSEC101	Skill Development	17-18	
Programming paradigm	16PCSEE125	Skill Development	17-18	
Language processors	16PCSEE126	Skill Development	17-18	
Game theory	16PCSEE127	Employability/Skill Development	17-18	
CAD for VLSI	16PCSEE130	Employability/Skill Development	17-18	
Linear algebra and Random process	16PCSEE134	Skill Development	17-18	

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Natural Language Processing and Text Mining	16PCSEE135	Skill Development	17-18	
Distributed systems	16PCSEC201	Skill Development	17-18	
High Performance Computing	16PCSEE225	Skill Development	17-18	
Software engineering	16PCSEE227	Skill Development	17-18	
Data science	16PCSEE229	Employability/Skill Development	17-18	
Cyber security	16PCSEE230	Employability/Skill Development	17-18	
Machine learning	16PCSEE232	Employability/Skill Development	17-18	
Fault tolerent computing	16PCSEE233	Skill Development	17-18	
Soft computing	16PCSEE234	Skill Development	17-18	
Internet Of things	16PCSEE235	Employability/Skill Development	17-18	

	Year 1 21-22	Year 2 20-21	Year 3 19-20	Year 4 18-19	Year 5 17-18
New courses	4	5	-	1	16
Total courses	27	20	-	18	28
Percentage	14.8%	25%	-	5.55%	57.14%

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20PCSEE326	Software Defined Networks	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This 3 credit elective course at PG level aims to learn about fundamentals of software defined networking, an emerging paradigm in computer networking that allows a logically centralized software program to control the behavior of an entire network. It also enables the students to explore network virtualization and data center network technologies.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO-1	**Explain** and **discuss** the basic concepts and architectural differences of conventional networking approaches and SDN.	-	3,6	-
CO-2	**Analyze** the implementation of SDN through Open Flow Switches	1,3	2,5,6	-
CO-3	**Describe** Network Functions Virtualization components and their roles in SDN	1,3	2,5,6	-
CO-4	**Describe** the role of SDN in data centers.	-	3,6	-
CO-5	**Describe** SDN advanced switch features and SDN Controllers.	1,3,6	2,5	-

Mapping level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	3	2	2.6	-	2	2.2

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Prerequisites:

Knowledge of Data Communication Networks, Network Management at introductory level.

Contents:

1	**Software Defined Networking:** Introduction, Modern Data Center, Traditional Switch Architecture, Layer 2 & 3 Control, Evolution of switches and control planes, Data Center Innovation & Needs, The Evolution of Networking Technology, Forerunners of SDN, Open Source Contributions and Network Virtualization.	**7 Hrs**
2	**Working of SDN:** Fundamental Characteristics of SDN, SDN Operation SDN Devices, SDN Controller, SDN Applications. **The Open Flow Specification:** Open Flow Overview, Open Flow 1.0 and Open Flow Basics, Open Flow 1.1, 1.2, and 1.3 Additions and Open Flow Limitations.	**8 Hrs**
3	**Network Functions Virtualization :** Background and Motivation for NFV- Virtual Machines- NFV Concepts: Simple Example of the Use of NFV, NFV Principles, High-Level NFV Framework, NFV Benefits and Requirements- NFV Reference Architecture: NFV Management and Orchestration	**8 Hrs**
4	**Data centres definition:** Data centres definition, Data centres demand, tunnelling technologies for Data centres Path technologies in data centres, Ethernet fabrics in Data centres, SDN use case in Data centres.	**8 Hrs**
5	**SDN Applications & Open Source:** Reactive versus Proactive Applications, Analyzing Simple/reactive SDN java Applications, Controllers: Floodlight, Open Daylight, Cisco XNC, Hewlett Packard, Creating Network visualization Tunnels, Offloading flows in Data Center, Access Control for the campus, Traffic Engineering for service Providers, Switch implementations, Controller implementations, SDN Applications, Orchestration & Network Virtualization, Open Stack, Applying SDN Open source.	**8 Hrs**

Reference Books:

1. William Stallings, “Foundations of Modern Networking”, Pearson Ltd., 2016.
2. Software Defined Networks: A Comprehensive Approach by Paul Goransson and Chuck Black,Morgan Kaufmann Publications, 2014

3. SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013

4. Feamster, Nick, Jennifer Rexford, and Ellen Zegura. "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review 44.2 (2014): 87-98.
5. Kreutz, Diego, et al. "Software-defined networking: A comprehensive survey." Proceedings of the IEEE 103.1 (2015): 14-76.

