MALNAD COLLEGE OF ENGINEERING, HASSAN

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Ethics: Apply ethical principles and commit to professional ethics and responsibilitiesand norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a memberor leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex engineering activities withthe engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding ofthe engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognize the need for, and have the preparation and ability toengage in independent and life-long learning in the broadest context of technological change.

Scheme & Syllabus for IV Year
B. E. Information Science and Engineering
Academic Year 2023-24

VII Semester					
Course Category	**Course Code**	**Course Title**	**L-T-P In hrs**	**Credits**	**Contact hours**
PC-25	20IS701	Cryptography, Network Security and Cyber Law	3-0-0	3	3
PC-26	20IS702	Cloud Computing	3-0-0	3	3
PC-27	20IS703	Machine Learning	3-0-2	4	5
PC-28	20ID01	Industry Driven Course	1-0-0	1	2
PROJ-3	20IS704	Main Project Phase 1	0-0-2	1	2
PE-2	20IS7XX	Elective II	3-0-0	3	3
PE-3	20IS7XX	Elective III	3-0-0	3	3
OE-1	20OEISXX	Open Elective – 2	3-0-0	3	3
PC-29	20SW02	SWAYAM course - 2 (Mandatory Audit Course)	-	0	0
		Total Credits		**21**	**23**

Elective Group II		**Elective Group III**		**Open Electives**	
20IS751	User Interface Design	20IS761	Big Data Technologies	20OEIS71	Data Warehousing & Mining
20IS752	Digital Image Processing	20IS762	Service Oriented Architecture	20OEIS72	Internet of Things
20IS753	Enterprise Resource Planning	20IS763	Principles of Programming Languages	20OEIS73	Introduction to Java Programming
20IS754	Mobile Computing Applications	20IS764	Robotic Process Automation	20OEIS74	Data Science

VIII Semester					
Course Category	Course Code	Course Title	L-T-P	Credits	Contact hours
SR-1	20IS801	Seminar on Advanced Topics	0-2-0	1	-
PROJ-4	20IS802	Main Project Work Phase 2	0-0-10	10	9
IN	20IS803	Internship (two weeks)	0-0-1	1	-
PC-30	20IS804	Software Testing	3-0-0	3	3
PE-5	20IS8XX	Elective - IV	3-0-0	3	3
PE-6	20IS8XX	Elective - V	3-0-0	3	3
Total Credits				21	11

SR: Seminar Technical is based on Research paper of recent years on Technology Trends in Healthcare, Finance etc.

IN: Summer/Winter Internship (with any company during mandatory internship of at least TWO/FOUR weeks during the vacation period.

Elective Group-IV		Elective Group-V	
20IS851	Data Science	20IS861	Block Chain Technology
20IS852	Pattern Recognition	20IS862	Object Oriented Modelling and Design
20IS853	System Modelling & Simulation	20IS863	Information Retrieval Methods
20IS854	Parallel Computing	20IS864	Deep Learning
20IS855	Internet Engineering	20IS865	Natural Language Processing

Course Title	CRYPTOGRAPHY, NETWORK SECURITY AND CYBER LAW		
Course Code	20IS701	(L-T-P)C	(3-0-0) 3
Exam	3 Hrs	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: The course provides a basic understanding of the fundamentals of Cryptographic techniques and various algorithms used to provide security services.

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Describe the basics of cryptographic techniques, principles & practices, Cyber security and cyber law.	1	-
2.	Apply cryptographic techniques to secure the data in transit.	2	-
3.	Analyze different cryptographic techniques to handle security threats	2	-
4.	Elucidate and adopt Cyber security and Cyber law	8	-

MODULE – 1	10 Hrs.

Overview: Computer Security Concepts. The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms. A Model for Network Security. Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques.

Block Ciphers and the Data Encryption Standard: Traditional Block Cipher Structure, The Data Encryption Standard, A DES Example, The Strength of DES, Block Cipher Design Principles.

MODULE – 2	10 Hrs.

Asymmetric Ciphers: Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie Hellman Key Exchange.

Message Authentication Codes: Message Authentication Requirements, Message Authentication Functions. **Digital Signatures**: Digital Signatures, NIST Digital Signature Algorithm.

Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificate.

MODULE -3	10 Hrs.

User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos, Remote User-Authentication Using Asymmetric Encryption, Federated Identity Management, Personal Identity Verification.

Network and Internet Security: Network Access Control and Cloud Security: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control, Cloud Computing, Cloud Security Risks and Countermeasures.

MODULE -4	10 Hrs.

Transport-Level Security: Web Security Considerations, Secure Sockets Layer Transport Layer Security, HTTPS, Secure Shell (SSH).

Cyber Law: IT act aim and objectives, Scope of the act, Major Concepts, Important Provisions, Attribution, acknowledgement, and dispatch of electronic records. Regulation of certifying authorities, Penalties and adjudication, The cyber regulations appellate tribunal.

Text Books:

1. William Stallings, “Cryptography and Network Security”, 7th Edition, Pearson Education, 2014.
2. Bernard Menezes, “Cryptography, Network Security and Cyber Laws", Cengage Learning, 2010 Edition.

Reference Books:

1. Charlie Kaufman, Radia Perlman, Mike Speciner, “Network Security: Private Communication in a Public World”, 2nd Edition, Pearson Education India, 2016.
2. Atul Kahate, “Cryptography and Network Security”, 3rd edition, Tata McGraw-Hill, 2011.

MOOC Course:

1. Cryptography and Network Security https://nptel.ac.in/courses/106/105/106105031/

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2		3												
CO3		2												
CO4								2						

Course Title	CLOUD COMPUTING		
Course Code	20IS702	L-T-P	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Outcomes: At the end of the course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Elucidate the concepts of Cloud Computing architecture and its design challenges	2	-
2	Describe the principles of Parallel and Distributed Computing.	2	-
3	Apply the fundamental concepts in datacenters to understand the tradeoffs in power, efficiency and cost.	3	-
4	Apply principles of best practice in cloud application design and management.	3	-

Module - 1	10 Hrs.

Cloud computing basics: cloud computing overview, deployment models applications, intranets and the cloud first movers in the cloud. Your organization and cloud computing: when you can use cloud Computing, benefits limitations, security concerns, regulatory issues.

Module - 2	10 Hrs.

Cloud computing with the titans: Google, Microsoft, Amazon, salesforce.com the business case or Going to the cloud: cloud computing services, how those applications help your business, deleting your datacenter, thomsons routers. Cloud computing technology: hardware and infrastructure clients, security, network, services.

Module - 3	10 Hrs.

Cloud storage: overview, cloud storage providers, standards: application, client, infrastructure, service Cloud computing at work: software as a service: overview, driving forces, company offerings, industries Software plus services: overview, mobile device integration, providers, Microsoft online.

Module - 4	10 Hrs

Software plus services Developing applications: Google, Microsoft, troubleshooting, Application management. Local clouds and thin clients: virtualization in your organization, server solutions, thin clients, case study. Migrating to the cloud: cloud services for individuals, cloud services aimed at mid market, enterprise class cloud offerings, migration.

Text Books:

1. Cloud Computing- A practical approach, McGraw Hill publication, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter 2022

Reference Books:

1. Cloud Computing: Theory and Practice, Dan C Marinescue, first edition, MK publishers 2017.

2. Mastering Cloud Computing, McGraw Hill publication, RajkumarBuyya, Christian Vecchiola, S. Thamarai Selvi 2021

MOOC:

1. Cloud Computing https://nptel.ac.in/courses/106/105/106105167/

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1		2												
CO2		2												
CO3			2											
CO4			2											

Course Title	MACHINE LEARNING		
Course Code	20IS703	L-T-P	(3-0-2)4
Exam Hours	3 Hrs.	Hours / Week	5
SEE	50 Marks	Total Hours	48L+10P

Course Objective: To apply the techniques of machine learning for real time problems.

Course Outcomes (COs) : Upon completion of the course, students shall be able to:

#	Course outcomes	Mapping to PO's	Mapping to PSO's
1.	Describe and Apply preprocessing, Modeling, Evaluation and concept learning for the given problem.	2,3	-
2.	Depict and Apply supervised and unsupervised machine learning algorithms for solving the given problem	3	1
3.	Illustrate and utilize the Neural networks, Bayesian learning and other forms learning for the given problem	3	1
4.	Conduct experiments for demonstrating machine learning algorithms and data visualization methods.	3,5	1

MODULE 1	12 Hrs.

Introduction to Machine learning: Human learning and its types, Machine learning and its types, Applications, tools and issues in machine learning, Activities in machine learning, Types of data, Exploring structure of data, Data quality and Preprocessing.

Modelling and Evaluation: Introduction, Selecting a model, training a model, model representation and interpretability, Evaluating performance of a model.

MODULE 2	12 Hrs.

Learning Problems and Concept Learning: Well Posed learning problems, Designing a Learning systems, Concept Learning Tasks, Search, Find-S, Version Spaces and Candidate Elimination Algorithm, Inductive bias. **Supervised Learning:** Introduction, example, classification model, classification learning steps, Common algorithms –KNN, decision tree, Random forest model.

MODULE 3	12 Hrs.

Supervised Learning: SVM, Regression-Simple linear regression, Multiple linear regression, Assumptions in Regression analysis.

Unsupervised Learning: Supervised Vs Unsupervised, Application, clustering, Finding pattern using Association rule.

MODULE 4	12 Hrs.

Basics of Neural Networks: Exploring the artificial neuron, Types of activation function, Early implementations of ANN, Architectures of NN, Learning process in ANN, Backpropogation algorithm.

Bayesian learning: Introduction, Bayes theorem, Bayes theorem and concept learning, Bayesian Belief Networks

Other types of Learning – Representation learning, Active Learning, Instance based Learning, Association rule Learning, Ensemble learning

Practical Component

1. Demonstration of Python Libraries for Machine Learning-Pandas, Sklearn, numpy, matplotlib.
2. Demonstration of Exploratory Data Analysis and Data Visualization.
3. Implement the concept learning algorithms.
4 Implementing classification Algorithms
7. Implement Regression algorithms
9. Implement a clustering algorithm using K-means clustering for the given dataset.
10. Implement simple neural networks.

