



Dayananda Sagar University School Of Engineering

Devarakagalahalli, Harohalli, Kanakapura Road, Ramanagara Dt., Bengaluru – 562 112
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Total number of courses having focus on employability/ entrepreneurship/ skill development offered by the University during the year 2023-2024.

LINEAR ALGEBRA & DIFFERENTIAL EQUATIONS [As per Choice Based Credit System (CBCS) scheme]	
SEMESTER – I	
Course Code : 23EN1101	Credits : 03
Hours / Week : 03 Hours	Total Hours : 39 Hours
L-T-P-J : 3-0-0-0	
Course Learning Objectives: This Course will enable students to: 1. Apply the method of Gauss elimination to solve systems of linear equations and determine the row echelon form of a matrix 2. Analyze vector spaces, subspaces, and their properties to identify linear independence, span, and bases in the context of finite-dimensional vector spaces. 3. Evaluate and compute the dimensions of vector spaces by understanding the concepts of rank and nullity 4. Analyze the properties and characteristics of linear transformations and their corresponding matrices to gain a deeper understanding of their behaviour and applications. 5. Utilize the concepts of eigenvalues and eigenvectors, employing diagonalization techniques to determine the diagonal form of a matrix and its implications in various contexts.	
UNIT – I	08 Hours
INTRODUCTION: System of Linear equations. (<i>Text Book-1: Chapter 1: 1.1</i>) Row reduction and echelon form. (<i>Text Book-1: Chapter 1: 1.2</i>) Rank of a matrix by row echelon form. (<i>Text Book-1: Chapter 4: 4.6</i>) Gauss elimination, Inverse of a matrix by Gauss Jordan (<i>Text Book-5: Chapter 3: 3.7 and 3.11</i>) LU decomposition (<i>Text Book-1: Chapter 2: 2.5</i>).	
UNIT – II	08 Hours
Vector spaces – Subspaces (<i>Text Book-1: Chapter 4: 4.1</i>) Linear independence – Span - Bases and Dimensions -Finite dimensional vector spaces (<i>Text Book-1: Chapter 4: 4.3</i>) Dimensions, finite dimensional vector spaces (<i>Text Book-1: Chapter 4: 4.5</i>)	
UNIT – III	09 Hours
Linear transformation - Matrices of linear transformations (<i>Text Book-1: Chapter 1: 1.7 and 1.8</i>) Vector space of linear transformations – Inner Product, Orthogonal Vectors - Projections (<i>Text Book-1: Chapter 6: 6.1, 6.2 and 6.3</i>) Gram- Schmidt Orthogonalization process (<i>Text Book-1: Chapter 6: 6.4</i>)	



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UNIT – IV												07 Hours		
Introduction to Eigenvalues and Eigenvectors (Text Book-1: Chapter 5: 5.1)														
Diagonalization of a Matrix (Text Book-1: Chapter 5: 5.3)														
UNIT – V												07 Hours		
Linear second order ordinary differential equation with constant coefficients (Text Book-5: Chapter 2)														
Solutions of homogenous and non-homogenous equations (Text Book-5: Chapter 2: 2.2 to 2.7)														
Method of variation of parameters (Text Book-5: Chapter 2: 2.10)														
Solutions of Cauchy-Euler and Cauchy-Legendre differential equations (Text Book-5: Chapter 2: 2.5)														
Course Outcomes:														
At the end of the course the student will be able to:														
1. Solve systems of linear equations using Gauss elimination and determine the inverse of a matrix by applying the Gauss-Jordan method.														
2. Solve problems involving row reduction and echelon form in linear algebra to demonstrate an understanding of the concepts and their applications in solving systems of linear equations and transforming matrices.														
3. Analyze matrices and determine their rank by using row echelon form, examining the relationships between rows and columns, and identifying the motives or causes behind the rank.														
4. Apply LU decomposition techniques to factorize a matrix into lower and upper triangular matrices, illustrating their understanding of the process and its applications.														
5. Apply the concepts of vector spaces, subspaces, linear independence, span, bases, and dimensions to solve problems related to finite-dimensional vector spaces, applying acquired knowledge and techniques.														
Table: Mapping Levels of COs to POs / PSOs														
COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1						1					
CO2	3	2	1		1				1					
CO3	3	2	1		1				1					
CO4	3	2	1						1					
CO5	3	2	1		1				1					

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)



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TEXT BOOKS:

1. D C Lay, S R Lay and JJ McDonald, Linear Algebra and its Applications, PearsonIndia, Fifth edition.
2. Linear Algebra and its Applications by Gilbert Strang, 4th Edition, ThomsonBrooks/Cole, Second Indian Reprint 2007.
3. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R.Hill, 9th Edition, Pearson Education, 2011.
4. Thomas' Calculus, George B. Thomas, D. Weir and J. Hass, 2014, 13th edition, Pearson.
5. Advanced engineering mathematics, Erwin Kreyszig, Wiley, London, 1972.

REFERENCE BOOKS:

1. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).
2. Higher Engineering Mathematics by B S Grewal, 42nd Edition, Khanna Publishers.
3. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition, Academic Press (2016).
4. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003.
5. Practical Linear Algebra, Farin and Hansford, CRC Press (2013).

E-Resources:

1. <https://nptel.ac.in/courses/111101115>
2. <https://nptel.ac.in/courses/111108066>
3. Linear Algebra Basics | Coursera
4. <https://nptel.ac.in/courses/111108081>
5. <https://nptel.ac.in/courses/111106100>
6. Differential Equations for Engineers Course (HKUST) | Coursera

Activity Based Learning (Suggested Activities in Class)

1. Introduce the concept of matrix transformations, such as translation, rotation, scaling, and reflection. Provide visual examples and interactive tools that allow students to manipulate shapes and observe the effects of different transformation matrices.
2. Using real-life scenarios or word problems to make the activity of solving linear equations using matrix method.
3. Some real-world scenarios that can be modelled using ODEs, such as population growth, radioactive decay, or chemical reactions that can be discussed and solve using appropriate methods.



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ENGINEERING CHEMISTRY

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

SEMESTER – I/II

Course Code : 23EN1103	Credits : 03
Hours / Week : 04 Hours	Total Hours : 26 + 26 Hours
L-T-P-J : 2-0-2-0	

Course Learning Objectives:

This Course will enable students to:

- **Understand** the principles of chemical fuel towards energy production.
- **Apply** the concept of energy conversion from solar to electric energy in photovoltaic cells.
- **Understand** the basic principles of electrochemistry to measure the potential of redox reactions. **Illustrate** the construction, working, and applications of batteries, and fuel cells as energy storage devices.
- **Understand** the electrochemical theory of corrosion of metals and its prevention by metal finishing techniques.
- **Understand** the synthesis, structure–property relationship, and the applications of commercial polymers.
- **Understand** the different techniques for the purification of sewage water. **Analyse** the impurities present in waste water systems.

Teaching-Learning Process (General Instructions)

These are some of the innovative pedagogical approaches to accelerate the attainment of the various course outcomes.

1. **Lecture method:** Chalk and talk method, and demonstrations may be adopted to achieve the course outcomes.
2. **Interactive Teaching: Active learning** that includes brainstorming, group work, formulating questions, notetaking, and annotating.
3. Show **Videos** to explain and illustrate the various concepts.
4. Encourage **Collaborative** learning in the class.
5. **Problem Based Learning**, may foster students' analytical skills, ability to evaluate, and process the information.
6. Inculcate the culture of research and encourage students to come up with their own creativity.



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UNIT – I Chemical Energy Source	06 Hours
Fuels: Introduction to energy; Fuels - definition, classification, importance of hydrocarbons as fuels; Calorific value-definition, Gross and Net calorific values (SI units). Determination of calorific value of a solid / liquid fuel using Bomb calorimeter. Numerical problems on GCV&NCV. Petroleum cracking-fluidized catalytic cracking. Reformation of petrol. octane number, cetane number, anti-knocking agents, power alcohol, and Biodiesel. <i>(Text Book-1: Module-3)</i> Solar Energy: Thermal energy: Photovoltaic cells-Introduction, definition, importance, working of PV cell. Solar grade silicon physical and chemical properties relevant to photo-voltaics, doping of silicon by diffusion technique. <i>(Text Book-1: Module-3)</i>	
UNIT – II Energy Science and Technology	06 Hours
Electrochemistry and Battery Technology: Single electrode potential - Definition, and sign conventions. Standard electrode potential- Definition. EMF of a cell-Definition, notation and conventions. Reference electrodes- Calomel electrode, Ag/AgCl electrode. Measurement of standard electrode potential. Battery technology: Basic concepts including characteristics of anode, cathode, electrolyte and separator. Battery characteristics. Classification of batteries- primary, secondary and reserve batteries. State of the art Batteries-Construction working and applications of Zn-air, Lead acid battery, Nickel-Metal hydride and Lithium ion batteries. <i>(Text Book-2: Module-1)</i> Fuel Cells: Introduction to fuel cells, types of fuel cells. Construction, working and application of Methanol-Oxygen fuel cell. <i>(Text Book-2: Module-1)</i>	
UNIT – III Corrosion Science and Surface Modification Techniques	06 Hours
Corrosion Science: Definition, Chemical corrosion and Electro-chemical theory of corrosion, Types of corrosion, Differential metal corrosion, Differential aeration corrosion (pitting and water line corrosion), Stress corrosion. Factors affecting the rate of corrosion, Corrosion control: Metal coatings-Galvanization, Tinning and its disadvantages. Cathodic protection of Corrosion: Sacrificial anode method and current impression method. <i>(Text Book-2: Module-2)</i> Surface Modification Techniques: Definition, Technological importance of metal finishing. Significance of polarization, decomposition potential and over-voltage in electroplating processes. Electroless Plating. Distinction between electroplating and Electroless plating, advantages of electroless plating. Electroless plating of copper. <i>(Text Book-2: Module-2)</i>	
UNIT – IV Polymers	02 Hours
Polymers: Introduction to polymers, Glass transition temperature, structure and property relationship. Synthesis, properties and applications of Teflon. PMMA. Synthesis, properties and application of silicone rubber. <i>(Text Book-1: Module-4)</i>	
UNIT – V Water Technology & Instrumental Methods of Analysis:	06 Hours



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Water Technology: Impurities in water. Hardness of Water: Types of Hardness and determination of total hardness of water by using disodium salt of ethylenediaminetetraacetic acid method. Alkalinity. Potable water treatment by Electro dialysis and Reverse Osmosis. Water analysis- Biochemical oxygen demand and Chemical oxygen demand. Determination of COD. Numerical problems on COD. Sewage treatment. (Text Book-2: Module-5)

Instrumental Methods of Analysis: Instrumental methods of analysis, Principles of Potentiometry, Conductometry (Strong acid against strong base, weak acid against strong base, mixture of strong acid and a weak acid against strong base).

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Determination of calorific value of fuels and apply the concepts of energy conversion for photovoltaic cells.	L3
2	Apply the basic principles of electrochemistry for the construction of energy storage devices.	L3
3	Implement the electrochemical theory to analyze the concept of corrosion of metals and its prevention by surface modifications.	L3
4	Apply the concept of polymerization for the synthesis of polymers and study their structure-property relationship for commercial applications.	L3
5	Demonstrate the techniques in the purification of sewage water. Determine the hardness and oxygen demand of the provided waste water samples.	L2

Table: Mapping Levels of COs to POs

COs	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3	3	0	0	0	0	0	0	0	0	0
CO2	3	2	2	0	0	0	0	0	0	0	0	0
CO3	3	1	1	0	0	0	0	0	0	0	0	0
CO4	3	1	3	0	0	0	0	0	0	0	0	0
CO5	3	1	3	0	0	0	0	0	0	0	0	0

3: Substantial (High)

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Text Books

1. Engineering Chemistry, Edited by Dr. Mahesh B and Dr. Roopashree B, SunstarPublisher, Bengaluru, ISBN 978- 93-85155-70-3, 2022.
2. Engineering Chemistry - by Chandra Shekara B M and Basavaraju B C, Banbayalu(publications), Bengaluru, 2014, 294 pages.

Reference Books

1. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
2. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.
3. Wiley's Engineering Chemistry (Wiley India), 2nd Edition, 2013, 1026 pages.

E-Resources

1. <https://nptel.ac.in/>
2. <https://swayam.gov.in/>
3. [https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_\(Analytical_Chemistry\)/Electrochemistry/Basics_of_Electrochemistry](https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Electrochemistry/Basics_of_Electrochemistry)

Activity Based Learning (Suggested Activities in Class)

1. Analyze research problems by reading research articles, group discussion, and presentations.
2. Demonstration of solution to a problem through experiential learning.
3. Demonstrations using real objects, taking students on an educational tour.

ENGINEERING CHEMISTRY- LABORATORY

Total: 26 Hrs

Volumetric Analysis and Preparations

1. Evaluation of quality of water in terms of total hardness by complexometric titration.
2. Determination of Chemical Oxygen Demand (COD) of the given industrial wastewater sample.
3. Determination of alkalinity of the given water sample

Instrumental methods of Analysis

1. Potentiometric titration–Estimation of FAS using standard $K_2Cr_2O_7$ solution.
2. Conductometric estimation of a mixture of a weak and strong acid using standardsodium hydroxide solution
3. Determination of viscosity coefficient of a given liquid
4. Colorimetric estimation of copper in a given solution
5. Determination of pKa of given weak acid.

Reference Books

1. Dayananda Sagar University laboratory manual.
2. J. Bassett, R.C. Denny, G.H. Jeffery, Vogels, Text book of quantitative inorganic analysis, 4th Edition.



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SEMESTER	I/II					
COURSE CODE	23EN1104					
TITLE OF THE COURSE	INTRODUCTION TO MECHANICAL ENGINEERING					
SCHEME OF INSTRUCTION	L	T	P	J	Total Hours	Credits
	2	0	2	0	26(L)+26(P) = 52	3

COURSE OBJECTIVES:

The course will enable the students to

- Acquire a basic understanding of renewable energy resources and basic concepts of hydraulic turbines.
- Acquire knowledge of various engineering materials and metal joining techniques.
- Acquire essential knowledge of modern manufacturing tools and techniques.
- Acquire knowledge on basics of refrigeration and air-conditioning.
- Explain about the cooling of electronic devices.
- Acquire knowledge of basic concepts of mechatronics and robotics.
- Explain about the electric and hybrid vehicles.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
C01	Describe basic concepts of renewable energy resources and power generation	L2
C02	Distinguish various engineering materials and metal joining techniques	L2
C03	Demonstrate different modern manufacturing tools and techniques	L3
C04	Make use of basic concepts of refrigeration and air-conditioning concepts	L3
C05	Illustrate essential knowledge of basic concepts of mechatronics and robotics	L2
C06	Comprehend the important concepts of electric and hybrid vehicles	L2



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COURSE CONTENT:	
MODULE 1 Energy Sources and Power Generation	10 Hrs
Review of energy sources: Construction and working of Hydel power plant, Thermal power plant, Nuclear power plant, Solar power plant, Tidal power plant, Wind power plant. Principle and Operation of Hydraulic turbines, Pelton Wheel, Francis Turbine and Kaplan Turbine. Working of Centrifugal Pump & reciprocating pump. Thermodynamics: System, boundary, surroundings, types of systems, Zeroth law, First and second laws of thermodynamics, Efficiency, COP, Carnot theorem	
MODULE 2 Engineering Materials and Metal Joining Processes	10 Hrs
Metals- Ferrous: Tool steels and stainless steels. Non-ferrous /metals: aluminum alloys. Ceramics- Glass, optical fiber glass, cermets. Composites- Fiber reinforced composites, Metal matrix Composites. Smart materials- Piezoelectric materials, shape memory alloys, semiconductors, and super-insulators. Metal Joining Processes: Fitting, Sheet metal, Soldering, brazing and Welding: Definitions. Classification and methods of soldering, brazing, and welding. Brief description of arc welding, Oxy- acetylene welding, Introduction to TIG welding and MIG welding.	
MODULE 3 Modern Manufacturing Tools and Techniques	12 Hrs
CNC: Introduction, components of CNC, advantages and applications of CNC, CNC Machining centres and Turning Centers Concepts of Smart Manufacturing and Industrial IoT. Additive Manufacturing: Introduction to reverse Engineering, Traditional manufacturing vs Additive Manufacturing, Computer aided design (CAD) and Computer aided manufacturing (CAM) and Additive Manufacturing (AM), Different AM processes, Rapid Prototyping, Rapid Tooling, 3D printing: Introduction, Classification of 3D printing process, Applications to various fields.	
MODULE 4 Thermal Systems and Management	10 Hrs



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Heat in Electronic Devices: Modes of Heat Transfer, heat generation in electronics, temperature measurement, heat sink, Cooling of electronic devices: Active, Passive, and Hybrid Cooling

Refrigeration: Principle of refrigeration, Refrigeration effect, Ton of Refrigeration, COP, Refrigerants and their desirable properties. Principles and Operation of Vapor Compression and Vapor absorption refrigeration. Applications of Refrigerator.

Air-Conditioning: Classification and Applications of Air Conditioners. Concept and operation of Centralized air conditioning system.

MODULE 5 Advanced Technologies

10 Hrs

Mechatronics: Introduction, Concept of open-loop and closed-loop systems, Examples of Mechatronic systems and their working principle.

Robotics: Introduction, Robot anatomy, Joints & links, common Robot configurations. Applications of Robotics in Material Handling, Processing, Assembly, and Inspection.

Electric and Hybrid Vehicles: Introduction, Components of Electric and Hybrid Vehicles, Drives and Transmission. Advantages and disadvantages of EVs and Hybrid vehicles.

List of Laboratory/Practical Experiments activities to be conduct

- Demonstration on Principle and Operation of any one Turbo machine
- Demonstration on pumps
- Visit any one Conventional or Renewable Energy Power Plant and prepare a comprehensive report.
- One exercises each involving Fitting and Sheet metal. One exercises each involving welding and Soldering.
- Study oxy-acetylene gas flame structure and its application to gas welding
- Demonstration on Principle and Operation of CNC machine.
- Demonstration on Principle and Operation of 3D printing process.
- Demonstration of anyone Heat transfer application device and prepare a comprehensive report.
- Demonstration of anyone air conditioning system.
- Demonstration of the machine consists of Gear Trains.
- Demonstration of various elements of mechatronic system.
- Demonstration of any one model of Robot



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TEXT BOOKS:

1. Basic and Applied Thermodynamics, P.K.Nag, Tata McGraw Hill 2nd Ed., 2002
2. Non-Conventional Energy Sources, G.D Rai, Khanna Publishers, 2003
3. Elements of Workshop Technology (Vol. 1 and 2), Hazra Choudhry and Nirzar Roy, Media Promoters and Publishers Pvt. Ltd., 2010
4. Thermal Management in Electronic Equipment, HCL Technologies, 2010
5. Robotics, Appu Kuttan KK K. International Pvt Ltd, volume 1

REFERENCES:

1. An Introduction to Mechanical Engineering, Jonathan Wickert and Kemper Lewis, Third Edition, 2012
2. Turbo Machines, M. S. Govindgowda and A. M. Nagaraj, M. M. Publications 7th Ed, 2012
3. Manufacturing Technology- Foundry, Forming and Welding, P.N.Rao Tata McGraw Hill 3rd Ed., 2003.
4. Thermal Management of Microelectronic Equipment, L. T. Yeh and R. C. Chu, ASME Press, New York, 2002
5. Fundamentals of Robotics: Analysis and Control, Robert J. Schilling, Pearson Education (US).



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INTRODUCTION TO ELECTRICAL ENGINEERING

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

SEMESTER – I/II

Course Code : 23EN1105	Credits : 02
Hours / Week : 02 Hours	Total Hours : 26 Hours
L-T-P-J : 2-0-0-0	

Course Learning Objectives:

This course enables students to:

- **Demonstrate** a foundational understanding of electrical quantities, including current, voltage, power, and energy.
- **Apply** fundamental laws of electric circuits, such as Ohm's law and Kirchhoff's laws to evaluate electrical circuits.
- **Explain** fundamental concepts of electro-magnetic circuits.
- **Demonstrate** a foundational understanding of the working principles, construction, and characteristics of DC machines.
- **Illustrate** the construction, operation, and types of transformers, considering their significance in electrical systems.
- **Explain** the structure and components of electrical power system, highlighting their interconnections.
- **Explain** emerging trends of green energy technologies and smart metering.
- **Explain** the importance of earthing, protective devices, and proper wiring for ensuring electrical safety.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. **Interactive Teaching: Adopt the Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show **Video/animation** films to explain functioning of various concepts.
4. Encourage **Collaborative** (Group Learning) Learning in the class.
5. To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
6. Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.



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UNIT – I	10 Hours
Fundamentals laws of Electrical circuit and elements: Electrical charge, potential; current; power and energy; AC and DC current (mathematical treatment); Ohm's law; KCL and KVL in resistive circuits; series and parallel combination of resistors; voltage and current division rule; V-I relationships for inductor and capacitor under AC voltage; impedance and admittance (series RC and RL); Overview of active power, reactive power and power factor; Introduction to 3 phase systems; Simulation using LTspice software to demonstrate voltage division, current division in resistive circuits. Simulation using LTspice software to show voltage and current waveform for RC and RL circuit.	
<i>(TextBook-1: Chapter 1: 1.1 to 1.4, 1.6 to 1.8. Chapter 2: 2.1 to 2.3. Chapter 4: 4.1 to 4.4 Chapter 6: 6.1 to 6.4)</i>	
UNIT – II	10 Hours
Electromagnetic circuits: Magnetic circuits: Basics of magnetic circuits (flux, mmf, permeability, reluctance, B and H); Relation between field theory and circuit theory; Faraday's and lenz's laws , Lorentz force; Self and Mutual inductance. DC machines: Principle of operation of DC generator; generated EMF equation; classification; characteristics and applications. (Introductory treatment only); Principle of operation of DC Motor; back EMF; speed and torque; classification; characteristics and applications. Losses and efficiency in DC machines. Transformers: Construction, working principle , induced emf equation; step-up and step down; losses and efficiency.	
<i>(TextBook-2: Chapter 7: 7.1 to 7.12; Textbook 1: 10.1, 10.2, 10.4, 10.5, 10.8, 10.9, 10.11 and 10.12; Chapter 8: 8.1, 8.2 and 8.9)</i>	
UNIT – III	06Hours
Powers system fundamentals: Power system structure; generations sources; green energy; smart meters; power tariff calculations; Electrical safety and standards (IS: 732-2019, IEC: 60446); Colour code of wires for single phase supply, earthing, fuse and MCB.	
<i>(Textbook 1: , Chapter 16: 16.1 to 16.5; Textbook 2: Chapter 24: 24.1 to 24.6)</i>	



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Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
C01	Solve for voltage, current, power and energy in purely R, series RL and RC circuits under DC and AC voltages.	L3
C02	Demonstrate understanding of principle of operation of DC machines and its applications.	L2
C03	Demonstrate understanding of the working principle of transformers.	L2
C04	Demonstrate understanding of the working principle of transformers, generation sources, the significance of renewable energy sources in electrical engineering, and safety practices.	L2
C05	Demonstrate proficiency in using simulation software (e.g., LTspice) to simulate and solve electrical parametrs.	L3



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Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2		1	3						1		1		
CO2	3	2									1		1		
CO3	3	2									1		1		
CO4	3					2	3	2			1		1	1	2
CO5	3	3	2	1	3				1	1	2	2	1	1	

TEXT BOOKS:

1. D.P.Kothari and I.J. Nagrath, "Basic Electrical Engineering", 4th Edition, Tata McGraw Hill, 2019.
2. B.L. Theraja and A.K. Therja, "A textbook of electrical technology, Vol. I (Basic electrical Engineering)", S. Chand Publishing, 23rd Rev Ed, 2006.

REFERENCE BOOKS:

1. Clayton Paul, Syed A Nasar and Louis Unnewehr, "Introduction to Electrical Engineering", 2nd Edition, McGraw-Hill, 1992.
2. William H Hayt and Jack E Kimberly and Steven M Durbin, "Engineering CircuitAnalysis" 8th Edition, McGraw-Hill, 2013.

E-Resources:

1. <https://nptel.ac.in/courses/108/108/108108076>

Activity Based Learning (Suggested Activities in Class):

1. Real world problem solving using group discussion and hands-on activities.
E.g., Interfacing different types of sensors using Arduino.
2. Simulation of different electrical circuits. E.g., RL and RC circuits.



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C PROGRAMMING FOR PROBLEM SOLVING [As per Choice Based Credit System (CBCS) scheme]	
SEMESTER – I	
Course Code : 23EN1102	Credits : 04
Hours/Week : 05 Hours	Total Hours : 26(L) + 13(T) + 26 (P) Hours
L-T-P-J : 2-1-2-0	
Course Learning Objectives: This Course will enable students to: 1. Elucidate the basic architecture and functionalities of C programming language. 2. Apply programming constructs of C language to solve the complex problems 3. Explore data structures like arrays, structures, unions and pointers in implementing solutions to real world problems 4. Design and Develop Solutions to problems using structured programming constructs such as functions.	
Teaching-Learning Process (General Instructions) These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes. 1. Lecture method means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes. 2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying. 3. Show Video/animation films to explain functioning of various concepts. 4. Encourage Collaborative (Group Learning) Learning in the class. 5. To make Critical thinking, ask at least three Higher order Thinking questions in the class. 6. Adopt Problem Based Learning, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it. 7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them. 8. Discuss how every concept can be applied to the real world - and when that possible, it helps improve the students' understanding.	
UNIT – I	07 Hours
Basics and overview of C: Introduction to Problem Solving using Algorithms and Flowchart: Key features of Algorithms: Sequence, Decision, Repetition with examples. Background, structure of C program, keywords, Identifiers, Data Types, Variables, Constants , Input / Output statements, Operators (Arithmetic, relational, logical, bitwise etc.), Expressions, Precedence and Associativity, Expression Evaluation, Type conversions. Conditional Branching Statements -if and switch statements, iterative statements (loops)-while, for, do-while statements, Loop examples, Nested loops, break, continue, go to statement. (Text Book-1: Chapter 2 & Chapter 3)	



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UNIT – II	05 Hours
Arrays: Introduction, declaration & initialization of array, reading and writing array elements, Operations on array: Traversal, searching (Linear and Binary search), sorting (Bubble sort and Selection Sort). Declaration and Initialization of two-dimensional arrays. Matrix Operations (addition, subtraction, multiplication, transpose) using two-dimensional array. Strings: Definition, declaration, initialization, and representation. String handling functions and character handling functions. <i>(Text Book-1: Chapter 5:5.1 to 5.9 & Chapter 6)</i>	
UNIT – III	06 Hours
Pointers: Definition and declaration and initialization of pointers. Accessing values using pointers. Accessing array elements using pointers. Functions: Definition and declaration. Built-in functions and User-defined functions. Categories of functions with example. Pointers as function arguments, array as function argument, Call-by-value and call-by-reference. Recursion. <i>(Text Book-1: Chapter 7: 7.1 to 7.17 & Chapter 4:4.1 to 4.8, 4.10)</i>	
UNIT – IV	04 Hours
Structures: Purpose and usage of structures. Declaration of structures. Assignment with structures. Structure variables and arrays. Nested structures. Student and employee database implementation using structures. Unions: Declaration and initialization of a union. Difference between structures and unions. Example programs. <i>(Text Book-1: Chapter 8: 8.1, 8.2,8.6)</i>	
UNIT – V	04 Hours
Memory allocation in C programs: Dynamic memory allocation, memory allocation process, allocating a block of memory, releasing the used space, altering the size of allocated memory. Files: Defining, open, read, write, seek and closing of both textual and random files. <i>(Text Book-1: Chapter 7: 7.18 to 7.20 & Chapter 9: 9.1 to 9.5, 9.8)</i>	



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Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Apply programming constructs of C language to solve the real-world problem.	L3
2	Choose appropriate data type for implementing solutions to solve problems like searching and sorting.	L3
3	Examine suitable user-defined data structures in implementing solutions, using modular programming constructs.	L4
4	Analyze efficient ways for managing data and storage.	L4
5	Justify a solution using a modern IDE and associated tools, conduct a code review and contribute in a small-team.	L5

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2		2												
CO3			2										1	
CO4				2										
CO5					3				2				1	

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)

TEXT BOOKS:

1. Reema Thareja, "Programming in C". Oxford University Press, Second Edition, 2016.

REFERENCE BOOKS:

1. Brian W. Kernigham and Dennis M. Ritchie, (2012) "The C Programming Language", 2nd Edition, PHI.
2. Behrouz A. Forouzan, Richard F. Gilberg, "Computer Science - A Structured Approach Using C", Cengage Learning, 2007.
3. Vikas Gupta, "Computer Concepts and C Programming", Dreamtech Press 2013.

E-Resources:

1. <https://nptel.ac.in/courses/106/105/106105171/> MOOC courses can be adopted for more clarity in understanding the topics and verities of problem-solving methods.
2. <https://www.w3schools.com/c/index.php>
3. <https://www.guvi.in/courses/web-development/c-programming/>
4. <https://www.tutorialspoint.com/cprogramming/index.htm>
5. <https://pythontutor.com/>



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C PROGRAMMING FOR PROBLEM SOLVING LABORATORY

Total Contact Hours: 26

List of Laboratory/Practical Experiments activities to be conducted

1. Programming Basics: Swapping Numbers, Simple Interest, and Factorial.
2. Quadratic Equation Solver
3. Number Operations: Palindrome Check and Power Calculation.
4. Fibonacci Series and Greatest Common Divisor (GCD) Calculation.
5. Calculator Emulation
6. String Manipulation
7. Sorting an Array of Integer Elements.
8. Searching an Array of Elements.
9. Pointer Demonstration using Functions.
10. Case Study on Strings and Functions.



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ENGINEERING MECHANICS

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

SEMESTER – I/II

Course Code : 23EN1106	Credits : 02
Hours / Week : 02 Hours	Total Hours : 26 Hours
L-T-P-J : 2-0-0-0	

Course Learning Objectives:

This Course will enable students to:

1. **Illustrate** Couples and equivalent force couple system
 2. **Understand the** principles of resolution and composition of forces
 3. **Calculate** moment of coplanar concurrent and coplanar non-concurrent forces
 4. **Draw** free body diagrams of objects subjected to coplanar concurrent and non-concurrent force systems
 5. **Calculate** center of gravity/centroid for various planar figures
 6. **Determine** area moment of inertia for various planar geometrical objects and standard symmetrical sections
 7. **Explain** Limiting friction and Laws of Friction
 8. **Solve numerical on** wedge friction, ladder friction
 9. **Explain** assumptions made in analysis of Trusses
 10. **Determine** axial forces in members of Planar determinate Truss
- Illustrate** rectilinear, plane curvilinear and projectile motions

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. **Interactive Teaching: Adopt the Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show **Video/animation** films to explain functioning of various concepts.
4. Encourage **Collaborative** (Group Learning) Learning in the class.
5. To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
6. Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.



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UNIT – I Introduction to Engineering Mechanics	06 Hours
INTRODUCTION: Introduction to Engineering Mechanics, Force Systems Basic concepts, Particle Equilibrium in 2-D; System of Forces, Co-planar Concurrent Forces, Resultant- Moment of Forces and its Application; Couples and Resultant of force System, Equilibrium of System of Forces.	
UNIT – II Centroid, Centre and gravity and Moment of inertia	05 Hours
Introduction, Centroid of simple figures from first principle , centroid of standard sections Centre of Gravity and its implications; Area moment of inertia Definition , Moment of inertia of plane sections from first principles, Theorems of moment of inertia , Moment of inertia of standard sections	
UNIT – III Friction	05 Hours
Introduction, Free body diagrams, Equations of Equilibrium. Types of friction, Limiting friction, Cone of Friction, Laws of Friction , Static and Dynamic Friction; Motion of Bodies, related problems.	
UNIT – IV Dynamics	05 Hours
Introduction, Rectilinear motion ; Plane curvilinear motion (rectangular path, and polar coordinates); Projectile motion , Basic terms, general principles in dynamics; Types of motion, motion and simple problems, Kinetics- Newton's laws of motion and related problems.	
UNIT – V Analysis of Trusses	05 Hours
Introduction, Classification of trusses, Equilibrium in two and three dimension; Method of Joints; To determine if a member is in tension or compression; Simple Trusses; Zero force members.	
Course Outcomes: At the end of the course the student will be able to: 1. Compute Resultant and reactions by principles and resolution of forces in a plane. 2. Analyse the objects under the action of applied and frictional forces in a plane by equations of equilibrium. 3. Determine the Moment of Inertia of composite geometrical sections in a plane 4. Analyse determinate two-dimensional truss by the method of joints and method of section. 5. Analyse the motion of objects by equations of motion, equations of equilibrium, and Newton's laws of motion and calculate quantities in projectile motion by equations of motion.	



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Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	0	0	1	1	0	0	0	0	1	3	2
CO2	2	2	2	2	0	0	1	0	0	0	0	0	2	2	0
CO3	3	3	2	2	0	0	1	0	1	0	0	0	3	2	0
CO4	3	3	2	2	0	0	1	0	0	0	0	0	3	3	0
CO5	3	2	2	2	0	0	1	0	0	0	0	0	2	2	0

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall publications.
2. A Nelson (2009), Engineering Mechanics: Statics and dynamics, Tata McGraw Hill publications.

REFERENCE BOOKS:

1. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill publications.
2. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
3. H.J. Sawant, S.P Nitsure (2018), Elements of Civil Engineering and Engineering Mechanics, Technical Publications.

E-Resources:

1. <https://archive.nptel.ac.in/courses/105/105/105105108/>
2. https://onlinecourses.nptel.ac.in/noc22_ce46/preview
3. <https://www.youtube.com/watch?v=LIZ-PQbGZkA>

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion.
2. Demonstration of solution to a problem through experiential learning.
3. Demonstrations using real objects, taking students on an educational tour.



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TECHNICAL ENGLISH [As per Choice Based Credit System (CBCS) scheme]	
SEMESTER - I / II	
Course Code : 23EN1107	Credits : 02
Hours / Week : 02 Hours	Total Hours : 26 Hours
L-T-P-J : 2-0- 0-0	
Objective: Developing Communicative competence: Enhancing the Language competence in the technical discourse and augmenting the strategic competence in the social and professional environment.	
Course Learning Objectives: This course will enable students to: - To enable students to improve their lexical and grammatical competence. - To enhance their verbal and nonverbal communication in a professional environment - To optimize oral and written communication. - To familiarize the students with employability and job search skills. - To enhance the students with soft skills - To inculcate critical thinking	
Teaching-Learning Process (General Instructions) These are some of the innovative pedagogical approaches to accelerate the attainment of the various course outcomes. Lecture method: Anecdotes, case studies and Examples from real-life situations may be adopted along with the traditional method of chalk and talk to achieve the course outcome. Interactive Teaching: Active learning may be adopted which includes brainstorming, Teamwork, focused listening, formulating questions, note-taking, and Role play. Collaborative learning through Debates and Group Discussion Activity-based learning to inculcate Critical thinking – conceptualizing, applying, analyzing, synthesizing, and/or evaluating information from observation, perception, and expression. Minimum three higher-order questions from the real-world context Problem-Solving method through Activities and discussion / Minimum of three situations to inculcate Problem-Solving skills and encourage the students to come up with creative ways to solve the problem Audio-visual methods through language Lab in the teaching of LSRW skills. Short films/ Ted talks/ Videos/Animation films to explain the functioning of various concepts. Flipped learning Peer learning / Peer tutoring	
Module – I	06 Hours



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Grammar and Usage, Language and Communication.

[Branches of Grammar and Vocabulary Word Formation and Types of Word Formation.

Communication process diagram. Types of Communication: Managerial, Corporate, Technical and Other Organizational Communication. **Barriers to Effective Communication.** Listening: Types and their Importance. **Difference between hearing and listening.** Speaking: Different aspects of Effective Speaking. **Oral presentation Pronunciation Guidelines- Common Errors of Pronunciation-Various Techniques for Neutralization of Mother Tongue Influence)**

Objective:

- Revising and practicing grammar will help students to optimize their language Competence
- Listening steps up language learning and improves pronunciation
- Speaking improves one's ability to construct phrases naturally and spontaneously in everyday discussions, Clarity and comprehensiveness in speech.
- Communicating effectively in the Professional environment, to interact with the colleagues and to involve in collaborate initiatives

Module – II

06 Hours

Reading: Extensive and Intensive. Technical Paper Writing and Minutes of the Meeting.