20PCSEE327 Software Project Management (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course is at post graduate level for 3 credits, 39 contact hours with emphasis on practice-based learning. Student gets mastery on the various standards, procedures and industry relevant tools for effective management of scope, time, costs, and quality, ensuring satisfying the needs for which the project was undertaken.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO-1	**Use** appropriate metrics to manage the software development outcome.	3,4,6	1,2, 5	-
CO-2	**Identify** the various risk for the given project and propose mitigation plan	3,4,6	1,2, 5	-
CO-3	**Use** industry relevant project configuration management tool	3,4,6	1,2, 5	-
CO-4	**Estimate** the cost and resource required for the given project specification.	3,4,6	1,2, 5	-
CO-5	**Use** tools to monitor the project progress in terms of targets, slippage, resources &	3,4,6	1,2, 5	-

	revision.			
CO-6	**Develop** comprehensive project plan.	3,4,6	1,2, 5	-

Mapping level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	2	2	3	3	2	3

Prerequisites:

- Software Engineering.

Contents:

1 **Metrics**: Introduction, The Metrics Roadmap, A Typical Metrics Strategy, What Should you Measure?, Set Targets and track Them, Understanding and Trying to minimize variability, Act on data, People and Organizational issues in Metrics Programs, Common Pitfalls to watch out for in Metrics Programs, Matrices implementation checklists and tools.

Software configuration management: Introduction, Some Basic Definitions and terminology, the processes and activities of software configuration management, configuration status accounting, configuration audit, software configuration management in geographically distributed teams, Metrics in software configuration management, software configuration management tools and automation. **08 Hrs**

2 **Risk Management**: Introduction, What is risk management and why is it important?, Risk management cycle, Risk identification: common tools and techniques, Risk Quantifications, Risk Monitoring, Risk Mitigation, Risks and Mitigation in the context of global project teams, some practical techniques risk management, Metrics in risk management.

Project Planning and Tracking: Components of Project Planning and Tracking, The "What " Part of a Project Plan, The "What Cost " Part of a Project Plan, The "When " Part of Project Planning, The "How " Part of a Project Planning: Tailoring of Organizational Processes For the Project, The " By Whom " Part of the Project Management Plan : Assigning Resources, Putting it all together : The Software Management Plan, Activities Specific to Project Tracking, Interfaces to the Process Database. Project Closure: When Does Project Closure Happen?. Why Should We **09 Hrs**

Explicitly do a Closure?, An Effective Closure Process, Issues that Get Discussed During Closure, Metrics for Project Closure, Interfaces to the Process Database.

3	**Software Requirements gathering**: Inputs and start criteria for requirements gathering, Dimensions of requirements gathering, Steps to be followed during requirements gathering, outputs and quality records from the requirements phase, skill sets required during requirements phase, differences for a shrink-wrapped software, challenges during the requirements management phase, Metrics for requirements phase. **Estimation**: What is Estimation? when and why is Estimation done?, the three phases of Estimation, Estimation methodology, formal models for size Estimation, Translating size Estimate into effort Estimate, Translating effort Estimates into schedule Estimate, common challenges during Estimation , Metrics for the Estimation processes.	**09 Hrs**
4	**Design and Development Phases**: Some differences in our chosen approach, salient features of design, evolving an architecture/ blueprint, design for reusability, technology choices/ constraints, design to standards, design for portability, user interface issues, design for testability, design for diagnose ability, design for maintainability, design for install ability, inter-operability design, challenges during design and development phases, skill sets for design and development, metrics for design and development phases. **Project management in the testing phase**: Introduction, What is testing?, what are the activities that makeup testing?, test scheduling and types of tests, people issues in testing, management structures for testing in global teams, metrics for testing phase.	**08 Hrs**
5	**Project management in the Maintenance Phase**: Introduction, Activities during Maintenance Phase, management issues during Maintenance Phase, Configuration management during Maintenance Phase, skill sets for people in the maintenance phase, estimating size, effort, and people resources for the maintenance phase, advantages of using geographically distributed teams for the maintenance phase, metrics for the maintenance phase. **Impact of the internet on project management**: Introduction, the effect of internet on project management, managing projects for the internet, Effect on the project management activities. People focused process models: Growing emphasis on people centric models, people capability maturity model (P-CMM), other people focused models in the literature, how does an organization choose the models to use?	**05 Hrs**

Reference Books:

1. Watts Humphrey, "Managing the Software Process", Pearson Education, 2000.
2. Pankaj Jalote, "Software Project Management in practice", Pearson Education, 2002.
3. Ramesh Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2013.