Text Books:

Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Machine Learning, Pearson, 2019

Tom M. Mitchell, Machine Learning, McGraw-Hill Education (INDIAN EDITION), 2013

Reference Books:

1. Hands-on machine learning with scikit-learn and tensorflow, Concepts, Tools, and Techniques to Build Intelligent Systems. O'Reilly Media, Aurélien Géron, Second Edition, 2019.
2. EthemAlpaydin, Introduction to Machine Learning, 2nd Ed., PHI Learning Pvt. Ltd., 2013
3. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, Springer; 1st edition, 2001

e-Books:

1. https://www.oreilly.com/library/view/hands-on-machine-learning/9781492032632/

MOOCS:

1. https://swayam.gov.in/nd1_noc19_cs52/preview
2. https://www.coursera.org/learn/machine-learning/
3. https://nptel.ac.in/courses/106106139/

Course Articulation Matrix

	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2	3											
CO2			3										2	
CO3			3										2	
CO4			3		3								3	

Course Title	Industry Driven Course		
Course Code	20ID01	(L-T-P)C	(1-0-0)1
Exam		Hours/Week	1
SEE		Total Hours	15L

Course Objective:

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Develop android applications using views, intents, fragments and graphics.	1,2,3,5	1,2
2.	Design an application using Internal and external database.	3,5	1
3.	Design an application using image capturing	3,5	1

Hour 1: Module 1 - Introduction to Mobile App Development (1 hour)
1.1 Overview of Mobile App Development

Hour 2: Module 1 - Introduction to Mobile App Development (1 hour)
1.2 Setting up the Development Environment

Hour 3: Module 2 - Basic App Structure and UI Development (1 hour)
2.1 Creating a New Project

Hour 4: Module 2 - Basic App Structure and UI Development (1 hour)
2.2 User Interface (UI) Design (Part 1)

Hour 5: Module 2 - Basic App Structure and UI Development (1 hour)
2.2 User Interface (UI) Design (Part 2)

Hour 6: Module 2 - Basic App Structure and UI Development (1 hour)
2.3 Handling User Input

Hour 7: Module 3 - Programming Logic and Control Structures (1 hour)
3.1 Basic Programming Concepts (Part 1)

Hour 8: Module 3 - Programming Logic and Control Structures (1 hour)
3.1 Basic Programming Concepts (Part 2)

Hour 9: Module 3 - Programming Logic and Control Structures (1 hour)
3.2 Loops and Iteration

Hour 10: Module 4 - Data Handling and Storage (1 hour)
4.1 Working with Data (Part 1)
Hour 11: Module 4 - Data Handling and Storage (1 hour)
4.1 Working with Data (Part 2)

Hour 12: Module 4 - Data Handling and Storage (1 hour)
4.2 User Preferences and Local Storage

Hour 13: Module 5 - Building Interactive Features (1 hour)
5.1 Introducing Interactivity

Hour 14: Module 5 - Building Interactive Features (1 hour)
5.2 Implementing Navigation (Part 1)

Hour 15: Module 5 - Building Interactive Features (1 hour)
5.2 Implementing Navigation (Part 2)

Text Books:

1. "Android Programming: The Big Nerd Ranch Guide" by Bill Phillips and Chris Stewart

Reference Books:

1. "Android Design Patterns: Interaction Design Solutions for Developers" by Greg Nudelman

MOOC Course:
https://onlinecourses.swayam2.ac.in/nou21_ge41/preview

Course Title	Main Project Phase 1		
Course Code	20IS704	L-T-P	(0-0-1)1
		CIE	100 Marks

Course Outcomes:

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

#	Course Outcomes	Mapping to PO	Mapping to PSOs
1.	Identify a problem, through Extensive literature Survey leading to publication of a survey paper.	1,2	-
2.	Plan & design the solution to the chosen problem	3	2
3.	Make oral presentation and documentation of the work carried out	9,10	-

During VII semester, Candidates in consultation with the guides shall carry out literature survey to finalize the topic of the project. Students are expected to present the project synopsis, system analysis, Requirements Specification and **should publish a technical paper on Literature Survey.**

- **Project Phase 1 – Team Formation , Topic Selection & Guide allotment**
- **Project Phase 2 – Extensive Literature Survey , Problem Definition**
- **Project Phase 3 – System Design, Report Preparation and Publication**

  The evaluation of the project phases shall be carried out by the evaluation committee comprising of project guide & other faculty members. The committee will be constituted by the project coordinator in consultation with the Head of the department.

  The topic chosen during Mini Project 3 will be continued & implemented during eighth semester

Performance Indicators	Low	Medium	High
Literature Survey and Problem Definition (30 Marks)	Literature Survey not pertaining to the title of the project	Incomplete literature survey and improper problem definition	Extensive literature survey with clear state of the art problem definition
Design (10 Marks)	Has no coherent strategies for problem Solving	Has some strategies for problem – solving, but does not apply them consistently	Formulates strategies for solving problems
Presentation/ communication (20 Marks)	Disorganized and ineffective presentation	Organized, but ineffective presentation	Effective organized presentation
Report Preparation (20 Marks)	Disorganized and contents not sufficient	Organized but not good content wise	Effectively organized and well framed contents
Paper Publication (10Marks)	Paper submitted & awaiting results	National conference International Conference	Journal

Punctuality(Project Dairy Maintenance) (10 marks)	Not meeting the guide regularly	Meeting regularly but doesn't document details of every session	Up to date dairy maintenance

Course Articulation Matrix

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	-	-	-

Course Title	USER INTERFACE DESIGN		
Course Code	20IS751	(L-T-P)C	(3-0-0)3
Exam	3Hrs	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Students will be able to apply the concepts and principles of User Interface Design and evaluate User Interfaces.

Course Outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Describe the theories and design processes of interactive systems	1	-
2	Identify the desirable features of User interfaces and visualization techniques	1	-
3	Analyze different types of user interfaces, devices and quality of service issues	2	-
4	Design appropriate user interface for the given requirement	3	-

MODULE – 1 **10Hrs.**

Usability of Interactive Systems: Introduction, Usability Goals and Measures, Usability Motivations, Universal Usability, Goals for our Profession. Guidelines, Principles, and Theories: Introduction, Guidelines, Principles, Theories. Managing Design Processes: Introduction, Organizational Design to Support Usability, the Four Pillars of Design, Development Methodologies, Ethnographic Observation, Participatory Design, Scenario Development, and Social Impact Statement for Early Design Review, Legal Issues. Evaluating Interface Designs: Introduction, Expert Reviews, and Usability Testing and Laboratories, Survey Instruments.

MODULE – 2 **10Hrs.**

Direct Manipulation and Virtual Environments: Introduction, Examples of Direct Manipulation, Discussion of Direct Manipulation. Menu Selection, Form Fill-in, and Dialog Boxes: Introduction, Task Related Menu Organization, Single Menus, Combination of Multiple Menus, Content Organization, Fast Movement through Menus, and Data Entry with Menus: Form Fill-in, Dialog Boxes, and Alternatives, Audio Menus and Menus for Small Displays. Command and Natural Languages: Introduction, Command-Organization Functionality, Strategies, and Structure, Naming and Abbreviation, Natural Language in Computing.

MODULE -3 **10Hrs.**

Interaction Devices: Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory Interfaces Displays-Small and Large. Quality of Service: Introduction, Models of Response-Time Impacts, Expectations and Attitudes, User Productivity, Variability in Response Time, Frustrating Experiences. Balancing Function and Fashion - Introduction, Error Messages, Non anthropomorphic Design, Display Design, Web Page Design, Window Design, and Colour.

MODULE -4	10Hrs.

User Documentation and Online Help: Introduction, Online Versus Paper Documentation, Reading from Paper versus from Displays, Shaping the Content of the Documentation, Accessing the Documentation, Online Tutorials and Animated Demonstrations, Online Communities for User Assistance, the Development Process. Information Search: Introduction, Searching in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Search Interfaces. Information Visualization: Introduction, Data Type by Task Taxonomy, Challenges for Information Visualization.

Text Books:

1. Ben Schneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs - Designing the User Interface-Strategies for Effective Human-Computer Interaction, 5th Edition, Pearson Education Inc. - Dorling Kindersley (India) Pvt. Ltd., 2014

Reference Books:

2. Alan J Dix et. Al, —Human Computer Interaction, 3rd Edition, PHI, 2004
3. Wilber O Galitz, —The Essential Guide to User Interface Design - An Introduction to GUI Design, Principles and Techniques‖, Wiley Dreamtech India Pvt. Ltd., 2007

MOOC Course:

2. User Interface Design https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ar10/

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**													
CO2	**3**													
CO3		**3**												
CO4			**3**											

Course Title	DIGITAL IMAGE PROCESSING		
Course Code	20IS752	(L-T-P)C	(3-0-0) 3
Exam	3 Hrs	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Students will be able to develop image processing applications.

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Describe the fundamental concepts of digital image processing	1	-
2.	Apply the concept of filters for image enhancement in spatial and frequency domains	2	-
3.	Apply different algorithms for image segmentation	2	-
4.	Analyze different image compression techniques	2	-

MODULE – 1	10 Hrs.

Introduction: What is Digital Image Processing, Examples of fields that use Digital Image Processing, Fundamentals steps in Digital Image Processing, Components of an Image Processing System. Digital Image Fundamentals: Elements of Visual Perception, Image Sampling and Quantization, Basic relationships between pixels.

MODULE – 2	10 Hrs.

Intensity Transformations and Spatial Filtering: Background, Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering. Filtering in the Frequency Domain: Background, Preliminary Concepts, The Basics of Filtering in the Frequency Domain, Image Smoothing Using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters

MODULE -3	10 Hrs.

Image Compression: Fundamentals –Coding Redundancy, Spatial and Temporal Redundancy, Irrelevant Information, Fidelity Criteria, Image Compression Models. Some Basic Compression Methods - Huffman coding, Arithmetic Coding, Run-Length Coding, LZW coding, Bit-Plane Coding

MODULE -4	10 Hrs.