Objective:

- Reading provides exposure to the chosen field and helps in the coherence of the thought process
- **Technical writing techniques** enable the knowledge in the relevant domain and creates better content based on the need of the target group
- Meeting minutes allows to access information such as facts, opinions, votes cast, conflicts, attendees, and other crucial elements at the workplace.

Module – III

05 Hours

Memo and E-mail Etiquette. Referencing Skills for Academic Report Writing.

Objective:

- Familiarizing with **email etiquettes** and correspondence provides learners to form an excellent first impression, **establishing trust and confidence.**
- Following the Academic conventions helps the students to optimize their reference skills and use references to acknowledge the input of other authors and scholars in their work and avoid **plagiarism.**
- Writing technical reports develop competence in creating a legally bound account of efforts and choices and engineering technical report propose a solution to a problem in order to inspire action.

Module – IV

04 Hours

Group Discussion: Definition, How GD Helps in Student Life & Corporate Life.

Objective: GD helps individuals to achieve the skills of organizing and presenting the ideas and concepts in a cohesive manner and to overcome the inhibition of expression in communication

Module – V

05 Hours



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Drafting Curriculum Vitae, Resumes, and Cover- Letters. Job Applications.

{Types of Resumes, Preparing Resume, CV and Cover- Letter. Filling Job Application. Difference between Curriculum Vitae, Interview techniques: Telephonic interviews, Group interviews, face-to-face interviews -Mannerism and etiquette}.

Objective: Learning the specifics of creating a CV or Resume helps in the effective presentation of their achievements and skills, and a cover letter is a chance for them to exhibit a few aspects of their personality.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course, the student will be able to:		
1	Developing language competence improves one's ability to construct phrases naturally in everyday discussions and Communication skills and soft skills enhance the self-confidence of students,	L3
2	Applying the fundamentals of technical writing techniques provides adequate exposure to the respective domain and creates better content. Implementing the technicalities of writing provides better exposure in the domain.	L3
3	Following an appropriate style of email reveals the aspect of professionalism. Develop technical writing skills to increase the quality of the work and testimony of conduct.	L3
4	Practicing communication with greater clarity and ease enable the students to discuss a wide spectrum of topics.	L3
5	Writing resumes or curriculum vitae provides a practice to exhibit their skills and achievements concisely and writing a covering letter enables them to express their personality in the formal context.	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C01										2				
C02										2				
C03										2				
C04										2				
C05										2				



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TEXT BOOKS:

1. Dhanavel, S.P. "English and Communication Skills for Students of Science and Engineering". Orient Blackswan Pvt. Ltd., 2009.
2. Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice". 3rd Edition, Oxford University Press, 2009.
3. Murphy R. "English Grammar in Use", Cambridge University Press, 2012.
4. N. Krishnaswamy and T. Sri Raman. "Creative English for communication", Macmillan Publication, 2005.

REFERENCE BOOKS:

1. Day. R A. "Scientific English: A Guide for Scientists and Other Professional". 2nd Edition, Hyderabad: Universities Press, 2000.
2. Ashraf Rizvi M. "Effective Technical Communication". McGraw Hill Education, 2017.
3. Eastwood J. "Oxford Practice Grammar". Oxford University Press, 1999.
4. Swan M and Walter C. "Oxford English Grammar Course". Oxford University Press, 2011.
5. Dale, Carnegie. "The Quick and Easy Way to Effective Speaking". JAICO Publishing House, 2019.
6. Chauhan, Gajendra S and Smita, Kashiramka. "Technical Communication". India: Cengage Learning India Private Limited, 2018.
7. Bailey, Stephen. "Academic Writing: A Handbook for International Students". 5th Edition, Routledge, 2017.
8. Kumar, Shiv K and Nagarajan, Hemalatha. "Learn Correct English: Grammar, Composition and Usage". 1st edition, India: Pearson, 2005.
9. Board of Editors. Language and Life: A Skills Approach. Orient BlackSwan, 2018.
10. Sudharshana, NP and C Savitha. English for Engineers. Cambridge University Press, 2018.
11. Kumar, Sanjay and Pushp Lata. English Language and Communication Skills for Engineers. Oxford University Press, 2018.
12. Thomson, A.J. and Martinet, A.V. A Practical English Grammar, OUP, New Delhi: 1986
13. Anne Laws, —Writing Skills||, Orient Black Swan, Hyderabad, 2011
14. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

E-Resources:

1. <https://gnindia.dronacharya.info/ME/Common-Subjects/Downloads/Technical-Communication/Books/Technical-Communication-Book-9.pdf>. Web.
2. https://projects.iq.harvard.edu/files/hks-communications-program/files/ho_murphy_michael_pp-slides_9_30_14.pdf. Web.
3. <https://www.youtube.com/watch?v=TR0JZiapxXM>. Web.
4. <file:///C:/Users/rochn/Downloads/ManualofEnglishGrammarandComposition10012575.pdf>. Web.
5. <https://www.youtube.com/watch?v=f5Tao6KHV5w>. Web.
6. https://www.sastra.edu/nptel/download/Prof%20GPRagini/pdf_New/Unit%2026.pdf. Web.
7. https://www.hansrajcollege.ac.in/hCPanel/uploads/elearning/elearning_docu



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- [me nt/English communication chapter 13.pdf](#). Web.
8. <https://www.youtube.com/watch?v=voyGGhlpBR8>. Web.

Activity Based Learning (Suggested Activities in Class)

1. Observing and responding appropriately to the real-life situations.
2. Encouraging students to participate in Group discussions.
3. Articulating internal observations precisely and confidently through extempore.
4. Producing sentences easily without any grammatical errors in speaking, writing essays, and creative writing.
5. Conducting mock interviews, to refine their expressions, familiarize them with the interview techniques, and provide training for the spontaneous response to tricky questions.
6. Directing students for PowerPoint presentations and orienting them towards the higher order skills of expressing their ideas and concepts with cohesion.



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SINGLE AND MULTI VARIABLE CALCULUS

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

SEMESTER – II

Course Code : 23EN1201	Credits : 03
Hours / Week : 03 Hours	Total Hours : 39 Hours
L-T-P-J : 3-0-0-0	

Course Learning Objectives:

This Course will enable students to:

1. **Apply** sophisticated techniques of differential calculus to solve problems involving functions of multiple variables.
2. **Apply** double and triple integrals in various coordinate systems (Cartesian, polar, cylindrical, and spherical) and effectively employ them to calculate areas, volumes.
3. **Acquire** a comprehensive understanding of fundamental concepts related to functions of multiple variables, including limits, continuity, and partial derivatives.
4. **Analyze** critical points of functions of two or more variables using partial derivatives and Lagrange multipliers, evaluate extreme values.
5. **Apply** vector calculus principles, such as line integrals, surface integrals, and the divergence theorem effectively to vector field.
6. **Analyze** the convergence and divergence of sequences and infinite series of real numbers by employing various convergence criteria and tests.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. **Interactive Teaching:** Adopt the **Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show **Video/animation** films to explain functioning of various concepts.
4. Encourage **Collaborative** (Group Learning) Learning in the class.
5. To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
6. Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

UNIT – I

09 Hours

Differential Calculus

Functions of two or more variables: Definition, Region in a plane, Level curves, Level surfaces, Limits, Continuity, Partial derivatives, Differentiability, Extreme values and saddle points, Lagrange multipliers. (*Textbook 1: Chapter 14: 14.1 – 14.4, 14.7, 14.8*)

Self-Learning Component: Single variable calculus



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UNIT – II		09 Hours
Integral calculus Double integral and iterated integrals - Cartesian and polar coordinates, Triple integral, Change of variables, Multiple integrals in cylindrical and spherical coordinates. (<i>Textbook 1: Chapter 15: 15.1 – 15.5, 15.7</i>)		
UNIT – III		09 Hours
Vector Calculus Line Integrals, Vector Fields, Work, Circulation and flux, Path independence, Potential functions, and Conservative fields, Green's theorem in the plane, Surface area and surface integrals, Surface area of solid of revolution, Parametrized surfaces, Stokes' theorem, The Divergence theorem. (<i>Textbook 1: Chapter 16: 16.1-16.8</i>), (<i>Textbook 2: Chapter 10: 10.1, 10.2, 10.4 – 10.7, 10.9</i>)		
UNIT – IV		6 Hours
Sequence and Series I: Sequences of real numbers and their convergence criteria, Infinite series, Sequence of partial sums, Tests for convergence/divergence - nth term test, Boundedness and monotonicity, Integral, Condensation, Comparison, Ratio and root tests (<i>Textbook 1: Chapter 10: 10.1-10.5</i>)		
UNIT – V		06 Hours
Sequence And Series II: Alternating series, Absolute and conditional convergence, Rearrangement theorem, Power series, Taylor and Maclaurin series (one and two variables). (<i>Textbook 1: Chapter 10: 10.6-10.8</i>)		
Course Outcomes: At the end of the course the student will be able to:		
1. Apply the principles of differential calculus to solve problems involving functions of two or more variables. 2. Utilize double and triple integrals in Cartesian, polar, cylindrical, and spherical coordinates to compute areas, volumes, and evaluate mathematical expressions. 3. Extend a comprehensive understanding of the concepts related to functions of multiple variables, encompassing topics such as limits, continuity, and partial derivatives, and effectively apply them to practical situations and problem-solving scenarios. 4. Analyze and evaluate critical points, including extreme values and saddle points, in functions of two or more variables using partial derivatives and Lagrange multipliers. 5. Analyze vector calculus concepts, such as line integrals, surface integrals, and the divergence theorem, in the context of vector fields and their applications. 6. Apply convergence criteria and various tests, such as the nth term test, boundedness and monotonicity, integral, condensation, comparison, ratio, and root tests, to analyze and determine the convergence or divergence of sequences and infinite series of real numbers.		



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Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1						1					
CO2	3	2	1						1					
CO3	3	2	1						1					
CO4	3	2	1						1					
CO5	3	2	1						1					
CO6	3	2	1						1					

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)

TEXT BOOKS:

1. Thomas' Calculus, George B. Thomas, D. Weir and J. Hass, 2014, 13th edition, Pearson.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 2015, 10th Edition, Wiley India.

REFERENCE BOOKS:

1. Higher Engineering Mathematics, B.S. Grewal, 2015, 43rd Edition, Khanna Publishers.
2. Higher Engineering Mathematics, John Bird, 2017, 6 th Edition, Elsevier Limited.
3. Calculus: Early Transcendentals, James Stewart, 2017, 8 th edition, Cengage Learning.
4. Engineering Mathematics, K.A. Stroud and Dexter J. Booth, 2013, 7 th Edition, PalgraveMacmillan.
5. Basic Multi Variable Calculus, Marsden, Tromba and Weinstein, W.H. Freeman, ThirdEdition

E-Resources:

1. https://www.youtube.com/playlist?list=PLtKW B- wrvn4nA2h8TFxzWL2zy8O9th_fy
2. <https://www.youtube.com/playlist?list=PLU6SqdYcYsfJqbZvQECrwnlQrp4fg 6isX>

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion.
2. Demonstration of solution to a problem through programming.



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ENGINEERING PHYSICS [As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – I /II			
Course Code	:23EN1110	Credits	: 04
Hours / Week	: 03 Hours	Total Hours	: 39 + 26 Hours
L-T-P-J	: 3-0-2-0		
<u>Course Learning Objectives:</u> This Course will enable students to: 1. To introduce the fundamental ideas of quantum mechanics that are necessary for understanding and addressing engineering challenges. 2. To comprehend solids' band structure, semiconductors' electrical conductivity, and semiconductor devices such as LEDs, photodiodes, and solar cells, as well as their applications. 3. To examine many types of engineering materials, including electronic, electrical, mechanical, and magnetic materials, as well as dielectric material properties and applications in science and engineering. 4. To comprehend various crystal systems and determine structure using miller-indices. 5. Describe thin-film phenomena, thin-film production processes, and applications in science and engineering. 6. To understand how to create Nano materials utilizing a top-down and bottom-up method, as well as to explore Nano science and technology, as well as its practical applications in engineering, biology, and medicine.			



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Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. **Interactive Teaching:** Adopt the **Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show **Video/animation** films to explain functioning of various concepts.
4. Encourage **Collaborative** (Group Learning) Learning in the class.
5. To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
6. Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

SYLLABUS

MODULE – I

08 Hours

QUANTUM MECHANICS:

- **Foundations of quantum theory**, Wave function and its properties, de-Broglie hypothesis, Heisenberg Uncertainty principle. One dimensional time independent Schrodinger wave equation, **Eigen values and Eigen functions**. Applications: one dimensional motion of an electron in a potential-well. **Basics of Quantum computing - Concepts of Superposition, entanglement, Interference and Qubit**. [5 hours]
(Text book 1: Chapter 1.5 and Chapter 2 all units)
- **LASER PHYSICS:** **Introduction to lasers**. Conditions for laser action. Requisites of a Laser system Principle, Construction and working of Nd-YAG and Semiconductor Laser. **Application of Lasers in Defense (Laser range finder), Engineering (Data storage) and Applications of Lasers in medicine** [3 hours]
(Text book 1: Chapter 5.1, 5.2, 5.3, 5.4, 5.5)

MODULE – II

08 Hours



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Semiconductor Physics: Band structure, Fermi level in intrinsic and extrinsic semiconductors, Density of energy states in conduction and valence bands of a semiconductor (Mention the expression), Expression for concentration of electrons in conduction band (Derivation), Hole concentration in valence band (Mention the expression), Intrinsic carrier concentration, Conductivity of semiconductors, Hall effect, Numericals. (5 hours) (Text Book-2: Chapter 24.1 to 24.9, Chapter 25.9 to 25.11) Semiconducting devices for optoelectronics applications: - Principle and working of LED, photodiode, Solar cell, BJT [3 hours] (Text Book-2: Chapter 25.1 to 25.8)	
MODULE – III	08 Hours
Dielectrics: Introduction – Dielectric polarization – Dielectric Polarizability, Susceptibility and Dielectric constant - Types of polarizations: Electronic, Ionic and Orientation polarizations (qualitative) – Lorentz Internal field (Expression only) – Claussius - Mossoti equation (derivation) – Applications of Dielectrics – Numericals. (4 hours) (Text book 1: Chapter 4.1, 4.2, 4.3, 4.4, 4.5) Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability - Classification of magnetic materials: Dia, para, Ferro, antiferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials - Engineering applications. Numericals (4 hours) (Text book 1: Chapter 4.9, 4.10, 4.11)	
MODULE – IV	08 Hours
Crystallography: Lattice, unit cell, lattice parameters, crystal systems, Bravais lattices, Packing fraction for SCC, BCC and FCC crystal systems. Introduction to Miller Indices. Determination of Crystal structure by Miller Indices. Expression for Inter-planar distance. X-ray diffraction, Bragg's law and Determination of Crystal structure by Powder method. Numericals [4 hours] (Text book 1: Chapter 7 all units) Mechanical Engineering Materials – mechanical properties: stress- strain curve for different materials. Introduction to Tensile strength, Compressive strength, Ductility, Toughness, Brittleness, Impact strength, Fatigue, Creep. Testing of engineering materials: Hardness Tests: Brinell and Vickers hardness test& Numericals- (4 hours) Text Book-2: Chapter 2.1 to 2.7)	
MODULE – V	07 Hours



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• Thin films technology: Introduction to thin-films-Advantages of thin-films over bulk materials. Thin film deposition processes- Physical vapour deposition (Thermal evaporation technique, and sputtering technique) process, Applications of Thin films. [3 hours] (Ref. Text Book-2: Chapter 2. All units) • Nano Science & technology: Introduction to Nano materials, Classification of nano materials, Size dependent properties of materials, Top-down and Bottom-up approach- Ball-milling and Photolithography, Process. Fundamental Principles of Biophysics & Applications of Nano technology in Biology and Engineering. [4 hours] (Text Book-1: Chapter 8.1 to 8.7)		
Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Describe the concepts of Quantum mechanics and applications of Schrodinger time independent wave equation in one dimension.	L1 & L3
2	Illustrate Semiconductors, Semiconductor devices like Photo diode, LED, Solar cell and its applications.	L2 & L3
3	Distinguish the different engineering materials such as Electronic, electrical and mechanical materials properties and their applications in engineering. Apply the concept of magnetism to magnetic data storage devices.	L2 & L3
4	Classify Lattice parameters of different crystalline solids by using X-ray diffraction methods and its applications in science and engineering	L1 & L3
5	Interpret Basic concepts of thin films and thin film deposition processes and their applications leads to Sensors and engineering devices.	L2
6	Categorize Nano materials, Properties, and fabrication of Nano materials by using Top-down and Bottom -up approach's - Applications for Science and technology.	L2 & L3



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Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													1
CO2	2													1
CO3	2													1
CO4	1													1
CO5	1											1		2
CO6	3											2		3

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)

TEXT BOOKS:

1. P. S. Aithal, H. J. Ravindra, Textbook of Engineering Physics (2011), Acme learning Private Limited, New Delhi, India.
2. Shatendra Sharma, Jyotsna Sharma, Engineering Physics (2019), Pearson, Noida, Uttar Pradesh, India.

REFERENCE BOOKS:

1. M. Young (1977), Optics & Lasers An Engineering Physics approach, Springer
2. K.L. Chopra, Thin film Phenomena, McGraw Hill, New York.
3. S. O. Pillai (2018), Solid State Physics, revised edition, New Age International Publishers, New Delhi
4. M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy (2018), A textbook of Engineering Physics, S Chand, New Delhi.

E-Resources:

1. <https://nptel.ac.in/courses/106/101/106101060/>
2. <http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms>

Activity Based Learning (Suggested Activities in Class)

1. Demonstration of solution to a problem through Project demo model.



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ENGINEERING PHYSICS LAB

Total Contact Hours: 26

Following are experiments to be carried out in Engineering Physics Lab

LABORATORY EXPERIMENTS:

List of Experiments:

1. I-V characteristics of a Zener Diode

I-V Characteristics of a Zener diode in forward and reverse bias condition (Module 2)

2. Planck's constant

Measurement of Planck's constant using LED (Module 2)

3. Transistor characteristics

Input and output characteristics of a NPN transistor in C-E configuration (Module 2)

4. Dielectric constant

Determination of dielectric constant of a dielectric material (Module 2)

Torsional Pendulum

Determination of moment of inertia of a circular disc using torsional pendulum

5. Diffraction grating

Determination of wavelength of a laser light using diffraction grating (Module 4)

6. LCR series and parallel resonance

Study the frequency response of a series and parallel LCR circuit (Module 3)

7. Band gap energy

Determination of energy gap of an intrinsic semiconductor (Module 2)



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

INTRODUCTION TO ELECTRONICS ENGINEERING

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

SEMESTER – I/II

Course Code : 23EN1111

Credits : 03

Hours / Week : 03 Hours

Total Hours : 39 Hours

L-T-P-J : 3-0-0

Course Learning Objectives:

This course enables students to

1. **Understand** the fundamental principles of diodes and their applications, including the band diagram of insulators, conductors, and semiconductors, diode construction, and V-I characteristics.
2. **Analyze** diode circuits under different biasing conditions and comprehend the behavior of diodes in applications such as AND gates, OR gates, rectifiers, and voltage regulators and simulate the same circuits using LTspice software.
3. **Comprehend** the construction, operation, and characteristics of bipolar junction transistors (BJTs), including input and output characteristics, different biasing techniques, and transistor amplification.
4. **Simulate** common emitter amplifier circuits with voltage divider bias using LTspice software.
5. **Demonstrate** an understanding of operational amplifiers (Op-amps), including their symbols, operation modes, properties, and applications such as amplifiers, comparators, and oscillators.
6. **Demonstrate** an understanding of digital electronics, including binary number systems, Boolean algebra, logic gates, sequential logic circuits, and the application of Flip-Flops.
7. **Simulate** digital circuits and components using LTspice software.
8. **Familiarize** themselves with microprocessors and microcontrollers, specifically Arduino boards, and understand their architecture and components.
9. Set up the Arduino development environment, write and upload code to the Arduino board, and **execute** simple Arduino programs.
10. Interface various sensors and engage in hands-on activities to reinforce understanding, including LED blinking and **designing** and **implementing** a complete Arduino-based system as a student project.



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Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
2. **Interactive Teaching: Adopt the Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show **Video/animation** films to explain functioning of various concepts.
4. Encourage **Collaborative** (Group Learning) Learning in the class.
5. To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
6. Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

UNIT – I

09 Hours

Diodes and its application: Band diagram of insulators, conductors and semiconductors; semiconductor types: intrinsic and extrinsic (n-type and p-type); overview of diode construction; diode under no-bias, forward bias and reverse bias; V-I characteristics of diode; simplified equivalent circuit of practical diode and ideal diode; overview of diode specifications: peak inverse voltage, reverse leakage current and maximum forward current; numerical on series diode configuration with DC input.

Applications: AND gate and OR gate using diodes, half wave rectifier and full-bridge full wave rectifier with smoothing capacitor; simulation of rectifier circuits with smoothing circuit using LTspice software; zener diode: zener region and voltage regulator; numerical on rectifier and voltage regulator.

(Textbook 1: Chapter 1: 1.1 to 1.7, 1.9, 1.12, 1.15, Chapter 2: 2.3, 2.5, 2.6, 2.7, 2.11)

UNIT – II

08 Hours

Transistors: Construction of npn and pnp BJT transistors; transistor operation; input and output characteristics of CB and CE configurations; significance of different regions of operation: active, cut-off and saturation (transistor as a switch); alpha, beta and current relations; transistor amplifying action; numerical on current relations and amplification; Need for biasing: Q-point; types of biasing: fixed, emitter stabilized and voltage divider; simulation of common emitter amplifier with voltage divider bias using LTspice software; numerical on biasing circuits; construction and characteristics of n-channel depletion type MOSFET;

(Textbook 1: Chapter 3: 3.1 to 3.5, Chapter 4: 4.1 to 4.5, Chapter 6.1 and 6.7)

UNIT – III

08 Hours



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Operational amplifiers: Op-amp symbols, terminals and operation: single mode, differential mode and common mode; basic properties of ideal and practical Op-amp: input offset voltage, input resistance, output resistance, gain, bandwidth, CMRR, slew rate; **basic Op-map applications:** inverting amplifier, non-inverting amplifier, summing amplifier, differential amplifier, differentiator and integrator; Op-amp comparator; feedback: positive and negative feedback; criteria for stability and oscillations (Barkhausen criterion); **RC phase shift and Wein bridge oscillators;** **simulation of summing amplifier and oscillators in LTspice software;**

(Textbook 1: Chapter 10: 10.1, 10.4 to 10.7, Chapter 14: 14.5 to 14.7)

UNIT – IV

08 Hours

Digital Electronics: **Binary number system:** conversion and representation; logic levels: high and low; **Boolean algebra:** operators and DeMorgan's law; **logic gates with truth-table** and representation: AND, OR, NOT, XOR, NAND, NOR; combination of gates and associated numerical; **sequential logic circuits:** SR latch using NAND/NOR gate, SR FLIP-FLOP, J-K Flip-Flop, D Flip-Flop; application of Flip-Flops: **4 bit binary counter and 4 stage shift register;** simulation of counter using LTspice;

(Textbook 2: Chapter 1: 1.1 to 1.3, Chapter 2: 2.1 to 2.5, Chapter 4: 4.1 to 4.3, Chapter 5.1 to 5.5, Chapter 6.1 to 6.4)

UNIT – V

06 Hours

Electronic Prototyping with Arduino: Introduction to microprocessor and microcontrollers (Architecture), **introduction to the Arduino board (UNO, R3) and components;** **setting up the Arduino development environment;** writing and running a simple Arduino program in *wokwi* environment; **introduction to various sensors and actuators** compatible with Arduino in *wokwi* environment; student project: Designing and implementing a complete Arduino-based system.

E-Resources: 1 and 2

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Demonstrate a solid understanding of the fundamental principles underlying electronic components, such as diodes, transistors, operational amplifiers, logic gates, and microcontrollers.	L2
2	Apply knowledge of electronic components to analyze circuits for various applications, such as rectification, amplification, filtering, and digital logic operations.	L4
3	Analyze the performance of operational amplifiers (Op-amps) in various circuit configurations, including amplifiers, comparators, and oscillators, to optimize their functionality and address design requirements.	L4



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4	Demonstrate proficiency in using simulation software (e.g., LTspice) to simulate and analyze electronic circuits, validate designs, and troubleshoot circuit performance.	L4
5	Design and implement electronic systems using Arduino microcontrollers, integrating sensors, actuators, and programming concepts to achieve specific functionalities and solve practical problems.	L6

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1		3							2	3		
CO2	3	3	2	1	3							2	3		
CO3	3	3	2	2	3							2	3	2	
CO4	3	3	2	2	3							2	3	2	
CO5	3	3	3	1	3							3	3	3	

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)

TEXT BOOKS:

1. R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", 11th Ed, Pearson Education, 2013.
2. M. Moris. Mano and Michael D. Ciletti, "Digital Electronics", 4th Ed, Pearson Education, 2006.

REFERENCE BOOKS:

1. David A Bell, "Electronic Devices and Circuits", 5th Ed, Oxford university press, 2008.
2. Millman & Halkias, "Electronics Devices and Circuits", 2nd Ed, McGraw Hill, 2010.

E-Resources:

1. Arduino- <https://docs.arduino.cc/learn/>
2. Wokwi- <https://wokwi.com/arduino/>
3. NPTEL- <https://nptel.ac.in/courses/122/106/122106025>
4. Virtual Labs- <http://vlabs.iitkgp.ac.in/be/>

Activity Based Learning (Suggested Activities in Class):

1. Real world problem solving using group discussion and hands-on activities.
E.g., Interfacing different types of sensors using Arduino.
2. Simulation of different electronic circuits. E.g., Rectifiers and Amplifiers.



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OBJECT ORIENTED PROGRAMMING [As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – II			
Course Code	: 23EN1202	Credits	: 04
Hours / Week	: 05 Hours	Total Hours	: 26(L) + 13(T) + 26(P) Hours
L–T–P–J	: 2–1–2–0		
Course Learning Objectives: This Course will enable students to: 1. Understand different programming paradigms, significance of object-oriented programming approach and their applications. 2. Make use of Python programming environment to develop programs using conditionals, iterations, functions, strings and files to store and retrieve data in system. 3. Gain skills to develop python programs using core data structures like Lists, Tuples, Sets and Dictionaries. 4. Describe the concepts of object-oriented concept using class, objects, methods. Polymorphism and different levels of inheritance. 5. Explain operator overloading, overriding, single and multiple exception handling capabilities in python.			
Teaching-Learning Process (General Instructions) These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes. 1. Lecture method means it includes not only traditional lecture method, but different <i>type of teaching methods</i> may be adopted to develop the course outcomes. 2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying. 3. Show Video/animation films to explain functioning of various concepts. 4. Encourage Collaborative (Group Learning) Learning in the class. 5. To make Critical thinking, ask at least three Higher order Thinking questions in the class. 6. Adopt Problem Based Learning, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it. 7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them. 8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
UNIT – I			05 Hours



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INTRODUCTION TO OBJECT ORIENTED PROGRAMMING AND PYTHON

Programming paradigms, Object oriented programming features, applications, merits & demerits, Features of Python, variables, Data types, input operation, Reserved words, Indentation, Expressions, String operations, Type conversions.

(Text Book-1: Chapter 2: 2.3,2.4,2.5,2.6 Chapter 3: 3.1,3.6,3.7,3.8,3.10,3.11,3.13,3.14,3.16)

DECISION AND LOOP CONTROL STATEMENTS:

Conditional branch statements, Iterative statements, Nested loops, break, continue, pass, The else statement used with loops.

(Text Book-1: Chapter 4: 4.1-4.8)

UNIT – II

5 Hours

FUNCTIONS AND MODULES:

Need for functions, Function definition, Function call, Scope, Return statement, Lambda functions, Recursive functions, Modules.

(Chapter 5: 5.1 to 5.11)

PYTHON STRINGS:

String operations, Immutable, string formatting operator, built-in string methods, string slices, membership operator, comparing strings, Iterating strings.

(Chapter 6: 6.1 to 6.9)

UNIT – III

6 Hours

DATA STRUCTURES IN PYTHON:

Sequence, List, Tuple, sets, dictionaries

(Chapter 8: 8.1, 8.2, 8.4 to 8.6)

FILE HANDLING METHODS:

File path, File types, File operations, File positions, Rename and delete files.

(Chapter 7: 7.1 to 7.7)

UNIT – IV

5 Hours

USER DEFINED CLASSES & OBJECTS:

Classes, Objects, class method and self Argument, constructor, destructor, class variables, public and private data members, private methods, Calling methods, static methods.

(Chapter 9: 9.1 to 9.10, 9.15)

INHERITANCE:

Introduction, Polymorphism, overriding, types of inheritance

(Text Book: Chapter 10: 10.1 to 10.6)

UNIT – V

5 Hours



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OPERATOR OVERLOADING:

Introduction, Implementation of operator overloading, Reverse addition, overriding methods and functions.

(Text Book: Chapter 11: 11.1 to 11.7)

ERROR AND EXCEPTION HANDLING:

Errors, Handling exceptions, Multiple except blocks, Multiple exceptions, Except block without exception, The else clause, Raising exceptions, Built-in and user defined exceptions, Finally block, clean-up action

(Text Book: Chapter 12: 12.1 to 12.7, 12.10 to 12.12)

Course Outcomes:

At the end of the course the student will be able to:

1. **Write** a python program using 4 conditionals, definite loop, indefinite loop with jump statements.
2. **Write** an application using lambda, recursive functions, strings and files to store and retrieve the data from the system.
3. **Write python** programs using Core data structures like Lists, Tuples, Sets and Dictionaries.
4. **Implement** the concepts of object-oriented concept using class, objects, methods. Polymorphism and different levels of inheritance.
5. **Implement** operator overloading, overriding, single and multiple exception handling program capability in python

**Table: Mapping Levels of COs to POs /
PSOs**

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1		2					1				
CO2	3	2	1		2					1		2	1	
CO3	3	2	2		2					1		2	1	
CO4	3	2	2		2					1		2	1	
CO5	3	2	2		2					1		2	1	

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)

TEXT BOOKS:

1. Reema Thareja, "Python programming: Using problem solving approach", 2nd Edition, Oxford university press, 2019.

REFERENCE BOOKS:

1. John V Guttag, "Introduction to Computation and Programming Using Python", The MIT press, 3rd edition, 2021.
2. Tony Gaddis, "Starting out with python", 4th edition, Pearson, 2019.



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3. Allen Downey, Jeffrey Elkner and Chris Meyers, "How to think like a Computer Scientist, Learning with Python", Green Tea Press, 2014.
4. Richard L. Halterman, "Learning to Program with Python", 2011.
5. Charles Dierbach, "Computer Science Using Python: A Computational Problem-Solving Focus", John Wiley, 2012.

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion.
2. Demonstration of solution to a problem through programming.

OBJECT ORIENTED PROGRAMMING LABORATORY

Total 26Hours

List of Programming Experiments:

1. Python Program for Data Handling and Expression Evaluation.
2. Python Program for Quadratic Equation Roots and Number Analysis.
3. Python Program for Function Illustration and Module Creation.
4. Python Program for String Operations and Data Validation.
5. Python Program for File Handling and Script Copying.
6. Python Program for Data Structures and Built-in Methods.
7. Python Program for Object-Oriented Concepts and Inheritance.
8. Python Program for Operator Overloading and Special Methods.



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ENGINEERING GRAPHICS & DESIGN THINKING [As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I/II

Course Code : 23EN1112	Credits : 03
Hours / Week : 04 Hours	Total Hours : 26+26 Hours
L-T-P-J : 2-0-2-0	

Course Learning Objectives:

This Course will enable students to:

1. **Create** awareness and emphasize the need for Engineering Graphics & design thinking through Manual Sketching & Autocad Software
2. **Learn** using professional CAD software for construction of geometry
3. **Understand** the concepts of orthographic and isometric projections
4. **Draw** orthographic projection of points, lines, planes and solids by Manual Sketching & AutoCad Software
5. **Draw** development of surfaces of solids
6. **Draw** isometric projections of planes and solids
7. **Create** simple engineering 3D components
8. **Work** in a team for creating conceptual design of products
9. **Learn** application of design methods and tools on real world problem through Autocad Software & Physical Models

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. **Interactive Teaching:** Adopt the **Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show **Video/animation** films to explain functioning of various concepts.
4. Encourage **Collaborative** (Group Learning) Learning in the class.
5. To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
6. Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.



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MANUAL & COMPUTER SKETCHING	
UNIT – I Introduction	06 Hours
Introduction to Engineering Graphics: Fundamentals, Drawing standard - BIS, dimensioning, Lines, lettering, scaling, symbols, dimensioning & tolerances, conventions, Introduction to orthographic projection. Types of projections & their principles - (For CIA only) (For CIA only) (Text Book-1: Chapter 3 & 8)	
Introduction to Computer Aided Drafting software- Co-ordinate system and reference planes HP, VP, RPP & LPP of 2D/3D. Selection of drawing sheet size and scale. Commands and creation of Lines, coordinate points, axes, polylines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, coloring, mirror, rotate, trim, extend, break, chamfer, fillet and curves - (For CIA only) (Text Book-2: Chapter 23 & 24; Text Book-1: Chapter 26)	
UNIT – II Projections of Points, Lines and Planes	12 Hours
Projection of Points - Orthographic projections of points in all the quadrants, Orthographic projections of lines- inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. Orthographic projections of planes -triangle, square, rectangle, pentagon, hexagon and circular laminae. (First Angle Projection only) (Text Book-1: Chapter 9,10,12)	
UNIT – III Projection of Solids & Development of Surfaces	14 Hours
Projection of regular solids like prisms, pyramids, cylinder & cone inclined to both the planes (change of position method) (First Angle Projection only) (Text Book-1: Chapter 13)	
Development of lateral surfaces of regular solids – Prisms, pyramids cylinders and cones. (Text Book-2: Chapter 16)	
UNIT – IV Isometric Projections	14 Hours
Isometric projection - Principles of Isometric Projection, Isometric Scale, Isometric View, Isometric projection of combination of two solids (Text Book-1: Chapter 17)	
Transformation of Projections- Conversion of Isometric Views to Orthographic Views & Conversion of orthographic views to isometric projections. (Text Book-1: Chapter 20; Text book- 2: Chapter 21)	



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UNIT - V Introduction to Design Thinking for Innovations		10 Hours
A brief history of Design, Engineering Design process, Product development cycle, creation of models and their presentation in standard 3D view. Theory, Practice & Examples in Design thinking, Storytelling, Creativity and Idea Generation, Concept Development, Testing and Prototyping. (For CIA only) (Text Book-3: Part 1- Chapter 1&2, Part3-Chapter 10)		
Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Make use of instruments, dimensioning & tolerance principles, conventions and standards related engineering drawing	L1
2	Construct orthographic projections of points, lines, planes and solids	L3
3	Develop lateral surfaces of solids and construct isometric projections of solids	L3
4	Apply the design thinking principles for innovative product development	L3
5	Make use of AutoCad for modelling engineering components	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	0	0	0	0	0	0	0	0	0	0	3	0	2
CO2	2	1	0	0	0	0	0	0	0	0	0	0	3	0	2
CO3	2	1	0	0	0	0	0	0	0	0	0	0	3	0	2
CO4	2	1	0	0	0	0	0	0	0	0	0	0	3	0	2
CO5	3	1	0	0	0	0	0	0	0	0	0	0	3	0	2

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)

TEXT BOOKS:

1. Engineering Drawing, Bhatt N.D., 54th Edition, Charotar Publishing House, Gujarat, India, 2023
2. Engineering Drawing & Graphics+Autocad, K Venugopal, Fifth Edition, New Age International Publishers, 2011.
3. Engineering Design- A Project Based Introduction, C. L. Dym and Patrick Little, John Wiley & Sons, 2022



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REFERENCE BOOKS:

1. A Textbook of Computer Aided Engineering Drawing, Gopalakrishna, K. R. and Sudheer Gopala Krishna, Subash Publishers, Bangalore, India, 2017
2. Engineering Drawing with Introduction to AutoCAD, Dhananjay .A .J, Tata McGraw-Hill Publishing Company Ltd, 2018
3. Product Design and Development, Karl T Ulrich, Steven D Eppinger, Seventh Edition, McGraw-Hill Education, 2020

E-Resources:

1. <https://archive.nptel.ac.in/courses/112/102/112102304/>
2. <https://nptel.ac.in/courses/112103019>
3. <https://nptel.ac.in/courses/112/105/112105294/>
4. <https://fractory.com/engineering-drawing-basics/>

Activity Based Learning (Suggested Activities in Class)

1. Activity which makes students to apply the concepts learned in the course to the practical engineering graphics will be discussed in class.
2. Activity provides space to students giving responsibility for their own design & engineering drawing methods for the products
3. Activity that makes the students for the development of skill set in computer drafting
4. Activity that makes the students to have critical thinking, developing a mind set, problem-solving and teamwork in design thinking process.
5. Real world problem solving and puzzles using group discussion.
6. Demonstration of solution to a problem through experiential learning.