20PCSEE329 Human Computer Interface (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course enables the students to represent the real-time problems as games using pure and mixed strategies. It also focuses on the different types of games such as extensive, Bayesian and repeated.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO-1	**Design** and **Develop** processes and life cycle of Human Computer Interaction.	-	1,4,5	2
CO-2	**Analyze** product usability evaluations and testing methods.	-	1	3
CO-3	**Apply** the interface design standards / guidelines for cross cultural and disabled users.	-	1,2,3,4	-
CO-4	**Categorize, Design** and **Develop** Human Computer Interaction in proper architectural structures.	-	1,2,3	4,5

Mapping level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	2.0	1.67	1.67	1.67	1.5	-

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Prerequisites:

- Knowledge of user interface design

Contents:

1	**HCI - Foundations:** Introduction, Input–output channels, Human memory, Thinking: reasoning and problem solving, Emotion, Individual differences, Psychology and the design of interactive systems, Text entry devices, Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Paper: printing and scanning	**7 Hrs**
2	**Designing - Programming Interactive systems:** Models of interaction, Frameworks and HCI, Ergonomics, Interaction styles, Elements of the WIMP interface, The context of the interaction, Experience, engagement and fun, Paradigms for interaction.	**7 Hrs**
3	**Cantered design and testing:** Interaction design basics-The process of design, User focus, Scenarios, Navigation design, Screen design and layout, Iteration and prototyping, Design for non-Mouse interfaces, HCI in the software process, Iterative design and prototyping, Design rules, Principles to support usability, Standards and Guidelines, Golden rules and heuristics, HCI patterns	**8 Hrs**
4	**Implementation support:** Elements of windowing systems, Programming the application, Using toolkits, User interface management systems, Evaluation techniques, Evaluation through expert analysis, Evaluation through user participation, Universal design, User support	**9 Hrs**
5	**Models and Theories:** Cognitive models, Goal and task hierarchies, Linguistic models, The challenge of display-based systems, Physical and device models, Cognitive architectures **Collaboration and communication:** Face-to-face communication, Conversation, Text-based communication, Group working, Dialog design notations, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and design	**8 Hrs**

Reference Books:

1. A Dix, Janet Finlay, G D Abowd, R Beale, Human-Computer Interaction, 3rd Edition, Pearson Publishers, 2008.
2. Shneiderman, Plaisant, Cohen and Jacobs, Designing the User Interface: Strategies for Effective Human Computer Interaction, 5th Edition, Pearson Publishers, 2010.
3. Jonathan Lazar et al "Research Methods in Human Computer Interaction", 2nd Edition, Morgan Kaufmann Publication 2017

20PCSEE330	Applied Cryptography	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This is a 3-credit course at postgraduate level that focuses on both theoretical concepts and practical applications of cryptography and network security techniques.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO-1	**Explain** the fundamentals of cryptography and **revise** the basic mathematics required for cryptography.	-	1,3	-
CO-2	**Explain** the principles of symmetric encryption techniques and **apply** them in solving security related problems.	1,3,6	2	-
CO-3	**Explain** the principles of asymmetric encryption techniques and **apply** them in solving security related problems.	1,3,6	2	-
CO-4	**Apply** cryptographic techniques to solve data integrity and authentication problems.	1,3,6	2	-
CO-5	**Explain** the basic principles of web and email security.	-	2,5,6	-

Mapping level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	2.75	2	2.75	-	1	2.75

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Prerequisites:

- Basic Knowledge of Computer Networks.

Contents:

1	**Computer Network Security Concepts and Number Theory:** Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Fundamental Security Design Principles. Divisibility and the Division Algorithm, The Euclidean Algorithm, Modular Arithmetic , Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem, Discrete Logarithms.	**5 Hrs**
2	**Symmetric Ciphers**: Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques. Block Ciphers and the Data Encryption Standard: Traditional Block Cipher Structure, The Data Encryption Standard, A DES Example, The Strength of DES. Advanced Encryption Standard: Finite Field Arithmetic, AES Structure, AES Transformation Functions, AES Key Expansion, An AES Example, AES Implementation.	**10 Hrs**
3	**Asymmetric Ciphers**: Public-Key Cryptography and RSA: Principles of Public- Key Cryptosystems, The RSA Algorithm.Other Public-Key Cryptosystems: Diffie-Hellman Key Exchange, Elgamal Cryptographic System, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.	**8 Hrs**
4	**Cryptographic Data Integrity Algorithms and Mutual Trust** Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA). Message Authentication Codes: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, MACs Based on Hash Functions: HMAC, Digital Signatures: Digital Signatures, Elgamal Digital Signature Scheme. Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure. User Authentication: Remote User-Authentication	**10 Hrs**
5	**Transport layer and E-mail security**: Web Security Considerations, Transport Layer Security, HTTPS, Secure Shell (SSH).Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security, S/MIME, Pretty Good Privacy.	**6 Hrs**

Reference Books:

1. W. Stallings. Cryptography and Network Security: Principles and Practices (7th edition). Prentice Hall, 2016, ISBN-13: 978-0134444284.
2. Bruce Schneier, Applied Cryptography, John Wiley & Sons, Second Edition, 2007, ISBN 978-1-119-09672-6.
3. William Stalling & Lawrie Brown, Computer Security: Principles and Practice, Pearson 2008, Indian Edition 2010.