Image Segmentation: Fundamentals, Point, Line, and Edge Detection, Thresholding- Foundation, Basic Global Thresholding, Optimum Global Thresholding Using Otsu's Method Image Segmentation Continued: Region-based segmentation, Segmentation by morphological watersheds, the use of motion in Segmentation

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods: "Digital Image Processing", 3rd Edition, Pearson Education,2 012.

Reference Books:

1. Anil K. Jain: "Fundamentals of Digital Image Processing", Prentice-Hall of India Pvt. Ltd., 2011.

2. Image Processing, Analysis, and Machine Vision, Milan Sonka, Vaclav Hlavac and Roger Boyle, Second Edition, Thomson Learning.

MOOC Course:

1. Digital Image Processing https://nptel.ac.in/courses/117/105/117105135/

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**													
CO2		**2**												
CO3		**2**												
CO4		**2**												

Course Title	Enterprise Resource Planning		
Course Code	20IS753	(L-T-P)C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective:

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Explain the significance and benefits of concepts in Enterprise Resource Planning	1,12	-
2.	Describe the social and ethical responsibilities of a professional	8,12	-
3.	Elucidate the dynamics of Industrial ,Financial Systems, SAP MFG/PRO and ERP Marketing	8,10,12	-
4.	Apply the concept of ERP package to Financial systems.	12	-

MODULE – 1	10 Hrs.

Enterprise Resource Planning: An Overview, Accommodating Variety, Integrated Management Information, Seamless Integration, Supply Chain Management, Resource Management, Integrated Data Model, Scope, Technology, Benefits of ERP, Evolution, ERP revisited, ERF and its Modern Enterprise. Business Engineering and ERP: An overview, what is Business Engineering? Significance, Principles, BRP, ERP and IT, Business Engineering with Information Technology, ERP and Management Concerns. Business Modelling for ERP: An Overview, Building Business Model.

MODULE – 2	10 Hrs.

ERP- Implementation: An overview, Role of Consultants, Vendors and Users, Customization, Precautions, ERP-Post Implementation Options, ERP- Implementation Methodology, Guidelines for Implementation. The ERP Domain-1: An Overview, MFG/PRO, IFS/Avalon- Industrial and Financial Systems.

MODULE -3	10 Hrs.

The ERP Domain-2: Baan IV, SAP, SAP R/3 Applications, Example of an Indian ERP Package, The arrival of ERP. ERP and the Competitive Advantage: An Overview, ERP and the Competitive strategy. Marketing of ERP– 1: An overview.

MODULE -4	10 Hrs.

Marketing of ERP–2, TQM–1: Market Dynamics and Competitive Strategy, Total Quality Management. TQM–2, Case Studies: TQM - ISO 9000, An overview, Mercedes-Benz, KeeHin Industries, Bull Electronics Angers Plant Manufacturers, Twentieth Century Companies, Ameritech, Essar Steel. Jindal Iron and Steel Company. Godrej Soaps and Associated Companies, Indian Renewable Energy Development Agency, ERP Handles Pressure, Sara ERP Case Study-Hawkins Cookers Ltd., A Wholesome Enterprise Application.

Text Books:

1. Vinod Kumar Garg., N. K. Venkatakrishnan, Enterprise Resource Planning - Concepts and Practice, PHI. 2003.
2. S. Sadagopan, Enterprise Resource Planning, PHI, 1999.

Reference Books:

1. Ellen F. Monk, Bret Wagner, Concepts in Enterprise Resource Planning, Cengage Learning India, 4th edition, 2013

MOOC Course:

1. Enterprise Resource Planninghttps://nptel.ac.in/courses/110/105/110105083/

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PS O1**	**PSO2**
CO1	**2**											**2**		
CO2								**2**				**2**		
CO3								**2**		**2**		**2**		
CO4												**2**		

Course Title	MOBILE COMPUTING AND APPLICATIONS		
Course Code	20IS754	L-T-P	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Students will be able to apply solutions to mobile computing applications.

Course Outcomes: At the end of course, student will be able to:

#	Course Outcomes (CO)	Mapping to POs	Mapping to PSOs
1.	Elucidate the various methodologies used in Wireless Communication Networks.	2	-
2.	Analyze various protocols of all layers for mobile and adhoc wireless communication networks.	2	-
3.	Demonstrate and apply the knowledge for cellular networks design	2	-
4.	. Develop skills of finding solutions and building software for mobile computing applications using wireless languages and J2ME	2	-

MODULE-1	10Hrs.
Introduction: Mobile computing, Types of Networks, Architecture for Mobile Computing, 3-tier Architecture, Design Considerations for Mobile Computing, Global system for mobile communication(GSM), Short Service Message (SMS), GSM Architecture, Entities, Call services,PLMN Interfaces,GSM Addresses and Identifiers,Network Aspects in GSM, Mobility Management,GSM Frequency Allocation,Mobile Computing Over SMS, Short Message Service(SMS), Value Added Services through SMS	
MODULE-2	**10 Hrs.**
GPRS: GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS, Applications for GPRS, Billing and Charging in GPRS. CDMA 3G and WiMAX : Spread Spectrum technology, IS-95, CDMA versus GSM, Wireless Data.	
MODULE-3	**10 Hrs.**

Mobile Client: Moving beyond desktop, Mobile handset overview, Mobile phones and their features, PDA, Design Constraints in applications for handheld devices. Mobile IP: Introduction, discovery, Registration, Tunneling, Cellular IP, Mobile IP with IPv6,Mobile OS .	
MODULE-4	**10 Hrs.**
Mobile Internet Applications: Thin client Architecture, the client, Middleware, messaging Servers, Processing a Wireless request, Wireless Applications Protocol (WAP) Overview, Wireless Languages: Markup Languages, HDML, WML, HTML, cHTML, XHTML, VoiceXML.	
Text Books: 1. Dr. Ashok Talukder, Ms Roopa Yavagal , Mr . Hasan Ahmed: Mobile Computing, Technology, Applications and Service Creation, 7th Edition, TataMcGraw Hill, 2017. 2. Martyn Mallik: Mobile and Wireless Design Essentials, Wiley, 2018.	
Reference Books: 1. Raj kamal: Mobile Computing, Oxford University Press, 2016. 2. Iti Saha Misra: Wireless Communications and Networks, 3G and Beyond, Tata McGraw Hill, 2015.	
MOOC: https://archive.nptel.ac.in/courses/106/106/106106147/	

Course Atriculation Matrkx:

Course Outcomes	**Program Outcomes [POs]**													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1		2												
CO2		2												
CO3		2												
CO4			2											

Courses for Elective - III

Course Title	BIG DATA TECHNOLOGIES		
Course Code	20IS761	L-T-P	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Acquire the knowledge, skills and tools to manage big data

Course Outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe big data concepts, database models and big data techniques	1	-
2.	Describe architectural elements of HDFS, Map Reduce, YARN, Spark and Storm	1	-
3.	Apply big data concepts and techniques to address issues in a given scenario	1	1
4.	Design Map reduce solution or Hbase query for a given problem	3	1

Module - 1	10 Hrs

Introducing Hadoop and Seeing What It's Good for – Big Data and the Need for Hadoop, The Origin and Design of Hadoop, Examining the Various Hadoop Offerings. **Use Cases for Big Data in Hadoop** – The Keys to Successfully Adopting Hadoop, Log Data Analysis, Data Warehouse Modernization, Fraud detection, Risk modeling, Social Sentiment Analysis, Image Classification, Graph Analysis, To Infinity and Beyond.

Storing Data in Hadoop: The Hadoop Distributed System – Data Storage in HDFS, Sketching Out the HDFS Architecture, HDFS Federation, HDFS High Availability.

Module - 2	**10 Hrs**

MapReduce Programming – Thinking in Parallel, Seeing the Importance of MapReduce, Doing Things in Parallel: Breaking Big Problems into Many Bite-Size Pieces, Writing MapReduce Applications, Getting Your Feet Wet: Writing a Simple MapReduce Application.

Frameworks for Processing Data in Hadoop: YARN and MapReduce – Running Application Before Hadoop 2, Seeing a World Beyond MapReduce, Real-time and Streaming Applications. **Statistical Analysis in Hadoop –** Pumping Up Your Statistical Analysis, Machine Learning with Mahout, R on Hadoop.

Module - 3	**10 Hrs**

Hadoop and the Data Warehouse: Friends or Foes? – Comparing and Contrasting Hadoop with Relational Databases, Modernizing the Warehouse with Hadoop.

Extremely Big Tables: Storing Data in HBase – Say Hello to HBase, Understanding the HBase Data Model, Understanding the HBase Architecture, Taking HBase for a Test Run, Getting Things Done with HBase, HBase and the RDBMS world.

Module - 4	**10 Hrs**

Introducing Spark: Spark's Background and History, Common Use Cases for Spark, Understanding How Spark Processes Information, How Spark Benefits the Entire Organization, Core Spark Technology Components, Comparing Hadoop/MapReduce and Spark, Spark's Open-Source Challenges.

How Spark, Hadoop and MapReduce Work Together: Choosing the Optimal Big Data Solution, Big Data in Action. Storm – What is storm? Storm architecture, Why Storm? Industry Use cases of storm (refer online material for storm)

Text Books:

1. Dirk deRoos, Paul C. Zikopoulos, Bruce Brown, Rafael Coss, Roman B. Melnyk, Hadoop for Dummies John Wiley & Sons, Inc,2014, ISBN: 978-1-118-60755-8
2. Robert D. Schneider and Jeff Karmiol, Spark for Dummies®, 2nd IBM Limited Edition, John Wiley & Sons, Inc, 2019, ISBN: 978-1-119-57697-6 (pbk); 978-1-119-57696-9 (ebk)

Reference Books:

1. Seema Acharya, Subhashini Chellappan, Big data and Analytics, Wiley publications, 2014.
2. Eric Sammer, Hadoop Operations other text for spark and storm, O'Reilley, 2012.