ENGINEERING GRAPHICS & DESIGN THINKING LABORATORY

Total Contact Hours: 26

Following are practical/laboratory experiments to be carried out:

1. Problems to be solved in first quadrant system.
2. Manual & Computer Sketching problems for all the modules in sketch book and also take print out of the problems.
3. Usage of various commands in AutoCad software and few simple exercises on the above commands
4. Practice Problems on Projections of Points, Lines and Planes using Manual Sketching & AutoCad Software
5. Solve Problems on Projection of Solids & Development of Surfaces
6. Practice problems on Isometric Projections
7. Individual/Group work on Introduction to Design Thinking for Innovations (Examples on Solid Modeling - Using 3D Modelling Software & Physical Model Prototype).



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TRANSFORMS AND NUMERIAL TECHNIQUES

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

SEMESTER – III

Course Code : 22CS2301

Credits : 03

Hours / Week : 03 Hours

Total Hours : 39 Hours

L-T-P-J : 3-0-0-0

Course Objectives:

This Course will enable students to:

1. **Apply** their knowledge of Laplace transforms and inverse Laplace transforms to proficiently solve linear ordinary differential equations with constant coefficients, facilitating the analysis and modelling of complex systems.
2. **Analyze** periodic functions using Fourier series, assessing the convergence properties and precision of the series expansion, thereby enhancing their ability to understand and manipulate periodic phenomena.
3. **Utilize** complex exponential form, Fourier transforms of basic functions, and Fourier sine and cosine transforms to solve problems involving Fourier integrals, developing proficiency in applying these techniques to various mathematical scenarios.
4. **Employ** numerical methods, including Euler's Method, Runge-Kutta 4th order, Adams-Bashforth, and Adams-Moulton Methods, to solve differential equations and effectively analyze dynamic systems, enabling them to model real-world phenomena and make accurate predictions.
5. **Apply** finite difference methods, including the Crank-Nicolson method and appropriate techniques for hyperbolic PDEs, to effectively solve different types of partial differential equations (PDEs) such as elliptic, parabolic, and hyperbolic equations, enhancing their problem-solving skills in the context of differential equations and their applications.



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Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. **Interactive Teaching:** Adopt the **Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show **Video/animation** films to explain functioning of various concepts.
4. Encourage **Collaborative** (Group Learning) Learning in the class.
5. To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
6. Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

UNIT – I: Laplace Transform and Inverse Laplace Transform

09 Hours

Laplace Transforms of Elementary functions (without proof),

(Text Book-1: Chapter 6: 203 to 207).

Laplace Transforms, Periodic functions, Unit step function and impulse functions

(Text Book-1: Chapter 6:208-230).

Inverse Laplace Transforms- By the method of Partial Fractions, Logarithmic and Trigonometric functions, **Convolution Theorem**, Inverse Laplace transform using Convolution Theorem **(Text Book-1: Chapter 6: 238).**

Solution to Differential Equations by Laplace Transform.

(Text Book-1: Chapter 238-242).

UNIT – II: Fourier Series

09 Hours

Periodic Functions, Trigonometric Series

(Text Book-1: Chapter 11: 495).

Fourier series Standard function, Functions of any Period $2L$, Even and Odd functions, Half-range Expansions.

(Text Book-1: Chapter 11: 483-492)

Practical Harmonic analysis (calculate average power and RMS values of periodic waveforms)



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UNIT – III: Fourier Transform	06 Hours
Calculation of Fourier integrals using complex exponential form (<i>Text Book-1: Chapter 11: 510</i>).	
Fourier transform of basic functions (<i>Text Book-1: Chapter 11: 510-516</i>). Fourier sine and cosine transforms. (<i>Text Book-1: Chapter 11: 518-522</i>).	
UNIT – IV: Numerical Methods for Solving Ordinary Differential Equations	07 Hours
Euler's Method-Basic principles of Euler's method for solving first-order ODEs (<i>Text Book-1: Chapter 1:10-12</i>). Runge-Kutta 4th order (<i>Text Book-1: Chapter 21:904</i>). Multistep Methods-Explanation of multistep methods (Adams-Bashforth, Adams-Moulton Methods) (<i>Text Book-1: Chapter 21:911-913</i>). Second-Order ODE. Mass-Spring System (Euler Method, Runge-Kutta Methods) (<i>Text Book-1: Chapter 21:916-918</i>).	
UNIT – V: Numerical Methods for Partial Differential Equations	08 Hours
Classification of PDEs (elliptic, parabolic, hyperbolic), (<i>Text Book-1: Chapter 21:922-923</i>). Finite Difference Methods (Laplace and Poisson Equations), Derivation of finite difference approximations (<i>Text Book-1: Chapter 21:923-927</i>). Crank-Nicolson Method (<i>Text Book-1: Chapter 21:938-941</i>). Method for Hyperbolic PDEs (<i>Text Book-1: Chapter 21:943-945</i>).	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Apply Laplace transforms and inverse Laplace transforms to solve linear ordinary differential equations with constant coefficients, demonstrating proficiency in system analysis and modelling.	L3
2	Analyze periodic functions using Fourier series and evaluate the convergence properties and precision of the series expansion.	L2 & L3
3	Solve problems involving Fourier integrals by applying complex exponential form, Fourier transforms of basic functions, and Fourier sine and cosine transforms.	L3
4	Utilize numerical methods such as Euler's Method, Runge-Kutta 4th order, Adams-Bashforth, and Adams-Moulton Methods to solve differential equations and analyze dynamic systems	L2 & L3
5	Apply finite difference methods, including the Crank-Nicolson method and appropriate techniques for hyperbolic PDEs, to solve various types of partial differential equations (PDEs) such as elliptic, parabolic, and hyperbolic equations.	L3



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Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C01	3	2	2	1					1					
C02	3	2	2						1					
C03	3	2	2	1					1					
C04	3	2	2	1					1					
C05	3	2	2	1					1					

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)

TEXT BOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 2015, 10th Edition, Wiley India.

REFERENCE BOOKS:

1. Higher Engineering Mathematics, B.S. Grewal, 2015, 43rd Edition, Khanna Publishers.
2. Higher Engineering Mathematics, John Bird, 2017, 6 th Edition, Elsevier Limited.

E-Resources:

1. <https://nptel.ac.in/courses/111106139>
2. <https://nptel.ac.in/courses/111101164>
3. <https://nptel.ac.in/courses/111105038>



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DATA STRUCTURES

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

SEMESTER – III

Course Code	: 22CS2302	Credits	: 04
Hours / Week	: 03 Hours	Total Hours	: 39(Th)+26(P) Hours
L-T-P-J	: 3-0-2-0		

Prerequisites:

Proficiency in a C programming language.

Course Objectives:

This Course will enable students to:

1. **Understand** the basic approaches for analysing and designing data structures.
2. **Introduce** dynamic memory allocation and C language concepts required for building data structures
3. **Develop** essential skills to construct data structures to store and retrieve data quickly and **efficiently**.
4. **Utilize** different data structures that support different sets of operations which are suitable for various applications.
5. **Explore & Implement** how to insert, delete, search and modify data in any data structure- Stack, Queues, Lists, Trees.
6. **Develop** applications using the available data structure as part of the course for mini-project.



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Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. **Interactive Teaching: Adopt the Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show **Video/Animation** films to explain functioning of various concepts.
4. Encourage **Collaborative** (Group Learning) Learning in the class.
5. To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
6. Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

UNIT - I

08 Hours

INTRODUCTION:

Introduction to Data Structure, **Classification, C Structure and Union, Array Definition, Representation**, Operations (Insertion, Deletion, Search and Traversal), Two/Multidimensional Arrays, sparse matrix, C Pointers
TB1: 1.1, 2.2, 2.5 ; TB2: 1.1, 1.2, 1.3.1-1.3.4; RB1: 5.1 – 5.12, 6.4

UNIT - II

09 Hours

INTRODUCTION TO ADT:

Stack: Definition, **Array Representation of Stack**, Operations on Stacks.

Applications of Stack: Expression evaluation, **Conversion of Infix to Postfix, Infix to Prefix Recursion**, Tower of Hanoi

Queue: Definition, Representation of Queues, Operations of Queues, Circular Queue.

Applications of Queue: **Job Scheduling**, A Maze Problem

TB1: 3.1, 3.2, 3.3, 3.4, 3.5 ; TB2: 2.1, 2.2, 2.3, 3.2, 3.3

UNIT - III

09 Hours

DYNAMIC DATA STRUCTURES:

Linked List: Types, **Representation of Linked Lists in Memory. Traversing, Searching, Insertion & Deletion from Linked List. Circular List, Doubly Linked List, Operations on Doubly Linked List (Insertion, Deletion, Traversal).**

Applications: **Stack & Queue Implementation using Linked Lists.**

Case Study: Josephus problem.

TB2: 4.2, 4.3, 4.5



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UNIT – IV	08 Hours
TREES: Basic Terminology, Binary Trees and their representation, Complete Binary Trees, Binary Search Trees, Threaded Binary Trees, Operations on Binary Trees (Insertion, Deletion, Search & Traversal) . TB1: 5.1,5.2,5.3,5.5,5.7 Applications: Expression Evaluation Case Study: Game Tree TB2: 5.5.3,5.5.4,5.6	
UNIT – V	05 Hours
Efficient Binary Search Trees: Optimal Binary Search Trees, AVL Trees, Red Black Trees, Splay Trees. Case Study: B Trees TB1: 10.1,10.2,10.3,10.4, 11.2	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Demonstrate the key C programming concepts such as pointers, structures, unions and arrays data structures to perform operations such as insertion, deletion, searching, sorting, and traversing.	L3
2	Utilize the fundamental concepts of stacks and queues to solve the standard applications like tower of Hanoi, conversion and evaluation of expressions, job scheduling and maze.	L3
3	Implement Singly Linked List, Doubly Linked List, Circular Linked Lists, stacks and queues using linked list.	L3
4	Develop critical thinking and problem-solving skills by designing and implementing efficient algorithms for Non-linear tree data structure and perform insertion, deletion, search and traversal operations on it.	L3
5	Apply advanced techniques, such as balancing algorithms for AVL trees, Splay trees and Red-Black trees to maintain the balance and efficiency of binary trees.	L3



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Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C01	3												2	
C02	3		3									2	2	
C03	3		3									2	2	
C04	3	2	3									2	2	
C05	3	2	3									2	2	

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)

TEXT BOOKS (TB):

1. Ellis Horowitz, Susan Anderson-Freed, and Sartaj Sahni, "Fundamentals of Data structures in C", 2nd Edition, Orient Longman, 2008.
2. A.M. Tannenbaum, Y Langsam, M J Augentien "Data Structures using C", 1st Edition, Pearson, 2019.

REFERENCE BOOKS:

1. Brian. W. Kernighan, Dennis. M. Ritchie, "The C Programming Language", 2nd Edition, Prentice-Hall, 1988.
2. Gilbert & Forouzan, "Data Structures: A Pseudo-code approach with C", 2nd Edition, Cengage Learning, 2014.
3. Jean-Paul Tremblay & Paul G. Sorenson, "An Introduction to Data Structures with Applications", 2nd Edition, McGraw Hill, 2013.
4. R.L. Kruse, B.P. Learly, C.L. Tondo, "Data Structure and Program design in C", 5th Edition, PHI, 2009.

E-Resources:

1. <https://nptel.ac.in/courses/106102064>
2. <https://www.coursera.org/learn/data-structures?specialization=data-structures-algorithms>
3. <https://www.udemy.com/topic/data-structures/free/>
4. <https://www.mygreatlearning.com/academy/learn-for-free/courses/data-structures>
5. <https://cse01-iiith.vlabs.ac.in/>
6. <https://kremlin.cc/k&r.pdf>



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Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving using group discussion.
2. Role play E.g., Stack, Queue, etc.,
3. Demonstration of solution to a problem through programming.
4. Flip class activity E.g., arrays, pointers, dynamic memory allocation, etc.,

LABORATORY EXPERIMENTS

Total Contact Hours: 26

Following are experiments to be carried out using either C programming language

1. To Implement C programs with concepts of pointers, structures.
2. To implement multidimensional array Matrix Multiplication.
3. To search elements in data structure with different search methods.
4. To implement stack, queue and their variations using arrays.
5. To implement stack, queue and their variations using singly linked lists
6. To implement conversion & evaluation of expression using stacks.
7. To Implement doubly circular Linked Lists and variations and use them to store data and perform operations on it.
8. To Implement Addition/multiplication of 2 polynomial using linked lists.
9. To implement binary tree traversal techniques.

OPEN-ENDED EXPERIMENTS

1. A man in an automobile search for another man who is located at some point of a certain road. He starts at a given point and knows in advance the probability that the second man is at any given point of the road. Since the man being sought might be in either direction from the starting point, the searcher will, in general, must turn around many times before finding his target. How does he search to minimize the expected distance travelled? When can this minimum expectation be achieved?
2. The computing resources of a cloud are pooled and allocated according to customer demand. This has led to increased use of energy on the part of the service providers due to the need to maintain the computing infrastructure. What data structure will you use for allocating resources which addresses the issue of energy saving? Why? Design the solution.
3. Mini-Project on applying suitable data structure to a given real-world problem.



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DIGITAL LOGIC DESIGN [As per Choice Based Credit System (CBCS) scheme]	
SEMESTER – III	
Course Code : 22CS2303	Credits : 04
Hours / Week : 03 Hours	Total Hours : 39(Th) + 26(P) Hours
L-T-P-J : 3-0-2-0	
Course Learning Objectives: This Course will enable students to: 1. Translate the elements of digital logic functions to digital system abstractions using Verilog. 2. Illustrate simplification of Boolean expressions using Karnaugh 3. Model combinational logic circuits for arithmetic operations and logical operations 4. Analyse and model sequential elements flip-flops, counter, shift registers. 5. Outline the concept of Mealy Model, Moore Model and apply FSM to solve a given design problem.	
Teaching-Learning Process (General Instructions) These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes. 1. Lecture method means it includes not only traditional lecture method, but different <i>type of teaching methods</i> may be adopted to develop the course outcomes. 2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying. 3. Show Video/animation films to explain functioning of various concepts. 4. Encourage Collaborative (Group Learning) Learning in the class. 5. To make Critical thinking, ask at least three Higher order Thinking questions in the class. 6. Adopt Problem Based Learning, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it. 7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them. 8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.	
UNIT – I	08 Hours



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INTRODUCTION:

Number System- Binary, Hexa, Decimal, Octal and its conversion. Canonical Notation - SOP & POS forms, Minimization of SOP and POS forms.

(Text Book-1: Chapter 1: 1.2 to 1.4, Chapter 2: 2.6)

ARITHMETIC CIRCUITS AND VERILOG MODELLING

Adders: Half adder, full adder, Ripple carry adder, parallel adder /subtractor, fast adders-CLA, comparator- 2 bit. Simplification using K-Maps

(Text Book-2: Chapter 5: 5.2, 5.3.3, 5.4, 5.5.2, 5.5.3)

Introduction to Verilog, Syntax of Verilog coding, Modelling styles in Verilog, Verilog Operators, Test bench for simulation

(Text Book-3: Chapter 1: 1.1, 1.2.2, 1.3.1, 1.3.2, 1.3.3, 1.4.2, 1.5.1.2, 1.5.2.2, 1.5.3.2, 1.5.4.2, 1.6.2)

UNIT – II

07 Hours

Combinational Circuit Building Multiplexers 4:1, 8:1, decoders 3:8, 2:4, demultiplexers 1:4, encoders 8:3, 4:2, code converters- B to G and G to B- Simplification using K-Maps

Verilog for combinational circuits, if else, case-casez, for loop, generate.

(Text Book-2: Chapter 6: 6.1, 6.2, 6.3, 6.4, 6.6)

UNIT – III

08 Hours

Sequential Circuits-1

Basic Latch, Gated latches, Flip Flops SR, D, JK, T, master-slave flip-flops JK, Characteristic equations, 0's and 1's Catching Problem, Race round condition, Switch debounce, shift registers- SISO, SIPO, PISO, PIPO, Setup time, Hold time, Propagation Delay

(Text Book-2: Chapter 7: 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.8)

UNIT – IV

08 Hours

Sequential Circuits-2

Binary counters – asynchronous and synchronous, mod-n counter, ripple counter- 4 bit.

Verilog blocking and non-blocking,

Mealy Model, Moore Model, State machine notation, Construction of Finite State Machine.

(Text Book-2: Chapter 7: 7.9, 7.11, 7.12.3, 7.12.4, 8.1, 8.2, 8.3, 8.4)

UNIT – V

08 Hours

Introduction to Electronic Design Automation:

FPGA Design Flow, ASIC Design flow, architectural design, logic design, simulation, verification and testing, 3000 Series FPGA architecture.

Applications:

Design 4 Bit ALU, 7 Segment display, Vending Machine, 3 Pipeline.

(Text Book-4: Chapter 1)

Laboratory Experiments

Experiments are conducted using Verilog tool /Kits

1. Introduction to Xilinx tool, FPGA flow
2. Adder – HA, FA using data flow and behaviour modelling styles
3. Adder – HA, FA using structural modelling style



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4.	Combinational designs – I (blocking and non-blocking/looping examples)
a.	Multiplexer: 4:1, 8:1 MUX.
b.	De Multiplexer: 1:4, 1:8 DEMUX.
5.	Combinational designs – II (different types of case statements)
c.	Encoder with and without Priority: 8:3 and 4:2.
d.	Decoder: 3:8 and 2:4.
6.	Design of 4-bit ALU
7.	Flip Flop: D FF, T FF, JK FF
8.	Design of Mod – n Up/Down Counter with Synchronous reset
9.	Design of Mod – n Up/Down Counter with Asynchronous reset.
10.	Design of Universal shift Register using FSM

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Interpret Boolean Expressions of digital design in simplified form	L2
2	Build the various elements of digital logic system with Verilog	L3
3	Construct Combinational and Sequential logic circuits	L3
4	Analyse the hardware model of a digital system at different levels of abstraction in Verilog	L4
5	Evaluate the functionality of digital design by implementing on FPGA kits	L5
6	Design digital systems using FSM	L3

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	1	-	-	-	-	-	-	-	1	-	1	-	-
CO2	3	2	1	2	3	-	-	-	1	-	1	1	2	1	-
CO3	3	2	3	1	2	-	-	1	1	-	1	1	2	1	-
CO4	3	3	2	3	3	1	-	1	-	1	2	1	2	2	1
CO5	3	3	2	3	3	1	-	-	-	1	-	-	2	2	1
CO6	3	3	3	3	3	2	-	1	2	2	2	2	2	1	2

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)



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TEXT BOOKS:

1. M. Morris Mano Michael D. Ciletti , “Digital Design with an Introduction to the Verilog HDL”, 6th Edition, Pearson Education, 2014.
2. Stephen Brown, Zvonko Vranesic, “Fundamentals of Digital Logic with Verilog design”, McGraw Hill, 2014.
3. Nazein M. Botros, “HDL programming (VHDL and Verilog)”, Dreamtech Press, 2006.
4. Douglas J Smith, “HDL Chip Design”, Doone publications 1996.

REFERENCE BOOKS:

1. John M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2014.
2. Donald D. Givone, “Digital Principles and Design”, McGraw Hill, 2015.
3. Samir Palnitkar, “Verilog HDL: A Guide to Digital Design and Synthesis”, Pearson Education, 2016.

E-Resources:

1. <https://archive.nptel.ac.in/courses/106/105/106105165/>
2. <https://nptel.ac.in/courses/117105080>

Activity Based Learning (Suggested Activities in Class)

1. Design problem solving and Programming using group discussion. E.g., Traffic light controller, Digital Clock, Elevator.
2. Demonstration of solution to a problem through simulation.



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DISCRETE MATHEMATICS AND GRAPH THEORY			
[As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – III			
Subject Code	: 22CS2304	Credits	: 03
Hours / Week	: 03 Hours	Total Hours	: 39Hours
L–T–P–J	: 3–0–0–0		
Course Learning Objectives: This Course will enable students to: 1. Learn the set theoretic concept and its application in theory of computation. 2. Determine the concepts of mathematical induction, recursive relations and their application. 3. Illustrate the association of functions, relations, partial ordered set and lattices with problems related to theoretical computer science and network models. 4. Discuss the basics of graph theory and its application in computer networks. Learn the concepts of counting techniques and its application.			
Teaching-Learning Process (General Instructions) These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes. 1. Lecture method means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes. 2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying. 3. Show Video/animation films to explain functioning of various concepts. 4. Encourage Collaborative (Group Learning) Learning in the class. 5. To make Critical thinking, ask at least three Higher order Thinking questions in the class. 6. Adopt Problem Based Learning, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it. 7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them. 8. Discuss how every concept can be applied to the real world - and when that possible, it helps improve the students' understanding.			
UNIT – I			08 Hours
SET THEORY: Sets and subsets, Operations on Sets: Basic set operations, algebraic properties of sets, The Addition Principle RELATIONS AND ITS PROPERTIES: Relations and their properties, N-Ary Relations and their applications, Representing relations. Textbook – 2: 1.1, 1.2 ; Textbook – 1: 7.1., 7.2, 7.3			
UNIT – II			06 Hours



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RELATIONS AND ORDER RELATIONS: Closure of relations, Equivalence Relations, Partial Orderings, Functions, The Growth of Functions. Self-Study: Transitive Closure and Warshall's Algorithm. Textbook – 1: 7.4., 7.5, 7.6, 3.2	
UNIT – III	08 Hours
MATHEMATICAL INDUCTION AND RECURSION: Mathematical Induction, Recurrence Relations: Rabbits and the Fibonacci Numbers, The Tower of Hanoi, Code word Enumeration, Solving Linear Recurrence Relations Self-Study: Basic Connectives and Truth Tables Textbook-1: 4.1;6.1, 6.2;1.1	
UNIT – IV	09 Hours
GRAPH THEORY: Graphs and Graph Models. Graph Terminology and Special Types of Graphs: Basic Terminology, Some Special Simple Graphs, Bipartite Graphs, Complete Bipartite Graphs. Representing Graphs and graph isomorphism: Adjacency lists, Adjacency Matrices, Incidence Matrices, Connectivity: Paths, Connectedness in Undirected and Directed Graphs, Vertex and Edge connectivity and their applications. Textbook-1: 8.1, 8.2, 8.3, 8.4	
UNIT – V	08 Hours
GRAPHS AND ITS APPLICATIONS: Euler and Hamilton Paths and their applications, Planar Graphs and their Applications, Graph Coloring and its applications. Textbook-1: 8.5, 8.7, 8.8	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Identify the membership of the Set and Relations and perform basic Algebraic operations	L3
2	Illustrate the concept of Mathematical Induction and create linear recurrence relations for the given problem	L4
3	Construct different types of graphs based on the properties and the real time applications of graph theoretical concepts	L3
4	Analyze the methods for optimizing the solution for graph coloring problem, Eulerian and Hamiltonian circuits/planes	L4

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)



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TEXT BOOKS:

1. Kenneth H. Rosen, “Discrete Mathematics and its applications”, Tata McGraw Hill, 2003.
2. Bernard Kolman, Robert C. Busby, Sharon Ross, “Discrete Mathematical Structures”, 3rd Edition, PHI 2001.

REFERENCE BOOKS:

1. Ralph P. Grimaldi, “Discrete and Combinatorial Mathematics”, IV Edition, Pearson Education, Asia, 2002.
2. J. P. Tremblay, R. Manohar, “Discrete Mathematical Structures with applications to computer Science”, Tata McGraw Hill, 1987.
3. J K Sharma, “Discrete Mathematics”, 3rd edition, 2013, Macmillan India Ltd.

E-Resources:

1. Discrete Mathematics with Algorithms by M. O. Albertson, J. P. Hutchinson - J. 1988, Wiley.
2. Discrete Mathematics for Computer Science, Gary Haggard, John Schlipf, Sue

Table: Mapping Levels of COs to POs / PSOs														
COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	2					1	1	1		2	2	1
CO2	3	3	2					1	1	1		2	2	1
CO3	3	3	3					1	1	1		1	2	1
CO4	3	3	3					1	1	1		2	2	1
Avg	3	2.5	2.5					1	1	1		1.75	2	1

Whitesides, Thomson Brooks/Cole, 2006.

3. <http://ocw.mit.edu/courses/mathematics/>
4. <http://www.nptelvideos.in/2012/11/discrete-mathematical-structures.html>
5. <http://cglab.ca/~discmath/notes.html>
6. https://www.cs.odu.edu/~toida/nerzic/content/web_course.html

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion.
2. Demonstration of solution to a problem using graph theory.



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FULL STACK DEVELOPMENT [As per Choice Based Credit System (CBCS) scheme]	
SEMESTER – III	
Course Code : 22CS2305	Credits : 03
Hours / Week : 03 Hours	Total Hours : 39 Hours
L-T-P-J : 3-0-0-0	
Course Learning Objectives: This Course will enable students to: 1. Understand the major areas and challenges of web programming.. 2. To create websites using HTML5, CSS3, JavaScript 3. Front end framework for developing Interactive WebApp using ReactJS 4. Understand server-side scripting language-Node.JS 5. Latest Framework for fast API development using GraphQL	
Teaching-Learning Process (General Instructions) 1. These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes. 2. Lecture method means it includes not only traditional lecture method, but different <i>type of teaching methods</i> may be adopted to develop the course outcomes. 3. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, focused listening, and formulating questions. 4. To make Critical thinking, ask at least three higher order Thinking questions in the class. 5. Adopt Problem Based Learning, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it. 6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them 7. Discuss how some concept can be applied to the real world - and when that's possible.	
UNIT – I	07 Hours
Markup Language (HTML5): Introduction to HTML and HTML5 - Formatting and Fonts - Commenting Code - Anchors - Backgrounds - Images - Hyperlinks - Lists - Tables - HTML Forms, Audio, Video Tag.	
UNIT – II	08 Hours
CSS3: Levels of style sheets; Style specification formats; Selector forms; Property value forms; Font properties; List properties; Color; Alignment of text; Background images, Conflict Resolution, CSS Box Model .CSS3 features: Box Shadow, Opacity, Rounded corners, Attribute selector.	
UNIT – III	08 Hours



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JavaScript: Overview of JavaScript; Object orientation and JavaScript; General syntactic, characteristics; Primitives, operations, and expressions; Screen output and keyboard input. **Control statements; Arrays; Functions, Constructors; A brief introduction on pattern matching using regular expressions, DOM Events, JSON**

UNIT – IV

08 Hours

Node JS: Introduction to NodeJS, **Set up Dev Environment, Node JS Modules, Node Package Manager, File System, Events, Database connectivity using Mongo DB.**

UNIT – V

08 Hours

Express.JS: Introducing Express: Basics of Express, Express JS Middleware: Serving Static Pages, Listing Directory Contents, Accepting JSON Requests and HTML Form Inputs, Handling Cookies.

Course Outcome	Description	Bloom's Taxonomy Level
1	Use the common HTML5 elements(tags) and CSS3 operations(styling properties) to interpret the fundamental of web page technologies	L1,L2
2	Apply Cascading Style Sheets and HTML5 elements for visual presentation and design well-structured web pages.	L3
3	Implement the JavaScript programming concepts to develop client-side scripts and display the contents dynamically.	L3
4	Develop dynamic server-side applications by employing Node.js event-driven, non-blocking I/O model and its integration with Mongo dB to work with dynamic schemas.	L3
5	Utilize the Node.js framework-Express.js basic concepts , and middleware to construct web applications more efficiently and intelligently, enabling faster development and smarter design	L3



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Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1		2		2							2	2	
CO2	2		2		2							2	3	
CO3	2		2		2							2	3	
CO4	3		3		2							2	3	
CO5	3		3		2							2	3	

TEXT BOOKS:

1. Robert W. Sebesta , "Programming the World Wide Web", 7th Edition, Pearson Education, 2008.
2. Basarat Ali Syed," Beginning Node.js ",Apress ,2014

REFERENCES:

1. Lionel Lopez,React Quickstart Step-by-Step Guide to Learning React Javascript Library
2. Kirupa Chinnathambi, JavaScript Absolute Beginner's Guide, 1st Edition, 2017.
3. Robert W Sebesta, Pearson, Programming the World Wide Web, 7th Edition, 2013.
4. Kirupa Chinnathambi, Learning React, 1 Edition, Addison-Wesley Professional
5. Mark Pilgrim,HTML5Up and Running,O'Reilly, 1st Edition, 2012.

E-Resources:

<https://www.edureka.co/blog/ebook/web-development-ebook>

MOOC:

<https://www.coursera.org/learn/server-side-javascript-with-nodejs>

Activity Based Learning (Suggested Activities in Class)

1. Hands-on Lab exercises
2. Mini Project
3. Freecode camp/OpenSource Online Coding Boot Camp
4. Coding platform Challenges – Hackerrank, CodeChef
5. Case based learning



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LINUX PROGRAMMING AND SCRIPTING [As per Choice Based Credit System (CBCS) scheme] SEMESTER – III	
Course Code : 22CS2306	Credits : 02
Hours / Week : 02 Hours	Total Hours : 26 Hours
L–T–P–J : 2–0–0–0	
<u>Course Learning Objectives:</u> This Course will enable students to: - To learn the fundamentals of OS - To Know the features of Linux OS and learn the Linux commands - To gain knowledge about the Linux networking and Linux administration - To understand the fundamentals of Shell scripting & Perl programming. - To discuss about the Inter Process Communication. - To understand the concept of client server communication by using sockets	
Teaching-Learning Process (General Instructions) These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes. Lecture method means it includes not only traditional lecture method, but different <i>type of teaching methods</i> may be adopted to develop the course outcomes. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying. - Show Video/animation films to explain functioning of various concepts. - Encourage Collaborative (Group Learning) Learning in the class. - To make Critical thinking, ask at least three Higher order Thinking questions in the class. - Adopt Problem Based Learning, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it. - Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them. - Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.	
UNIT 1 : INTRODUCTION TO OS & LINUX	06 Hours
Operating System Objectives and Functions, The Evolution of Operating Systems developments Leading to Modern Operating Systems, Modern UNIX Systems, Linux, Bootting Process of Linux operating system File System of the Linux , Basic File Attributes, Basic commands, Linux users and group, Permissions for file, directory and users, Filters: cut, tr, grep. Find Command with various options, Filters using Regular Expression: grep & sed, The vi editor Networking Tools: TCP/IP basics, Resolving IP addresses, ping, telnet and ftp, cron commands	
UNIT 2: SHELL PROGRAMMING:	05 Hours



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List of Experiments

1. Study and Practice on various commands like man, passwd, tty, clear, date, cal, cp, mv, ln, rm, unlink, mkdir, rmdir, du, df, mount, umount, find, unmask, ulimit, ps, who
2. Study and Practice on various commands like cat, tail, head, sort, nl, uniq, grep, egrep, fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, tar, cpio
3. Implement in C the following Unix commands using System calls A.cat B.ls .mv
4. Creating shell programs for automating tasks
5. Write perl script to ask from user repeatedly to enter a number, and when the user enters 0, print the total of all numbers entered so far
6. Implement the following IPC forms a) FIFO b) PIPE
7. Write a C program (sender.c) to create a message queue with read and write permission to write 3 messages to it with different priority numbers.
8. Write a C program (receiver.c) that receives the messages (from the above message queue as specified) and displays them
9. Write client and server programs (using c) for interaction between server and client processes using TCP Elementary functions.
10. Write client and server programs (using c) for interaction between server and client processes using UDP Elementary functions

TEXT BOOKS:

1. Unix Concepts and Applications, 4th Edition, Sumitabha Das, TMH.
2. Unix System Programming using C++, T.Chan, PHI.

REFERENCES:

1. Unix Network Programming, W.R.Stevens, PHI.
2. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Pearson Education, 2004.

E-Resources

1. <https://archive.nptel.ac.in/courses/117/106/117106113/>
2. <https://www.learnshell.org/?ref=itsfoss.com>
3. <https://hackr.io/tutorials/learn-perl>
4. <https://www.tutorialspoint.com/perl/index.htm>



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PROBABILITY AND STATISTICS [As per Choice Based Credit System (CBCS) scheme] SEMESTER – IV	
Course Code : 22CS2401	Credits : 03
Hours / Week : 03 Hours	Total Hours : 39 Hours
L-T-P-J : 3-0-0-0	
<u>Course Learning Objectives:</u> This Course will enable students to: 1. Apply statistical principles and probability concepts to solve complex problems in real-world scenarios involving uncertainty and randomness. 2. Evaluate and select appropriate probability distributions and statistical techniques to analyze and interpret data accurately in various applications. 3. Justify the use of estimation methods and hypothesis testing techniques for drawing meaningful inferences about population parameters. 4. Analyze and interpret sample test results for different statistical relationships, such as means, variances, correlation coefficients, regression coefficients, goodness of fit, and independence, to make informed decisions. 5. Identify sample tests using appropriate statistical procedures to investigate the significance of observed data and communicate findings effectively.	
Teaching-Learning Process (General Instructions) These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes. 1. Lecture method means it includes not only traditional lecture method, but different <i>type of teaching methods</i> may be adopted to develop the course outcomes. 2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying. 3. Show Video/animation films to explain functioning of various concepts. 4. Encourage Collaborative (Group Learning) Learning in the class. 5. To make Critical thinking, ask at least three Higher order Thinking questions in the class. 6. Adopt Problem Based Learning, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it. 7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them. 8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.	
UNIT – I : Probability	09 Hours



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Definitions of Probability, Addition Theorem, Conditional Probability, Multiplication Theorem, Bayes' Theorem of Probability	
UNIT – II: Random Variables and their Properties and Probability Distributions	09 Hours
Discrete Random Variable, Continuous Random Variable, Joint Probability Distributions Their Properties, Probability Distributions : Discrete Distributions: Binomial, Poisson Distributions and their Properties; Continuous Distributions: Exponential, Normal, Distributions and their Properties.	
UNIT – III: Estimation and testing of hypothesis	06 Hours
Sample, Populations, Statistic, Parameter, Sampling Distribution, Standard Error, Un-Biasedness, Efficiency, Maximum Likelihood Estimator, Notion & Interval Estimation.	
UNIT – IV: Sample Tests-1	07 Hours
Large Sample Tests Based on Normal Distribution , Small Sample Tests : Testing Equality of Means, Testing Equality of Variances, Test of Correlation Coefficient.	
UNIT – V: Sample Tests-2	08 Hours
Test for Regression Coefficient; Coefficient of Association, 2 – Test for Goodness of Fit, Test for Independence.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Apply the principles of probability to solve complex problems in various real-world scenarios.	L2 & L3
2	Solve and compare different probability distributions, including discrete and continuous random variables, in order to make informed decisions and predictions.	L2 & L3
3	Apply statistical estimation techniques, such as maximum likelihood estimation and interval estimation, to draw meaningful inferences about population parameters from sample data.	L3
4	Examine hypothesis testing methods, including large and small sample tests, to assess the significance of observed data and draw valid conclusions.	L4



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5	Analyze statistical relationships and perform sample tests to assess the Equality of means in different populations, Correlation coefficients between variables to determine the strength and direction of the relationship. Independence of variables using appropriate statistical tests to assess the absence of any relationship.	L4
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Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C01	3	2	2		2				1					
C02	3	2	2		2				1					
C03	3	2	2						1					
C04	3	2	2		2				1					
C05	3	2	2		2				1					

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)

TEXT BOOKS:

1. Probability & Statistics for Engineers and Scientists, Walpole, Myers, Myers, Ye. Pearson Education.

REFERENCE BOOKS:

1. Probability, Statistics and Random Processes T. Veerarajan Tata McGraw – Hill
2. Probability & Statistics with Reliability, Queuing and Computer Applications, Kishor S. Trivedi, Prentice Hall of India ,1999

E-Resources:

1. <https://nptel.ac.in/courses/106104233>
2. <https://nptel.ac.in/courses/117103067>
3. <https://nptel.ac.in/courses/103106120>
4. <https://www.coursera.org/learn/probability-intro#syllabus>
5. <https://nptel.ac.in/courses/111104073>

Activity Based Learning (Suggested Activities in Class)

1. Tools like Python programming, R programming can be used which helps student to develop a skill to analyze the problem and providing solution.
2. Regular Chapter wise assignments/ Activity/Case studies can help students to have critical thinking, developing an expert mind set, problem-solving and teamwork.