I – Semester

20PRMIC100	**Research Methodology and IPR**	**(2-0-0) 2**

Contact Hours: 26

Course Learning Objectives (CLOs):

The students are expected to learn about the need and types of research, problem formulation, literature review, measurement, scaling, data collection, testing of hypothesis, result interpretation and report writing. Further, the students shall know about the intellectual property rights, copy rights, trademarks, patents, patents filing procedure, infringement & remedies and information technology act etc.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Formulate** the research problem, carryout literature survey and decide the methodology.	-	1	-
CO-2	**Use** measurement and scaling and **carryout** data collection.	-	1	-
CO-3	**Test** the hypothesis, **interpret** & **analyze** the results and **write** the report.	2	3	-

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CO-4	**Explain** the need of IPR, copy right, patents, trademarks, & the filing procedure and know about infringement, remedies and regulatory framework.	-	2	-

Mapping level:

POs	**PO-1**	**PO-2**	**PO-3**
Mapping Level	2	2.5	2

Prerequisites: Branch specific course on problem analysis (Preferred)

Contents:

1. **Research Methodology:** Introduction, meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, importance of knowing how research is done, research process, criteria of good research and problems encountered by researchers in India.
   2 Hrs

   Defining the Research Problem: Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem, an illustration
   . **1 Hr**

2. **Reviewing the literature:** Importance of the literature review in research, How to review the literature, searching the existing literature, reviewing the selected literature and writing about the literature reviewed. **2 Hrs**

   Research Design: Meaning of research design, need for research design, features of a good design, important concepts relating to research design, different research designs, basic principles of experimental designs, important experimental designs
   3 **Hrs**

3. **Measurement and Scaling:** Measurement in research, measurement scales, sources of error in measurement, scaling, meaning of scaling and important scaling techniques
   2 **Hr**

Data Collection: Collection of primary data, observation method, interview method, collection of data through questionnaires, collection of data through schedules, difference between questionnaires and schedules, collection of secondary data
2 **Hr**

4. **Testing of Hypotheses:** What is a Hypothesis? Basic concepts concerning testing of hypotheses, procedure for hypothesis testing, flow diagram for hypothesis testing, measuring the power of a hypothesis test, tests of hypotheses

2 **Hr**

5. **Interpretation and Report Writing:** Meaning of interpretation, technique of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, oral presentation and mechanics of writing a research report, precautions for writing research reports, plagiarism and its significance. 3 **Hr**

6. **Introduction to Intellectual Property Rights:** Meaning and conception of IPR, competing, rationale for protection, international conventions, world court.

1 Hr

Copy right: Historical evolution of the law on copy right, meaning, content, substance, ownership, primary, special rights, obligations, period, assignment and relinquishment of copy rights. License and application for registration of copy right.
1 Hr

Patents: Meaning of Patent, purpose and policy object of patent law, gains to inventor, application of patents, joint application, discovery and invention, patentable and non-patentable inventions, publications and public use, priority date and its purpose, procedure for obtaining patent. Stages of procedure, refusal to grant patent - consequence, protection period, drafting if claims, grant of patent and significance of date of patent and date of ceiling. Services available with patent office, jurisdiction, appellate authorities, powers and obligations of central government, patent agent and controller – not a civil court. **3**

Hr

I**ndustrial design:** Concepts & Significance **1 Hr**

Trademarks: Definitions and conceptions of Trademark, advantages of registration, marks which are not registrable, known and well-known trademarks, application for registration and procedure for registration, procedure and certification of Trademarks **1 Hr**

Infringement and Remedies: Meaning of infringement, acts of infringements, suit against infringement and defence against infringement, reliefs and certificate of validity. **1 Hr**

The information Technology Act: Definitions, certifying authority, meaning of compromise of digital signature, offences and penalties, applicability of IPRs, cybercrimes, adjudicating officer, violation, damages and penalties, Cyber regulation appellate tribunal, World Wide Web and domain names and cyber flying. Self-Study. **1 Hr**

Reference Books:

1. C.R. Kothari, Gaurav Garg, Research Methodology: Methods and Techniques, New Age International, 4th Edition, 2018.
2. Ranjit Kumar, Research Methodology a step-by-step guide for beginners, SAGE Publications, 3rd Edition, 2011.
3. Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 2009.

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