MOOC:

1. Big Data Computing:https://nptel.ac.in/courses/106/104/106104189/

Course Title	Service Oriented Architecture		
Course Code	19IS762	L-T-P	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Outcomes: At the end of the course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Describe MEP's, Coordination, Orchestration and Choreography in Web Services, their protocols and service layers	1	-
2	Describe Addressing issues, Policies related to web services	2	-
3	Apply basic WS-BPEL language constructs	3	-
4	Analyze the security aspects related to web services	2	-

Module - 1	10 Hrs

Introduction of SOA, Evolution of SOA: Fundamental SOA, Common Characteristics of Contemporary SOA, Common Tangible Benefits of SOA, An SOA Timeline (from XML to Web Services to SOA), The Continuing Evolution of SOA (Standards Organizations and Contributing Vendors).

Web Services and Primitive SOA: The Web Services Framework, Services (as Web services), Service Descriptions (with WSDL), Messaging (with SOAP).

Module - 2	10 Hrs

Web Services and Contemporary SOA-1: Message Exchange Patterns, Service Activity, Coordination, Atomic Transactions, Business Activities. Web Services and Contemporary SOA-2: Orchestration, Choreography, Addressing, Reliable Messaging, Correlation.	
Module - 3	**10 Hrs**
Web Services and Contemporary SOA-3: Polices, Metadata Exchange, Security, Notification and Eventing. Principles of Service–Orientation: Services-Orientation and the Enterprise, Anatomy of a Service-Oriented Architecture, Common Principles of Service-Orientation, How Service Orientation Principles Inter Relate, Service-Orientation and Object-Orientation, Native Web Service Support for Service-Orientation Principles.	
Module - 4	**10 Hrs**
Service Layers: Service-Orientation and Contemporary SOA, Service Layer Abstraction, Application Service Layer, Business Service Layer, Orchestration Service Layer, Service Layer Configuration Scenarios. Business Process Design: WS-BPEL Language Basics, WS-Coordination Overview, Service-Oriented Business Process Design, WS-Addressing Language Basics, WS-Reliable Messaging Language Basics.	
Text Books: 1. Thomas Erl, Service-Oriented Architecture – Concepts, Technology, and Design, Pearson Education, 2008.	
Reference Books: 1. Eric Newcomer, Greg Lomow, Understanding SOA with Web Services, Pearson Education, 2009.	
MOOC: 1. Service Oriented Architecturehttps://www.coursera.org/learn/service-oriented-architecture	

Course Title	**PRINCIPLES OF PROGRAMMING LANGUAGES**		
Course Code	**20IS763**	**L-T-P**	**(3-0-0) 3**
Exam	**3 Hrs.**	**Hours/Week**	**3**
SEE	**50 Marks**	**Total Hours**	**40**
MODULE-1			**10 Hrs.**
Introduction; **Names, Scope, and Bindings – 1**: Language design; Programming language spectrum; why study programming languages? Compilation and interpretation; Programming environments. Names, scope, and bindings: Concept of binding time; Object lifetime and storage management; Scope rules and implementing scope. **Names, Scope, and Bindings – 1**; Control Flow – 1: The binding of reference environments; Binding within a scope; Separate compilation. Control Flow – 1: Expression evaluation.			
MODULE-2			**10 Hrs.**
Control Flow – 2: Structured and unstructured flow; Sequencing; Selection; Iteration; Recursion; Non-determinacy **Data Types – 1**: Type systems; Type checking; Records and variants; Arrays			
MODULE-3			**10 Hrs.**

Data Types – 2: Strings; Sets; Pointers and recursive types; Lists; Files and Input/output; Equality testing and assignment

Subroutines and Control Abstraction – 1: Review of stack layout; Calling sequences; Parameter passing; Generic subroutines and modules; Exception handling.

MODULE-4	**10 Hrs.**

Control Abstraction – 2; Data Abstraction, Object Orientation: Control abstraction – 2: Coroutines Data Abstraction, Object Orientation: Object oriented programming; Encapsulation and Inheritance; Dynamic method binding; Multiple inheritance; Object oriented programming revisited

Functional Languages, Logic Languages, Scripting Languages: Functional Languages: Origins; Concepts; An overview of scheme; Evaluation order revisited; Higher-order functions; Functional programming in perspective. Logic Languages: Concepts; Prolog; Logic programming in perspective. Scripting Languages: Common characteristics.

Text Books:

1. Michael L. Scott: Programming Language Pragmatics, 2nd Edition, Elsevier, 2006. (Chapters 1.1 to 1.5, 3 excluding the sections on CD, 6 excluding the sections on CD, 7 including the sections on CD, 8 excluding the sections on CD, 9 including the sections on CD, 10 excluding the sections on CD, 11 excluding the sections on CD, 13.1. Note: Text Boxes titled Design & Implementation are excluded)
2.

Reference Books:

1. Ravi Sethi: Programming languages Concepts and Constructs, 2nd Edition, Pearson Education, 1996.
2. R Sebesta: Concepts of Programming Languages, 8th Edition, Pearson Education, 2008.
3. Allen Tucker, Robert Nonan: Programming languages, Tata McGraw-Hill, 2002.

MOOC:

1. Principles of Programming Languageshttps://nptel.ac.in/courses/106/102/106102067/

Course Title	**ROBOTIC PROCESS AUTOMATION**		
Course Code	**20IS764**	**(L-T-P)C**	**(3-0-0)3**
Exam	**3Hrs**	**Hours/Week**	**3**
SEE	**50 Marks**	**Total Hours**	**40**

Course Objective:

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Elucidate application and implementation of RPA	1	-
2	Apply suitable techniques to handle User Events and various types of Exceptions and strategies.	2	-
3	Analyze the facility for scheduling bots and specifying the time intervals and communicate the same	3,5,9,10	1
4	Conduct experiments with workflow to get the optimal output from a Bot.	4,5	2

MODULE – 1	**10 Hrs.**

What is Robotic Process Automation?: What is Robotic Process Automation? Scope and techniques of automation Robotic process automation, About UiPath, The future of automation.

Record and Play: Record and Play, UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio.

MODULE – 2	**10 Hrs.**

Sequence, Flowchart, and Control Flow: Sequence, Flowchart, and Control Flow, Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart, Step-by-step example, using Sequence and Control flow. Data Manipulation: Data Manipulation, Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example

MODULE -3	**10 Hrs.**

Taking Control of the Controls: Taking Control of the Controls, Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with UiExplorer, Handling events, Revisit recorder, Screen Scraping,

Tame that Application with Plugins and Extensions: Tame that Application with Plugins and Extensions, Terminal plugin, SAP automation, Java plugin.

MODULE -4	**10 Hrs.**

Handling User Events and Assistant Bots: Handling User Events and Assistant Bots, What are assistant bots? Monitoring system event triggers, Monitoring image and element triggers, Launching an assistant bot on a keyboard event.

Exception Handling, Debugging, and Logging: Exception Handling, Debugging, and Logging, Exception handling

Managing and Maintaining the Code: Managing and Maintaining the Code, Project organization.

Text Books:

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath by Alok Mani Tripathi, Packtpub, March 2018.

Reference Books:

1. Learning Service Now by Tim Woodruff, Packtpub, March 2017.
2. Service Now Automation by Ashish Rudra Srivastava, Packtpub.

MOOC Course:

1. https://www.coursera.org/specializations/roboticprocessautomation#courses

Course Articulation Matrix:

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1													
CO2		2												
CO3			3	3									1	
CO4			3		3				3				2	

Course Title	**DATA WAREHOUSING AND MINING**		
Course Code	**20OEIS71**	**(L-T-P)C**	**(3-0-0)3**
Exam	**3 Hrs**	**Hours/Week**	**4**
SEE	**50 Marks**	**Total Hours**	**40**

Course Objective: Students will be able to select appropriate data mining techniques to extract useful patterns.

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Describe the data quality and data pre-processing techniques	1	-
2	Apply data mining algorithm for, Classification, Association and cluster Analysis	3	-
3	Describe the design of Data Warehouse , Modelling and usage	1	-

MODULE – 1 **10Hrs**

Introduction: Data: Why Data Mining? What is Data Mining? What kinds of data can be mined?, What kinds of pattern can be mined?, Which technologies are used? Major issues in data mining.

Getting to know your data: Data objects and attribute types, Basic statistical description of data: measuring the central tendency, Measuring the dispersion of data, measuring data similarity and dissimilarity.

MODULE – 2 **10Hrs**

Data Pre-processing: Data Pre-processing: An overview, Data cleaning, Data integration, Data Reduction: overview of data reduction strategies, wavelet transforms, Principal component analysis, attributes subset selection, Data Transformation: min-max normalization and Z-score normalization.

Data Warehouse and online Analytical processing: Data Warehouse: Basic Concepts ,Data Warehouse modelling : Data cube and OLAP , Data warehouse design and usage: A business analysis frame work for data warehouse design, Data warehouse design process, Data warehouse usage for information processing.

MODULE -3 **10 Hrs**

Classification: Preliminaries, General Approach to Solving a Classification Problem, Decision Tree Induction, Rule-based classification, K- Nearest-neighbour Classifier. Mining frequent patterns **Association and correlations: Basic Concepts and Methods**: Basic Concepts, Frequent item set mining methods: Apriori Algorithm, generating association rules from frequent item sets, Improving the efficiency of Apriori, A Pattern growth Approach for Mining Frequent item sets.

MODULE -4 **10 Hrs**

Cluster Analysis: Basic Concepts and Methods, Cluster Analysis, Partitioning Methods, Agglomerative versus divissive hierarchical clustering, DBSCAN**.** Data Mining Trends and research frontiers : Data Mining Applications , Data mining and society, Data mining trends.

Text Books:

1**.** Jiawei Han and Micheline Kamber: Data Mining – Concepts and Techniques, 4th Edition, Morgan Kaufmann,2018.

Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Education, 2020.