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DESIGN AND ANALYSIS OF ALGORITHMS

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

SEMESTER – IV

Course Code	: 22CS2402	Credits	: 04
Hours / Week	: 03 Hours	Total Hours	: 39(Th)+26(P) Hours
L-T-P-J	: 3-0-2-0		

Course Learning Objectives:

This Course will enable students to:

1. **Analyze** the non-recursive and recursive algorithms and to represent efficiency of these algorithms in terms of the standard Asymptotic notations.
2. **Acquire** the knowledge of Brute Force and Divide and Conquer techniques to design the algorithms and apply these methods in designing algorithms to solve a given problem.
3. **Master** the Decrease and Conquer, Transform and Conquer algorithm design techniques, and Time versus Space Trade-offs.
4. **Learn** Greedy method and dynamic programming methods and apply these methods in designing algorithms to solve a given problem.
5. **Understand** the importance of Backtracking and Branch and Bound algorithm design techniques to solve a given problem.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. **Interactive Teaching: Adopt the Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show **Video/animation** films to explain functioning of various concepts.
4. Encourage **Collaborative** (Group Learning) Learning in the class.
5. To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
6. Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.



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7. Show the <i>different ways to solve</i> the same problem and encourage the students to come up with their own creative ways to solve them. 8. Discuss how every <i>concept can be applied to the real world</i> - and when that's possible, it helps improve the students' understanding.	
UNIT – I	08 Hours
INTRODUCTION: What is an Algorithm? Fundamentals of Algorithmic Problem Solving. (Text Book-1: Chapter 1: 1.1 to 1.2) FUNDAMENTALS OF THE ALGORITHMS EFFICIENCY: Analysis Framework, Asymptotic Notations and Standard notations and common functions (Text Book-2: Chapter 3: 3.1, 3.2), Mathematical Analysis of Non-recursive and Recursive Algorithms, (Text Book-1: Chapter 2: 2.1, 2.3, 2.4,)	
UNIT – II	08 Hours
BRUTE FORCE: Background, Selection Sort, Brute-Force String Matching. TSP (Text Book-1: Chapter 3: 3.1, 3.2) DIVIDE AND CONQUER: General method, Recurrences: The substitution method, The recursion-tree method, The master method. (Text Book-2: Chapter 4: 4.4, 4.5), Merge sort, Quick sort, Binary Search, Multiplication of large integers, Case study: Strassen's Matrix Multiplication. (Text Book-1: Chapter 4: 4.1 to 4.3, 4.5)	
UNIT – III	06 Hours
DECREASE & CONQUER: General method, Insertion Sort, Graph algorithms: Depth First Search, Breadth First Search, Topological Sorting. TRANSFORM AND CONQUER: Case study: Heaps and Heap sort. TIME AND SPACE TRADEOFFS: Input Enhancement in String Matching: Horspool's algorithm, Hashing: Open and Closed hashing. (Text Book-1: Chapter 5: 5.1 to 5.3, Chapter 6: 6.3 to 6.4, Chapter 7: 7.2 to 7.3)	
UNIT – IV	9 Hours
GREEDY TECHNIQUE: General method of Greedy technique, Single-Source Shortest Paths: General method, The Bellman-Ford algorithm, Single-Source Shortest Paths in DAGs, Dijkstra's Algorithm (Text Book-2: Chapter 24: 24.1 to 24.3). Minimum Spanning Trees: Prim's Algorithm, Optimal Tree problem: Huffman Trees; Case study: Kruskal's Algorithm. Fractional Problem (Text Book-1: Chapter 9: 9.1, 9.2, 9.4). DYNAMIC PROGRAMMING:	



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General method, The Floyd-Warshall Algorithm, Johnson's algorithm for sparse graphs (*Text Book-2: Chapter 25: 25.1 to 25.3*),
The Knapsack problem (*Text Book-1: Chapter 8: 8.4*).

UNIT – V

08 Hours

LIMITATIONS OF ALGORITHMIC POWER

P, NP and NP-complete problems (*Text Book-1: Chapter 11: 11.3*)

BACKTRACKING:

General method, N-Queens problem, Subset-sum problem.
(*Text Book-1: Chapter 12: 12.1*)

BRANCH AND BOUND:

General method, Travelling Salesman problem, Approximation algorithms for TSP.

Case study: Knapsack Problem.

(*Text Book-1: Chapter 12: 12.2, 12.3*)

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Exemplify the algorithm design techniques and standard Asymptotic notations. Analyze non-recursive and recursive algorithms to obtain worst-case running times of algorithms using asymptotic analysis	L3
2	Interpret the brute-force, divide-and-conquer paradigms and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.	L3
3	Demonstrate the Decrease and Conquer, Transform and Conquer algorithm design techniques and analyze the performance of these algorithms.	L3
4	Identify and interpret the greedy technique, dynamic-programming paradigm as to when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize dynamic-programming algorithms and analyze them	L3
5	Illustrate the Backtracking, Branch and Bound algorithm design paradigms and explain when an algorithmic design situation calls for it. Recite algorithms that employ these paradigms. Summarize the limitations of algorithmic power.	L3



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Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C01	3	3										2		3
C02	3	3	2									2		3
C03	3	3										1		3
C04	3	3	2									2		3
C05	3	3										1		3

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)

TEXT BOOKS:

1. Anany Levitin, "Introduction to the Design & Analysis of Algorithms", 2nd Edition, Pearson Education, 2011.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, PHI, 2014.

REFERENCE BOOKS:

1. Horowitz E., Sahni S., Rajasekaran S, "Computer Algorithms", Galgotia Publications, 2001.
2. R.C.T. Lee, S.S. Tseng, R.C. Chang & Y.T. Tsai, "Introduction to the Design and Analysis of Algorithms A Strategic Approach", Tata McGraw Hill, 2005.

E-Resources:

1. <https://nptel.ac.in/courses/106/101/106101060/>
2. <http://cse01-iiith.vlabs.ac.in/>
3. <http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms>
4. <https://www.coursera.org/specializations/algorithms>



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Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion. E.g., Fake coin identification, Cabbage puzzle, Konigsberg bridge puzzle etc.,
2. Demonstration of solution to a problem through programming.

LABORATORY EXPERIMENTS

Total Contact Hours: 26

Following are experiments to be carried out using either C programming language or Object-oriented programming language:

1. Apply divide and conquer method and Design a C program to implementation of Binary Search algorithm.
2. Sort a given set of n integer elements using Merge Sort method and compute its time complexity. Demonstrate this algorithm using Divide-and-Conquer method.
3. Sort a given set of n integer elements using Quick Sort method and compute its time complexity. Demonstrate this algorithm using Divide-and-Conquer method.
4. Incorporate the array data structure and demonstrate whether a given unweighted graph is connected or not using DFS method.
5. Implement the graph traversal technique using BFS method to print all the nodes reachable from a given starting node in an unweighted graph.
6. Compute the Transitive Closure for a given directed graph using Warshall's algorithm.
7. For a given weighted graph, construct an All-Pairs Shortest Paths problem using Floyd's algorithm and implement this algorithm to find the shortest distance and their shortest paths for every pair of vertices.
8. Implement 0/1 Knapsack problem using Dynamic Programming Memory Functions technique
9. Find Minimum Cost Spanning Tree for a given weighted graph using Prim's and Kruskal's algorithm.
10. From a given vertex in a weighted connected graph, determine the Single Source Shortest Paths using Dijkstra's algorithm.
11. Mini project proposal should be submitted and Implementation should be done based on the problem stated in the proposal

Open ended experiments

1. Implement Fractional Knapsack problem using Greedy Method.
2. Implement N-Queens problem using Backtracking technique.
3. implementation of Travelling Sales man problem using Dynamic programming



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DATABASE MANAGEMENT SYSTEM

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

SEMESTER – IV

Course Code	: 22CS2403	Credits	: 04
Hours / Week	: 03 Hours	Total Hours	: 39(Th)+26(P) Hours
L-T-P-J	: 3-0-2-0		

Course Learning Objectives:

This course will enable students to:

1. **Acquire** the concept of databases, Entity-Relationship Model and relational model for creating and designing databases for the real-world scenario.
2. **Develop** queries to extract data from the databases using a structured query language.
3. **Differentiate** SQL and NoSQL.
4. **Demonstrate** the operations on MongoDB, Database connectivity with front end and **Optimize** the Database design using Normalization Concepts.
5. **Understand** the importance of Transaction Management, Concurrency control mechanism and recovery techniques.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. **Interactive Teaching: Adopt Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show **Video/animation** films to explain the functioning of various concepts.
4. Encourage **Collaborative** (Group Learning) Learning in the class.
5. To make **Critical thinking**, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the student's understanding.



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INTRODUCTION TO DATABASE SYSTEMS :

Introduction, Characteristics of the Database Approach, Advantages of using DBMS Approach, Data Models, Schemas, Instances and Data Independence, Three Schema Architecture, various components of a DBMS.

(Text Book-1: Chapter 1: 1.1 to 1.4, 1.6, Chapter 2: 2.1, 2.2, 2.4)

ENTITY-RELATIONSHIP MODEL:

Entity Types, Entity Sets, Attributes and Keys, Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; ER Diagrams

(Text Book-1: Chapter 7: 7.3, 7.4, 7.5, 7.7).

UNIT - II

07 Hours

RELATIONAL MODEL :

Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update operations and Dealing with Constraint Violations.

(Text Book-1: Chapter 3: 3.1 to 3.3).

SQL -THE RELATIONAL DATABASE STANDARD:

SQL Data Definition and Data types, Specifying constraints in SQL, Basic Queries in SQL-Data Definition Language in SQL, Data Manipulation Language in SQL;

(Text Book-1: Chapter 4: 4.1 to 4.4).

UNIT - III

08 Hours

SQL -THE RELATIONAL DATABASE STANDARD:

Additional Features of SQL; Views (Virtual Tables) in SQL; Database Programming Issues and Techniques ;

(Text Book-1: Chapter 4: 4.5; Chapter 5: 5.1 to 5.4).

SQL AND NOSQL DATA MANAGEMENT:

Triggers, Database connectivity using Python, SQL vs NoSQL, Introduction to MongoDB,

(Text Book-1: Chapter 5: 5.2, 5.3)(Text Book-2 Chapter 1: 1.1 to 1.5)

UNIT - IV

07 Hours

NOSQL DATA MANAGEMENT:

Data Types, Data Modelling, CRUD Operations.

(Text Book-2 Chapter 1: 1.1 to 1.5)

DATABASE DESIGN:

Design Guidelines, Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form;

(Text Book-1: Chapter 14: 14.1 to 14.5)

UNIT - V

07 Hours

TRANSACTION MANAGEMENT

The ACID Properties; Transactions and Schedules; Concurrent Execution of Transactions; Concurrency Control Mechanisms; Error recovery methods.

(Text Book-1: Chapter 20: 20.1 to 20.5, Chapter 21: 21.1 to 21.3, Chapter 22: 22.1 to 22.4)

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		



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1	Use the basic concepts of database management system in the design and creating database blueprint using E-R model and relational model.	L3
2	Formulate SQL and NoSQL queries for building structure and unstructured databases	L3
3	Demonstrate database connectivity using vendor specific drivers	L3
4	Apply normalization techniques to design relational database management system	L3
5	Adapt Transaction Management, concurrency control and recovery management techniques in database management system.	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	-	-	-	-	-	2	2	-	2	3	-
CO2	3	2	1	-	3	-	-	-	2	2	-	2	3	-
CO3	2	2	2	-	3	-	-	-	2	2	-	2	3	-
CO4	3	1	2	-	1	-	-	-	2	2	-	2	3	-
CO5	2	1	-	-	-	-	-	-	2	2	-	2	3	-

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)

TEXT BOOKS:

1. Elmasri and Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2021, 2015.
2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", First Edition, Pearson Education, Inc. 2012.

REFERENCE BOOKS:

1. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", Third Edition, McGraw-Hill, 2003.
2. Silberschatz, Korth and Sudharshan: "Database System Concepts", Seventh Edition, McGrawHill, 2019.
3. C.J. Date, A. Kannan, S. Swamynatham: "An Introduction to Database Systems", Eight Edition, Pearson Education, 2012.

E-Resources:

1. <http://nptel.ac.in/courses/106106093/>



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2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-830-database-systems-fall-2010/lecture-notes/>
3. <http://agce.sets.edu.in/cse/ebook/DBMS%20BY%20RAGHU%20RAMAKRISHNAN.pdf>
4. <http://iips.icci.edu.iq/images/exam/databases-ramaz.pdf>
5. <https://db-class.org/>
6. <https://www.w3schools.com/mongodb/>

Activity Based Learning (Suggested Activities in Class)

1. Database designing and data extraction using group discussion.
2. Collaborative Activity is minor project development with a team of 4 students.

LABORATORY EXPERIMENTS

Total Contact Hours: 26

Following are experiments to be carried out using either oracle or mysql, Mongo Db .

1. Design any database with at least 3 entities and establish proper relationships between them. Draw suitable ER/EER diagrams for the system. Apply DCL and DDL commands.
 2. Design and implement a database and apply at least 10 Different DML Queries for the following task.
 - a. For a given input string display only those records which match the given pattern or a phrase in the search string. Make use of wild characters and like operators for the same. Make use of Boolean and arithmetic operators wherever necessary
 3. Write SQL statements to join table and retrieve the combined information from tables.
 4. Execute the Aggregate functions count, sum, avg, min, max on a suitable database. Make use of built in functions according to the need of the database chosen .
 5. Retrieve the data from the database based on time and date functions like now(), date(), day(), time() etc., Use of group by and having clauses.
 6. Write and execute database trigger. Consider row level and statement level triggers.
 7. Write and execute program to perform operations on MongoDB Database.
 8. Write and execute program to perform CRUD operations.
-



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OBJECT ORIENTED DESIGN AND PROGRAMMING

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

SEMESTER – IV

Course Code	: 22CS2404	Credits	: 04
Hours / Week	: 03 Hours	Total Hours	: 39(Th)+26(P) Hours
L-T-P-J	: 3-0-2-0		

Course Learning Objectives:

This course will enable students to:

- Understand the basic concepts of object-oriented design techniques.
- Understand the fundamentals of object-oriented programming with Java.
- Draw UML diagrams for the software system.
- Impart basics of multi-threading and database connectivity.
- Develop GUI using event handling techniques in Java.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

7. **Lecture method** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
8. **Interactive Teaching: Adopt Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
9. Show **Video/animation** films to explain the functioning of various concepts.
10. Encourage **Collaborative** (Group Learning) Learning in the class.
11. To make **Critical thinking**, ask at least three Higher-order Thinking questions in the class.
12. Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the student's understanding.

UNIT – I

8 Hours



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An Overview of Object-Oriented Systems Development: Introduction; Two Orthogonal Views of the Software; Object-Oriented Systems Development Methodology; Why an Object-Oriented? Overview of the Unified Approach. **Object Basics:** Introduction; An Object-Oriented Philosophy; Objects; Objects are Grouped in Classes; **Attributes:** Object State and Properties; Object behavior and Methods; Object Respond to Messages; **Encapsulation** and Information Hiding; **Class Hierarchy:** **Inheritance;** Multiple Inheritance; **Polymorphism;** Object Relationships and Associations: **Consumer-Producer Association;** **Aggregation and Object Containment;** **Case Study** - A Payroll Program; Object-Oriented Systems Development Life Cycle: Introduction; Software Development Process; Building High-Quality Software; **Object-Oriented Systems Development:** A Use Case Driven Approach; Reusability. Software; Object-Oriented Systems Development: A Use Case Driven Approach; Reusability.

UNIT - II

08 Hours

Unified Modelling Language: Introduction; Static and Dynamic models; Why Modeling? Introduction to the UML; UML Diagrams; UML Class Diagram; Use-Case Diagram. **Introduction to Java:** Java's Magic: The Bytecode; JVM; **Object-Oriented Programming;** Simple Java programs; Two Control Statements; Lexical Issues; Data Types; Variables, Arrays and String constructors; Operators; Control Statements; Input/Output: I/O Basic; Reading console input Writing Console output.

UNIT - III

10 Hours

Introducing Classes: Class Fundamentals; objects; methods; constructors; this Keyword; Garbage Collection; finalize() method; Parameter Passing; Overloading; Access Control Keywords. Inheritance basics; method overriding; abstract classes; Packages and interfaces. **Exception handling** fundamentals; multiple catch; nested try statements. **Multi-Threaded Programming** :Multi-Threaded Programming: Java Thread Model; The main Thread; Creating a thread and multiple threads; Extending threads; Implementing Runnable; Synchronization; Inter Thread Communication; producer consumer problem consumer problem. **Input/Output: I/O Basic;** Reading console input Writing Console output.

UNIT - IV

08 Hours

Event and GUI Programming: Introducing Swing; The Origins of Swing; Swing Is Built on the AWT; Two Key Swing Features; The MVC Connection; Components and Containers; The Swing Packages; A Simple Swing Application; Event Handling; JLabel; JTextField; JButton

UNIT - V

05 Hours

Database Access:
The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; ResultSet

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Develop simple java programs that make use of classes and objects	L3
CO2	Write Java application programs using OOP principles and proper program structuring	L3
CO3	Make use of inheritance and interfaces to develop java application	L3



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CO4	Model exception handling, multi threading concepts in java.	L3
CO5	Create the Graphical User Interface based application programs by utilizing event handling features and Swing in Java	L3
CO6	Develop Java program that connects to a database and be able to perform various operations.	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C01	3		3		3								2	
C02	3		3		3								2	
C03	3		3		3								2	
C04	3		3		3								2	
C05	3		3		3								2	

TEXT BOOKS:

1. Bahrami A.; Object Oriented Systems Development using the Unified Modeling Language; McGraw Hill; 1999.
2. Schildt; Herbert. Java The Complete Reference; 8th Edition. US: McGraw-Hill Osborne Media; 2011.
3. Jim Keogh; J2EE: The Complete Reference; McGraw Hill Education in 2002.

REFERENCES:

1. Barclay K., J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.
2. Y. Daniel Liang, Introduction to Java Programming, 7th edition, Pearson, 2013.

E-Resources:

1. The Complete Reference-JAVA: <https://gfgc.kar.nic.in/sirmv-science/GenericDocHandler/138-a2973dc6-c024-4d81-be6d-5c3344f232ce.pdf>
2. Introduction to Programming using Java: <https://www.iitk.ac.in/esc101/share/downloads/javanotes5.pdf>
3. Java language specification: <https://docs.oracle.com/javase/specs/jls/se8/jls8.pdf>
4. Java Programming Tutorial for Beginners - The Net Ninja
5. "Java Tutorial for Beginners" - Programming with Mosh-
<https://youtu.be/eIrMbAQSU34?si=XH4NEaZ1OQePurbB>
6. "Java Programming Full Course" - freeCodeCamp.org

Activity Based Learning:

1. Interactive Quizzes on online platforms like Quizizz, Kahoot with instant feedback to reinforce learning and engage students actively during lectures.
2. Conducting Debugging Workshops where code snippets with intentional bugs are introduced and ask students to



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identify and fix the issues. This helps them develop critical debugging skills.

3. Conducting coding challenges based on the topic taught in class.
4. Construct class, use-case, and activity diagrams using on-line tools.

COMPUTER ORGANIZATION AND ARCHITECTURE [As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – IV			
Course Code	: 22CS2405	Credits	: 03
Hours / Week	: 03 Hours	Total Hours	: 39 Hours
L-T-P-J	: 3-0-0-0		
Course Learning Objectives: This Course will enable students to: 1. Understand the Architecture and programming of ARM microprocessor. 2. Develop program using Arm instruction set and appreciate the advanced features provided in the ARM 3. Understand the exception handling techniques. 4. Study in detail the concept of instruction level parallelism and concepts of pipelining. 5. Understand various cache memory mapping techniques and memory Organization.			



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Teaching-Learning Process

1. **Lecture method** along with traditional lecture method, different *type of teaching methods* may be adopted to develop the course outcomes.
2. **Interactive Teaching:** incorporating brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Showing **Video/animation** films to explain functioning of various concepts.
4. Encourage **Collaborative** (Group Learning) Learning in the class.
5. To make **Critical thinking**, asking Higher order Thinking questions in the class in the form of Quiz and writing programs with complex solutions.
6. Showing the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.

UNIT – I

05 Hours

An Overview of Computing Systems:

History of Computers, The Computing Device,

The ARM7TDMI Programmers' Model:

Introduction, Data types, Processor Modes, Registers, Program Status Registers, The vector Table.

Assembler Rules and Directives: Structure of Assembly Language Modules, Registers, Directives and Macros.

Loads, Stores and Addressing: LODS and STORES instructions, Operand Addressing , ENDIANNESS

Text Book-1: 1.1 to 1.3; 2.1 to 2.6 ; 4; 5.3, 5.4, 5.5

UNIT – II

05 Hours

Constants and Literal Pools: The ARM Rotation Scheme, Loading Constants and address into Registers

Logic and Arithmetic: Flags and their Use, Compare instructions, Data Processing Instructions

Loops and Branches: Branching, Looping, Conditional Execution, Straight-Line Coding

Subroutines and Stacks: Stack, Subroutines, Passing parameters to subroutines, The ARM APCS.

(Text Book-1: 6.1 to 6.4; 7.1 to 7.4; 8.2 to 8.6; 10.1 to 10.5

UNIT – III

05 Hours

Mixing C and Assembly Language: Inline Assembler Embedded Assembler, Calling Between C and Assembly.

Exception Handling: Interrupts, Error Conditions, Processor Exception Sequence, The Vector Table, Exception Handlers, Exception Priorities, Procedures for Handling Exceptions.

(Text Book-1: 11.1 to 11.8; 14.1 to 14.4



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UNIT – IV	12 Hours
Pipelining: Basic and Intermediate Concepts Introduction, The Major Hurdle of Pipelining, How Pipelining Implemented, What makes Pipelining hard to Implement, Extending the MIPS Pipeline to Handle Multicycle Operations, The MIPS R4000 Pipeline, Crosscutting Issues. Text Book-2: C.1 to C.7	
UNIT – V	12 Hours
Memory Hierarchy: Introduction, Cache Performance, Six basic cache Optimizations, Virtual Memory, Protection and examples of Virtual Memory, Fallacies and Pitfalls. Text Book-2: B.1 to B.6	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Apply knowledge of the internal architecture and organization of ARM microprocessors to utilize their components and functionalities.	L3
2	Apply the instruction set of ARM Microprocessor by writing Assembly language programs.	L3
3	Analyze and compare the various exception handling techniques.	L4
4	Examine the concept of instruction-level parallelism and analyze the principles of Pipelining techniques.	L4
5	Compare and Contrast memory hierarchy and its impact on computer cost/performance.	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
C01	3		2										2	
C02	3		3		1								2	
C03	3	3	1										2	
C04	3	3	1										2	
C05	3	3	1										2	

3: Substantial (High) 2: Moderate (Medium)

1: Poor (Low)



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TEXT BOOKS:

1. William Hohl, “ARM Assembly Language”, 2nd Edition, CRC Press, 2009.
2. John L Hennessy, David A Patterson, “Computer Architecture, A Quantitative Approach”, 5th Edition, Morgan Kaufmann publishers, 2012.

REFERENCE BOOKS:

1. David A Patterson, John L Hennessy, “Computer Organization and Design”, 4th Edition, Morgan Kaufmann publishers, 2010.
2. Steve Furber, “ARM System-on-chip Architecture”, 2nd Edition, Pearson Publications, 2000.
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, “Computer Organization”, 5th Edition, Tata McGraw Hill, 2002.

E-Resources:

1. <https://www.udemy.com/topic/arm-cortex-m/>
2. <https://www.edx.org/school/armeducation>
3. https://onlinecourses.nptel.ac.in/noc22_cs93/preview

Activity Based Learning (Suggested Activities in Class)

1. Mini project implementation using Assembly Language Programming.
2. Demonstration of solution to a problem through programming.



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SPECIAL TOPICS [As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – IV			
Course Code	: 22CS2406	Credits	: 02
Hours / Week	: 04 Hours	Total Hours	: 52 Hours
L-T-P-J	: 0-0-4-0		
<u>Course Learning Objectives:</u> This course will enable students to: 1. To develop problem solving abilities 2. To build the necessary skill set and analytical abilities for developing computer Based solutions for real life problems. 3. To train students in professional skills related to Software Industry 4. To prepare necessary knowledge base for research and development in Computer Science			

Following are some of the ways (but not limited to) of delivering the "Special Topics":

1. **Engaging Students in Small Batches (maximum 3/batch) in Projects:** DSU Faculty will define and supervise a project which has a well-defined scope. Students will work from requirements to delivering a prototype.
2. **Delivery from an Industry Expert:** An industry Expert can offer a project for around 20-25 students, clearly defining the scope. The project will have 4-5 sub-modules. Each student group will work on one sub-module from requirements gathering and analysis all the way to a working module. The sub-teams will integrate the modules and will together deliver a working prototype. The industry expert will engage all the teams on one afternoon face to face. One or two SOE faculty will also co-supervise the project.
3. **A Start-up company might have a few project ideas** to try out and they would engage a team of 20-25 students (in 4-5 batches) to work on these project ideas from concept to a prototype, with a close supervision from the start-up company technologist together with DSU faculty.
4. **Testing a new Product:** A Company has come up with a new product and they require a team of 30-40 students to thoroughly test all the features of the product and come up with a validation of the features of the product, a summary of features that fail to work and also a recommendation on a set of features that may have to be added to the product.
5. A professor from an elite university from within India or abroad, **offering a short course** on a domain which is very current and state of art. The content has a built in project component.
6. **Industry Project:** Students in a small team of 4-5 work on a project defined by an industry (including DERBI and AIC) during a semester and successfully complete the project.
7. **Summer Internship:** A group of students take up Summer Internship at DSU or outside, successfully complete the internship. If done within DSU, a project exhibition will also form a part of evaluation.



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8. **Visit to a University Abroad:** A group of students participate in a well-structured program in a University abroad and complete all the requirements of the university.
9. **Working under a Research professor** within DSU or from premium institutes such as IISc, IIT, IIIT etc. on a specific project/task.

CO No.	Outcomes	Bloom's Taxonomy Level
C01	Identify and formulate problem statement in the interested domain	L2
C02	Design and evaluate a concept/model/product	L3
C03	Use the various tools and techniques, coding practices for developing real life solution to the problem	L3
C04	write effective technical report and demonstrate through presentation	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3							2	2	2		2	2
2		3	3						2	2	2		2	2
3					3				2	2	2		2	2
4								3	2	2	2		2	2



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IOT AUTOMATION [As per Choice Based Credit System (CBCS) scheme] SEMESTER – IV	
Subject Code : 22CS2407	Credits : 02
Hours / Week : 03 Hours	Total Hours : 26 Hours
L–T–P–J : 2–0–0–0	
<u>Course Learning Objectives:</u> This course will enable students to: 1. Basic fundamental concepts of Analog & Digital Circuits, Microprocessor & Microcontroller with the introduction of Embedded Systems, Understand the fundamentals of the Internet of Things and its significance. 2. Demonstration of using Analog & digital Sensors & actuators along with Arduino for data Acquisition 3. Learn the basics of using Tinkercad for IoT simulation. 4. Explore various IoT components, sensors, actuators, and communication protocols.	
Teaching-Learning Process (General Instructions) These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes. 1. Real-World Examples: Use real-world examples and scenarios to demonstrate the practical relevance of Java programming concepts which enhances their understanding of how Java is used in real-world applications 2. Interactive Coding Sessions: Conduct Interactive coding sessions where students can code alongside the teacher or participate in coding challenges. This promotes active participation and helps students develop their coding skills 3. Project-Based Learning: Assign projects or mini-projects that require students to apply Java programming concepts and develop complete applications. This approach fosters independent learning, problem solving skills and a deeper understanding of Java Programming Principles. 4. Active Learning Strategies: Incorporate active learning strategies such as group discussions, problem-solving activities, case studies, and hands-on coding exercises. This allows students to actively engage with the material and apply their knowledge in practical scenarios 5. Collaborative Learning: Encourage students to work in pairs or small groups on programming tasks. Collaborative learning promotes peer-to-peer learning, fosters teamwork, and allows for the exchange of ideas and knowledge.	
UNIT – I	06 Hours
Introduction to IoT and Tinkercad: Basics of Analog & Digital Circuits. (using Electronics Workbench Software), Brief History of Microprocessor, Microcontroller, Embedded Systems, Definition and importance of IoT, IoT Components and communication: Sensors and actuators, Communication protocols (WiFi, Bluetooth, MQTT), Trends in the Adoption of IoT in modern applicants, Risks, Privacy, and Security. Sensor Networks, Sensors and actuators, Analog/Digital Conversion (Text book-1: Ch 2, Ch 3).	



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UNIT – II	05 Hours
Fundamentals of Arduino & raspberry Pi: Architecture of Arduino and raspberry Pi3, basic concepts of Embedded C Programming & Arduino	
IoT Data Acquisition: Analog and digital sensors, reading sensor data using Tinker cad / Electronic Work Bench (Text book 1: Ch 4, Ch 5).	
UNIT – III	05 Hours
Using Electronics workbench software designing & debugging of Analog, Digital & mixed Circuits	
UNIT – IV	05 Hours
IoT Project Development I: Designing an IoT project concept, Setting up the simulation environment IoT Project Development II: Implementing the IoT project using Tinkercad, temperature & humidity measurement using Raspberry Pi 3 & DHT11 Sensor using Python Programming.	
UNIT – V	05 Hours
IoT Applications and Case Studies: Smart home systems, Industrial IoT, Healthcare applications. Final Project and Presentation: Developing an advanced IoT project, Presenting the project and its functionalities	

List of experiments (Simulation and/or Hardware)

1. Installation of EWB software
2. Controlling blinking of LED using 555 Timer
3. Verification of all Boolean expression using basic gates & universal Gates.
4. Using flipflops for various counters
5. Stop timer using 555 & digital IC's

List of Projects using Tinkercad-IoT (both Simulation & Hardware _using Arduino & Raspbery Pi3)

1. Smart Parking system.
2. Smart Notice Board for announcement in classroom
3. Sensing temperature & displaying the same on LCD.
4. 4-way traffic light designing & automating.
5. Sun tracking solar Panel.
6. Generating National anthem of Bharath using Arduino



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CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Identification of different Analog & Digital circuits, study on the various controllers	L2
CO2	Utilize the Features & Architecture of Arduino & raspberry Pi3 for reading data from sensors	L3
CO3	Analyze the working of Electronic Workbench Software tool to design analog, digital & mixed circuits	L4
CO4	Examine problem-solving and critical thinking skills for IoT applications	L4
CO5	Design Smart circuits in real time environment using Arduino & Raspberry Pi	L6

Table: Mapping Levels of COs to POs / PSOs														
Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	2	-	1	1	-	-	-	-	-	-	2	-
CO2	2	1	1	-	1	1	-	-	-	-	-	-	2	1
CO3	3	1	2	-	1	1	-	-	-	-	-	-	1	1
CO4	3	2	3	-	2	1	-	-	-	-	-	-	2	2
CO5	3	2	3	-	2	1	-	-	-	-	-	-	2	2

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)

TEXT BOOKS:

- "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes, et al.

E-Resources:

- Online tutorials and documentation on Tinkercad and Arduino.

Tinkercad: www.tinkercad.com/circuits

Activity Based Learning (Suggested Activities in Class)

- Using Hardware components Lab exercises and assignments to assess practical skills
- Mid-term project to gauge project development abilities
- Class participation and discussions on IoT concepts and trends



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TECHNICAL WRITING			
[As per Choice Based Credit System (CBCS) scheme]			
SEMESTER – IV			
Subject Code	: 22CS2408	Credits	: 02
Hours /Week	: 03 Hours	Total Hours	: 13(T) + 26(P) Hours
L–T–P–P	: 1–0–2–0		
Course Learning Objectives:			
This Course will enable students to:			
1. Analyze developmental writing and introductory technical writing that focus on building study skills alongside effective workplace and academic writing skills. 2. Able to write documents, focusing on Writing Sentences, Organizing Paragraphs Using Appropriate Style and Language. 3. Design the documents and Integrating Graphic Elements. 4. Conducting Research Identifying Secondary Sources, Selecting Secondary Sources, Interviewing for Information 5. Create Instructions, Short Reports, and Presentations			
Teaching-Learning Process (General Instructions)			
These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.			
1. Lecture method means it includes not only traditional lecture method, but different <i>type of teaching methods</i> may be adopted to develop the course outcomes. 2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying. 3. Show Video/animation films to explain functioning of various concepts. 4. Encourage Collaborative (Group Learning) Learning in the class. 5. To make Critical thinking, ask at least three Higher order Thinking questions in the class. 6. Adopt Problem Based Learning, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it. 7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them. 8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.			
UNIT – I			04 Hours
INTRODUCTION:			
Fundamentals of Technical Writing:			
What is technical writing, why is it important to study technical and professional communication, Characteristics of technical writing, Functions of technical discourse			
UNIT – II			08 Hours
THE WRITING PROCESS: Introduction to the writing process			
Pre-writing stage: Introduction, analyzing audience, analyzing purpose, considering style and tone, generating ideas, Outlining			
Writing stage: Introduction, Drafting Structuring the paragraph, developing paragraph patterns, Providing intra-paragraph coherence, Developing essay patterns			
Post-writing stage: Introduction, revising content and organization, checking for grammatical accuracy, editing for style, Proofreading and peer review, Academic and sample texts			
Case Study: To write a report on any organization			
UNIT – III			04 Hours
Grammar, Style and Punctuation: Introduction, Main constituents in language: the phrase, the clause and the sentence, Revision of intra- and inter- coherence, Revision of grammar and style, Punctuation.			
Case Study: Blog /Email generating			
UNIT – IV			05 Hours
Instructions, Short Reports, and Presentations: Writing Instructions, Writing Incident Reports, Writing Progress Reports, Delivering Presentations.			
Case Study: To write a report on technical specification document on any hardware/software product			



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UNIT – V	05 Hours
Conducting Research: Identifying Secondary Sources, Selecting Secondary Sources, Interviewing for Information. Paper writing using IEEE/Springer Templates using Latex.	
Case study: To write a technical paper on work done in special topics	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Explain What is technical writing? why is it important to study technical and professional communication?	L2 & L3
2	Interpret. Different types of writing processes like pre-writing, writing, post writing stages.	L2 & L3
3	Describe Main constituents in language, Revision of grammar and style	L2 & L3
4	Create Instructions, Short Reports, and Presentations.	L2 & L3
5	Conduct Research on Identifying Secondary Sources, Selecting Secondary Sources, Interviewing for Information.	L2

Table: Mapping Levels of COs to POs / PSOs														
COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3		2	3							2		3
CO2	3	3	2	3	3							2		3
CO3	3	3		3	3							1		3
CO4	3	3	2	2	3							2		3
CO5	3	3			2							1		3

3: Substantial (High)

2: Moderate (Medium)

1: Poor (Low)

TEXT BOOKS:

1. Carmen Bombardo Soles, Marta Aguilar Perez, Claudia Barahona Fuentes, "Technical Writing A Guide for Effective Communication", EDICIONS UPC, PHI, 2007.
2. Dawn Atkinson, Stacey Corbitt, "Mindful Technical writing- an Introduction to the fundamentals", TRAILS 2021.

E-Resources:

1. <https://medium.com/@magdalenaszpunar1995/five-step-technical-writing-process-by-k-morgan-12c47c36b8f>
2. https://mis.kp.ac.rw/admin/admin_panel/kp_lms/files/digital/Core%20Books/Communication%20skills%20books/Mindful%20Technical%20Writing.pdf
3. <http://ndl.ethernet.edu.et/bitstream/123456789/33633/1/21.pdf>
4. <https://www.youtube.com/watch?v=G1LfiMLRycc>
5. https://www.youtube.com/watch?v=a_ZtDxApHss

Activity Based Learning (Suggested Activities in Class)

1. Technical Report writing on the projects carried out in Special topics.
2. Writing Technical papers using IEEE and Springer format.