Reference Books:

1. K.P.Soman, Shyam Diwakar, V. Ajay, Insight into Data Mining–Theory and Practice, PHI, 2006.

MOOC:

1. Datawarehouingandmininghttps://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ar10/

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3													
CO2			3											
CO3	3													

Course Title	**INTERNET OF THINGS**		
Course Code	**20OEIS72**	**(L-T-P)C**	**(3-0-0)3**
Exam	**3 Hrs.**	**Hours/Week**	**3**
SEE	**50 Marks**	**Total Hours**	**40hrs**

Course Objective: Students will be able to develop IOT applications

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Explain the fundamentals and applications of IoT, its Architecture, Design Principles and Standards	1	
2	Apply programming skills to design IoT applications	3	
3	Analyze IoT system management	2	2
4	Design and Implement applications of IoT and make presentation in team	5,10	2

MODULE – 1	**10 Hrs**

Introduction to Internet of Things: Definition and characteristics of IoT, Physical design of IoT, Things in IoT, IoT Protocols, Logical Design, IoT functional blocks, IoT communication Models, IoT communication API's, IoT enabling Technologies Wireless sensor networks, Cloud Computing, Big Data Analytics, Communication protocols, embedded systems.

IoT levels and deployment template Domain specific IoTs, - IoT levels, Introduction, Home Automation; Cities; Environment; Energy; Retail; Logistics; Agriculture; Industry; Health &Lifestyle.

MODULE – 2	**10 Hrs**

IoT and M2M IoT System management with NETCONF-YANG Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT- Software defined networking, network function virtualization Need for IoT Systems management; SNMP; Network Operator Requirements; NETCONF; YANG; IoT Systems management with NETCONFYANF; NETOPEER.

IoT platform Design Methodology - IoT Design Methodology; Introduction; Case Study on IoT System for Weather Monitoring, motivation for using python.

MODULE -3	**10 Hrs**

IoT Physical Devices and End points - What is an IoT device; Exemplary Device- Raspberry Pi, Linux on Raspberry Pi, Raspberry Pi Interfaces, Other IoT devices.

IoT Physical Servers & Cloud Offerings: Designing a Restful Web API, Amazon Web Services for IoT, AmazonEC2, Amazon Auto Scaling, AmazonS3, Amazon RDS.

MODULE -4	**10 Hrs**

Case studies illustrating IoT Design: Introduction to IOT Design, Home Automation, Smart Lighting, Home Intrusion Detection, Cities, Smart Parking.

Data Analytics for IOT- Apache Hadoop, Using Hadoop Map Reduce for Batch Data Analysis.

Text Books:

1. Internet of Things - A Hands on Approach, ArshdeepBahga and Vijay Madisetti Universities Press, 2015

Reference Books:

1. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, 2nd Edition, Wiley ISBN: 978-1-119-99435-0, 370 pages, January 2012.
2. Vijay Madisetti, ArshdeepBahga, Internet of Things: A Hands-On Approach Vijay Madisetti, 1st Edition ISBN-10: 0996025529, 2014

MOOC Course:

Design for Internet of things https://nptel.ac.in/courses/108/108/108108098/

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3													
CO2			2											
CO3		3												2
CO4					3					3				3

Course Title	Introduction to Java Programming		
Course Code	20OEIS73	(L-T-P)C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective:

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
4.	Comprehend the fundamental concepts Object Oriented Programming.	1	1
5.	Apply Object Oriented constructs for program development.	3	1
6.	Identify the syntax & logical errors in a java program for identifying bugs.	2	

MODULE – 1	10 Hrs

Object Oriented Concepts and Java: Concepts of Object-Oriented programming language: Object, Class, message passing, inheritance, encapsulation, and polymorphism, relationships among objects, Difference between OOP and other conventional programming – advantages and disadvantages of OOP.

Introduction to Java: Java and Java Applications, How Java Changed the Internet, Java Development Kit(JDK), The Byte Code, Servlets, The Java Buzzwords, Object-Oriented Programming, Simple Java Programs using Control Statements and Blocks of code, Lexical Issues, Data Types, Variables, and Arrays

: The primitive Types, Integers, Floating-Point Types, Characters, Booleans, Literals, Variables, Type Conversion and Casting, Arrays, Strings, Operators : Arithmetic, Bitwise, Relational, Boolean Logical, Assignment Operator, The ? Operator, Operator Precedence. Program Control Statements: Input characters from the Keyword, if statement, Nested ifs, if-else-if Ladder,

MODULE – 2	10 Hrs

Program Control Statements: Switch Statement, Nested switch statements, for Loop, Enhanced for Loop, While Loop, do-while Loop, Use break, Use continue, Nested Loops.

Introducing Classes, Objects and Methods: Class Fundamentals, Declaring Objects, Object Reference Variables, Methods, Constructors, The this keyword, Garbage collection, Overloading Methods and constructors, Argument Passing.

MODULE -3	10 Hrs

Inheritance, Packages and Interfaces: Inheritance Basics, Using Super, Multilevel Hierarchy, When Constructors are called, Method Overriding, Abstract Classes, Interfaces.

Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and Catch, Multiple catch Clauses, Nested try Statements, throw and throws

MODULE -4	10 Hrs

Multi Threading: The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using is Alive() and join(), Synchronization, Inter thread Communication

Event Handling: Two event handling mechanisms; The delegation event model; Event classes; Sources of events; Event listener interfaces; Using the delegation event model;

Text Books:

1. Herbert Schildt, "Java the Complete Reference, 9th Edition, Tata McGraw Hill, 2018
2. E Balaguruswamy, Programming with Java A Primer, Second Edition, Tata McGraw Hill companies**.**

Reference Books:

1. Y. Daniel Liang, "Introduction to JAVA Programming, Brief Version", 9th Edition, Pearson Education,2014.
2. Kogent Learning Solutions, "Java 6 Programming Black Book", Dreamtech Publication, 2014.

MOOC Course:

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3													
CO2			3											
CO3		2												

Course Title	DATA SCIENCE		
Course Code	20OEIS74	(L-T-P)C	(3-0-0)3
Exam	3Hrs	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Apply the principles of data science for solving real time problems

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mappin to PSO'
1	Describe various Data Science process like statistical modelling, Exploratory data analysis, Data visualization.	1	-
2	Apply suitable Machine Learning Algorithms for a given scenario	3	1
3	Develop effective visualization for the given data using R	5	1

MODULE – 1	10 Hrs

Introduction: What is Data Science? Big Data and Data Science hype - and getting past the hype, Why now? – Datafication, Current landscape of perspectives, Skill sets needed.

Statistical Inference - Populations and samples, Statistical modelling, probability distributions, fitting a model.

MODULE – 2	10 Hrs

Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA.

The Data Science Process, Case Study: RealDirect (online real estate firm). Three Basic Machine Learning Algorithms - Linear Regression

MODULE -3	10 Hrs

k-Nearest, Neighbors (k-NN), k-means. One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam

Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web.

MODULE -4	10 Hrs

Feature Generation and Feature Selection Motivating application: user (customer) retention, Feature Generation Feature Selection algorithms, Filters; Wrappers; Decision Trees, Random Forests

Data Visualization - Data Visualization History, What Is Data Science, Redux?, A Sample of Data Visualization Projects

Text Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly.2014.

Reference Books:

1. Jure Leskovek, Anand Rajaraman and Jeffery Ullman. Mining of Massive Datasets. V2.1, Cambridge University Press. 2004.

2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.

3. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.

MOOC Course:

1. Introduction to data Analytics nptel.ac.in/courses/110106064/E-Books: a) An Introduction to Data Science. By J. Stanton, 2013.

2. Data Sciencehttps://drive.google.com/file/d/0B6iefdnF22XQeVZDSkxjZ0Z5VUE/edit

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3													
CO2			3										1	
CO3					3								1	

Course Title	Seminar on Advanced Topics		
Course Code	20IS801	L-T-P	(0-2-0) 1
Exam	3 Hrs.	Hours/Week	-
SEE	50 Marks	Total Hours	-

Course Objective: Promotes engaged learning, critical thinking and presentation skills on advanced technical topics

Course Outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Analyze different research papers in academic field	1,2,12	-
2.	Depict recent advances in engineering and technology and document them.	1, 10	-
3	Realize the importance of communication skills and presentation skills	9, 10	-

Seminar topic must be selected by students in consultation with their respective final year project guide and the selected topic must reflect recent advances in engineering and technology and should be relevant to current trends. The topics must be selected from recent IEEE papers or reputed journals.

Seminar Evaluation Rubrics

Level of Performance			
Criteria	**High**	**Medium**	**Low**
Synopsis Submission (10)	In time Submission and Topic relevant to current trends - 10 marks	Delay in submission and relevant topic- 8 marks	Late submission - 6 marks
Seminar Report (25)	Report contents relevant to the topic, adheres to appropriate style. Reports regularly to guide - 25 marks	Writing clear and effective for the most part and minor errors in adherence with appropriate style guidelines- 22 marks	Ineffective presentation for chosen content - 19 marks
Organization of PPT slides (15)	Demonstrates proficiency in slides, logical sequence and visuals (use of colours/fonts/hyperlinks) - 15 marks	Not enough logical sequence and visuals - 12 marks	Poor organization of slides and visuals -09 marks
Knowledge/Q&A (15)	Answers all questions with explanations and elaborations - 15 marks	Answers average number of questions -12marks	Fails to answer questions related to topic- 09 marks
Literature Survey and references (15)	Clear and effective writing and adherence to appropriate literature reviewed and properly cited - 15 marks	Moderate number of References reviewed - 12 marks	Inadequate survey 09 marks
Presentation Skills (20)	Clear and effective Communication - 20 marks	Communication is clear - 15 marks	Lacks communication skills- 10 marks

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3										3		
CO2	3									3				
CO3									3	3				

Course Title	Main Project Work Phase-2		
Course Code	20IS802	L-T-P	(0-0-10) 10
Exam	3 Hrs.	Hours/Week	2
CIE	50 Marks	SEE	100 Marks

Course Outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO	Mapping to PSOs
1	Implement the design with appropriate techniques, resources and contemporary tools	3,5	1,2
2	Communicate effectively with team members and mentors, make presentations and prepare technical document	9,10,11,12	2
3	Use ethical practices in all endeavours	8	-
4	Share the responsibilities for carrying out the project & playing individual roles appropriately	9	-

The project teams will implement the design of the project started in their seventh semester.

Rubrics :

Performance Indicators	Low	Medium	High
Implementation Techniques / Verification of the results (50)	No proper technique for implementation	Has some techniques but does not apply them consistently	Uses well defined implementation techniques
Presentation/ communication (20)	Disorganized and ineffective presentation	Organized, but ineffective presentation	Effective organized presentation
Report Preparation (20)	Disorganized and contents not sufficient	Organized but not good content wise	Effectively organized and well framed contents
Technical Paper (10)	Paper not submitted to conference/Journal	Paper submitted	Paper Accepted/ published

The project work is to be carried out in two phases:

Project Phase I (30M) - First internal evaluation shall be taken up during this phase. This includes presentation on fine tuning of SRS & Design carried out in seventh semester.

Project Phase II (70M) - Final internal evaluation shall be taken up during this phase. This includes presentation, project demonstration, report submission and details of technical paper publication.

The evaluation of the project phases – I & II shall be carried out by the evaluation committee comprising of project guide & other faculty members.

Course Title	INTERNSHIP (two weeks)		
Course Code	20IS803	L-T-P	(0-0-1)1

The students have to undergo internship in Private industries/R&D organizations/Centres of Excellence/Laboratories of Reputed Institutions/Govt. & Semi Govt. organizations, PSUs, construction companies, entrepreneurial organizations, inter departments within the college etc. to get an exposure to the external world for a period of 4 weeks. The students have to prepare a report on the internship work carried out. The internal faculty shall monitor the student and award marks. There is a CIE in which the student shall present his/her work before a panel of examiners constituted at department level during VIII semester. The performance shall be communicated to the COE office and the same will be reflect in the VIII semester grade card.

Course Outcomes : At the end of the course , students will be able to :

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Demonstrate the application of Knowledge and Skill sets acquired	1,3	
2	Exhibit critical thinking and problem solving skills by analyzing underlying problems	2,4	
3	Exhibit professional ethics by displaying positive disposition during Internship	8	
4	Prepare a document and present effectively	10,12	

Internship Evaluation Rubrics (Panel Evaluation - 100 marks)

Performance Indicators	High	Medium	Low
Organization of Presentation (25)	Demonstrates proficiency in slides, logical sequence and visuals (use of colors/ fonts/ hyperlinks) 25 marks	Not enough logical sequence and visuals 16-20 marks	Poor organization of slides and visuals 10-15marks
Knowledge/Q&A (25)	Answers all questions with explanations and elaborations 25 marks	Answers average number of questions 16-20 marks	Unable to clarify the queries 10-15 marks
Report Preparation (25)	Clear and effective writing and description of the work 25 marks	Moderate description of the work 16 -20marks	Poor description of the work 10- 15 marks
Presentation Skills (25)	Clear and effective Communication 25 marks	Communication is clear 16-20 marks	Ineffective communication 10-14 marks

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3		3											
CO2		3		3										
CO3								3						
CO4										3		3		

Course Title	SOFTWARE TESTING		
Course Code	20IS803	(L-T-P)C	(3-0-0)3
Exam	3Hrs	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Students will be able to apply effective testing techniques for developing quality software.

Course Outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Explain the concepts of Software Testing & its documentation process	1	2
2	Apply various testing techniques in the process of software development	3	2
3	Apply different approaches of verifying and validating a software product.	3,5	-
4	Apply various project management activities	3	2

MODULE – 1	10Hrs.

A Perspective on Testing, Examples: Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, code based testing, fault taxonomies, Levels of testing. Examples: Generalized pseudocode, The triangle problem, The NextDate function, The commission problem, The SATM (Simple Automatic Teller Machine) problem, The currency converter, Saturn windshield wiper, Garage Door Opener.**Boundary Value Testing, Equivalence Class Testing, Decision Table-Based Testing**: Boundary value analysis, Robustness testing, Worst-case testing, Special value testing, Examples, Random testing, Equivalence classes,traditional Equivalence Class Testing Improved Equivalence Class Testing Equivalence test cases for the triangle problem, Next Date function, and the commission problem, Guidelines and observations. Decision tables, Test cases for the triangle problem, NextDate function, and the commission problem, cause effect graphing,Guidelines and observations.

MODULE – 2	10Hrs.

Path Testing, Data Flow Testing: DD paths, Test coverage metrics, Basis path testing, guidelines and observations. Definition-Use testing, Slice-based testing, program Slicing Tools Guidelines and observations.**Life cycle based testing, model based testing**: Traditional waterfall testing ,testing in iterative life-cycle, agile testing, agile model-driven development , Testing Based on Models Appropriate Models, Commercial Tool Support for Model-Based Testing

MODULE -3	10Hrs.

Integration Testing: Decomposition-based integration, call graph-based, Path-based integrations. **System Testing**: Threads, Basic concepts for requirements specification, Model-Based Threads, Use Case–Based Threads Long versus Short Use Cases, How Many Use Cases?, Coverage Metrics for System Testing, Supplemental Approaches to System Testing , Non functional System Testing Atomic System Function Testing Example.

MODULE -4	10Hrs.

Process Framework: Validation and verification, Degrees of freedom, Varieties of software. Basic principles: Sensitivity, redundancy, restriction, , partition, visibility, Feedback. The quality process, Planning and monitoring, Quality goals, Dependability properties, Analysis, Testing, Improving the process, Organizational factors.**Planning and Monitoring the Process, Documenting Analysis and Test**: Quality and process, Test and analysis strategies and plans, Risk planning, Monitoring the process, Improving the process, The quality team, Organizing documents, Test strategy document, Analysis and test plan, Test design specifications documents, Test and analysis reports.

Text Books:

1. Paul C. Jorgensen: Software Testing, A Craftsman's Approach, 4rd Edition, Auerbach Publications, 2014.
2. Mauro Pezze, Michal Young: Software Testing and Analysis – Process, Principles and Techniques, Wiley India, 2008.

Reference Books:

1. Aditya P Mathur: Foundations of Software Testing, Pearson Education, 2008.
2. Srinivasan Desikan, Gopalaswamy Ramesh: Software testing Principles and Practices, 2nd Edition, Pearson Education, 2007.

MOOC Course:

1. https://onlinecourses.nptel.ac.in › noc20_cs77

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**													
CO2			**2**											
CO3			**2**		2									
CO4			**2**											

Course Title	DATA SCIENCE		
Course Code	20IS851	L-T-P	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	5
SEE	50 Marks	Total Hours	40L

Course Objective: Students will be able to apply the data science process to real-time data.

Course Outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO	Mapping to PSOs
1.	Describe the Data Analytics life cycle.	2	1
0.	Perform data analytics using R tool.	3,5	1
0.	Understand advanced analytical theory and methods	2	1
0.	Apply various data analytics methods to solve a problem	3	1

MODULE-1	10 Hrs.

Introduction: What is Data Science? Big Data and Data Science hype - and getting past the hype, Why now? –Datafication, Current landscape of perspectives, Skill sets needed.

Statistical Inference - Populations and samples, Statistical modelling, probability distributions, fitting a model.

MODULE-2	10 Hrs.

Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA.

The Data Science Process, Case Study: RealDirect (online real estate firm). Three Basic Machine LearningAlgorithms - Linear Regression.

MODULE-3	10 Hrs.

k-Nearest, Neighbors (k-NN), k-means. One More Machine Learning Algorithm and Usage in Applications -Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam Data Wrangling: APIs and other tools for scrapping the Web.

MODULE-4	10 Hrs.

Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a RecommendationEngine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: buildyour own recommendation system.

Data Visualization - Data Visualization History, What Is Data Science, Redux?, A Sample of Data VisualizationProjects

Text Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly. 2014.

Reference Books:

1. Jure Leskovek, Anand Rajaraman and Jeffery Ullman. Mining of Massive Datasets. V2.1, Cambridge University Press. 2004.

2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.

3. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining andData-analytic Thinking. ISBN 1449361323. 2013.

MOOC

1. Introduction to data Analytics **nptel**.ac.in/courses/110106064/**E-Books: a)** An Introduction to Data Science. By J. Stanton, 2013.

2. Data Sciencehttps://drive.google.com/file/d/0B6iefdnF22XQeVZDSkxjZ0Z5VUE/edit

Course Articulation Matrix

Course Outcomes	**Program Outcomes [POs]**													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1		3												
CO2			2		3									
CO3		2												
CO4			2											

Course Title	Pattern Recognition		
Course Code	20IS852	L-T-P	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Ability to understand decision theory and statistical decision making	1, 2	-
2.	Knowledge of different techniques for estimation of error rates	1,2, 3	-
3.	Understand the concepts of clustering	1,2	-
4.	Learn about non parametric decision making	1,2	-
5.	Learn about adaptive decision boundaries techniques	1,2,3	-

MODULE-1 **10 Hrs**

Introduction: Applications, Statistical Decision Theory, Application of PR to Image Processing & Analysis, Introduction to Probability, Events, Random Variables. Joint Distribution and Densities, Moments of Random Variables, Estimation, Minimum Risk Estimators.

MODULE-2 **10 Hrs**

Statistical Decision Making: Baye's Theorem, Multiple Features, Conditionally Independent Features, Decision Boundaries. Unequal Cost of Errors: Estimation of Errors Rates, leaving–One–Out Technique, Characteristic Curves, Estimating the Composition of Population

MODULE-3 **10 Hrs**

Nonparametric Decision Making: Introduction, Histograms, Kernel 2 Window Estimators, Nearest Neighbor Classification Technique. Adaptive Decision Boundaries: Discriminant Functions, Minimum Squared Error Discriminant Function, choosing a Decision Making Technique.