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SEMESTER	V					
YEAR	III					
COURSE CODE	21CS3501					
TITLE OF THE COURSE	DATABASE MANAGEMENT SYSTEMS					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)

#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES :

- To learn data models, conceptualize and depict a database system using ER diagram
- To understand the internal storage structures in a physical DB design
- To know the fundamental concepts of transaction processing techniques

COURSE OUTCOMES

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Demonstrate the basic elements of a relational database management system	L2
CO2	Identify the data models for relevant problems	L2
CO3	Apply normalization for the development of application software9s	L3
CO4	Use Structured Query Language (SQL) for database manipulation.	L3
CO5	Understand transactions and their properties (ACID)	L2
CO6	Design and develop a large database with optimal query processing	L6

COURSE CONTENT:

MODULE 1	8Hrs
Introduction: Purpose of Database System-3Views of data3data models, database management system, three-schema architecture of DBMS, components of DBMS. E/R Model - Conceptual data modeling - motivation, entities, entity types, attributes relationships, relationship types, E/R diagram notation, examples.	
MODULE 2	8Hrs



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Relational Model: Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL -Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL, notion of aggregation , aggregation functions group by and having clauses.	
MODULE 3	8Hrs
Database Design: Dependencies and Normal forms, dependency theory 3functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF	
MODULE 4	8 Hrs
Transactions: Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods.	
MODULE 5	7Hrs
Embedded SQL: triggers, procedures and database connectivity. Introduction to NoSQL	

TEXT BOOKS :

1. Silberschatz, Henry F. Korth, and S. Sudharshan, <Database System Concepts=, 5thEd, Tata McGraw Hill, 2006.
2. J. Date, A. Kannan and S. Swamynathan, <An Introduction to Database Systems=, 8thed, Pearson Education, 2006.

REFERENCES :

1. Ramez Elmasri and Shamkant B. Navathe, <Fundamentals of Database Systems=, Fourth Edition, Pearson/Addision Wesley, 2007
2. Raghu Ramakrishnan, <Database Management Systems=, Third Edition, McGraw Hill, 2003
3. S. K. Singh, <Database Systems Concepts, Design and Applications=, First T. Edition, Pearson Education, 2006



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SEMESTER	V					
YEAR	III					
COURSE CODE	21CS3502					
TITLE OF THE COURSE	OBJECT ORIENTED DESIGN AND PROGRAMMING					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- Understand the basic concepts of object-oriented design techniques.
- Understand the fundamentals of object-oriented programming with Java.
- Draw UML diagrams for the software system.
- Impart basics of multi-threading and database connectivity.
- Develop GUI using event handling techniques in Java.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Apply the concepts of object-oriented programming in software design process.	L3
CO2	Develop Java programs using Java libraries and construct to solve real-time problems.	L3
CO3	Understand, develop and apply various object-oriented features using Java to solve computational problems	L2
CO4	Implement exception handling and JDBC connectivity in Java.	L3
CO5	Build an event-oriented GUI (graphical user interface).	L6



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COURSE CONTENT:	
MODULE 1	08 Hrs
An Overview of Object-Oriented Systems Development: Introduction; Two Orthogonal Views of the Software; Object-Oriented Systems Development Methodology; Why an Object-Oriented? Overview of the Unified Approach. Object Basics: Introduction; An Object-Oriented Philosophy; Objects; Objects are Grouped in Classes; Attributes: Object State and Properties; Object behavior and Methods; Object Respond to Messages; Encapsulation and Information Hiding; Class Hierarchy: Inheritance; Multiple Inheritance; Polymorphism; Object Relationships and Associations: Consumer-Producer Association; Aggregation and Object Containment; Case Study - A Payroll Program; Object-Oriented Systems Development Life Cycle: Introduction; Software Development Process; Building High-Quality Software; Object-Oriented Systems Development: A Use Case Driven Approach; Reusability.	
MODULE 2	08 Hrs
Unified Modelling Language: Introduction; Static and Dynamic models; Why Modeling? Introduction to the UML; UML Diagrams; UML Class Diagram; Use-Case Diagram. Introduction to Java: Java9s Magic: The Byte-code; JVM; Object-Oriented Programming; Simple Java programs; Two Control Statements; Lexical Issues; Data Types; Variables, Arrays and String constructors; Operators; Control Statements; Input/Output: I/O Basic; Reading console input Writing Console output.	
MODULE 3	10 Hrs
Introducing Classes: Class Fundamentals; objects; methods; constructors; this Keyword; Garbage Collection; finalize() method; Parameter Passing; Overloading; Access Control Keywords. Inheritance basics; method overriding; abstract classes; Packages and interfaces. Exception handling fundamentals; multiple catch; nested try statements. Multi-Threaded Programming :Multi-Threaded Programming: Java Thread Model; The main Thread; Creating a thread and multiple threads; Extending threads; Implementing Runnable; Synchronization; Inter Thread Communication; producer consumer problem	
MODULE 4	08 Hrs
Event and GUI Programming: Introducing Swing; The Origins of Swing; Swing Is Built on the AWT; Two Key Swing Features; The MVC Connection; Components and Containers; The Swing Packages; A Simple Swing Application; Event Handling; JLabel; JTextField; JButton	
MODULE 5	05 Hrs
Database Access: The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; ResultSet.	



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TEXT BOOK:

1. Bahrami A.; Object Oriented Systems Development using the Unified Modeling Language; McGraw Hill; 1999.
2. Schildt; Herbert. Java The Complete Reference; 8th Edition. US: McGraw-Hill Osborne Media; 2011.
3. Jim Keogh; J2EE: The Complete Reference; McGraw Hill Education in 2002.

REFERENCES:

1. Barclay K., J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.
2. Y. Daniel Liang, Introduction to Java Programming, 7th edition, Pearson, 2013.



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SEMESTER	V					
YEAR	III					
COURSE CODE	21CS3503					
TITLE OF THE COURSE	OPERATING SYSTEMS					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	1	-	-	39	4

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	***	***	****

COURSE OBJECTIVES:

- To understand the basic concepts and functions of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various Memory and Virtual memory management, File system and storage techniques.
- To discuss the goals and principles of protection in a modern computer system.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO 1	Interpret the different structures, functions, services of operating system and use operating system level virtualization to improve security, manageability and availability of today's complex software environment with small runtime and resource overhead & with minimal changes to the existing computing infrastructure	L2
CO 2	Infer the performance of various CPU scheduling algorithms to make the system more efficient, faster & fairer	L4
CO 3	Use the knowledge of synchronization hardware, semaphores, monitors to resolve process synchronization problems	L3
CO4	Identify the deadlocks using resource allocation graph & resolve the deadlocks using roll back & abort algorithm, bankers algorithm to ensure system is free from dead locks	L2, L3
CO 5	Compare & Contrast various memory management schemes to implement the virtual address & provide the memory protection	L4
CO 6	Examine the various file management techniques, disk scheduling methods for efficient resource utilization & Interpret the system, network, program threats & employ protection principles to safeguard the system resources	L2, L5



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COURSE CONTENT:	
MODULE 1: OS Overview and System Structure	8 Hrs
Introduction to operating systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Computing environments. Operating System Services: User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines;	
MODULE 2: Process Management	8 Hrs
Process Management: Process concept; Process scheduling; Operations on processes. Multi-threaded Programming: Overview; Multithreading models; Threading issues. Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms.	
MODULE 3: Process Coordination	8 Hrs
Process Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors Deadlocks: Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.	
MODULE 4: Memory Management	7 Hrs
Memory Management Strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation. Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.	
MODULE 5: File System and Secondary Storage Structure	8 Hrs
File System, Implementation of File System: File system: File concept; Access methods; Directory structure; File system mounting; File sharing. Protection: Implementing File system: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management. Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management. Protection and Security: Protection: Goals of protection, Principles of protection, System Security: The Security Problem, Program Threats, System and Network Threats.	

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne,
Operating System Principles 8th edition, Wiley-India, 2010

REFERENCES:

1. Operating Systems-Internals and Design Principles, William Stallings,
6th Edition, Pearson Education, 2009.
2. Operating Systems: A Modern Perspective, Gary J. Nutt, Addison-Wesley, 1997



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SEMESTER	V					
YEAR	III					
COURSE CODE	21CS3504					
TITLE OF THE COURSE	MACHINE LEARNING					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/ Projects Hours	Total Hours	Credits
	3	-	2	-	39+26	4

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	**	****

COURSE OBJECTIVES:

- Define machine learning and understand the basic theory underlying machine learning.
- To understand the working principle of Machine Learning Algorithms
- To apply various techniques of Machine Learning Algorithms
- Perform statistical analysis of machine learning techniques.

COURSE OUTCOMES:

CO No.	Outcomes	Taxonomy Level
CO1	Outline the basic concepts of Supervised, unsupervised and reinforcement machine learning algorithms.	L2
CO2	Employ probability density functions, the basics of the sampling theorem and estimating the maximum likelihood to develop new predictive models.	L4
CO3	Implement supervised learning algorithms for regression and classification problems using Machine learning tools.	L3
CO4	Apply Unsupervised Machine Learning algorithms and feature engineering techniques to develop machine learning models.	L3
CO5	Evaluate the performance of machine learning algorithms based on Accuracy, precision, sensitivity, specificity and F1 score.	L5



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COURSE CONTENT:	
MODULE 1: Introduction to Machine Learning	7Hrs
Well posed learning problems, Designing a Learning system. Introduction to AI, Machine learning and Deep learning with applications. Types of learning: supervised, unsupervised and reinforcement learning. Perspective and Issues in Machine Learning.	
Classical paradigm of solving learning problems, The learning problems--classes and types of learning, fundamental of statistical learning and its framework. Introduction to feature Representation and extraction.	
MODULE 2: Mathematics for Machine Learning	8Hrs
Introduction to Statics Probability (joint probability, conditional probability, Bayes theorem, different distributions, univariate and multivariate Gaussian distribution, PDF, MLE, Motivation, estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms.	
MODULE 3: Supervised Learning	9Hrs
Introduction to Supervised Learning, Introduction to Perceptron model and its adaptive learning algorithms (gradient Decent and Stochastic Gradient Decent), Introduction to classification, Naive Bayes classification Binary and multi class Classification, decision trees and random forest, Regression (methods of function estimation) --Linear regression and Non-linear regression, logistic regression, Introduction To Kernel Based Methods of machine learning: K-Nearest neighbourhood, kernel functions, SVM, Introduction to ensemble based learning methods	
MODULE 4: Unsupervised Learning	8 Hrs
Introduction to Unsupervised Learning, Clustering (hard and soft clustering) Hierarchal clustering: K-means, Fuzzy C-Means (FCM) algorithm, Gaussian mixture models (GMM), Expectation Maximization algorithm, feature Engineering in Machine Learning, Dimensionality reduction, Linear Discriminant Analysis and Principle Component Analysis.	
MODULE 5: Model Selection	7Hrs
Machine Learning model validation - Confusion Matrix, Accuracy, Precision, F score, Cost function, Machine Learning Optimization algorithms: Gradient descent, stochastic GD. Regularization: Normalization and Standardization overfitting, underfitting, optimal fit, bias, variance, cross-validation.	

List of Laboratory/Practical Experiments activities to be conducted

1. Implementation of linear and logistic regression
2. Implementation of SVM, KNN, Naïve Bayes ML algorithms
3. Implementation of Decision trees, Random Forest classifiers
4. Implement ensemble algorithms.
5. Implementation of different clustering algorithms and PCA Implementation of different neural networks
Capstone project in specific domains (Health care, Transportation, Telecom etc.)



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TEXT BOOKS;

1. Thomas M. Mitchell, Machine Learning, McGraw- Hill, Inc. New York, ISBN: 0070428077 9780070428072.
2. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation. (2015).

REFERENCE BOOKS:

55

1. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning series), The MIT Press; second edition, 2009.
2. V. N. Vapnik < The Nature of statistical Learning=



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SEMESTER	V					
YEAR	III					
COURSE CODE	21CS3505					
TITLE OF THE COURSE	DATABASE MANAGEMENT SYSTEMS LAB					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	2	-	26	1
Perquisite Courses (if any)						
#	Sem/Year	Course Code	Title of the Course			
*	**	**	*****			

COURSE OBJECTIVES :

- Understand the fundamental concepts of database management. These concepts include aspects of database design, database languages, and database-system implementation.
- To provide a strong formal foundation in database concepts, recent technologies and best industry practices.
- To give systematic database design approaches covering conceptual design, logical design and an overview of physical design.
- To learn the SQL and NoSQL database system.
- To learn and understand various Database Architectures and its use for application development.
- To programme PL/SQL including stored procedures, stored functions, cursors and packages

COURSE OUTCOMES :

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Install and configure database systems.	L3
CO2	Analyze database models & entity relationship models.	L3
CO3	Design and implement a database schema for a given problem-domain	L3
CO4	Understand the relational and document type database systems.	L2
CO5	Populate and query a database using SQL DML/DDDL commands.	L3

List of Laboratory/Practical Experiments activities to be conducted

1. Design any database with at least 3 entities and relationships between them. Apply DCL and DDL commands. Draw suitable ER/EER diagram for the system.
2. Design and implement a database and apply at least 10 different DML queries for the following task. For a given input string display only those records which match the given pattern or a phrase in the search string. Make use of wild characters and LIKE operator for the same. Make use of Boolean and arithmetic operators wherever necessary.
3. Execute the aggregate functions like count, sum, avg etc. on the suitable database. Make use of built in functions according to the need of the database chosen. Retrieve the data from the database based on time and date functions like now (), date (), day (), time () etc. Use group by and having clauses.



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4. Implement nested sub queries. Perform a test for set membership (in, not in), set Comparison (<some, >=some, <all etc.) and set cardinality (unique, not unique).
5. Write and execute suitable database triggers. Consider row level and statement level triggers.
6. Write and execute PL/SQL stored procedure and function to perform a suitable task on the database. Demonstrate its use.
7. Write a PL/SQL block to implement all types of cursor.
8. Execute DDL statements which demonstrate the use of views. Try to update the base table using its corresponding view. Also consider restrictions on updatable views and perform view creation from multiple tables.
9. Mini project.

TEXT BOOKS :

1. Ramon A. Mata-Toledo, Pauline Cushman, Database management systems, TMGH, ISBN: IS978-0-07-063456-5, 5th Edition.

REFERENCES :

1. Dr. P. S. Deshpande, SQL and PL/SQL for Oracle 10g Black Book, DreamTech.
2. Ivan Bayross, SQL, PL/SQL: The Programming Language of Oracle, BPB Publication.
3. Dalton Patrik, SQL Server 3 Black Book, DreamTech Press.



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SEMESTER	V					
YEAR	III					
COURSE CODE	21CS3506					
TITLE OF THE COURSE	OPERATING SYSTEMS LAB					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	2	-	26	1

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	***	****

COURSE OBJECTIVES:

- To learn creating process and Threads
- To implement various CPU Scheduling Algorithms
- To implement Process Creation and Inter Process Communication.
- To implement Deadlock Avoidance and Deadlock Detection Algorithms
- To implement Page Replacement Algorithms
- To implement File Organization and File Allocation Strategies

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Implement system calls to expose the operating system's services to user programs.	L3
CO2	Develop multi-threading and CPU Scheduling algorithms to make the system more efficient, faster, and fairer.	L3
CO3	Implement process synchronization problem using semaphores for the coordination of the process interactions in an Operating System.	L3
CO4	Implement bankers algorithm for the purpose of deadlock avoidance to ensure system is in safe state.	L3
CO5	Develop the page replacement algorithms for effective management of virtual memory.	L3
CO6	Implement file organization and file allocation strategies for efficient disk space utilization.	L3



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List of Laboratory/Practical Experiments activities to be conducted		
Exp. No	Division of Experiments	List of Experiments
1	System Calls	Write a C program to create a new process that exec a new program using system calls fork(), execlp() & wait()
2		Write a C program to display PID and PPID using system calls getpid () & getppid ()
3		Write a C program using I/O system calls open(), read() & write() to copy contents of one file to another file
4	Process Management	Write a C program to implement multithreaded program using pthreads
5		Write C program to simulate the following CPU scheduling algorithms a) FCFS b) SJF c) Priority d) Round Robin
6	Process synchronization	Write a C program to simulate producer-consumer problem using semaphores
7	Deadlock	Write a C program to simulate Bankers algorithm for the purpose of deadlock avoidance.
8		Write a C program to simulate deadlock detection.
9	Memory Management	Write a C program to simulate paging technique of memory management
10		Write a C program to simulate page replacement algorithms a) FIFO b) LRU c) LFU
11	I/O System	Write a C program to simulate the following file organization techniques a) Single level directory b) Two level directory
12		Write a C program to simulate the following file allocation strategies. a) Sequential b) Indexed

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition, Wiley-India, 2010

REFERENCES:

1. Operating Systems-Internals and Design Principles, William Stallings, 6th Edition, Pearson Education, 2009.



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SEMESTER	V					
YEAR	III					
COURSE CODE	21CS3507					
TITLE OF THE COURSE	Special Topics-II					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	-	4	52	2

Course objectives

1. To develop problem solving abilities
2. To build the necessary skill set and analytical abilities for developing computer based solutions for real life problems.
3. To train students in professional skills related to Software Industry
4. To prepare necessary knowledge base for research and development in Computer Science

Course Content

Following are some of the ways (but not limited to) of delivering the "Special Topics":

(i) Engaging Students in Small Batches (maximum 3/batch) in **Projects**: DSU Faculty will define and supervise a project which has a well defined scope. Students will work from requirements to delivering a prototype.

(ii) **Delivery from an Industry Expert**: An industry Expert can offer a project for around 20-25 students, clearly defining the scope. The project will have 4-5 sub-modules. Each student group will work on one sub-module from requirements gathering and analysis all the way to a working module. The sub-teams will integrate the modules and will together deliver a working prototype. The industry expert will engage all the teams on one afternoon face to face. One or two SOE faculty will also co-supervise the project.

(iii) **A Start-up company might have a few project ideas** to try out and they would engage a team of 20-25 students (in 4-5 batches) to work on these project ideas from concept to a prototype, with a close supervision from the start-up company technologist together with DSU faculty.

(iv) **Testing a new Product**: A Company has come up with a new product and they require a team of 30-40 students to thoroughly test all the features of the product and come up with a validation of the features of the product, a summary of features that fail to work and also a recommendation on a set of features that may have to be added to the product.

(v) A professor from an elite university from within India or abroad, offering **a short course** on a domain which is very current and state of art. The content has a built in project component.

(vi) A student undergoes a **on-line certification Course**, (Such as coursera, Edx founded by Harvard and MIT, MOOC, NPTEL, SWAYAM etc). Student obtains a certificate and an 'End of the Semester' exam will be conducted by the respective department.



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- (vii) An expert from a company offers a **3 or 4 day workshop** (on-campus or outside the campus) involving mostly hands-on and a project component and a group of students successfully complete the workshop, with well defined learning components and deliverables.
- (viii) Students participate and successfully complete **a Hackathon** (of Minimum two days), conducted by a reputed institution/organization. The deliverables include the pre-hackathon components, work done during Hackathon and post-Hackathon work (if applicable).
- (ix) **Industry Project:** Students in a small team of 4-5 work on a project defined by an industry (including DERBI and AIC) during a semester and successfully complete the project.
- (x) **Summer Internship:** A group of students take up Summer Internship at DSU or outside, successfully complete the internship. If done within DSU, a project exhibition will also form a part of evaluation.
- (xi) **Visit to a University Abroad:** A group of students participate in a well structured program in a University abroad and complete all the requirements of the university.
- (xii) **Working under a Research professor** within DSU or from premium institutes such as IISc, IIT, IIITetc on a specific project/task.



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SEMESTER	V
YEAR	III



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COURSE CODE	GRAPH THEORY					
TITLE OF THE COURSE	21CS3508					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3
Perquisite Courses (if any)						
#	Sem/Year	Course Code		Title of the Course		
*	**	***		****		

COURSE OBJECTIVES:

- To Understand and explain the basic concepts of graph theory.
- To understand the concept of digraphs, Euler digraphs and Hamiltonian digraphs.
- To develop the understanding of Geometric duals in Planar Graphs.
- To introduce the idea of coloring in graphs

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Appreciate the definition and basics of graphs along with types and their examples	L2
CO2	Understand the definition of a tree and learn its applications to fundamental circuits.	L2
CO3	Know the applications of graph theory to network flows.	L2
CO4	Understand the notion of planarity and coloring of a graph.	L2
CO5	Relate graph theory to real-world problems.	L3

COURSE CONTENT:

MODULE 1: Paths, Circuits and Graph Isomorphisms		8Hrs
Definition and examples of a graph, Subgraph, Walks, Paths and circuits; Connected graphs, disconnected graphs and components of a graph; Euler and Hamiltonian graphs, Graph isomorphism, Adjacency matrix and incidence matrix of a graph, Directed graphs and their elementary properties.		



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MODULE 2: Trees and Fundamental Circuits	8Hrs
Definition and properties of trees, Rooted and binary trees, Cayley's theorem on a Counting tree, Spanning tree, Fundamental circuits, Minimal spanning trees in a connected graph.	
MODULE 3: Cut-Sets and Cut-Vertices	8 Hrs
Cut-set of a graph and its properties, Fundamental circuits and cut-sets, Cut-vertices, Connectivity and separability, Network flows, 1- isomorphism and 2- isomorphism	
MODULE 4: Planar Graphs	7Hrs
Planar graph, Euler theorem for a planar graph, Various representations of a planar graph, Dual of a planar graph, Detection of planarity, Kuratowski's theorem.	
MODULE 5: Graph Coloring	8Hrs
Chromatic number of a graph, Chromatic partition, Chromatic polynomial, Matching and coverings, Four color problem	

TEXT BOOKS:

1. R. Balakrishnan & K. Ranganathan (2012). A Textbook of Graph Theory. Springer.
2. Narsingh Deo (2016). Graph Theory with Applications to Engineering and Computer Science. Dover Publications.

REFERENCES:

1. Reinhard Diestel (2017). Graph Theory (5th edition). Springer.
2. Edgar G. Goodaire & Michael M. Parmenter (2018). Discrete Mathematics with Graph Theory (3rd edition). Pearson.
3. Douglas West (2017). Introduction to Graph Theory (2nd edition). Pearson.



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SEMESTER	V					
YEAR	III					
COURSE CODE	21CS3509					
TITLE OF THE COURSE	MICROCONTROLLERS AND EMBEDDED SYSTEMS 63					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3
Perquisite Courses (if any)						
#	Sem/Year		Course Code	Title of the Course		
*	**		***	***		

COURSE OBJECTIVES:

- Explain the architectural features and instructions of 32 bit microcontroller -ARM Cortex M3.
- Develop Programs using the various instructions of ARM Cortex M3 and C language for different applications.
- Identify and understand the unique characteristics and components of embedded systems
- Understand how can we interfacing different input and output devices/components to cortex M3 microcontroller
- Understanding of how Arduino Uno & Raspberry Pi work

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Describe the architectural features and instructions of 32 bit microcontroller ARM Cortex M3.	L2
CO2	Apply the knowledge gained for Programming ARM Cortex M3 for different applications	L3
CO3	Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.	L2
CO4	Develop an embedded application with Cortex M3 architecture	L3
CO5	Design embedded systems using Arduino board and RaspberryPi	L3



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COURSE CONTENT:	
MODULE 1: ARM-32 bit Microcontroller	8Hrs
Microprocessors versus Microcontrollers, Different Microcontroller Architectures (CISC, RISC, ARISC), Microcontroller Types: PIC, AVR, ARM, Background of ARM and ARM Architecture: A Brief History, Architecture Versions, The Thumb-2 Technology and Instruction Set Architecture, Cortex-M3 Processor Applications, Overview of the Cortex- M3: What Is the ARM Cortex-M3 Processor, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers, Exceptions and Interrupts.	
MODULE 2: ARM Cortex M3 Instruction Sets and Programming:	8Hrs
Assembly basics, Instruction List, Instruction Descriptions: Moving Data, LDR and ADR Pseudo-Instructions, Processing Data, Call and Unconditional Branch, Decisions and Conditional Branches, Combined Compare and Conditional Branch, Conditional Execution Using IT Instructions, Instruction Barrier and Memory Barrier Instructions, MSR and MRS, More on the IF-THEN Instruction Block, SDIV and UDIV, REV, REVH, and REVSH, Reverse Bit, SXTB, SXTB, UXTB, and UXTB.	
MODULE 3: Cortex-M3 Programming	8Hrs
A Typical Development Flow, Using C, CMSIS: Background of CMSIS, Organization of CMSIS, Using CMSIS, Using Assembly: The Interface between Assembly and C, The First Step in Assembly Programming, Producing Outputs, The <Hello World= Example, Using Data Memory, Simple programming exercises.	
MODULE 4: Embedded System Design Concepts	8Hrs
Introduction: Definition of Embedded System, Embedded Systems Vs General Computing Systems, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems, Core of the Embedded System: General Purpose and Domain Specific Processors, Embedded system architecture.	
MODULE 5: Embedded System Design using Raspberry Pi	7 Hrs
Introduction to RaspberryPi, About the Raspberry Pi board and programming (on Linux) Hardware Layout, Operating systems on RaspberryPi, Configuring raspberry Pi, Programming raspberry Pi with Python libraries.	



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TEXT BOOKS:

1. Joseph Yiu, <The Definitive Guide to the ARM Cortex-M3=, 2nd Edition, Newnes, (Elsevier),2010.
2. Shibu K V, <Introduction to Embedded Systems=, Tata McGraw Hill Education Private Limited, 2nd Edition.

REFERENCES:

1. Muhammad Tahir, Kashif Javed, ARM Microprocessor Systems: Cortex-M Architecture, CRC Press 2017
2. Richard Blum, <Arduino Programming in 24 Hours=, Sams Teach Yourself, Pearson Education, 2017.
3. Vijay Madiseti and Arshdeep Bahga, <Internet of Things (A Hands-on-Approach)=, 1st Edition, VPT, 2016
4. Srinivasa K G, Internet of Things,CENGAGE Learning India, 2017



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SEMESTER	V					
YEAR	III					
COURSE CODE	21CS3510					
TITLE OF THE COURSE	INTERNET OF THINGS					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To learn the building blocks of the Internet of Things (IoT) and their characteristics.
- To introduce the students to the programming aspects of the Internet of Things with a view toward rapid prototyping of IoT applications.
- To learn communication protocol for IoT.
- To learn Reference architectures for different levels of IoT applications.
- To learn IoT data analytics and

Tools for IoT. COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Use the characteristics of IoT, designs of IoT, addressing Management of IoT to develop an IoT device.	L3
CO2	Interpret the building blocks of the IoT to identify the application areas of IoT and to secure IoT.	L3
CO3	Use IoT protocols and Internet Connectivity Principles in practical domains of society like Smart Agriculture, Smart Cities, IoMT.	L3
CO4	Employ suitable hardware and development tool for IoT based applications: Smart Cities, IoMT, Smart Agriculture.	L4
CO5	Develop and program an IoT device to work with Data Analytics and Cloud Computing infrastructure.	L4



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COURSE CONTENT:	
MODULE 1: INTRODUCTION TO IOT	8 Hrs
Introduction: Concepts behind the Internet of Things, Definition, Characteristics of IoT, IoT Conceptual framework, Physical design of IoT, Logical design of IoT, Application of IoT, IoT and M2M, IoT System Management with NETCONF-YANG.	
MODULE 2: IOT ARCHITECTURE AND SECURITY	8 Hrs
M2M high-level ETSI architecture, IETF architecture for IoT, IoT reference model, IoT 3 Tier, and 5 tier architecture IoT Security: IoT and cyber-physical systems, IoT security vulnerabilities, attacks, and countermeasures), Security engineering for IoT development, IoT security lifecycle	
MODULE 3 : IOT PROTOCOLS	7 Hrs
IoT Access Technologies: Physical and MAC layers, Web Communication Protocols for connected devices, SOAP, REST, HTTP Restful, and Web Sockets. Internet Connectivity Principles: Internet Connectivity, Internet-based communication, Network Layer: IP versions, IP addressing in IoT, Zigbee, 6LoWPAN, Routing over Low Power and Lossy Networks.	
MODULE 4 : HARDWARE AND DEVELOPMENT TOOLS FOR IOT	8 Hrs
Sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, and participatory sensing technology. Embedded Platforms for IoT: Embedded computing basics, Overview of IoT supported Hardware platforms such as Arduino, Raspberry Pi, NodeMCU, Programming with Arduino, NodeMCU, and Raspberry Pi	
MODULE 5 : CASE STUDY AND REAL-WORLD APPLICATION	8 Hrs
Case Studies: Smart Agriculture, IoMT, Smart Cities (Smart Parking, Smart Lighting, Smart Road, Health and Lifestyle), Data Analytics for IoT, Cloud Storage Models & Communication APIs, Cloud for IoT, Amazon Web Services for IoT	

TEXT BOOK:

1. Arshdeep Bahga and Vijay Madisetti, Internet of Things - A Hands-On Approach
2. Rajkamal, = Internet of Things, Tata McGraw Hill publication

REFERENCES:

1. Hakima Chaouchi <The Internet of Things: Connecting Objects, Wiley publication.
2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of things, by David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry by CISCO
3. Donald Norris <The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black, McGraw Hill publication



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SEMESTER	V					
YEAR	III					
COURSE CODE	21CS3511					
TITLE OF THE COURSE	AGILE SOFTWARE ENGINEERING					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Project sHours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Ye a r	Cours e Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- Agile methodology, Scrums, Sprints.
- Agile testing, test automation, DevOps.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Compare and contrast the differences between Agile and other project management methodologies	L4
CO2	Interpret and apply various principles, phases and activities of the Scrum methodology	L3
CO3	Define the benefits of using an Agile approach to managing projects	L2
CO4	Understand Agile Testing principles ^{6e8} for real life situations and learn the basics of SAFe for scaled agile	L2
CO5	Identify and use various tools for Agile development and DevOps principles for CI/CD	L3

COURSE CONTENT:

MODULE 1	8Hrs
INTRODUCTION TO AGILE : Introduction to Software engineering, SDLC, Software process models- waterfall, V model, Iterative model, Spiral model; Introduction to Agile: Agile versus traditional method comparisons and process tailoring; Introduction to Agile, Various Agile methodologies -Scrum, XP, Lean, and Kanban, Agile Manifesto.	
MODULE 2	8Hrs



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SCRUM AND SPRINT:	
Scrum: Scrum process, roles - Product Owner, Scrum Master, Team, Release manager, Project Manager, product manager, architect, events, and artifacts; Product Inception: Product vision, stakeholders, initial backlog creation; Agile Requirements 3 User personas, story mapping, user stories, 3Cs, INVEST, acceptance criteria, sprints, requirements, product backlog and backlog grooming; Test First Development; Pair Programming and Code reviews;	
MODULE 3	8Hrs
AGILE PROJECT MANAGEMENT:	
Sprint Planning, Sprint Reviews, Sprint Retrospectives, Sprint Planning - Agile release and iteration (sprint) planning, Develop Epics and Stories, Estimating Stories, Prioritizing Stories (WSJF technique from SAFe), Iterations/Sprints Overview. Velocity Determination, Iteration Planning Meeting, Iteration, Planning Guidelines, Development, Testing, Daily Stand-up Meetings, Progress Tracking, Velocity Tracking, Monitoring and Controlling; Burn down Charts, Inspect & Adapt (Fishbone Model), Agile Release Train	
MODULE 4	7Hrs
AGILE TESTING :	
Testing: Functionality Testing, UI Testing(Junit, Sonar), Performance Testing, Security Testing, A/B testing; Agile Testing: Principles of agile testers; The agile testing quadrants, Agile automation, Test automation pyramid; Test Automation Tools - Selenium, Traceability matrix;	
MODULE 5	8Hrs
DEVOPS:	
DevOps: Continuous Integration and Continuous Delivery; CI/CD: Jenkins, Git/Github Creating pipelines, Setting up runners Containers and container orchestration (Dockers and Kubernetes) for application development and deployment; Build tools - maven; Checking build status; Configuration management - puppet, chef, ansible; Fully Automated Deployment; CM - Continuous monitoring with Nagios; Introduction to DevOps on Cloud	



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List of Laboratory/Practical Experiments activities to be conducted:
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- | |
|---|
| 1. Setting up Devops Environment |
| 2. Writing Requirements Document, Requirement Analysis (user stories) |
| 3. Estimation and Scrum Planning |
| 4. Implementation and Testing Using Iterative Sprint Model |
| 5. Test Automation using Selenium |
| 6. Unit Testing using Junit or Sonar or Python Test framework |
| 7. CI/CD using Jenkins as Orchestrion platform |
| 8. Containerzation using Docker or Kubernetes |

TEXT BOOKS:

1. Essential Scrum: A Practical Guide to the Most Popular Agile Process Kenneth S.Rubin 2012, published by Addison-Wesley Professional
2. Agile Software Development: The Cooperative Game Alistair Cockburn 2nd Edition, 2006, Addison-Wesley Professional

REFERENCES:

1. Scrum and XP from the Trenches Henrik Kniberg 2nd Edition, 2015, Published by C4Media, publisher of InfoQ.com
2. Agile Project Management: Creating Innovative Products, Second Edition By Jim Highsmith, Addison-Wesley Professional, 2009
3. Agile Project Management: Managing for Success, By James A. Crowder, Shelli Friess, Springer 2014



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SEMESTER	V					
YEAR	III					
COURSE CODE	21CS3512					
TITLE OF THE COURSE	DATA WARE HOUSE AND DATA MINING					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	*	**	***

COURSE OBJECTIVES:

- To extract knowledge from data repository for data analysis,
- Apply preprocessing statistical methods for any given raw data.
- Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
- Master data mining techniques in various applications like social, scientific and environmental context.
- Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Examine the techniques of data warehousing like Building the warehouse, mapping the Data Warehouse to Multiprocessor Architecture	L4
CO2	Apply the association rules like APRIORI, FP Growth Algorithm and Correlation Analysis for mining the data	L3
CO3	Design the classification algorithms like Decision Tree Induction, Bayesian Classification, Rule Based Classification, Support Vector Machines, K-nearest neighbor classification to classify the data	L6
CO4	Develop the basic data mining algorithms like Model Based clustering algorithms, Grid Based Methods, Density Methods and Constraint Based Clustering Analysis	L3
CO5	Evaluate various mining techniques on complex data objects, Partition Algorithms, Support and Confidence Measures	L5

COURSE CONTENT:	73
MODULE 1: DATA WAREHOUSING	7Hrs



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Data Warehouse, Data warehousing Components Building a Data warehouse - Mapping the Data Warehouse to a Multiprocessor Architecture DBMS Schemas for Decision Support Data Extraction, Cleanup, Transformation and loading, Tools, Metadata.	
MODULE 2: BUSINESS ANALYSIS	7Hrs
Reporting and Query tools and Applications Tool Categories The Need for Applications, Cognos Impromptu, Online Analytical Processing (OLAP) OLAP Guidelines, Multidimensional Data Model - Multidimensional versus Multi-relational OLAP OLAP Tools and the Internet. Case study: Data Warehouse tools in cloud (MS Azure, AWS)	
MODULE 3: DATA MINING	9 Hrs
Introduction to Data, Types of Data, Types of Data-attributes and measurements - types of data sets, Data Quality - Data Mining Functionalities, Interestingness of Patterns , Classification of Data Mining Systems, Data Mining Task Primitives, Integration of a Data Mining System with a Data Warehouse, Issues in DM, KDD process. Data Preprocessing.	
MODULE 4: CLUSTERING AND TRENDS IN DATA MINING	8Hrs
Cluster Analysis, Categorization of Major Clustering Methods - Partitioning Methods: K-means clustering. Hierarchical Methods: Agglomerative Methods and Divisive Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data, Constraint Based Cluster Analysis, Outlier Analysis, Data Mining Applications.	
MODULE 5: ASSOCIATION RULE MINING AND CLASSIFICATION	8 Hrs
Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures, Association Rule Generation, APRIORI Algorithm, Correlation Analysis. Classification and Prediction: General Approaches to solving a classification problem, Evaluation of Classifiers, Classification techniques	

TEXT BOOKS:

1. Alex Berson and Stephen J Smith, <Data Warehousing, Data Mining & OLAP=, Tata McGraw 3 Hill Edition, Tenth Reprint, 2007
2. Jiawei Han and Micheline Kamber, <Data Mining Concepts and Techniques=, Second Edition, Elsevier, 2007

REFERENCES:

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, <Introduction to Data Mining=, Person Education, 2007.
2. K.P. Soman, Shyam Diwakar and V. Ajay <, Insight into Data mining Theory and Practice=, Easter Economy, Edition, Prentice Hall of India, 2006.
3. G. K. Gupta, <Introduction to Data Mining with Case Studies=, Easter Economy Edition, Prentice Hall of India, 2006
4. Daniel T. Larose, <Data Mining Methods and Models=, Wile-Interscience, 2006



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SEMESTER	V					
YEAR	III					
COURSE CODE	21CS3513					
TITLE OF THE COURSE	MOBILE COMPUTING AND APPS DEVELOPMENT					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3
Perquisite Courses (if any)						
#	Sem/Year	Course Code	Title of the Course			
*	**	**	***			

COURSE OBJECTIVES:

- To understand the basic concepts of mobile computing
- To learn the setup of Android development environment
- To illustrate the interaction of app with the user interface and handling various activities
- To identify the options for saving the persistent application data
- To gain knowledge about different mobile platforms and application development

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Create, test and debug Android application by setting up the Android development environment	L6
CO2	Implement adaptive and responsive user interfaces that work across various devices	L2
CO3	Demonstrate the techniques involved to store, share and retrieve data in Android applications	L3
CO4	Acquire technical competency and skills in developing applications using Android and cross-platform	L3

COURSE CONTENT:

MODULE 1: INTRODUCTION TO MOBILE COMPUTING	7Hrs
Introduction to mobile computing, Architecture of mobile network, Generations of mobile communication, mobile operating systems, Application of mobile communication, Challenges of mobile communication.	
MODULE 2	8Hrs



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Introduction, trends, platforms, Android Development Setup like, Android Studio, Eclipse, Android SDK, tools. Emulator setup. App behavior on the Android Runtime (ART). Platform Architecture. Application framework and basic App Components resources. Hello World program in Android Studio	
MODULE 3 MOBILE APP DEVELOPMENT USING ANDROID	9 Hrs
Android user Interface - Layouts (Linear, Absolute, Table, Relative, Frame and Scroll), values, asset XML representation, generate R.Java file, Android manifest file. Activities, Intent and UI Design - activities life-cycle. Android Components - layouts, fragments, basic views (Button, Edit Text, Check box, Toggle Button, Radio Button), list views, picker views, adapter views, Spinner views, Menu, Action Bar and Managing data using SQLite database (Database create, Read, Update and delete).	
MODULE 4 : MESSAGING AND LOCATION BASED SERVICES	8Hrs
Sending SMS and mail, Google Maps - Displaying Google Maps in Android application, Networking - How to connect to Web using HTTP, Publishing Android Applications - how to prepare application for deployment, exporting application as an APK file and signing it with new certificate, how to distribute new android application and publish android application on market place	
MODULE 5: DATA PERSISTENCE AND GOOGLE APIS FOR ANDROID:	7Hrs
Introduction of Google APIs for Android. SQLite Databases. CROSS-PLATFORM APP DEVELOPMENT - Introduction to Cross platform App Development - Difference to nativeapps, Pros and cons, Development tools.	

TEXT BOOKS:

1. Mobile Cloud Computing by Debashis De, CRC Press, Taylor & Francis Group
2. **Head First Android Development by Jonathan Simon O'reilly**

Publications REFERENCES:

1. **Learning Android by Marko Gargenta O'reilly Publications**
2. Jochen H. Schller, <Mobile Communications=, Second Edition, Pearson Education, New Delhi, 2007.
3. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, <Principles of Mobile Computing=, Springer, 2003.
4. Erik Hellman, <Android Programming 3 Pushing the Limits=, 1st Edition, Wiley India Pvt Ltd, 2014
5. J F DiMarzio, <Beginning Android Programming with Android Studio=, 4th Edition, Wiley India Pvt Ltd, 2016.



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SEMESTER	V					
YEAR	III					
COURSE CODE	21CS3514					
TITLE OF THE COURSE	MOOC					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	--	-	--	39	3

Course Outcomes:

1. Enabling students to obtain certificates to make students employable in the industry or pursue a higher education program.
2. Relevant exposure to tools and technologies are being offered.

Massive Open Online Courses (MOOCs) – Guidelines & Policy

1. Students shall enroll the MOOC courses that is available on the NPTEL/SWAYAM (Swayam.gov.in) platform whenever it notifies (twice in a year).
2. The list of NPTEL / SWAYAM courses related to Computer Science & Engineering that is in line with the students interest will be announced at the departmental level for enrollment.
 - That is, the predefined list of courses is provided by the department to the students, and only those courses shall be considered and not others.
3. Students shall also enroll in Coursera / Udemy / Udacity / Infosys Spring Board, where DSU can consider the grades / marks provided by these platforms if they are proctored ones. Examinations are to be conducted by DSU if proctored assessments are not conducted by these platforms.
4. The MOOCs courses option shall be considered only for students having a minimum CGPA of 6.75.
5. The interested student has to enroll as per the guidelines of the NPTEL / SWAYAM or other platforms mentioned in item 3 within enrollment end date.
6. The credits assigned would depend on the number of weeks. The department shall consider 12 weeks course to map for 03 Credits.
7. A faculty member shall be appointed as SPOC to keep a track of students undertaking courses and collect certificates from students upon completion on the platforms mentioned above.
8. Student has to pursue and acquire a certificate for a MOOCs course and after successful completion, the student shall submit the certificate to the Department and credits shall be transferred to the grade card accordingly based on the items 1-3 above.
9. The examination fee for obtaining the certificate shall be borne by the student.
10. In case a student fails to complete the MOOC course, then the student shall repeat the same on the NPTEL/SWAYAM or other platforms mentioned in item 3 or the student may opt for department elective with permission of the department chair.
11. Following is the proposed range for the award of grades towards the credits transfer.



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Range: Consolidated MOOC Score (Assignment+ Proctored exam)	Proposed Grade Point	Grade
90-100	10	O
80-89	9	A+
70-79	8	A
60-69	7	B+
55-59	6	B
50-54	5	C
40-49	4	P
Less than 40	0	F



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SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3601					
TITLE OF THE COURSE	COMPILER DESIGN AND SYSTEMS SOFTWARE					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	1	-	-	39	4

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	**	***

COURSE OBJECTIVES:

1. To explain the basic system software components such as assembler, loader, linkers, compilers.
2. Provide an understanding of the fundamental principles in compiler design
3. To discuss the techniques of scanning, parsing & semantic elaboration well enough to build or modify front end.
4. To illustrate the various optimization techniques for designing various optimizing compilers.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Identify the data structures, algorithm, machine dependent Assembler features and build the object code for Simplified Instructional Computer program	L2
CO2	Infer how linker and loader builds an executable program from an object module generated by assembler	L4
CO3	Interpret the major phases of compilation and to apply the knowledge of Lex tool & YACC tool to build the appropriate parsing application	L2
CO4	Compare and Contrast various top down and bottom up parsing techniques to analyze grammatical structures involved in compiler construction.	L2
CO5	Use formal attributed grammars for specifying the syntax and semantics of programming languages.	L3
CO6	Select various optimization techniques used for dataflow analysis and build machine code from the source code of a novel language.	L2



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COURSE CONTENT:	
MODULE 1: Introduction to System Software, ASSEMBLERS	9Hrs
Introduction to System Software, Machine Architecture of SIC and SIC/XE. ASSEMBLERS: Basic assembler functions: A sim7p7le assembler, Assembler algorithm and data structures, Machine dependent assembler features: Instruction formats and addressing modes 3 Program relocation, Machine independent assembler features: Literals, Symbol-defining statements, Expressions, Program blocks	
MODULE 2 : LOADERS AND LINKERS:	7 Hrs
Basic loader functions: Design of an Absolute Loader, A Simple Bootstrap Loader, Machine dependent loader features: Relocation, Program Linking, Algorithm and Data Structures for Linking Loader, Machine-independent loader features: Automatic Library Search, Loader Options, Loader design options: Linkage Editors, Dynamic Linking	
MODULE 3: COMPILERS	8Hrs
Introduction: Language Processors, Structure of compiler, The science of building a compiler, Applications of compiler technology. LEXICAL AND SYNTAX ANALYSIS: Role of lexical Analyzer, Specification of Tokens, Lexical Analyzer generator Lex. SYNTAX ANALYSIS I: Role of Parser, Syntax error handling, Error recovery strategies, Writing a grammar: Lexical vs Syntactic Analysis, Eliminating ambiguity, Left recursion, Left factoring.	
MODULE 4: SYNTAX ANALYSIS II	8 Hrs
Top down parsing: Recursive Descent Parsing, First and follow, LL (1), 3Bottom up parsing: Shift Reduce Parsing, Introduction to LR parsing Simple LR: Why LR Parsers, Items and LR0 Automaton, The LR Parsing Algorithm. SYNTAX-DIRECTED TRANSLATION: Syntax-Directed Definitions: Inherited and Synthesized Attributes, Evaluation orders for SDDs: Dependency graphs, Ordering the evaluation of Attributes, S-Attributed Definition, L-Attributed Definition, Application: Construction of Syntax Trees.	
MODULE 5: INTERMEDIATE CODE GENERATION	7 Hrs
Three Address Code: Addresses and Instructions, Quadruples, Triples, indirect triples. CODE GENERATION: Issues in the design of code generator, Basic Blocks, Optimization of Basic Blocks, The Code Generation Algorithm, Peephole optimization. MACHINE INDEPENDENT OPTIMIZATION: The Principal Sources of Optimization	



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TEXT BOOKS:

1. Leland L. Beck, <System Software 3 An Introduction to Systems Programming=, 3rd Edition, Pearson Education Asia, 2006.
2. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, <Compilers 3 Principles, Techniques and Tools=, 2nd Edition, Pearson Education, 2007.

REFERENCES:

1. V. Raghavan, Principles of Compiler Design, Tata McGraw Hill Education Publishers, 2010.
2. Keith D Cooper and Linda Torczon, Engineering a Compiler, Morgan Kaufmann Publishers Elsevier Science, 2004.
3. D.M.Dhamdhare, Systems Programming and operating systems, Second Revised edition, Tata McGraw Hill.



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3602					
TITLE OF THE COURSE	COMPUTER NETWORKS					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem /Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To introduce the fundamental aspects of various types of computer networks.
- To demonstrate the TCP/IP and OSI models with merits and demerits.
- To Understand the working principle of layering structure and basic network components
- To explore the features of each layer by various approach and methods

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Identify and compare among different layers of networking and associated components.	L3
CO2	Implement error control and error detection mechanisms (CRC, Hamming Code) using the concept of the data link layer.	L3
CO3	Differentiate IP addressing modes, implement routing algorithms, and determine the range of congestion in any network.	L3
CO4	Identify the issues of the Transport layer to analyze the congestion control mechanism	L3
CO5	Compare application layer protocols (WEB and HTTP, FTP, E-MAIL (SMTP, POP3), TELNET, DNS, SNMP).	L4

COURSE CONTENT	
MODULE 1: Overview of Networks	9 Hrs
Network Components- Network Physical Structure, Classification of networks (LAN-MAN-WAN), Protocols and Standards , Data representation and data flow, Layered Architecture, Comparison of the OSI and TCP/IP reference model. Physical Layer: Introduction to wired and wireless transmission media . Transmission mode (Serial/Parallel signals, Analog/Digital Signals and Periodic/Aperiodic Signals), Line coding Schemes .	



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MODULE 2: Data Link Layer	9 Hrs
Data Link Layer, MAC (Media Access Control) and LLC (Logical Link Control) sublayer Functionalities, Design Issues: Framing, Flow control (Simplest protocol, Stop and wait, sliding window), Error control (CRC, Hamming code), Ethernet Basics-Multi Access Protocols: ALOHA, CSMA/CD, Connecting Devices: Hubs, Bridges, Switches, Routers, and Gateways	
MODULE 3: Network Layer	8 Hrs
Network Layer Design issues, Routing Protocol Basics, Routing Algorithm (Distance Vector Routing, Link State Routing and Hierarchical Routing). IP addressing, IP Packet format IPV4, IPV6 and IP Tunneling. Congestion control algorithms, QoS (Traffic Shaping, Packet Scheduling).	
MODULE 4: Transport Layer	7 Hrs
Transport Layer functions- Multiplexing and Demultiplexing. Introduction to TCP and UDP, The TCP Service Model, The TCP Segment Header, The TCP Connection Management, TCP Flow Control- Sliding Window, TCP Congestion Control, User Datagram Protocol	
MODULE 5: Application Layer	6 Hrs
Principles of Network Applications, WEB and HTTP, FTP, E-MAIL (SMTP, POP3), TELNET, DNS, SNMP	

TEXT BOOKS:

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.
2. Computer Networks - Andrew S Tanenbaum, 5th Edition, Pearson Education.

REFERENCES:

1. James F. Kurose, Keith W. Ross, <Computer Networking: A Top-Down Approach=, Seventh Edition, Pearson Education, 2017.
2. Larry L. Peterson, Bruce S. Davie, <Computer Networks: A Systems Approach=, Fifth Edition, Morgan Kaufmann Publishers Inc., 2011.
3. William Stallings, <Data and Computer Communications=, Tenth Edition, Pearson Education, 2014.



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SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3603					
TITLE OF THE COURSE	CLOUD COMPUTING					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- Understand various basic concepts related to cloud computing technologies
- Understand the architecture and concept of different cloud models: IaaS, PaaS, SaaS
- Understand the applications of Cloud Computing
- Get exposure to Microsoft Azure, Google Cloud Platform, Amazon Web Services

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Illustrate the main concepts, models, strengths, and limitations of cloud computing and make use of NIST cloud computing architecture to solve architecture design challenges	L3
CO2	Outline the key technologies and approaches for implementation of the cloud and also analyze the authentication, confidentiality, and privacy issues in cloud computing	L4
CO3	Evaluate the relative advantages and disadvantages of Virtualization technology and the taxonomy of Virtualization	L5
CO4	Infer the key and enabling technologies that help in the development of the cloud and the steps involved in migration to the cloud	L2
CO5	Utilize the main dimensions of current cloud platforms and identify the appropriate cloud services for a given application	L6



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COURSE CONTENT:	
MODULE 1: INTRODUCTION	8Hrs
Basics of cloud computing, Cloud Computing Models (Paas, Saas, Iaas), Understanding Public Clouds, Private Clouds, Community Cloud and Hybrid Clouds, Cloud Computing Benefits and risks, Cloud Computing Challenges, Cloud Computing Architecture and Virtualization	
MODULE 2: CLOUD Technologies	7 Hrs
Overview of Cloud Computing techniques (Grid Computing, Cloud Computing, Utility Computing, Fog Computing, Edge computing), Introduction to Cloud security.	
MODULE 3: CLOUD VIRTUALIZATION TECHNOLOGY	8Hrs
Introduction, why virtualization, virtualization benefits, Types of Virtualization-Storage, Application & Network Virtualization , implementing virtualization, Hypervisor.	
MODULE 4: ACCESSING THE CLOUD AND MIGRATING TO THE CLOUD	8Hrs
Accessing the Cloud: Cloud Web access technologies (SOAP, REST), Platforms, Web applications framework, web hosting service, web APIs, web browsers. Migrating to the Cloud: Broad approaches to migrating into the cloud, the seven-step model of migration in to a cloud.	
MODULE 5: CLOUD APPLICATIONS	8Hrs
Cloud Platforms in Industry: Amazon Web Services, Google Cloud Platform, Microsoft Azure. Cloud Applications: Scientific Applications (Healthcare: ECG Analysis in the Cloud) and Business and Consumer Applications (Social Networking, Smart Grids)	

TEXT BOOKS:

1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi Mastering Cloud. Computing McGraw Hill Education
2. Cloud Computing, Dr. Kumar Saurabh, Wiley Publications, 2012

REFERENCES:

1. Guide to Cloud Computing, Richard hill, Springer Publications, 2013
2. Cloud Computing A Practical Approach, Anthony T Velte et.al, MC Graw Hill publications, 2014
3. Cloud Computing Principles and Paradigms, Rajkumar Buyya et.al, Wiley Publications, 2015
4. Cloud Computing Technologies and Strategies of the Ubiquitous data center, Brain J.S et.al, CRC Press, 2014



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SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3604					
TITLE OF THE COURSE	COMPILER DESIGN AND SYSTEM SOFTWARE LAB					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	2	-	26	1
Perquisite Courses (if any)						
#	Sem/Year	Course Code		Title of the Course		
***	***	***		***		

COURSE OBJECTIVES:

- Experiment on the basic techniques of compiler construction and tools that can used to perform syntax- directed translation of a high-level programming language into an executable code.
- Know the implementation of assemblers, loaders and various parsing techniques.
- Learn how to optimize and effectively generate machine codes.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Identify patterns, tokens & regular expressions for lexical analysis.	L2
CO2	Develop LEX and YACC programs for lexical and syntax analysis phases of Compiler.	L3
CO3	Implement the two-pass assembler and absolute loader to translate assembly language into machine code and load the machine code into RAM for execution	L3
CO4	Implement the bottom-up parsing applied in the syntax analysis phase of the compiler	L3
CO5	Develop first sets of Context free grammar to generate a predictive parser used to check whether the input source code follows the syntax of the programming language.	L3

List of Laboratory/Practical Experiments activities to be conducted

- 1a. Program to count the number of characters, words, spaces and lines in a given input file.
- 1b. Program to recognize and count the number of identifiers in a file.



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2a. Program to count the numbers of comment lines in a given C program. Also eliminate them and copy the resulting program into separate file.
2b. Program to recognize whether a given sentence is simple or compound.
3a. Program to count no of: i. +ve and -ve integers ii. +ve and -ve fractions
3b. Program to count the no of scanf and printf statements in a C program. Replace them with readf and writef statements respectively.
4. Program to evaluate arithmetic expression involving operators +, -, *, /
5. Program to recognize a valid variable which starts with a letter, followed by any number of letters or digits.
6. Program to recognize the strings using the grammar ($a^n b^n$; $n \geq 0$)
7. C Program to implement Pass1 of Assembler
8. C Program to implement Absolute Loader
9. C program to find the FIRST in context free grammar.
10. C Program to implement Shift Reduce Parser for the given grammar $E \rightarrow E+E$ $E \rightarrow E * E$ $E \rightarrow (E)$ $E \rightarrow id$
11. C Program to implement intermediate code generation for simple expression

TEXT BOOKS:

1. Leland L. Beck, <System Software 3 An Introduction to Systems Programming=, 3rd Edition, Pearson Education Asia, 2006.
2. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, <Compilers 3 Principles, Techniques and Tools=, 2nd Edition, Pearson Education, 2007.



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SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3605					
TITLE OF THE COURSE	COMPUTER NETWORKS LAB					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	2	-	26	1

COURSE CONTENT

List of Laboratory/Practical Experiments activities to be conducted

PART A

1. Implement three nodes point - to - point network with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped.
2. Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
3. Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.
4. Implement simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the performance with respect to transmission of packets.
5. Implement and study the performance of GSM on NS2/NS3 (Using MAC layer) or equivalent Environment.
6. Implement and study the performance of CDMA on NS2/NS3 (Using stack called Call net) or equivalent environment.

PART B

Implement the following in Java:

7. Write a program for error detecting code using CRC.
8. Write a program to find the shortest path between vertices using bellman-ford algorithm.
9. Using TCP/IP sockets, write a client-server program to make the client send the file name and to make the server send back the contents of the requested file if present. Implement the above program using as message queues or FIFOs as IPC channels.
10. Write a program on datagram socket for client/server to display the messages in client side, typed at the server side.
11. Write a program for simple RSA algorithm to encrypt and decrypt the data.
12. Write a program for congestion control using a leaky bucket algorithm.



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SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3606					
TITLE OF THE COURSE	BLOCKCHAIN AND DISTRIBUTED LEDGER					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

COURSE OBJECTIVES:

- Learn the underlying principles and techniques associated with block chain Technologies.
- Understand and describe how blockchain works
- Familiarize with Ethereum, smart contracts and related technologies, and solidity language.
- Understand the application of Blockchain in various domains

COURSE OUTCOMES:

CO No.	Outcomes	Blooms Taxonomy Level
CO1	Outline the basic concepts of blockchain and cryptography ,mining ,merkle tree concepts used in blockchain to develop decentralized applications	L3
CO2	Use solidity programming for smart contract development in real world applications such as library management system ,student management system ,employee management system.	L3
CO3	Implement Ethereum blockchain applications using geth, metamask, ganache , truffle blockchain tools.	L3
CO4	Develop Block chain Application for IoT smart home ,healthcare using hyperledger platform	L6
CO5	Adapt the advanced concepts of blockchain programming language and tools to develop complex blockchain application	L6

COURSE CONTENT:

MODULE 1: Introduction to Blockchain

8Hrs

Distributed systems, P2P network Architecture of Blockchain, Generic elements of a blockchain: How blockchain works, Benefits, features, and limitations of blockchain How blockchain accumulates blocks, types of blockchain, Distributed ledger, Consensus mechanisms-Proof of work, Proof of Stake, Proof of Authority, CAP theorem, Decentralization, Disintermediation, Ecosystem - Storage, Communication and Computation



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MODULE 2: Cryptography and Smart Contracts	8Hrs
Symmetric cryptography (DES, AES), Asymmetric cryptography, Public and Private keys, Algorithms - RSA, Hash functions, SHA, SHA-256 Smart contracts - Benefits of Smart contracts, Solidity Programming-Types, Literals, Enums, write basic program using Solidity, Compile, verify and deploy.	
MODULE 3: Ethereum Blockchain	8Hrs
The Ethereum network, Ethereum Virtual Machine Execution Environment, Opcodes and their meaning, Structure of a Block, Genesis Block, Merkle tree, Geth, Transactions, Transaction receipts, Nonce, Gas - gasPrice, gasLimit, Ether, Mining, Wallets, Ethereum network (main net, test net), Metamask	
MODULE 4: Ethereum Development	8Hrs
Infura, Web3.0 for Blockchain, Web3J -Java frontend, Creating Blockchain network and peering, Truffle - build contract, migrate and deploy, Ganache CLI	
MODULE 5: Hyperledger	7Hrs
Projects under Hyperledger, Hyperledger reference architecture, Hyperledger design principles, Hyperledger Fabric, Hyperledger Sawtooth, Case study: Blockchain in IoT	

TEXT BOOKS:

1. Mastering Blockchain, Third Edition, Published by Packt Publishing Ltd, Published 2020, Imran Bashir.
2. Solidity Programming Essentials, First Edition, Published by Packt Publishing Ltd, April 2018 Blockchain for Dummies, Manav Gupta, IBM Limited Edition, John Wiley & Sons, Inc. 2017.



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SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3607					
TITLE OF THE COURSE	MACHINE LEARNING FOR HEALTHCARE					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	*	**	***

COURSE OBJECTIVES:

- To introduce the students to healthcare domain and to make them understand and practice to use machine learning techniques to data in the healthcare domain

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Identify different problems in the healthcare industry that need a Machine Learning solution and Analyze data to develop predictive models for risk stratification, disease diagnosis, prognosis, treatment response prediction, and anomaly detection.	L4
CO2	Recognize the challenges associated with medical image modalities and clinical text including privacy, data quality, handling missing values, use data preprocessing techniques to resolve them.	L2
CO3	Create Automatic workflow, applying deep learning algorithms which are more appropriate for medical imaging and wearable sensor of healthcare applications using Python-based toolkits	L6
CO4	Develop healthcare applications using Python-based toolkits incorporating NLP algorithms and machine learning techniques specifically tailored for clinical text and electronic health record (HER) data.	L4



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COURSE CONTENT:	
MODULE 1	8Hrs
Knowing Healthcare Industry: Overview of Healthcare & Life science Industry, Introduction to healthcare informatics, Key Components in Health care, Health Level Seven, Medical Standards and Coding Types, Global Health care Challenges and Trends; Past-Present-Future of AI&ML in Healthcare.	
MODULE 2	9Hrs
Advanced Analytics in Health Care: Overview of clinical care, Clinical Data, Data Types; Risk Stratification; Survival Modelling; Disease progression Modelling, Causal Inference, Re-enforcement learning in healthcare applications	
MODULE 3	8Hrs
Medical Image Diagnostics and NLP for healthcare: Medical Image modalities and management; ML applications in medical Ology space (cardiology, ophthalmology, dermatology, pathology, oncology, haematology, odontology, osteology, pulmonology); NLP for Healthcare: Payer Analytics - Insurance	
MODULE 4	8Hrs
Precision Medicine, Automating clinical workflow, Regulation of AI/ML, the challenge in deploying ML model, Public Health - Government, Provider Analytics, Care Management System, Wearable devices and Medical Bots.	
MODULE 5	6Hrs
Applications of Machine learning models (Linear regression, SVM, Random forest.) and Deep learning models (CNN, RNN....) for the Healthcare area (Case study)	

TEXT BOOKS:

1. Sumeet Dua, U. Rajendra Acharya, Perna Dua (Editors), Machine Learning in Healthcare Informatics, Intelligent Systems Reference Library 56, Springer,
2. Sergio Consoli, Diego ReforgiatoRecupero, Milan Petkovic (Editors), Data Science for Healthcare Methodologies and Applications

REFERENCES:

1. Thomas M. Deserno, Fundamentals of Bio-Medical Image processing, Biological and Medical Physics, Biomedical Engineering, Springer, ISBN 978-3-642-15816-2, 2011



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SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3608					
TITLE OF THE COURSE	DEEP LEARNING					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/ProjectsHours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To understand the basic building blocks and general principles that allows one to design Deep learning algorithms
- To become familiar with specific, widely used Deep learning networks
- To introduce building blocks of Convolution neural network architecture
- To learn to use deep learning tools and framework for solving real-life problems

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Identify the basic building blocks and general principles that allows one to design Deep learning algorithms	L2
CO2	Determine the working of various Deep learning networks	L3
CO3	Design and Implement Convolution neural network models for image processing applications	L3
CO4	Develop solutions for real-life problems using deep learning tools and frameworks	L3

COURSE CONTENT:

MODULE 1: Introduction to Deep Learning	8Hrs
Introduction to Neural Networks: Single layer and Multilayer NN, training neural networks, activation functions, loss functions, Model Selection.	
Introduction to Deep Learning, Principles of Deep Networks and Building blocks of deep networks.	



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MODULE 2	7Hrs
Mathematical background for Deep learning- Data Manipulation and Data Preprocessing, Linear Algebra, Calculus, Probability.	
MODULE 3	8Hrs
Forward Propagation, Backward Propagation, and Computational Graphs Layers and Blocks, shallow neural network, deep neural network, Optimization for Training Deep Models.	
MODULE 4	8 Hrs
Convolutional Neural Networks (CNNs) - Biological inspiration, Mapping of Human Visual System and CNN. Convolution operation, Convolutional Layers, Padding and Stride, Batch normalization and layers, Subsampling, Pooling.	
MODULE 5	8Hrs
Unsupervised Pretrained Networks (UPNs)- Autoencoders, Deep Belief Networks (DBNs) Introduction to Generative Adversarial Networks (GANs), Deep Learning Applications in Healthcare and other areas (Case study)	

TEXT BOOKS:

1. Aston Zhang, Zack C. Lipton, Mu Li, Alex J. Smola, <Dive into Deep Learning=, Amazon Science, 2020
2. Josh Patterson and Adan Gibson, <Deep Learning a Practitioners Approach=, July, 2018.

REFERENCES:

1. Tom Mitchell, Machine Learning, McGraw-Hill, 1997
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, <Deep Learning=, The MIT Press, 2016
3. François Chollet, <Deep Learning Python=, Manning Publications, 2018
4. Aurélien Géron, <Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems=, O'Reilly Media; 1 edition (April 9, 2017)
5. Neural Networks: A Comprehensive Foundation,=S. Haykin, 2ndEd, Prentice Hall of India, 2003.



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SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3609					
TITLE OF THE COURSE	DIGITAL IMAGE PROCESSING					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3
Prerequisite Courses (if any)						
#	Sem/Year		Course Code		Title of the Course	
***	***		***		***	

COURSE OBJECTIVES:

- To understand and to become familiar with the fundamentals of Digital Image Processing.
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Use the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms for image segmentation, object detection and recognition.	L3
CO2	Preprocess the images using the techniques of smoothing, sharpening and enhancement in spatial domain and frequency domain for object detection and recognition.	L4
CO3	Use image degradation, restoration and morphological processing to enhance preprocessed images.	L4
CO4	Apply object detection and recognition techniques using point, line, edge detection and thresholding.	L3
CO5	Apply the concept of image segmentation using Clustering, Graph Cuts, Morphological Watersheds.	L5



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COURSE CONTENT:	
MODULE 1 : INTRODUCTION	8 Hrs
Overview of Digital Image Processing, Origins of Digital Image Processing, Examples of fields that use Digital Image Processing, Fundamental Steps in Digital Image Processing, Components in Digital Image Processing System. DIGITAL IMAGE FUNDAMENTALS Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels.	
MODULE 2 : IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN	8 Hrs
Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering Smoothing (Lowpass) Spatial Filters, Sharpening (High-pass) Spatial Filters, High-pass, Band-reject, and Bandpass Filters from Lowpass Filters, Combining Spatial Enhancement Methods.	
MODULE 3: IMAGE ENHANCEMENT IN THE FREQUENCY DOMAIN	8 Hrs
Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform of One Variable, Some Properties of the 2-D DFT and IDFT, The Basics of Filtering in the Frequency Domain, Image Smoothing Using Low Pass Frequency Domain Filters, Image Sharpening Using High-pass Filters, The Fast Fourier Transform.	
MODULE 4: IMAGE RESTORATION AND MORPHOLOGICAL IMAGE PROCESSING	7 Hrs
A Model of the Image Degradation/Restoration process, Noise Models, Restoration in the Presence of Noise Only4Spatial Filtering, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transform, Some Basic Morphological Algorithms.	
MODULE 5: IMAGE SEGMENTATION	8 Hrs
Point, Line, and Edge Detection, Thresholding, Segmentation by Region Growing and by Region Splitting and Merging, Region Segmentation Using Clustering and Super pixels, Region Segmentation Using Graph Cuts, Segmentation Using Morphological Watersheds, Case Study: The Use of Motion in Segmentation.	



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TEXT BOOK:

1. Rafel C Gonzalez and Richard E. Woods, <Digital Image Processing=, 3rd Edition, Pearson Education, 2010.
2. A. K. Jain, <Fundamentals of Digital Image Processing=, Pearson, 2004.

REFERENCES:

1. Scott.E.Umbaugh, <Computer Vision and Image Processing=, Prentice Hall, 1997.
2. Kenneth R. Castleman, _Digital Image Processing8, Pearson, 2006.
3. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, _Digital Image Processing using MATLAB8, Pearson Education, Inc., 2011.
4. D,E. Dudgeon and RM. Mersereau, _Multidimensional Digital Signal Processing8, Prentice Hall Professional Technical Reference, 1990.
5. William K. Pratt, _Digital Image Processing8, John Wiley, New York, 2002
6. Milan Sonka et al _Image processing, analysis and machine vision8, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.



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SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3610					
TITLE OF THE COURSE	HUMAN COMPUTER INTERFACE					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/ Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	*	**	***

COURSE OBJECTIVES:

1. Learn the foundations of Human Computer Interface
2. Be familiar with the design technologies for individuals and persons with disabilities Be aware of mobile HCI
3. Learn the guidelines for user interface

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Recognize and Analyze the basics of Human Computer Interface, Ergonomics, and style elements with paradigms.	L3
CO2	Outline the knowledge about the navigational design, evaluation techniques, software process life cycle, golden design rules and guidelines.	L2
CO3	Relate the cognitive and collaborative model, Norman's principles and interaction with case studies	L3
CO4	Design a mobile responsive GUI, elements of mobile design tools -and web interfaces with case studies	L3



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CO5	Implement the conversational interface and similar tools to apply in real world applications.	L3
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COURSE CONTENT:	
MODULE 1: HCI INTRODUCTION	7 Hrs
The Human: I/O channels, Memory, Reasoning and problem solving; The computer: Devices, Memory, processing and networks; Historical evolution of HCI ; Interaction: Models, frameworks, Ergonomics, styles, elements, interactivity- Paradigms.	
MODULE 2: SOFTWARE PROCESS, MODELS AND THEORIES	9 Hrs
HCI in software process, software life cycle, usability engineering, Prototyping in practice, design rationale. Cognitive models Socio-Organizational issues and stake holder requirements, Communication and collaboration models. Keystroke level model (KLM), GOMS, CASE STUDIES. Shneiderman's eight golden rules; Norman's seven principles; Norman's model of interaction; Neilsen9s ten heuristics with example of use.	
MODULE 3: GETTING STARTED WITH GAME DEVELOPMENT	8 Hrs
Create Folders- Importing Textures and Meshes- Configuring Meshes - Planning and Configuring Textures- Building Sprites - Importing Audio - Create Prefabs - Scene Building Lighting and Light mapping - Building a Navigation Mesh.	
MODULE 4 : EVENT HANDLING & PLAYER CONTROLLER	8 Hrs
Event Handling 3 Notifications Manager 3 Send Message and Broadcast Message Character - Controllers and the First Person Controller - Beginning the Universal First Person Controller - Handling Cash Collection - Life and Death: Getting Started.	
MODULE 5: CONVERSATIONAL INTERFACE CASE STUDY	6 Hrs
Conversational Interfaces, IVR, Chatbot, ALEXIA, MONTANA and similar tools - Case Studies.	



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TEXT BOOKS:

1. Alan Dix, Inc, Finlay, Gregory Abowd, Russell Beale, Human Computer Interaction=, 3rd Edition, Pearson Education, 2004
2. Pro Unity Game Development with C#, Alan Thorn, Apress Berkeley, CA Publisher, ISBN 978-1-4302-6746-1, 2014.
3. Bill Scott and Theresa Neil, <Designing Web Interfaces=, First Edition, O'Reilly, 2009

REFERENCES:

1. Interaction Design, beyond Human Computer Interaction=, by I Jennifer Preece, Yvonne Rogers, Helen Sharp, John Wiley & Sons.
2. Brian Fling, <Mobile Design and Development=, First Edition, O'Reilly Media Inc., 2009.



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SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3611					
TITLE OF THE COURSE	UG Research Project-I/Product Development Foundation- I					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	-	6	-	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To identify key research questions within a field to carry out research in a team
- To identify and summarize the literature review of the relevant field
- To demonstrate relevant referencing and inculcate new skills in various aspects of academic writing
- To demonstrate the knowledge and understanding of writing the publication/report
- To showcase the strong evidence on the clarity of the argument, understanding of the selected domain area and presentation of its technical information
- To detail description of the process of carrying out the independent research in written document along with results and conclusions with reference to the existing literature
- To analyze and synthesize the new research findings

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Develop the research project by selecting an appropriate research problem.	L3
CO2	Compare the papers relevant to the selected problem domain.	L3
CO3	Construct the model and perform the model evaluation and analysis.	L6
CO4	Draft of the Publication or Demonstration of the Proof-of- concept product, Draft of patent application.	L2



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COURSE CONTENT:

The research topic proposed by both the guide and the student team should be approved by the department chairman to proceed further. A degree of industrial input and involvement will be encouraged, and can be facilitated through existing academic- industrial collaborations or by addressing specific topics that are of interest to industrial partners.

All projects will be closely supervised by the Project Guide with ongoing feedback and guidance at all stages of the project from the conception to completion.

The following criteria will be checked by the department chairman to approve for the research proposal:

a. Department staff as course guide

1. Ability to provide research direction to the student in the chosen field of interest
2. Ability to design an appropriate research strategy and methodology to carry out the research by student
3. Ability to provide and evaluate the strong literature review document for the chosen research topic
4. Ability to train students on research paper / technical writing skills
5. Conduct reviews in regular time period and submit the evaluation to department chairman

b. Student Team

1. To be dedicated and committed to work on a new research topic by learning new technical skills
2. To have fair knowledge on what is product development or research topic
3. To have constant interaction with allocated guide by providing weekly updates
4. To be committed to complete the project and submitting the technical paper within the stipulated time framed by the university

Evaluation:

There will be CIA evaluation as well as the Semester end evaluation of the work done. It will be done by a committee of senior researchers of the Department.