MODULE-4 **10 Hrs**

Clustering-I: Introduction, Hierarchical Clustering, Agglomerative, Single Linkage, Complete Linkage, Average Linkage, Word's Method Problems. Clustering–II: Introduction, Partitional Clustering, Forgy's Algorithm, K-Means

Text Books:

1. Earl Gose, Richard Johnsonbaugh, Steve Jost, Pattern Recognition and Image Analysis, PHI-2012.
2. Richard O. Duda, Peter E. Hart, and David G.Stork, Pattern Classification, 2nd Edition, Wiley-Interscience, 2001

MOOC:

1. Pattern Recognitionhttps://nptel.ac.in/courses/106/106/106106046/

Course Title	SYSTEM MODELLING AND SIMULATION		
Course Code	20IS853	(L-T-P)C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40hrs

Course Objective: course is to provide an understanding of methods, techniques and tools for modeling, simulation and performance analysis of complex systems such as communication and computer networks.

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping PSO's
1	Identify various simulation models and give practical examples for each category	1,2	
2	Understand and justify when simulation is important tool and when not.	1	
3	Construct a model for a given system and perform its discrete-event simulation	2	
4	Generate and test random number variates and apply them to develop simulation models	3	
5	Analyze output data produced by a model and test validity of the model	3	

MODULE – 1 **10 Hrs.**

Introduction: When Simulation is the Appropriate Tool and When it is Not Appropriate, Advantages and Disadvantages of Simulation, Areas of Application, Systems and System Environment, Components of a System, Discrete and Continuous Systems, Model of a System, Types of Models, Discrete-Event System Simulation, Steps in a Simulation Study. Simulation Examples: Simulation of Queuing Systems.

General Principles, Simulation Software: Concepts in Discrete-Event Simulation: The Event-Scheduling / Time-Advance Algorithm, World Views, Manual Simulation Using Event Scheduling, List Processing.

MODULE – 2 **10 Hrs.**

Statistical Models in Simulation: Review of Terminology and Concepts, Useful Statistical Models, Discrete Distributions, Continuous Distributions, Poisson Process, Empirical Distributions.

Queuing Models: Characteristics of Queuing Systems, Queuing Notation, Long-run Measures of Performance of Queuing Systems, Steady-state Behavior of M/G/1 Queue, Networks of Queues.

MODULE -3 **10 Hrs.**

Random-Number Generation, Random- Variate Generation: Properties of Random Numbers, Generation of Pseudo-random Numbers, Techniques for Generating Random Numbers, Tests for Random Numbers. Random-Variate Generation: Inverse Transform Technique, Acceptance-Rejection Technique.

Input Modeling: Data Collection, Identifying the Distribution with Data, Parameter Estimation, Goodness of Fit Tests, Fitting a Non-stationary Poisson Process.

MODULE -4	**10 Hrs.**

Output Analysis for a Single Model: Types of Simulations with Respect to Output Analysis, Stochastic Nature of Output Data, Measures of Performance and Their Estimation. Verification and Validation of Simulation Models,

Optimization: Model Building, Verification and Validation, Verification of Simulation Models, Calibration and Validation of Models.

Text Books:

Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, Discrete-Event System Simulation, 5th Edition, Pearson Education, 2007. (Chapters1, 2, 3, 4.4, 4.5, 5, 6.1 to 6.3,6.4.1,6.6, 7, 8, 9, 10, 11, 12.4)

Reference Books:

1. Lawrence M. Leemis, Stephen K. Park, Discrete, Event Simulation: A First Course, Pearson/ Prentice-Hall, 2006.

2. Averill M. Law, Simulation Modeling and Analysis, 4th Edition, Tata McGraw-Hill, 2007

Course Articulation Matrix

Course Outcomes	**Program Outcomes [POs]**													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2											
CO2	3	3												
CO3	3	3	2											
CO4	3	3	2											
CO5	3	3	2											

Course Title	Parallel Computing		
Course Code	20IS854	(L-T-P)C	(3-0-0)3
Exam	3 Hrs	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Objective:

Course outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Describe fundamentals of parallel computing	1	
2.	Analyse the performance and design the parallel platforms	2	2
3.	Develop parallel application using PThreads /OpenMP/MPI	3	2
4.	Analyse the given problem, identify the hotspot and parallelize the given application	2	

MODULE – 1	10 Hrs.

Introduction: Motivating Parallelism, Scope of Parallel Computing. Parallel Programming Platforms : Implicit Parallelism, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms, Interconnection Networks.

MODULE – 2	10 Hrs.

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models. Basic Communication Operations: One-to-All Broadcast, All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce, Scatter and Gather, Analytical Modelling: Sources of Overhead in Parallel Computing

MODULE -3	10 Hrs.

Programming Using the Message-Passing Paradigm: Principles of Message-Passing Programming, building blocks, MPI, Topologies and Embedding, Overlapping Communication with Computation, collective Communication and Computation Operations, Groups and Communicator

MODULE -4	10 Hrs.

Programming Shared Address Space Platforms Thread Basics, WhyThreads? The POSIX Thread API, Creation &Termination, OpenMP: Specifying concurrent tasks, "for" directive, Assigning iterations to threads, "section" directive, merging directives, Nesting directives, Synchronization constructs in OpenMP, Data Handling in OpenMP, OpenMP library functions.

Text Books:

1. Anantha Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing, Addison Wesley, 2003.

Reference Books:

3. Michael J. Quinn ,Parallel computing : Theory and Practice, McGraw-Hill, 2nd ed, 2002

MOOC Course:

3. https://nptel.ac.in/courses/106102163

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3													
CO2		3												3
CO3			3											3
CO4		3												

Course Title	Internet Engineering		
Course Code	20IS855	L-T-P	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Identify different Network protocols and architecture	1	-
2.	Test network performance using networking tools	2	-
3.	Identify network thread and vulnerabilities	1	-

MODULE-1	10 Hrs

INTRODUCTION: Communication model, Communication software, and communication protocol: Representation, Development methods, Protocol engineering process. NETWORK REFERENCE MODEL: Layered architecture, Network services and interfaces, protocol functions, OSI model, TCP/IP protocol suite, Application protocols.

PROTOCOL SPECIFICATION: Communication service specification, Protocol entity specification, Interface specifications, Interactions, Multimedia protocol specifications, Internet protocol specifications.

MODULE-2	10 Hrs

SPECIFICATION AND DESCRIPTION LANGUAGE (SDL): A protocol specification language: SDL.

Examples of SDL based protocol specifications, Other protocol specification languages. Protocol Verification And Validation, Protocol verification, Verification of a protocol using finite state machines.

Protocol validation: Protocol validation, Protocol design errors, and protocol validation approaches, SDL based protocol verification, SDL based protocol validation.

MODULE-3	10 Hrs

PROTOCOL CONFORMANCE TESTING: Conformance testing methodology and framework, Conformance test architectures, Test sequence generation methods, Distribute architecture by local methods, Conformance testing with TTCN, Conformance testing of RIP, Multimedia applications testing, SDL based tools for conformance testing.
MODULE-4 **10 Hrs**
PROTOCOL PERFORMANCE TESTING: SDL based performance testing of TCP, OSPF, Interoperability testing, SDL based interoperability testing of CSMA/CD and CSMA/CA protocol using bridge, Scalability testing. **PROTOCOL SYNTHESIS**: Synthesis methods, interactive synthesis algorithms, automatic synthesis algorithm, automatic synthesis of SDL from MSC protocol re synthesis.

Course Title	**Block Chain Technology**		
Course Code	**20IS861**	**L-T-P**	**(3-0-0)3**
Exam	**3 Hrs.**	**Hours/Week**	**3**
SEE	**50 Marks**	**Total Hours**	**40**

Course Outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Define and Explain the fundamentals of Blockcha	-	-
2	Illustrate the technologies of blockchain	2	1
3	Describe the models of blockchain	1	-
4	Analyze and demonstrate the Ethereum	1	1

MODULE-1	**10 Hrs**
Introduction: Basic Cryptographic primitives used in Blockchain – Secure, Collison- resistanthash functions, digital signature, public key cryptosystems, zero-knowledge proof systems. Needfor Distributed Record Keeping, Modelling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Why Nakamoto Came up with Blockchain based cryptocurrency?	
MODULE-2	**10 Hrs**
Technologies Borrowed in Blockchain – hash pointers, Consensus, Byzantine Models of fault tolerance, digital cash etc. Bitcoin blockchain - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin. Bitcoin, the challenges, and solutions	
MODULE-3	**10 Hrs**
Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS)based Chains - Hybrid models (PoW + PoS).Bitcoin scripting language and their use.	

MODULE-4	10 Hrs
Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity – Smart Contracts - The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts. Some attacks on smart contracts.	
Text Books: 1. Blockchain Technology: Cryptocurrency and Applications, S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Oxford University Press, 2019.	
Reference Books: 1. Green Computing: Tools and Techniques for Saving Energy, Money, and Resources Bud E. Smith CRC Press 2. Green Communications: Principles, Concepts and Practice- Samdanis et al, J. Wiley	

Course Title	Object Oriented Modelling and Design		
Course Code	20IS862	L-T-P	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Describe the concepts of object-oriented and basic class modelling problems.	-	-
2	Draw class diagrams, sequence diagrams and interaction diagrams to solve	2	1
3	Choose and apply a befitting design pattern for the given problem.	1	-

MODULE-1	10 Hrs
Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived Data; Packages. State Modeling: Events, States, Transistions and Conditions, State Diagrams, State diagram behaviour.	
MODULE-2	**10 Hrs**
Use Case Modelling and Detailed Requirements: Overview; Detailed object-oriented Requirements definitions; System Processes-A use case/Scenario view; Identifying Input and outputs-The System sequence diagram; Identifying Object Behaviour-The state chart Diagram; Integrated Object-oriented Models.	
MODULE-3	**10 Hrs**
Process Overview, System Conception and Domain Analysis: Process Overview: Development stages; Development life Cycle; System Conception: Devising a system concept; elaborating a concept; preparing a problem statement. Domain Analysis: Overview of analysis; Domain Class model: Domain state model; Domain interaction model; Iterating the analysis.	

MODULE-4	10 Hrs

Use case Realization :The Design Discipline within up iterations: Object Oriented Design The Bridge between Requirements and Implementation; Design Classes and Design within Class Diagrams; Interaction Diagrams-Realizing Use Case and defining methods; Designing with Communication Diagrams; Updating the Design Class Diagram; Package Diagrams Structuring the Major Components; Implementation Issues for Three-Layer Design.