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SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3612					
TITLE OF THE COURSE	GAME THEORY					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	***	****

COURSE OBJECTIVES:

- To provide a foundation of game theory to help students apply game theory to problem solving in a rigorous way.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Understand the fundamental concepts of non-cooperative and co-operative game theory, in particular standard game models and solution concepts.	L2
CO2	Understand a variety of advanced algorithmic techniques and complexity results for computing game-theoretic solution concepts (equilibria).	L2
CO3	Apply solution concepts, algorithms, and complexity results to unseen games that are variants of known examples	L3
CO4	Understand the state of the art in some areas of algorithmic research, including new developments and open problems.	L2

COURSE CONTENT:

MODULE 1: INTRODUCTION		8Hrs
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Game Theory, Games and Solutions Game Theory and the Theory of Competitive Equilibrium, Rational Behavior, The Steady State and Deductive Interpretations, Bounded Rationality Terminology and Notation Nash Equilibrium- Strategic Games, Nash Equilibrium Examples Existence of a Nash Equilibrium, Strictly Competitive Games, Bayesian Games: Strategic Games with Imperfect Information	
MODULE 2: MIXED, CORRELATED, AND EVOLUTIONARY EQUILIBRIUM	8Hrs
Mixed Strategy Nash Equilibrium Interpretations of Mixed Strategy Nash Equilibrium Correlated Equilibrium Evolutionary Equilibrium Rationalizability and Iterated Elimination of Dominated Actions-Rationalizability Iterated Elimination of Strictly Dominated Actions, Iterated Elimination of Weakly Dominated Actions	
MODULE 3: KNOWLEDGE AND EQUILIBRIUM	7Hrs
A Model of Knowledge Common Knowledge, Can People Agree to Disagree, Knowledge and Solution Concepts, The Electronic Mail Game	
MODULE 4: EXTENSIVE GAMES WITH PERFECT INFORMATION	7Hrs
Extensive Games with Perfect Information Subgame Perfect Equilibrium Two Extensions of the Definition of a Game the Interpretation of a Strategy, Two Notable Finite Horizon Games Iterated Elimination of Weakly Dominated Strategies Bargaining Games - Bargaining and Game Theory, A Bargaining Game of Alternating Offers Subgame Perfect Equilibrium Variations and Extensions.	
MODULE 5: REPEATED GAMES	9Hrs
The Basic Idea Infinitely Repeated Games vs. Finitely Repeated Games Infinitely Repeated Games: Definitions Strategies as Machines Trigger Strategies: Nash Folk Theorems Punishing for a Limited Length of Time: A Perfect Folk Theorem for the Limit of Means Criterion Punishing the Punisher: A Perfect Folk Theorem for the Overtaking Criterion Rewarding Players Who Punish: A Perfect Folk Theorem for the Discounting Criterion The Structure of Subgame Perfect Equilibria Under the Discounting Criterion Finitely Repeated Game.	

TEXT BOOKS:

1. Martin J. Osborne, Ariel Rubinstein. A Course in Game Theory. The MIT Press, August 1994.
2. Y. Narahari. Game Theory and Mechanism Design, IISc Press and the World Scientific Publishing Company, March 2014.

REFERENCES:

1. Andrés Perea, Epistemic Game Theory: Reasoning and Choice. Cambridge: Cambridge University, July 2012.
2. Michael Maschler, Eilan Solan, and Schmuel Zamir. Game Theory. Cambridge University Press, 2013.
3. Roger B. Myerson. Game Theory: Analysis of Conflict. Harvard University Press, September 1997



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SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3613					
TITLE OF THE COURSE	DATA SCIENCE					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3
Perquisite Courses (if any)						
#	Sem/Year	Course Code	Title of the Course			
*	**	**	***			

COURSE OBJECTIVES:

- To Understand the concept of Data Preprocessing and Transformation
- To use statistical and computational techniques to Discover, Analyze, Visualize and Present Data
- To analyse the data using visual & summary analytics and common probability distributions
- To acquire the knowledge about building and interpreting regression models and classification with one or more predictors
- To Applying Unsupervised learning approach to the applications

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Apply statistical techniques to preprocess data and perform exploratory data analysis.	L3
CO2	Understand and be able to use appropriate statistical and machine learning modeling techniques for data analysis and Modeling	L2
CO3	Use data visualization techniques for exploratory data analysis and communicating the results	L3
CO4	Evaluate and improve performance of Models	L5
CO5	Use appropriate python libraries for data preprocessing, analysis, modeling and visualization	L3



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COURSE CONTENT:	
MODULE 1	8Hrs
Overview of the Data Science process. Statistical thinking in the age of big data 3 Population and Samples, Measures of central tendencies, variability, hypothesis testing, correlation, statistical models and inference. Basic Python constructs and data structures, Jupyter Notebooks	
MODULE 2	8Hrs
Data Preprocessing: Data Cleaning - Missing values, Noisy data, Data cleaning process, data Reduction: Principal Components Analysis, Data Transformation : Strategies Overview, Data Transformation by normalization, Discretization by binning. Introduction to Pandas for Data Wrangling.	
MODULE 3	8Hrs
Exploratory Data Analysis and Data Visualization with Python : Introduction, Scatter Plots, Histogram, Box Plots, Violin Plot, Heat Map, waffle charts, word clouds, attractive regression plots. Visualizing geospatial data using Folium. choropleth maps. Case Study: Let my dataset change your mindset by Dr HansGosling.	
MODULE 4	7 Hrs
Basic Machine Learning Algorithms, Linear Regression, k-nearest neighbors, k- means,decision trees, naïve Bayes.	
MODULE 5	8Hrs
Model Evaluation : Confusion Matrix, Evaluation Measures. Comparing Classifiers based on cost-benefit and ROC curves. Improving Classifier accuracy: Ensemble Methods, Bagging and Boosting.	
Capstone Project	

TEXT BOOKS:

1. Cathy O'Neil and Rachel Schutt, Doing Data Science, O'Reilly Publications, 2014
2. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining Concepts and Techniques, 3rd edition, Elsevier, 2012

REFERENCES:

1. Jake VanderPlas, Python Data Science Handbook 3 Essential tools for working with data, O'Reilly, 2016
2. Data Science and Big Data Analytics, Wiley Publications, 2015
3. Hastie, Tibshirani, Friedman, <The Elements of Statistical Learning> (2nd edition), Springer, 2008



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SEMESTER	VI					
YEAR	III					
COURSE CODE	21CS3614					
TITLE OF THE COURSE	BIG DATA ANALYTICS					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	**	***

COURSE OBJECTIVES

- To optimize business decisions and create competitive advantage with Big Data analytics
- To explore the fundamental concepts of big data analytics
- To learn to analyze the big data using intelligent techniques
- To understand the various search methods and visualization techniques.
- To learn to use various techniques for mining data stream
- To understand the applications using Map Reduce Concepts
- To introduce programming tools PIG & HIVE in Hadoop eco

system. COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Outline the Hadoop related tools for big data analytics and perform basic Hadoop administration.	L1
CO2	Exemplify the concepts of HDFS and MapReduce framework.	L2
CO3	Illustrate the big data using programming tools like Pig and Hive	L3
CO4	Discriminate the big data for useful business applications and discuss the data for real time applications	L4
CO5	Interpret the various concepts of HBase, Zookeeper, Regression analysis and Visual data analysis techniques for real time applications	L2



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COURSE CONTENT:	
MODULE 1: Introduction to big data	8 Hrs
Introduction to Big Data Platform, Characteristics of big data-Data in the warehouse and data in Hadoop- Importance of Big data, Challenges of Conventional Systems, Analytic Processes and Tools - Analysis vs reporting, Introduction To Streams Concepts, Stream Data Model and Architecture - Stream Computing	
MODULE 2: Hadoop	7 Hrs
History of Hadoop, Hadoop Distributed File System (HDFS) , Introducing and Configuring Hadoop cluster (Local, Pseudo-distributed mode, Fully Distributed mode), Configuring XML files. Comparison between Hadoop1 and Hadoop2	
MODULE 3: Pig	8 Hrs
Hadoop Programming Made Easier, Admiring the Pig Architecture, Data processing operators in Pig, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin	
MODULE 4: Hive	8 Hrs
Applying Structure to Hadoop Data with Hive: Saying Hello to Hive, Seeing How the Hive is Put Together, Getting Started with Apache Hive, Examining the Hive Clients, Working with Hive Data Types, Creating and Managing Databases and Tables, Seeing How the Hive Data Manipulation Language Works, HiveQL 3 Querying Data in Hive	
MODULE 5: HBase	8 Hrs
Fundamentals of HBase and ZooKeeper, Predictive Analytics- Simple linear regression- Multiple linear regression- Visualizations - Visual data analysis techniques, IBM InfoSphere BigInsights and Streams	

TEXT BOOKS:

1. Tom White <Hadoop: The Definitive Guide= Third Edition, O'reilly Media, 2012.

REFERENCE BOOKS

1. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos,
<Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming
Data=, McGrawHill Publishing, 2012.
2. Bill Franks, <Taming the Big Data Tidal Wave: Finding Opportunities in
Huge Data Streams with Advanced Analytics=, John Wiley& sons, 2012.
3. Pete Warden, <Big Data Glossary=, O9Reilly, 2011.



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER	VI				
YEAR	IV				
COURSE CODE	21CS3615				
TITLE OF THE COURSE	QUANTUM COMPUTATION				
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours
	3	-	-	-	39

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To apply techniques of linear algebra to quantum mechanics
- To analyze basic quantum circuits
- To explore the techniques of quantum communication
- To study the protocols of quantum cryptography

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Apply techniques of linear algebra to quantum mechanics problems	L3
CO2	Analyze basic quantum circuits	L4
CO3	Explore the techniques of quantum communication	L2
CO4	Study the protocols of quantum cryptography	L2

COURSE CONTENT:

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MODULE 1: LINEAR ALGEBRA REVIEW	9 Hrs
Bases and Linear Independence, Linear Operators and Matrices, Inner Products, Eigen Vectors and Eigen Values, Adjoint and Hermitian Operators, Tensor Products. Operator Functions. Commutator and Anti-Commutator.	
MODULE 2: QUANTUM MECHANICS	8 Hrs
State Space, Evolution, Measurement, Distinguishing Quantum States , Projective Measurements and POVMs	
MODULE 3: QUANTUM GATES AND ALGORITHMS	7 Hrs
Universal set of gates, quantum circuits , Solovay-Kitaev theorem, Deutsch-Jozsa algorithm, Shor's factoring, Grover Algorithm and HHL Algorithm	
MODULE 4 : QUANTUM COMMUNICATION	8 Hrs
Overview of Quantum Operations, Quantum Noise , Distance Between Quantum States , Accessible Information , Data Compression , Classical Information Over Quantum Channels, Quantum Information Over Quantum Channels , Entanglement as a Physical Resource	
MODULE 5 : QUANTUM CRYPTOGRAPHY	8 Hrs
Private Key Cryptography, Privacy Amplification, Quantum Key Distribution, Privacy and Coherent Information, Security of Quantum Key Distribution	

TEXT BOOK:

1. Nielsen, M. A., & Chuang, I. (2002). Quantum computation and quantum information.

REFERENCES:

1. Phillip Kaye, Raymond Laflamme et. al., An introduction to Quantum Computing, Oxford University press, 2007.
2. Chris Bernhardt, Quantum Computing for Everyone, The MIT Press, Cambridge, 2020



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER	VII					
YEAR	IV					
COURSE CODE	21OE0003					
TITLE OF THE COURSE	WEB TECHNOLOGIES					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	45	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

1. Understand the major areas of web programming
2. To Create website using HTML5, CSS3, JavaScript.
3. Use of fast dynamic Interactive Responsive Website design using jQuery.
4. Server Side Scripting using Node.JS, Express JS and MongoDB

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Know the fundamentals of front-end web technologies - HTML5 and CSS3	L1
CO2	Client-Side Validation using Java script.	L2
CO3	Use of fast dynamic Interactive Responsive Website design using jQuery.	L3



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CO4	Building Web app using Node.js, Mongo dB	L5
CO5	Building Web app using Express JS	L5

COURSE CONTENT:	
MODULE 1	9 Hrs
Markup Language (HTML5): Introduction to HTML and HTML5 - Formatting and Fonts -Commenting Code – Anchors – Backgrounds – Images – Hyperlinks – Lists – Tables – HTML Forms. CSS3: Levels of style sheets; Style specification formats; Selector forms; Property value forms; Font properties; List properties; Color; Alignment of text; Background images, Conflict Resolution, CSS Box Model .CSS3 features: Box Shadow, Opacity, Rounded corners, Attribute selector.	
MODULE 2	9Hrs
JavaScript: Overview of JavaScript; Object orientation and JavaScript; General syntactic, characteristics; Primitives, operations, and expressions; Screen output and keyboard input. Control statements; Arrays; Functions, Constructors; Pattern matching using regular expressions.	
MODULE 3	9 Hrs
jQuery Getting started with jQuery: Introducing jQuery, Action/Reaction: Making Pages Come Alive with Events , Animations and Effects , DOM Traversal and Manipulation, Ajax the jQuery Way : The <i>load()</i> Function , The <i>get()</i> and <i>post()</i> Functions JSON: JSON syntax, data types, JSON. parse, JSON. stringify.	
MODULE 4	9 Hrs



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Node JS Introduction to NodeJS, Set up Dev Environment, Node JS Modules, Node Package Manager, File System, Debugging NodeJS Application, Events, MVC Architecture In Node JS Applications, Database connectivity using Mongo DB.	
MODULE 5	9 Hrs
Express.JS Introducing Express: Basics of Express, Express JS Middleware: Serving Static Pages, Listing Directory Contents, Accepting JSON Requests and HTML Form Inputs, Handling Cookies, Compression ,Time out Hanging Requests.	

Text Books

1. Robert W. Sebesta , "Programming the World Wide Web", 7th Edition, Pearson Education, 2008.
2. Basarat Ali Syed," Beginning Node.js ",Apress ,2014
- 3.
4. David Sawyer McFarland, "JavaScript & jQuery-the missing manual" , Second Edition, O'Reilly.

Reference Books

1. Internet & World Wide Web How to program – M. Deitel, P.J. Deitel, A. B. Goldberg, 3rd Edition, Pearson Education / PHI, 2004.
2. Callum Macre, Learning from JQuery, O'Reilly,
3. Beginning JSON, BEN SMITH, 2015.



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING



SEMESTER	V/VI/VII					
YEAR	III/IV					
COURSE CODE	21OE0004					
TITLE OF THE COURSE	SOCIAL NETWORKS AND ANALYTICS					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	--	2	--		3

Perquisite Courses (if any):			
#	Sem/Year	Course Code	Title of the Course
*	***	*	***

COURSE OBJECTIVES:

- To understand the Social network concepts and its issues/challenges, various tools of Social network analysis.
- To know about Social network APIs.
- To know about mining and classification techniques of Social networks.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Use the basic concepts of Social networks like nodes, edges, adjacency matrix, neighborhood, degree, geodesic, diameter and clustering coefficients to analyze the social network data.	L3
CO2	Interpret content-based analysis and static and dynamic analysis for real-time data or online content.	L3
CO3	Examine the importance of social network APIs and community detection in real-time networks..	L4
CO4	Predicting the relationship between nodes by analyzing the impact on the specified social network like twitter, LinkedIn and Facebook	L4
CO5	Simulate and validate the social networks by using different tools of SNA	L5



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COURSE CONTENT:	
MODULE 1	5Hrs
Introduction	
Social network concepts – Development of social network and analysis - Online social networks – Social Network Data - Issues and challenges	
MODULE 2	5Hrs
Linked-based and structural analysis - Content-based analysis - Static and dynamic analysis Mathematical Representation of social networks	
MODULE 3	6Hrs
Social networking systems and API - Statistical Analysis of Social Networks, Community Detection in Social Networks - Node Classification in Social Networks - Evolution in Dynamic Social Networks.	
MODULE 4	6Hrs
Social Influence Analysis -Link Prediction in Social Networks -Data Mining in Social Media Text Mining in Social Networks - Social Tagging -Building social services	
MODULE 5	6Hrs
UCINET – PAJEK– NETDRAW – StOCNET - SPlus - R – NodeXL- SIENA and RSIENA - Real-world networks (Facebook graph, Twitter networks,) Case Studies	

TEXT BOOKS:

1. Christina Prell, Social Network Analysis: History, Theory and Methodology, SAGE Publications Ltd, Publication Year 2011
2. Stanley Wasserman and Katherine Faust, "Social Network Analysis: Methods and Applications", Cambridge University Press, 1994

Reference:

1. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", 2010
2. Carrington and Scott (eds). The SAGE Handbook on Social Network Analysis SAGE, First Edition 2011



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER/YEAR : 5th or 6th or 7th /3rd or 4th year

COURSE CODE : 21OE0006

TITLE OF THE COURSE : Fundamentals of Cloud Computing

L: T/A: P: C : 3:0:0:3

COURSE OBJECTIVES:

This course will enable students to

- **Demonstrate** an understanding of guidelines, principles, and theories influencing cloud computing.
- **Survey** the methodologies and technologies supporting the cloud and identify the security implications of cloud computing.
- **Recognize** the importance of virtualization and how this has enabled the development of Cloud Computing.
- **Examine** the protocols and standards to access the cloud and the various approaches to migrate into the cloud
- **Analyze** the various industry cloud platforms like Microsoft Azure, Google Cloud Platform, Amazon Web Services, and the applications of the cloud.

COURSE OUTCOMES:

After completing this course, students will be able to

- **Illustrate** the main concepts, models, strengths, and limitations of cloud computing and **make use of** NIST cloud computing architecture to solve architecture design challenges
- **Outline** the key technologies and approaches for implementation of the cloud and also **analyze** the authentication, confidentiality and privacy issues in cloud computing
- **Evaluate** the relative advantages and disadvantages of Virtualization technology and the taxonomy of Virtualization
- **Infer** the key and enabling technologies that help in the development of the cloud and the steps involved in migration to the cloud
- **Discuss** the main dimensions of current cloud platforms and **identify** the appropriate cloud services for a given application



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MODULE 1 - INTRODUCTION

8 Hrs

Basics of cloud computing, Cloud Computing Models (Paas, Saas, Iaas), Understanding Public Clouds, Private Clouds, Community Cloud and Hybrid Clouds, Cloud Computing Benefits and risks, Cloud Computing Challenges, Cloud Computing Architecture and Virtualization.

MODULE 2- CLOUD Technologies

8 Hrs

Overview of Cloud Computing techniques (Grid Computing, Cloud Computing, Utility Computing, Fog Computing, Edge computing). Introduction to Cloud security.

MODULE 3 – CLOUD VIRTUALIZATION TECHNOLOGY

8 Hrs

Introduction, why virtualization, virtualization benefits, storage virtualization, Network virtualization implementing virtualization, Hypervisor.

MODULE 4 – ACCESSING THE CLOUD AND MIGRATING TO THE CLOUD

8 Hrs

Accessing the Cloud: Cloud Web access technologies (SOAP, REST), Platforms, web applications framework, web hosting service, web APIs, web browsers.

Migrating to the Cloud: Broad approaches to migrating into the cloud, the seven-step model of migration into a cloud.

MODULE 5- CLOUD APPLICATIONS

8 Hrs

Cloud Platforms in Industry: Amazon Web Services, Google Cloud Platform, Microsoft Azure.

Cloud Applications: Scientific Applications (Healthcare: ECG Analysis in the Cloud) and Business and Consumer Applications (Social Networking, Smart Grids)

Text Books

Module 1 & 5:

- Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi Mastering Cloud. Computing McGraw Hill Education

Module 2:

- Cloud Computing, Dr. Kumar Saurabh, Wiley Publications, 2012
- Guide to Cloud Computing, Richard hill, Springer Publications, 2013

Module 3:

- Computing A Practical Approach, Anthony T Velte et.al, MC Graw Hill publications, 2014
- Cloud Computing Principles and Paradigms, Rajkumar Buyya et.al Cloud, Wiley Publications, 2015

Module 4:

- Cloud Computing Technologies and Strategies of the Ubiquitous data center, Brain J.S et.al, CRC Press, 2014

References:

1. Cloud Computing Principles and Paradigms, Rajkumar Buyya et.al, Wiley Publications, 2015
2. Guide to Cloud Computing, Richard hill, Springer Publications, 2013



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER/YEAR	: 5 TH OR 6 TH OR 7 TH /3 RD OR 4 TH YEAR
COURSE CODE	: 210E0007
TITLE OF THE COURSE	: Machine Learning with Python
L: T/A: P: C	: 3:0:0:3

Course Objectives:

1. To understand the difference between the two main types of machine learning methods: supervised and unsupervised
2. To learn Supervised learning algorithms, including classification and regression
3. To learn Unsupervised learning algorithms, including Clustering and Dimensionality Reduction
4. To get hands-on experience in machine learning algorithms using libraries in Python
5. Real-life examples of the different ways machine learning affect society

Course Outcomes:

1. Differentiate between the two main types of machine learning methods: supervised and unsupervised
2. Program Supervised learning algorithms, including classification and regression
3. Program Unsupervised learning algorithms, including Clustering and Dimensionality Reduction

Course Content

Module 1: Introduction to Python and Machine Learning

Overview , Applications of Machine Learning, Types of Machine Learning, Basics of Python, Python Libraries for Machine Learning
Pandas for importing Data, Numpy, Scipy, data visualization using Matplotlib

9 hours

Module 2: Regression

Linear Regression, Non-linear Regression, Model Evaluation

7 hours

Module 3: Classification

Logistic Regression, K-Nearest Neighbor, Decision Trees, Naive Bayes classifier, Support Vector Machines, Model Evaluation

8 hours

Module 4: Feature selection and Dimensionality Reduction

Principal Component Analysis (PCA), Multidimensional Scaling (MDS), Bagging and Boosting

8 hours

Module 5: Unsupervised Learning

K-Means Clustering, Hierarchical Clustering, Density-Based Clustering

7 hours



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Textbooks:

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education
2. Sebastian Raschka, Python Machine Learning, third edition, 2019 Packt Publishing Ltd.
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson, First impression, 2014.
4. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining -Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publisher, 2012.

Reference Books:

1. Machine Learning Algorithms <https://www.oreilly.com/library/view/machine-learning-algorithms/9781785889622/>
2. Rudolph Russell :Machine learning step by step guide to implement
3. Shai Shalev-Shwartz, Shai Ben-David :Understanding Machine learning from theory to algorithms
4. Scikit-Learn : <https://link.springer.com/book/10.1007/978-1-4842-5373-1>



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER	VII					
YEAR	IV					
COURSE CODE	20CS4702					
TITLE OF THE COURSE	ADVANCED DRIVING ASSISTANCE SYSTEMS					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Prerequisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To apply the concepts, technologies, and components of Advanced Driving Assistance Systems
- To make use of a knowledge of sensors, planning, and control algorithms for autonomous vehicles
- To determine the operating system reliability and security of client systems in ADAS
- To discover the cloud platform architecture and services used with ADAS technology
- To improve the practical experience in developing ADAS components and evaluating their performance

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Utilize the principles and technologies behind autonomous driving and advanced driver assistance systems	L3
CO2	Develop a solid understanding of localization, prophecy, and routing algorithms used in autonomous vehicles	L6



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CO3	Survey the client's complex system and safety considerations involved in autonomous driving.	L4
CO4	Derive the distributed infrastructure with relevant software tools and simulation environments for autonomous driving.	L5
CO5	Examine the various application and design requirements of autonomous driving technology	L4

COURSE CONTENT:

MODULE 1 - INTRODUCTION TO AUTONOMOUS DRIVING

7 Hrs

Autonomous Driving Technologies Overview, Autonomous Driving Algorithms, Autonomous Driving Client System: **Robot Operating System**, Hardware Platform, Autonomous Driving Cloud Platform: Simulation, **HD Map Production**.

MODULE 2 - **AUTONOMOUS VEHICLE LOCALIZATION, PREDICTION, AND ROUTING**

8 Hrs

Localization with GNSS, Localization with LiDAR and High-definition maps, Planning and Control in a broader sense, Traffic prediction introduction, Lane Level Routing: Constructing a weighted directed graph for routing, Typical Routing Algorithms.

MODULE 3 - **CLIENT SYSTEMS FOR AUTONOMOUS DRIVING**

8 Hrs

Autonomous driving: A complex system, Operating System for Autonomous Driving, System Reliability, **Resource Management and Security**, Computing Platform, Computer Architecture Design Exploration.

MODULE 4 - **CLOUD PLATFORM FOR AUTONOMOUS DRIVING**

9 Hrs

Introduction, Infrastructure, Distributed Computing Framework, Distributed Storage, Heterogeneous Computing, Simulation, HD Map generation.



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MODULE 5 – CASE STUDY	7 Hrs
Applications/design requirements specifications of Autonomous vehicles (Aerial, under water, ground vehicles), Unmanned aerial vehicles, Google self driving cars.	

TEXT BOOKS:

1. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot, <Creating Autonomous Vehicle Systems=, Morgan and Claypool, 2018.
2. Hong Cheng, <Autonomous Intelligent Vehicles Theory, Algorithms, and Implementation=, Springer, 2011

REFERENCES:

1. Hermann Winner, Stephan Hakuli, Felix Lotz, Christina Singer, <Handbook of Driver Assistance Systems - Basic Information, Components and Systems for
2. Active Safety and Comfort=, Springer Reference
3. Umit Ozguner, Tankut Acarman, Keith Redmill, <Autonomous Ground Vehicles=, Artech House, 2011.
4. Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone, <Global Navigation Satellite Systems, Inertial Navigation, and Integration=, Third Edition, John Wiley and Sons, 2013.



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SEMESTER	VII					
YEAR	IV					
COURSE CODE	20CS4703					
TITLE OF THE COURSE	WIRELESS NETWORKS					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	***	*	***

COURSE OBJECTIVES :

- Understand the architecture and applications of current and next generation wireless networks
- Get a basic introduction to the key concepts and techniques underlying modern physical layer wireless and mobile communications
- Learn how to design and analyze various medium access and resource allocation techniques
- Learn how to design and analyze network layer routing protocols, along with key component mechanisms
- Learn to design and analyze transport layer protocols

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Use mathematics concept of probability theory and queuing theory for mobile ad-hoc and sensor networks.	L3
CO2	Implement various medium access and resource allocation techniques like CSMA, and Error CSMA/CD, CSMA/CA control techniques.	L3
CO3	Execute Multiple division techniques and Static and dynamic channel allocation techniques.	L3
CO4	Compare principles of the modern mobile and wireless communication systems such as 5G with 3G/4G.	L4



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COURSE CONTENT:	
MODULE 1	7Hrs
Introduction, Fundamentals of cellular systems, mobile ad-hoc and sensor networks, wireless PAN/LAN/MAN. Overview of probability theory, traffic theory, queuing theory, and discrete event driven simulations.	
MODULE 2	8Hrs
Mobile radio propagation, multi-path propagation, path loss, slow fading, fast fading. Channel coding and Error Control Techniques. Cellular concept, frequency reuse, cell splitting, cell sectoring. Multiple radio access protocols, CSMA, CSMA/CD, CSMA/CA and standards.	
MODULE 3	8Hrs
Multiple division techniques: FDMA, TDMA, CDMA, OFDM, SDMA. Static and dynamic channel allocation techniques. Mobile Communication Systems: Registration, Roaming, Multicasting, Security and Privacy.	
MODULE 4	8Hrs
Ad-hoc networks, routing in MANETs. Wireless sensor networks, MAC protocols for wireless sensor networks, routing in sensor networks. Wireless PAN (Bluetooth), Wireless LAN (Wi-Fi), Wireless MAN (WiMAX)	
MODULE 5	8Hrs
Introduction, 5G vision, 5G features and challenges, Applications of 5G, 5G Technologies: Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO systems, Adaptive Modulation and coding with time slot scheduler, Cognitive Radio.	

TEXT BOOKS:

1. Dharma Prakash Agrawal and Qing-An Zeng, Introduction to Wireless and Mobile Systems, Tomson, 2010, 3rd edition
2. William Stallings, "Wireless Communications and networks" Pearson / Prentice Hall of India, 2nd Ed., 2007.

REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, <3G Evolution HSPA and LTE for Mobile Broadband=, Second Edition, Academic Press, 2008
2. Vijay K. Grag and Joseph E. Wilkes, Wireless and Personal Communications Systems, 1996.
3. Christian Huitema, Routing in the Internet, Prentice Hall, 1995.
4. Gary. S. Rogers & John Edwards, <An Introduction to Wireless Technology=, Pearson Education, 2007



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SEMESTER	VII					
YEAR	IV					
COURSE CODE	20CS4704					
TITLE OF THE COURSE	CRYPTOGRAPHY					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Prerequisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	***	*	***

COURSE OBJECTIVES:

- Understand OSI security architecture and classical encryption techniques. Acquire fundamental knowledge on the concepts of finite fields and number theory
- To understand the various cryptographic concepts and algorithms
- To understand the underlying mathematical structures of cryptographic algorithm
- To get an overview of the various applications of the cryptographic algorithms and implement them in mini project.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Use basic concepts of encryption, decryption and mathematics associated with cryptography to solve cryptographic problems	L3
CO2	Apply basic, intermediate and advanced protocols to design cryptographic algorithms and techniques	L3
CO3	Implement cryptographic algorithms and techniques MD5, SHA, RSA, Diffie Hellma using modern mathematics for security applications	L3
CO4	Analyze the various cryptographic techniques to solve real world security based problems using modern tools: Metasploit, Wireshark, Burpsuite, Nmap	L4



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COURSE CONTENT:	
MODULE 1	7Hrs
Introduction & Number Theory Services, Mechanisms and attacks-the OSI security architecture-Network security model- Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography). Finite fields and number theory: Overview of Groups, Rings, Fields-Modular arithmetic-Euclid's algorithm. Finite fields- Polynomial Arithmetic, Prime numbers, Fermat's and Euler's theorem- Testing for primality -The Chinese remainder theorem- Discrete logarithms.	
MODULE 2	7Hrs
Cryptographic Protocols Foundations, Protocol Building Blocks - Basic Protocols - Intermediate Protocols, Advanced Protocols , Zero Knowledge Proofs - Zero-Knowledge Proofs of Identity -Blind Signatures - Identity-Based Public-Key Cryptography -Oblivious Transfer - Oblivious Signatures, Esoteric Protocols.	
MODULE 3	9Hrs
Cryptographic Techniques Key Length - Key Management - Electronic Codebook Mode - Block Replay - Cipher Block Chaining Mode, Stream Ciphers - Self-Synchronizing Stream Ciphers - Cipher-Feedback Mode - Synchronous Stream Ciphers, Output Feedback Mode - Counter Mode - Choosing a Cipher Mode - Interleaving - Block Ciphers versus Stream Ciphers -Choosing an Algorithm - Public-Key Cryptography versus Symmetric Cryptography - Encrypting Communications Channels -Encrypting Data for Storage - Hardware Encryption versus Software Encryption - Compression, Encoding and Encryption - Detecting Encryption, Hiding and Destroying Information.	
MODULE 4	7Hrs
Cryptographic Algorithms Information Theory - Complexity Theory - Number Theory - Factoring - Prime Number Generation 3 Discrete Logarithms in a Finite Field - Data Encryption Standard (DES) 3 Lucifer - Madryga - NewDES - GOST 3 3 Way 3 Crab3 RC5 - Double Encryption - Triple Encryption - CDMF Key Shortening - Whitening.	
MODULE 5	9Hrs



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Cryptographic Algorithms Design and Applications

Symmetric Algorithms (Pseudo-Random-Sequence Generators and Stream Ciphers, RC4 - SEAL - Cipher Design - N-Hash - MD4 - MD5 - MD2 - Secure Hash Algorithm (SHA) - One- Way Hash Functions Using Symmetric Block Algorithms)

Asymmetric Algorithms Using Public-Key Algorithms -Message Authentication Codes. RSA - Pohlig-Hellman - McEliece - Elliptic Curve Cryptosystems -Digital Signature Algorithm (DSA) - Gost Digital Signature Algorithm - Discrete Logarithm Signature Schemes, Ongchnorr - Shamir - Diffie-Hellman - Station-to-Station Protocol –Shamir's Three-Pass Protocol, IBM Secret-Key Management Protocol, Kerberos

Case study: IBM Common Cryptographic Architecture.

TEXT BOOKS:

1. Bruce Schneier, Applied Cryptography: Protocols, Algorithms, and Source Code in C, John Wiley & Sons, Inc, 2nd Edition, 2007.
2. William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education, 2013

REFERENCES:

1. Behrouz A. Ferouzan, <Cryptography & Network Security=, Tata McGraw Hill, 2007.
2. Man Young Rhee, <Internet Security: Cryptographic Principles=, <Algorithms and Protocols=, Wiley Publications, 2003.
3. Charles Pfleeger, <Security in Computing=, 4th Edition, Prentice Hall of India, 2006.
4. Ulysess Black, <Internet Security Protocols=, Pearson Education Asia, 2000.
5. Charlie Kaufman and Radia Perlman, Mike Speciner, <Network Security, Second Edition, Private Communication in PublicWorld=, PHI 2002.
6. Bruce Schneier and Neils Ferguson, <Practical Cryptography=, First Edition, Wiley Dreamtech India Pvt Ltd, 2003.
7. Charlie Kaufman, Radia Perlman and Mike Speciner, <Network Security=, Prentice Hall of India, 2002.
8. AtulKahate, Cryptography and Network Security, Tata McGrew Hill, 2003.
9. Wenbo Mao, Modern Cryptography Theory and Practice, Pearson Education, 2004.



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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER	VII					
YEAR	III					
COURSE CODE	20CS4705					
TITLE OF THE COURSE	NATURAL LANGUAGE PROCESSING					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**		*****

COURSE OBJECTIVES:

1. To understand the algorithms available for the processing of linguistic information and computational properties of natural languages
2. To conceive basic knowledge on various morphological, syntactic and semantic NLP task
3. To understand machine learning techniques used in NLP,
4. To write programs in Python to carry out natural language processing

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Use mathematics concept of regular expression and NLP text processing techniques including lemmatization, stop word, tokenization, stemming and spelling error correction for text processing	L2
CO2	Categorize words in the text using n-grams, Part-of-speech tagging for information extraction.	L3
CO3	Implement RNN, LSTM and learning algorithms for NLP with transformer Architectures for Language Modeling	L4
CO4	Implement machine learning algorithms for text data classification. Machine translation using Case study for Spam detection, consumer complaint classification.	L4
CO5	Create scripts and applications in Python to implement concepts of natural language processing used for text processing, categorization and classification.	L5



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COURSECONTENT:	
MODULE1: Introduction	7 Hrs
Past, present and future of NLP; Classical problems on text processing; Necessary Math concepts for NLP ; Regular expressions in NLP ; Basic text processing : lemmatization, stop word, tokenisation, stemming, Spelling errors corrections3 Minimum edit distance, Bayesian method	
MODULE2: Words & Sentences	8 Hrs
N-grams : Simple unsmoothed n-grams; smoothing, backoff, spelling correction using N-grams, Metrics toevaluate N-grams; Parts of Speech tagging: Word classes, POST using Brill's Tagger and HMMs; nformation Extraction: Introduction to Named Entity Recognition and Relation Extraction WordNet and WordNet based similarity measures, Concept Mining using Latent Semantic Analysis	
MODULE3: Sequence to sequence & Language Modelling	8 Hrs
Word embedding : skip-gram model, BERT; Sequence to sequence theory and applications, Attention theory and teacher forcing; Language Modelling: Basic ideas, smoothing techniques, Language modelling with RNN and LSTM;	
MODULE4: ML for NLP	8 Hrs
Classification - binary and multiclass, clustering, regression for text data processing; Machine translation: rule-based techniques, Statistical Machine Translation (SMT); Spam detection, consumer complaint classification.	
MODULE 5: Hidden Markov models and Hands on Practices	8 Hrs
Hidden Markov models : Morkov chains, likelihood Computation, Semantic Analyzer, Text summarization. Self-Learn & Hands on practice: Python libraries supporting NLP ; Hands on Data collection - from social network platforms, pdfs, wordfiles, json, html, Parsing text using regular expression; scraping data from web; Text processing: convert to lowercase, remove punctuation, remove stop words, standardising text, tokenising, stemming, lemmatising.	



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TEXT BOOKS :

1. Daniel Jurafsky and James H. Martin. 2009. Speech and Language Processing: An Introduction to Natural Language Processing, Speech Recognition, and Computational Linguistics. 2nd edition. Prentice-Hall.
2. Christopher D. Manning and Hinrich Schütze. 1999. Foundations of Statistical Natural Language Processing. MIT Press.

REFERENCES :

1. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning, Release 0.16.0, Jan 2021
2. Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT press, 2016.(deeplearningbook.org)
3. Lecture Notes | Advanced Natural Language Processing | Electrical Engineering and computerScience | MIT OpenCourseWare
4. Akshay Kulkarni, Adarsha Shivananda, "Natural Language processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python". ISBN-13 (pbk): 978-1-4842-4266-7 ISBN-13 (electronic): 978-1-4842-4267-4 <https://doi.org/10.1007/978-1-4842-4267-4>
5. Palash Goyal, Sumit Pandey, Karan Jain, Deep Learning for Natural Language Processing - Creating Neural Networks with Python. ISBN-13 (pbk): 978-1-4842-3684-0 ISBN-13 (electronic): 978-1-4842-3685-7, <https://doi.org/10.1007/978-1-4842-3685-7>



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SEMESTER	VII					
YEAR	IV					
COURSE CODE	20CS4706					
TITLE OF THE COURSE	PATTERN RECOGNITION					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	***	*	***

COURSE OBJECTIVES :

- Numerous examples from machine vision, speech recognition and movement recognition have been discussed as applications.
- Unsupervised classification or clustering techniques have also been addressed in this course.
- Analytical aspects have been adequately stressed so that on completion of the course the students can apply the concepts learnt in real life problems.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Identify feature extraction techniques and representation of patterns in feature space.	L2
CO2	Use statistical, nonparametric and neural network techniques for pattern recognition.	L3
CO3	Use techniques for recognition of time varying patterns.	L3



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COURSE CONTENT:	
MODULE 1	8Hrs
INTRODUCTION AND STATISTICAL PATTERN RECOGNITION Introduction: Feature extraction and Pattern Representation, Concept of Supervised and Unsupervised Classification, Introduction to Application Areas. Statistical Pattern Recognition: Bayes Decision Theory, Minimum Error and Minimum Risk Classifiers, Discriminant Function and Decision Boundary, Normal Density, Discriminant Function for Discrete Features, Parameter Estimation.	
MODULE 2	8Hrs
DIMENSIONALITY PROBLEM AND NONPARAMETRIC PATTERN CLASSIFICATION Dimensionality Problem: Dimension and accuracy, Computational Complexity, Dimensionality Reduction, Fisher Linear Discriminant, Multiple Discriminant Analysis. Nonparametric Pattern Classification: Density Estimation, Nearest Neighbour Rule, Fuzzy Classification	
MODULE 3	8Hrs
LINEAR DISCRIMINANT FUNCTIONS Linear Discriminant Functions: Separability, Two Category and Multi Category Classification, Linear Discriminators, Perceptron Criterion, Relaxation Procedure, Minimum Square Error Criterion, Widrow-Hoff Procedure, Ho-Kashyap Procedure, Kesler's Construction	
MODULE 4	8Hrs
NEURAL NETWORK CLASSIFIER AND TIME VARYING PATTERN RECOGNITION Neural Network Classifier: Single and Multilayer Perceptron, Back Propagation Learning, Hopfield Network, Fuzzy Neural Network, Time Varying Pattern Recognition: First Order Hidden Markov Model, Evaluation, Decoding, Learning	
MODULE 5	7Hrs
UNSUPERVISED CLASSIFICATION Unsupervised Classification: Clustering, Hierarchical Clustering, Graph Based Method, Sum of Squared Error Technique, Iterative Optimization	



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TEXT BOOKS :

1. Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification", John Wiley & Sons, 2001
2. Earl Gose, Richard Johnsonbaugh and Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall, 1999.

REFERENCES :

1. Robert J. Schalkoff, Pattern Recognition Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 1992.
2. Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974.



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SEMESTER	VII					
YEAR	IV					
COURSE CODE	20CS4707					
TITLE OF THE COURSE	SEQUENCE NETWORKS AND GAN					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	***	*	***

COURSE OBJECTIVES:

- Provide technical details about sequence networks
- Learn the fundamentals of Generative Adversarial Networks.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Design and implement efficient algorithms using Deep networks and GANs.	L3
CO2	Train and build models to develop real world Machine learning based applications and products.	L3

COURSE CONTENT:

MODULE 1		8Hrs
Introduction to Deep Learning: Evolution, Sigmoid activation, ReLU, ELU, Stochastic Gradient Descent, Learning rate tuning, Regularization, Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN) and Long Short Term Memory (LSTM) Networks, Discriminative versus Generative models.		
MODULE 2		7Hrs
Techniques to improve Neural Networks: Deep Neural Networks (DNN) Optimization and Regularization and Automated Machine Learning (AutoML), Unsupervised pre-training, transfer learning, and domain adaptation.		



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MODULE 3	8Hrs
Fundamentals of Generative Adversarial Networks (GANs): Unsupervised learning with GAN, Neural architecture search, network compression, graph neural networks. Automating human tasks with deep neural networks.	
MODULE 4	8Hrs
The purpose of GAN, An analogy from the real world, Building blocks of GAN. Implementation of GAN, Applications of GAN , Challenges of GAN Models, Setting up failure and bad initialization, Mode collapse, Problems with counting, Problems with perceptive.	
MODULE 5	8 Hrs
Improved training approaches and tips for GAN , Feature matching, One sided label smoothing, normalizing the inputs, optimizer and noise, Batch norm, Avoiding sparse gradients with ReLU, MaxPool	

TEXT BOOKS:

1. Kuntal Ganguly, (2017), Learning Generative Adversarial Networks, Packt Publishing
2. Good fellow, I., Bengio, Y., and Courville, A., (2016), Deep Learning, The MIT Press.

REFERENCES:

1. Charniak, E. (2019), Introduction to deep learning, The MIT Press.



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SEMESTER	VII					
YEAR	IV					
COURSE CODE	20CS4708					
TITLE OF THE COURSE	UG Research Project -II/Product Development Foundation-II					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	-	6	-	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	***	*	***

COURSE OBJECTIVES:

- To identify key research questions within a field to carry out research in a team
- To identify and summarize the literature review of the relevant field
- To demonstrate relevant referencing and inculcate new skills in various aspects of academic writing
- To demonstrate the knowledge and understanding of writing the publication/report
- To showcase the strong evidence on the clarity of the argument, understanding of the selected domain area and presentation of its technical information
- To detail description of the process of carrying out the independent research in written document along with results and conclusions with reference to the existing literature
- To analyze and synthesize the new research findings

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Develop the research project by selecting an appropriate research problem.	L4
CO2	Compare the papers relevant to the selected problem domain	L3
CO3	Construct the model and perform the model evaluation and analysis.	L6
CO4	Draft of the Publication or Demonstration of the Proof-of-concept product, Draft of the patent application.	L5



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COURSE CONTENT:

The research topic proposed by both the guide and the student team should be approved by the department chairman to proceed further. A degree of **industrial input and involvement will be encouraged**, and can be facilitated through existing academic-industrial collaborations or by addressing specific topics that are of interest to industrial partners.

All projects will be closely supervised by the Project Guide with ongoing feedback and guidance at all stages of the project from the conception to completion.

The following criteria will be checked by the department chairman to approve for the research proposal:

a. Department staff as course guide

1. Ability to provide **research direction to the student** in the chosen field of interest
2. Ability to **design an appropriate research strategy and methodology** to carry out the research by student
3. Ability to provide and evaluate the strong literature review document for the chosen research topic
4. Ability to train students on research paper / technical writing skills
5. Conduct reviews in regular time period and submit the evaluation to department chairman

b. Student Team

1. To be dedicated and committed to work on a new research topic by learning new technical skills
2. To have fair knowledge on what is product development or research topic
3. To have constant interaction with allocated guide by providing weekly updates
4. To be committed to complete the project and submitting the technical paper within the stipulated time framed by the university

c. Department staff as course guide

1. Ability to provide **research direction to the student** in the chosen field of interest
2. Ability to **design an appropriate research strategy and methodology** to carry out the research by student
3. Ability to provide and evaluate the strong literature review document for the chosen research topic
4. Ability to train students on research paper / technical writing skills
5. Conduct reviews in regular time period and submit the evaluation to department chairman

d. Student Team

1. To be dedicated and committed to work on a new research topic by learning new technical skills
2. To have fair knowledge on what is product development or research topic
3. To have constant interaction with allocated guide by providing weekly updates
4. To be committed to complete the project and submitting the technical paper within the stipulated time framed by the university



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Evaluation:

There will be CIA evaluation as well as the Semester end evaluation of the work done. It will be done by a committee of senior researchers of the Department.



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SEMESTER	VII					
YEAR	IV					
COURSE CODE	20CS4709					
TITLE OF THE COURSE	AWS WEB SERVICES					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course

COURSE OBJECTIVES:

- To understand fundamental concepts and hands-on knowledge of Cloud Computing using AWS Platform
- Conceive, Design and Develop state-of-the-art AWS Networking, Database, Storage Services
- Ability to understand and apply evolve Security and privacy in AWS Cloud across various domains like Storage, Database and applications.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Utilize the fundamental concepts of Cloud computing, Amazon EC2, load balancing and Auto scaling in developing AWS cloud platform.	L3
CO2	Examine the services such as compute, network and storage which runs on AWS platform.	L4
CO3	Design and Develop the latest AWS Networking, Database, and Storage Services on AWS Platform.	L3
CO4	Develop Amazon Simple Storage Service, Amazon Elastic File System, Glacier, Amazon Elastic Block storage gateway application using AWS tools.	L3



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CO5	Apply AWS database services design principles, framework and protocols to develop dependable systems and appropriate projects for real-world problems.	L3
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COURSE CONTENT:

MODULE 1: Introduction	8Hrs
What is Cloud Computing? How Does Cloud Computing Work? What is AWS? AWS Free Tier, Compute Services: Amazon EC2, Elastic Load Balancing, Auto Scaling	
MODULE 2: Networking Services	6 Hrs
Amazon VPC, Amazon Route 53	
MODULE 3: AWS Security	6Hrs
Shared Responsibility Model, AWS IAM and KMS	
MODULE 4 : Storage Services	9 Hrs
Amazon S3, Amazon EBS, Amazon EFS, Amazon Glacier, AWS Storage Gateway, Amazon Cloud Front	
MODULE 5: AWS Database Services, Application Services	10 Hrs
Amazon RDS, Amazon DynamoDB, Amazon ElastiCache, Amazon Simple Email Service (Amazon SES), Amazon Simple Notification Service (Amazon SNS), Amazon Simple Queue Service (Amazon SQS), Amazon Simple Workflow Service (Amazon SWF)	

TEXT BOOKS:

1. Ben Piper, David Clinton, AWS Certified Solutions Architect Study Guide: Associate SAA-C02 Exam (Aws Certified Solutions Architect Official: Associate Exam)= Paperback – 22 February 2021



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SEMESTER	VII					
YEAR	IV					
COURSE CODE	20CS4710					
TITLE OF THE COURSE	AUGMENTED REALITY AND VIRTUAL REALITY					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	--	-	--	39	3

COURSE OBJECTIVES:

- To understand the a scientifically sound principles of Augmented and Virtual Reality.
- Assess and compare technologies in the context of AR and VR systems design.
- Demonstrate the knowledge of the input devices, tracking and output devices for both compositing and interactive applications.
- Demonstrate the use of objects for managing large scale Virtual Reality environment in realtime.
- Discuss the various solutions using Virtual Reality system framework and development tools for industry and social relevant applications.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Review the Fundamental concepts of Virtual and Augmented Reality with hard and soft component and history	L1
CO2	Design the Perceptual Aspects of VR and Virtual World	L3
CO3	Describe the input devices, tracking and output devices in AR-VR Applications	L2
CO4	Summarize the interaction and real aspect of AR VR systems	L2
CO5	Articulate and illustrate the applications in authorizing and mathematical aspects of AR- VR tools	L4

COURSE CONTENT	
MODULE1	6Hrs
Introduction to Virtual and Augmented Reality	
What is Virtual Reality (VR)? What is Augmented Reality (AR)? What is the purpose of VR/AR? What are the basic concepts? What are the hard- and software components of VR/AR systems? How has VR/AR developed historically?	

MODULE 2	9 Hrs
Perceptual Aspects of VR and Virtual World VR phenomena-double vision and cybersickness. human perception processes, human information processing, different limitations of human perception, Virtual worlds, the contents of VR environments, dynamic behaviour of 3D objects. interactions with 3D objects.	
MODULE 3	9 Hrs
VR/AR Input Devices, Tracking and Output Devices How do Virtual Reality (VR) and Augmented Reality (AR) systems recognize the actions of users, know where the user is, track objects in their movement, input devices for VR and AR. Output devices and technologies for VR and AR. Devices for visual output play, stationary displays, acoustic and haptic outputs.	
MODULE 4	9 Hrs
Interaction in Virtual Worlds, Real-Time Aspects of VR Systems Design and realization of interaction and the resulting user interface of a VR/AR system, system control, selection, manipulation and navigation, real-time capability of VR systems., types of latencies, efficient collision detection.	
MODULE 5	9 Hrs
Authoring and Mathematical Foundations of VR/AR Applications. Authoring of VR and AR applications, the authoring process and the use of the tools, mathematical methods offer fundamental principles to model three-dimensional space Group	

Activity: Design a Google Cardboard in LAB for VR Experience.

Authoring of VR and AR applications, the authoring process and the use of the tools, mathematical methods offer fundamental principles to model three-dimensional space

Group Activity: Design a Google Cardboard in LAB for VR Experience.

List of Practical Experiments activities to be conducted

1. Open sources VR and AR Tools
2. Introduction to Unity: Interface overview and installation
3. start a new project, add a player character, import common assets, and use the asset store to add objects, lighting, scenes, and prefabs in Unity.
4. Scripting and Interaction using Unity: Object-Oriented Scripting in Unity, Public variables, the inspector
5. Workings on apps related to AR and VR



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TEXT BOOKS:

1. Ralf Doerner, Wolfgang Broll, Paul Grimm, Bernhard Jung: Virtual and Augmented Reality (VR/AR)-Foundations and Methods of Extended Realities (XR)-springers-2022.

REFERENCES:

1. Schmalstieg D. and Hollerer T., AugmentedAnd Virtual Reality, Addison–Wesley (2016).
2. Aukstakalnis S., Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR, Addison–Wesley (2016).
3. Erin Pangilinan, Steve Lukas, Vasanth Mohan: Creating Augmented and Virtual Realities: Theory and Practice for Next–Generation Spatial Computing.
4. Doug A. B., Kruijff E., LaViola J. J. and Poupyrev I. , 3D User Interfaces: Theory and Practice , Addison–Wesley (2005,201p) 2nd ed.
5. Parisi T., Learning Virtual Reality, O'Reilly (2016) 1st ed.
6. Whyte J., Virtual Reality and the Built Environment, Architectural Press (2002).



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SEMESTER	VIII					
YEAR	IV					
COURSE CODE	20CS4803					
TITLE OF THE COURSE	PARALLEL COMPUTING					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	--	--	--	39	3

Perquisite Courses (if any):

#	Sem/Year	Course Code	Title of the Course
*	***	*	***

COURSE OBJECTIVES:

- To understand the architectural, hardware, OS and programming aspects in High Performance Computing
- To understand the distributed memory programming, shared memory programming, and a few parallel applications

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Analyze the problem for various ways of parallelization, and design the best parallel algorithm.	L4
CO2	Design and implement parallel solutions to the given problem	L3
CO3	Apply the constructs of parallel programming model to convert a sequential program to parallel program	L3
CO4	Develop parallel programs using OpenMP and MPI construct	L3

COURSE CONTENT:

MODULE 1	8 Hrs
Introduction to Computer Systems: Processors, Memory, I/O Devices; Cost, timing, and scale (size) models. Program Execution: Process, Virtual Memory, System Calls, Dynamic Memory Allocation.	
MODULE 2	8 Hrs



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Machine-Level View of a Program: typical RISC instruction set and execution, Pipelining. Performance issues and Techniques, Cost and Frequency Models for I/O, paging, and caching. Temporal and spatial locality.	
MODULE 3	8Hrs
Typical Compiler Optimizations: Identifying program bottlenecks 3 profiling, tracing. Simple high-level language optimizations 3 locality enhancement, memory disambiguation. Choosing Appropriate Computing Platforms: benchmarking, cost- performance issues.	
MODULE 4	8Hrs
Parallel Computing: Introduction to parallel Architectures and Interconnection Networks, communication latencies. Program parallelization: task partitioning and mapping, data distribution, Message passing, synchronization and deadlocks.	
MODULE 5	7Hrs
Distributed memory programming using MPI/PVM. Shared memory parallel programming. Multithreading.	

TEXT BOOKS:

1. Dowd, K., High performance Computing, O'Reilly Series, 1993.
2. Culler, D., and Singh, J.P., Parallel Computer Architecture: A Hardware/Software Approach. Morgan Kaufmann Pub., 1999.

REFERENCES:

1. Gropp, W., Lusk, E., and Skjellum, A., Using MPI: Portable Parallel Programming with the Message-passing Interface, MIT Press, 1997.
2. Grama, Gupta, A., Karypis, G., Kumar, V., Introduction to Parallel Computing, Addison Wesley, 2003. ISBN:0-201-64865-2



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SEMESTER	VIII					
YEAR	IV					
COURSE CODE	20CS4804					
TITLE OF THE COURSE	SOCIAL NETWORKS AND ANALYTICS					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	--	2	--	26+26	3

Perquisite Courses (if any):

#	Sem/Year	Course Code	Title of the Course
*	***	*	***

COURSE OBJECTIVES:

- To understand the Social network concepts and its issues/challenges, various tools of Social network analysis.
- To know about Social network APIs.
- To know about mining and classification techniques of Social networks.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Use the basic concepts of Social networks like nodes, edges, adjacency matrix, neighborhood, degree, geodesic, diameter and clustering coefficients to analyze the social network data.	L3
CO2	Interpret content-based analysis and static and dynamic analysis for real-time data or online content.	L3
CO3	Examine the importance of social network APIs and community detection in real-time networks..	L4
CO4	Predicting the relationship between nodes by analyzing the impact on the specified social network like twitter, LinkedIn and Facebook	L4
CO5	Simulate and validate the social networks by using different tools of SNA	L5

COURSE CONTENT:

MODULE 1	5Hrs
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Introduction	
Social network concepts, Development of social network and analysis - Online social networks, Social Network Data - Issues and challenges	
MODULE 2	5Hrs
Linked-based and structural analysis - Content-based analysis - Static and dynamic analysis Mathematical Representation of social networks	
MODULE 3	6Hrs
Social networking systems and API - Statistical Analysis of Social Networks, Community Detection in Social Networks - Node Classification in Social Networks - Evolution in Dynamic Social Networks	
MODULE 4	6Hrs
Social Influence Analysis -Link Prediction in Social Networks -Data Mining in Social Media Text Mining in Social Networks - Social Tagging -Building social services	
MODULE 5	6Hrs
UCINET, PAJEK, NETDRAW, StOCNET - SPlus – R, NodeXL- SIENA and RSIENA - Real-world networks (Facebook graph, Twitter networks,) Case Studies	

TEXT BOOKS:

1. Christina Prell, Social Network Analysis: History, Theory and Methodology, SAGE Publications Ltd, Publication Year 2011
2. Stanley Wasserman and Katherine Faust, < Social Network Analysis: Methods and Applications=, Cambridge University Press, 1994

REFERENCES:

1. David Easley and Jon Kleinberg, <Networks, Crowds, and Markets: Reasoning Abouta Highly Connected World=, 2010
2. Carrington and Scott (eds). The SAGE Handbook on Social Network Analysis SAGE, First Edition 2011



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SEMESTER	VIII					
YEAR	IV					
COURSE CODE	20CS4805					
TITLE OF THE COURSE	COMPUTER VISION					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	--	2	--	26+26	3

Perquisite Courses (if any):			
#	Sem/Year	Course Code	Title of the Course
*	***	*	***

COURSE OBJECTIVES:

- To introduce various topics of computer vision with their applications.
- Combining the analytics with CV which helps in various Video Analytics processing.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Analyze the concepts of video analytics in a much easier way using Stereo Vision and Structure from motion features	L4
CO2	Identify Depth estimation and views of an object from different position using Homography, Rectification, RANSAC, 3-D reconstruction framework	L3
CO3	Observe the motion parameter to compute the movement of object and structure from motion of an object using Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo Vision.	L4
CO4	Evaluate Shape Representation and approaches for Segmentation using Multi resolution analysis, Region Growing, Edge Based approaches, Graph-Cut, Mean-Shift, Texture Segmentation	L5
CO5	Examine the real-time application of video analytics like. Identifying moving faces, biological perspectives, Computational Theories of temporal identification, identification using holistic temporal trajectories.	L4

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COURSE CONTENT:	
MODULE 1	5Hrs
Image Formation Models Introduction to Computer Vision, Monocular imaging system, Orthographic & Perspective Projection, Camera model and Camera calibration, Binocular imaging systems, Image representations (continuous and discrete), Edge detection, Image Enhancement, Restoration, Histogram Processing	
MODULE 2	6Hrs
Depth estimation, views & Object Recognition Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, RANSAC, 3-D reconstruction framework; Auto-calibration. Hough transforms and other simple, object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition.	
MODULE 3	5Hrs
Motion Estimation & Analysis Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion, Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.	
MODULE 4	5Hrs
Shape Representation and Segmentation Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, Multi resolution analysis, Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, Texture Segmentation; Object detection.	
MODULE 5	5Hrs
Multiview Identification: View based model, view correspondence, in identification, Generalization from multiple view. Identifying moving faces, Biological perspectives, Computational Theories of temporal identification, identification using holistic temporal trajectories, Identification by Continuous view transformation.	

TEXT BOOKS:

1. Computer Vision - A modern approach, by David A. Forsyth and Jean Ponce, Pearson, 2nd Edition, 2015
2. Computer Vision: Algorithms and Applications, by Richard Szeliski, Springer-Verlag London Limited 2011.



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REFERENCES:

1. Dynamic Vision: From Images to Face Recognition, Imperial College Press, World Scientific Publication Co Ltd, 2000
2. Introductory Techniques for 3D Computer Vision, by Emanuele Trucco and Alessandro Verri, Publisher: Prentice Hall. 1998
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
5. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison– Wesley, 1992

SEMESTER	VIII					
YEAR	IV					
COURSE CODE	20CS4806					
TITLE OF THE COURSE	CLOUD INFRASTRUCTURE MANAGEMENT					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-		39	3

Perquisite Courses (if any):

#	Sem/Year	Course Code	Title of the Course
*	***	*	***

COURSE OBJECTIVES:

- **Understand** Cloud Computing architecture for various Cloud based enterprises, challenges, workflow and architectural style of cloud computing.
- **Comprehend** Cloud Enabling Technologies that includes: virtualization technologies and their role in cloud computing, Differentiate between full and para virtualization, and Cloud resource management and scheduling
- **Analyze** Cloud storage Mechanisms and evaluate various infrastructure components in a cloud environment
- **Identify** common security challenges in cloud computing, Discuss security and privacy concern for cloud users, virtual machines and shared images.
- **Evaluate** the key technologies used in Xen VMM and various cloud applications

COURSE OUTCOMES:

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Examine the cloud computing infrastructure at Amazon, Google, and Microsoft and analyse the challenges of cloud.	L4
2	Identify the different layers of virtualization and make use of the proper scheduling algorithm to manage the resources.	L3
3	Compare the different types of file system used in cloud environment and analyze the transaction process using NoSQL databases.	L4, L5
4	Analyze the core issues of cloud computing, such as security, privacy, and interoperability.	L4
5	Evaluate the effectiveness of different cloud computing solutions for various applications.	L5



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COURSE CONTENT:	
MODULE 1: Cloud Infrastructure and Application Paradigms	9Hrs
Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. <i>(Textbook-1: Chapter 3: 67-95).</i> Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model. <i>(Textbook-1: Chapter 4: 99-115).</i>	
MODULE 2: Virtualization and Resource Management & Scheduling	9Hrs
Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and para virtualization, Hardware support for virtualization. <i>(Textbook-1: Chapter 5: 132-142).</i> Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Stability of a two level resource allocation architecture, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling. <i>(Textbook-1: Chapter 6: 164, 182-201).</i>	
MODULE 3: Cloud Storage Structure	7Hrs
The Evolution of Storage Technology, Storage Models, File Systems, and Databases, Distributed File Systems: The Precursors, General Parallel File System, Google File System, Apache Hadoop, Locks and Chubby: A Locking Service, Transaction Processing and NoSQL Databases, BigTable, Megastore. <i>(Textbook-1: Chapter 8: 242-278).</i>	
MODULE 4 : Cloud Security and Mechanisms	7Hrs
Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor. <i>(Textbook-1: Chapter 9: 274-298).</i>	
MODULE 5 : Case Study	7Hrs
The Grep The Web application, Cloud for science and engineering, High performance computing on a cloud, Cloud computing for Social computing, digital content and cloud computing <i>(Textbook-1: Chapter 4: 118-128).</i> Xen a VMM based para virtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization <i>(Textbook-1: Chapter 5: 144-156).</i>	



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TEXT BOOKS:

1. Cloud Computing: Theory and Practice, Dan C Marinescu Elsevier (MK), 2013.

REFERENCE BOOKS:

1. Computing Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley, 2014.
2. Cloud Computing Implementation, Management and Security John W Rittinghouse, James F Ransome, CRC Press, 2013.

SEMESTER	VII					
YEAR	IV					
COURSE CODE	20OE0003					
TITLE OF THE COURSE	WEB TECHNOLOGIES					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	45	3

Perquisite Courses (if any)

#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

1. Understand the major areas of web programming
2. To Create website using HTML5, CSS3, JavaScript.
3. Use of fast dynamic Interactive Responsive Website design using jQuery.
4. Server Side Scripting using Node.JS, Express JS and MongoDB

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Know the fundamentals of front-end web technologies - HTML5 and CSS3	L1
CO2	Client-Side Validation using Java script.	L2
CO3	Use of fast dynamic Interactive Responsive Website design using jQuery.	L3
CO4	Building Web app using Node.js, Mongo dB	L5
CO5	Building Web app using Express JS	L5

COURSE CONTENT:

MODULE 1		9 Hrs
Markup Language (HTML5): Introduction to HTML and HTML5 - Formatting and Fonts -Commenting Code – Anchors – Backgrounds – Images – Hyperlinks – Lists – Tables – HTML Forms.		
CSS3: Levels of style sheets; Style specification formats; Selector forms; Property value forms; Font properties; List properties; Color; Alignment of text; Background images, Conflict Resolution, CSS Box Model, CSS3 features: Box Shadow, Opacity, Rounded corners, Attribute selector.		
MODULE 2		9Hrs
JavaScript: Overview of JavaScript; Object orientation and JavaScript; General syntactic		
characteristics; Primitives, operations, and expressions; Screen output and keyboard input. Control statements; Arrays; Functions, Constructors; Pattern matching using regular expressions.		
MODULE 3		9 Hrs



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jQuery

Getting started with jQuery: Introducing jQuery, **Action/Reaction**: Making Pages Come Alive with Events , Animations and Effects , DOM Traversal and Manipulation, Ajax the **jQuery Way** : The *load()* Function , The *get()* and *post()* Functions

JSON: JSON syntax, data types, JSON. parse, JSON. stringify.

MODULE 4

9 Hrs

Node JS

Introduction to NodeJS, Set up Dev Environment, Node JS Modules, Node Package Manager, File System, Debugging NodeJS Application, Events, MVC Architecture In Node JS Applications, Database connectivity using Mongo DB.

MODULE 5

9 Hrs

Express.JS

Introducing Express: Basics of Express, Express JS Middleware: Serving Static Pages ,Listing Directory Contents, **Accepting JSON Requests and HTML Form Inputs, Handling Cookies, Compression ,Time out Hanging Requests.**

Text Books

1. Robert W. Sebesta , "Programming the World Wide Web", 7th Edition, Pearson Education, 2008.
2. Basarat Ali Syed," Beginning Node.js ",Apress ,2014 3.
4. David Sawyer McFarland, "JavaScript & jQuery-the missing manual" , Second Edition, O'Reilly.

Reference Books

1. Internet & World Wide Web How to program – M. Deitel, P.J. Deitel, A. B. Goldberg, 3rd Edition, Pearson Education / PHI, 2004.
2. Callum Macre, Learning from JQuery, O'Reilly,
3. Beginning JSON, BEN SMITH, 2015.

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SEMESTER/YEAR : 3rd or 4th Year
COURSE CODE : 200E0005
TITLE OF THE COURSE : MANAGEMENT INFORMATION SYSTEMS
L: T/A: P: C : 3 : 0 : 0 : 3

COURSE OBJECTIVES:

- 1) To learn Computer Systems, fundamentals of Information Systems, Telecommunications and Networks,
- 2) To study and understand the Data Source Management and DSS and Business Applications

COURSE OUTCOMES: At the end of the course students will be able to

1. Understand Computer Systems, Networks and fundamentals of Information Systems
2. Know the Data Resource Management and Decision Support System and apply them to Business Applications

Module 1: Computer System

7hrs

Introduction to computer technology, Computer System Concepts, Types of Computer Systems, Computer System Concepts, Memory (Primary Storage, Secondary Storage, Cache), CPU-Central Processing Unit, Hardware (input Devices, output Devices, Software and its Classification, Types of Computer System.

Module 2: Foundation of Information System

9hrs

Data, Data processing, Information, Information System, Characteristics of Information System, Need of Information Systems in Business, Fundamental Resources of Information System, Potential Risks for Information System, Types of Information System (TPS, MIS, DSS, ESS), Definition, objectives of MIS, Characteristics, Applications of MIS, Benefits and Limitations of MIS, Approaches of MIS Development, Implementations of MIS, System Development Life Cycle (SDLC) and its Stages, Success and Failure of MIS.

Module 3: Telecommunication and Network

7hrs

Networking the Enterprise, The Concept of a Network, The Business value of Telecommunications Networks, Types of Telecommunications Networks, Telecommunications Media, Network Topologies, Trends in Telecommunications.

Module 4: Data Resource Management and DSS

12hrs

Fundamental Data Concepts, Database structures, Database Development, Types of Databases, Technical Foundation of Database Management, Data warehouses and Data Mining, Decision Support in Business, Decision Structures, Decision Support Trends Decision Support Systems, online Analytical Processing. Using Decision support systems.

Practical: Microsoft Access, Database Creating New Database, Setting up Tables, Form and Report Design.

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Module 5: Business Applications

11 hours

E-business systems, Customer Relationship Management Customer Relationship Management CRM, Three Phases of CRM. Benefits and Challenges of CRM, Trends in CRM, Enterprise Resource Planning Enterprise Resource Planning ERP Benefits and Challenges of ERP, Trends in ERP supply Chain Management SCM, Roles of SCM, Benefits and Challenges of SCM, Trends in SCM, Ecommerce Systems E-Commerce and its scope, Essential e-Commerce Processes, Electronic Payment Processes

Applications and Case Studies : Introduction to Hospitality Information System, Characteristics of Hospitality Information System, Computer Reservation System (CRS), Global Distribution System (GDS), Property Management Systems (PMS), Point of sales Systems(POS)

Text Book :

1. O'Brien, J. A, Marakas, G. M. Management Information systems (10th Edition)
McGraw Hill, New York: 2011

Reference Book:

1. Kenneth, C. L. Jane P. L Management Information Systems (12th Edition) Pearson Education, New Jersey 2010
2. Tesone, D. F. Hospitality Information System & E-commerce John Wiley & Sons, New Jersey, 2006

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SEMESTER/YEAR	: 5TH OR 6TH OR 7TH /3RD OR 4TH YEAR
COURSE CODE	: 200E0007
TITLE OF THE COURSE	: Machine Learning with Python
L: T/A: P: C	: 3:0:0:3

Course Objectives:

1. To understand the difference between the two main types of machine learning methods: supervised and unsupervised
2. To learn Supervised learning algorithms, including classification and regression
3. To learn Unsupervised learning algorithms, including Clustering and Dimensionality Reduction
4. To get hands-on experience in machine learning algorithms using libraries in Python
5. Real-life examples of the different ways machine learning affect society

Course Outcomes:

1. Differentiate between the two main types of machine learning methods: supervised and unsupervised
2. Program Supervised learning algorithms, including classification and regression
3. Program Unsupervised learning algorithms, including Clustering and Dimensionality Reduction

Course Content

Module 1: Introduction to Python and Machine Learning

Overview , Applications of Machine Learning, Types of Machine Learning, Basics of Python, Python Libraries for Machine Learning

Pandas for importing Data, Numpy, Scipy, data visualization using Matplotlib **9 hours**

Module 2: Regression

Linear Regression, Non-linear Regression, Model Evaluation **7 hours**

Module 3: Classification

Logistic Regression, K-Nearest Neighbor, Decision Trees, Naive Bayes classifier, Support Vector Machines, Model Evaluation **8 hours**

Module 4: Feature selection and Dimensionality Reduction

Principal Component Analysis (PCA), Multidimensional Scaling (MDS), Bagging and Boosting

8 hours

Module 5: Unsupervised Learning

K-Means Clustering, Hierarchical Clustering, Density-Based Clustering **7 hours**

Textbooks:



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1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education
2. Sebastian Raschka, Python Machine Learning, third edition, 2019 Packt Publishing Ltd.
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson, First impression, 2014.
4. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining -Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publisher, 2012.

Reference Books:

1. Machine Learning Algorithms <https://www.oreilly.com/library/view/machine-learning-algorithms/9781785889622/>
2. Rudolph Russell :Machine learning step by step guide to implement
3. Shai Shalev-Shwartz, Shai Ben-David :Understanding Machine learning from theory to algorithms
4. Scikit-Learn : <https://link.springer.com/book/10.1007/978-1-4842-5373-1>

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SEMESTER/YEAR: 7/4

COURSE CODE: 200E0008

TITLE OF THE COURSE: BUSINESS INTELLIGENCE

L: T/A: P: C: 3: 0:0 :3

Course Objective:

- To understand the fundamentals of Business Intelligence
- To identify the appropriateness and need Analysis the data
- To learn the preprocessing, mining and post processing of the data
- To understand various methods, techniques and algorithms in Business Intelligence

Course Outcomes:

At the end of the course the students will be able to:

- Apply basic, intermediate and advanced techniques to analysis the data
- Analyze the output generated by the process of Business Intelligence
- Explore the hidden patterns in the data
- Optimize the mining process by choosing best Business Intelligence technique

Module 1: Business Intelligence

9 Hrs

Effective and timely decisions – Data, information and knowledge – Role of mathematical models – **Business intelligence architectures**: Cycle of a business intelligence analysis – Enabling factors in business intelligence projects – **Development of a business intelligence system** – Ethics and business intelligence.

Module 2: Knowledge Delivery

9 Hrs

The business intelligence user types, Standard reports, Interactive Analysis and Ad Hoc Querying, **Parameterized Reports and Self-Service Reporting, dimensional analysis. Visualization**: Charts, Graphs, Widgets, Scorecards and Dashboards, Geographic Visualization

Module 3: Decision Making Concepts

9 Hrs

Concepts of Decision Making, Techniques of Decision Support System (DSS), Types of Decision Support System (DSS), **Development of Decision Support System (DSS), Applications of DSS**, Role of Business Intelligence in DSS

Module 4: Classification & Unsupervised Learning

9 Hrs **Classification:**

Classification Problem, Classification Models, Classification Trees, Bayesian Method; **Association Rule**: Structure of Association Rule, Apriori Algorithm, General Association; Clustering: Clustering Methods, Partition Methods, Hierarchical Methods

Module 5: Business Intelligence Applications

9 Hrs

Data analytics, business analytics, ERP and Business Intelligence, BI Applications in CRM, BI Applications in Marketing, BI Applications in Logistics and Production, Role of BI in Finance, BI Applications in Banking, BI Applications in Telecommunications



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Text Books:

1. R. Sharda, D. Delen, & E. Turban, Business Intelligence and Analytics. Systems for Decision Support, 10th Edition. Pearson/Prentice Hall, 2015. ISBN-13: 978-0-13-305090-5, ISBN-10: 0-13-305090-4;
2. Business Process Automation, Sanjay Mohapatra, PHI.

References

1. Larissa T. Moss, S. Atre, “Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making”, Addison Wesley, 2003.
2. Carlo Vercellis, “Business Intelligence: Data Mining and Optimization for Decision Making”, Wiley Publications, 2009.
3. David Loshin Morgan, Kaufman, “Business Intelligence: The Savvy Manager’s Guide”, Second Edition, 2012.
4. Cindi Howson, “Successful Business Intelligence: Secrets to Making BI a Killer App”, McGraw-Hill, 2007.
5. Ralph Kimball , Margy Ross , Warren Thornthwaite, Joy Mundy, Bob Becker, “The Data Warehouse Lifecycle Toolkit”, Wiley Publication Inc., 2007.