Text Books :

1. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML,2nd Edition, Pearson Education,2005
2. Satzinger, Jackson and Burd: Object-Oriented Analysis & Design with the Unified Process, Cengage Learning, 2005.
3. Erich Gamma, Richard Helm, Ralph Johnson and john Vlissides: Design Patterns –Elements of Reusable Object-Oriented Software, Pearson Education,2007.

Reference Books:

1. Grady Booch et. al.: Object-Oriented Analysis and Design with Applications,3rd Edition,Pearson Education,2007.
2. Frank Buschmann, RegineMeunier, Hans Rohnert, Peter Sommerlad, Michel Stal: Pattern – Oriented Software Architecture. A system of patterns , Volume 1, John Wiley and Sons.2007.
3. Booch, Jacobson, Rambaugh : Object-Oriented Analysis and Design with Applications, 3rd edition, pearson, Reprint 2013

Course Title	Information Retrieval Methods		
Course Code	20IS863	L-T-P	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
SEE	50 Marks	Total Hours	40

Course Outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Build an Information Retrieval system using the available tools	2	-
2	Identify and design the various components of an Information Retrieval system	2	
3	Analyze the Web content structure	2	
4	Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval	2	1
5	Design an efficient search engine	3	-

MODULE-1	10 Hrs

Introduction: Motivation, Basic concepts, Past, present, and future, The retrieval process. Modeling: Introduction, A taxonomy of information retrieval models, Retrieval: Adhoc and filtering, A formal characterization of IR models, Classic information retrieval, Alternative set theoretic models, Alternative algebraic models, Alternative probabilistic models, Structured text retrieval models, Models for browsing.

MODULE-2	10 Hrs

Retrieval Evaluation: Introduction, Retrieval performance evaluation, Reference collections. Query Languages: Introduction, keyword-based querying, Pattern matching, Structural queries, Query protocols. Query Operations: Introduction, User relevance feedback, Automatic local analysis, Automatic global analysis.

MODULE-3	10 Hrs

Text and Multimedia Languages and Properties: Introduction, Metadata, Text, Markup languages, Multimedia. Text Operations: Introduction, Document preprocessing, Document clustering, Text compression, Comparing text compression techniques.

MODULE-4	**10 Hrs**

User Interfaces and Visualization: Introduction, Human-Computer interaction, The information access process, Starting pints, Query specification, Context, Using relevance judgments, Interface support for the search process. Searching the Web: Introduction, Challenges, Characterizing the web, Search engines, Browsing, Meta searchers, Finding the needle in the haystack, Searching using hyperlinks.

Text Books:

1. Modern Information Retrieval, Ricardo Baeza Yates, Berthier Ribeiro Neto, Pearson 1999.

Reference Books:

Information Retrieval Algorithms and Heuristics, David A. Grossman, Ophir Frieder Springer 2nd Edition 2004.

Course Title	**DEEP LEARNING**		
Course Code	**20IS864**	**L-T-P**	**(3-0-0)3**
Exam	**3 Hrs.**	**Hours/Week**	**3**
SEE	**50 Marks**	**Total Hours**	**40**

Course Objective: Introduce major deep learning algorithms and their applications to solve real world problems.

Course Outcomes: At the end of the course, student will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Comprehend the fundamentals of deep learning algorithms	1	-
2.	Apply specific deep learning algorithms to obtain solutions for appropriate problems.	3	2
0.	Identify and analyse deep learning techniques suitable for training the models using tensorflow and keras.	3,5	2
1.	Conduct various experiments to demonstrate techniques using Deep neural networks, Convolutional neural networks, Recurrent neural networks.	3,5	2

MODULE-1	**10 Hrs**

Introduction to Artificial Neural Networks with Keras- From Biological to Artificial Neurons, Biological Neurons, Logical Computations with Neurons, Architectures of Neural Network, Learning Process in ANN, The Perceptron, MultiLayer Perceptron (MLP) and Backpropagation, Types of Activation Functions, Regression MLps, Classification MLPs.

Implementing MLP's with Keras, : Installing TensorFlow 2, Building an Image Classifier Using the Sequential API, Building a Regression MLP Using the Sequential API, Building Complex Models Using the Functional API, Saving and Restoring a Model, Using Callbacks, Visualization Using TensorBoard, Fine-Tuning Neural Network Hyperparameters

MODULE-2	10 Hrs
Training Deep Neural Networks- Vanishing/Exploding Gradients, Glorot and He Initialization, Nonsaturating Activation Functions, Batch Normalization, Gradient Clipping, Reusing Pretrained Layers, Transfer Learning With Keras, Unsupervised Pretraining, Pretraining on an Auxiliary Task. Faster Optimizers, Momentum Optimization, Nesterov Accelerated Gradient, AdaGrad, RMSProp, Adam and Nadam Optimization, Learning Rate Scheduling. Avoiding Overfitting Through Regularization, ℓ1 and ℓ2 Regularization, Dropout, Monte-Carlo (MC) Dropout, Max-Norm Regularization.	
MODULE-3	**10 Hrs**
Loading and Preprocessing Data with TensorFlow – The Data API, Chaining Transformations, Shuffling the Data, Preprocessing the Data, Putting Everything Together, Prefetching, Using the Dataset With tf.keras. The TF Record Format , Compressed TFRecord Files, A Brief Introduction to Protocol Buffers, TensorFlow Protobufs, Loading and Parsing Examples, Handling Lists of Lists Using the Sequence Example Protobuf. The Features API, TF Transform, The TensorFlow Datasets (TFDS) Project. **Deep Computer Vision Using Convolutional Neural Networks** - Architecture of Visual Cortex, Convolutional Layer, Filters, Stacking Multiple Feature Maps, TensorFlow Implementation, Memory Requirements, Pooling Layer, TensorFlow Implementation.	
MODULE-4	**10 Hrs**
Deep Computer Vision Using Convolutional Neural Networks : CNN Architectures, LeNet-5, AlexNet, GoogLeNet, VGGNet, ResNet, Xception, SENet, Implementing a ResNet-34 CNN Using Keras, Using Pretrained Models From Keras, Pretrained Models for Transfer Learning, Classification and Localization, Object Detection: Fully Convolutional Networks (FCNs), You Only Look Once (YOLO), Semantic Segmentation **Processing Sequences Using RNNs and CNNs** - Recurrent Neurons and Layers , Training RNNs, Forecasting a Time Series, Baseline Metrics , Implementing a Simple RNN.	
Text Books: 1. "Hands-On Machine Learning with Scikit-Learn, Keras and Tensor Flow: Concepts, Tools and Techniques to Build Intelligent Systems – September 2019: Second Edition" by Aurelien Geron.	
Reference Books: 1."Python Machine Learning- Third Edition" by Sebastian Raschka and Vahid Mirjalili	
e-Books: 1. https://www.oreilly.com/library/view/hands-on-machine-learning/9781492032632/	
MOOCS 1. https://www.edx.org/course/deep-learning-with-tensorflow 2.https://www.deeplearning.ai/tensorflow- in-practice/	

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3													
CO2			3											
CO3			3		3									
CO4			2		3									

Course Title	**Natural Language Processing**		
Course Code	**20IS865**	**L-T-P**	**(3-0-0)3**
Exam	**3 Hrs.**	**Hours/Week**	**3**
SEE	**50 Marks**	**Total Hours**	**40**

Course objective: To introduce students the challenges of empirical methods for natural language processing (NLP) applications.

Course Outcomes: At the end of course, student will be able to:

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Understand the fundamental mathematical models and algorithms in the field of NLP	1	-
2	Understanding the principles of language resource annotation and its use in machine learning applications and apply the above principles in analysis of data and acquire intended information through the use of available tools.	1	-
3	Understanding the design and implementation issues in various NLP applications such as information retrieval and information extraction	1	1
4	Understanding the complexity of Natural Language Generation	1	1

MODULE-1	10 Hrs
Introduction to NLP: Definition, Knowledge in speech and language processing, Word Classes: Review of Regular Expressions, Morphology: Inflectional, derivational, parsing and parsing with FST, Combining FST lexicon and rules, human morphological processing.	
MODULE-2	**10 Hrs**
Phonology : Speech sounds, phonetic transcription, phoneme and phonological rules, optimality theory, machine learning of phonological rules, phonological aspects of prosody and speech synthesis. Pronunciation, Spelling and N-grams: Spelling errors, detection and elimination using probabilistic models, pronunciation variation (lexical, allophonic, dialect), decision tree model, counting words in Corpora, simple N-grams, smoothing (Add One, Written-Bell, Good-Turing), N-grams for spelling and pronunciation.	
MODULE-3	**10 Hrs**
POS Tagging: Tag sets, concept of HMM tagger, rule based and stochastic POST, algorithm for HMM tagging, transformation based tagging, Sentence level construction & unification: Noun phrase, co-ordination, sub-categorization, concept of feature structure and unification.	
MODULE-4	**10 Hrs**
Lexical Semantics and Word Sense Disambiguation: Semantics: Representing Meaning: Unambiguous representation, canonical form, expressiveness, meaning structure of language, basics of FOPC, semantics of FIPC. Semantic Analysis: Syntax driven, attachment & integration, robustness. Lexemes (homonymy, polysemy, synonymy, hyponymy), WordNet, internal structure of words, creativity and the lexicon: metaphor and metonymy and their computational approaches. Word Sense Disambiguation: Selectional restriction-based, machine learning based and dictionary based approaches	
Text Book: D.Jurafsky, J H Martin Speech and Language Processing – An introduction to Language processing, Computational Linguistics, and Speech Recognition, Pearson, Volume 1, 3rd edition, 2009.	
Reference Books: 1. Barry Nance , Natural Language Processing A Pananian Perspective, Prentice Hall, Eastern Economy Edition. Eugene Cherniak. 2. Allen, James, Natural Language Understanding, Benjamin/ Cummings, 2nd ed. Bharathi, A Vineet Chaitanya and Rajeev Sangal. 1995	