COURSE STRUCTURE

For

B.TECH. DEGREE

in

COMPUTER SCIENCE & ENGINEERING

(Applicable from the academic session 2024-2025)

Dr. B. C. Roy Engineering College
An Autonomous Institution

Approved by: All India Council for Technical Education (AICTE)
Affiliated to: Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly Known as -WBUT)

Jemua Road, Durgapur, West Bengal, India, 713206

・ The first year course structure (Page 3 and Page 4) is unanimously accepted and approved in the first BoS meeting held in the Department of a) Physics, b) Chemistry, c) Mathematics, d) English, e) Electrical Engineering, f) Electronics and Communication Engineering, g) Computer Science and Engineering, h) Mechanical Engineering.

・ The BoS of CSE (Computer Science and Engineering) in its first meeting (held in the Department of CSE (Computer Science and Engineering) on 6th November 2024 has unanimously accepted and approved the four year course structure of CSE (Computer Science and Engineering).

Semester 6								
Sl No	Course Type	Paper Code	Paper Name	Marks	L	T	P	Credit
Theory								
1	PC	CS601	Data Communication & Computer Network	100	3	0	0	3
2	PC	CS602	Machine Learning	100	3	0	0	3
3	PE	CS603-612	Core Elective II: Internet of Things & Applications / Web & Internet Technology / Image Processing / Human Computer Interaction / Blockchain Technology	100	3	0	0	3
4	PE	CS613-622	Core Elective III: Data Science / Cryptography & Network Security / Soft Computing / Pattern Recognition / Parallel & Distributed Computing	100	3	0	0	3
5	OE	CS623-632	Open Elective II: Optimization Techniques & Operational Research / Entrepreneurship Development: Theory & Practice / Mobile Application Development / Ad-Hoc & Sensor Network / Robotics	100	3	0	0	3
			Total Theory	500	15	0	0	15
Practical								
6	PC	CS691	Data Communication & Computer Network Lab	100	0	0	4	2
7	PC	CS692	Machine Learning Lab	100	0	0	4	2
8	PROJ	CS681	Research Methodology (Project I)	100	0	0	4 (S*)	2
			Total Practical	300	0	0	8	6
			Total of 5th Semester	800	15	0	8	21
Total Credits								**21**

Course Name: Data Communication & Computer Network
Course Code: CS601
(Semester- 6th)
Category: Major
Course Broad Category: Professional Core Course
[For Computer Science and Engineering]

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1. **Course Prerequisite:** Computer Organisation & Architecture, Operating Systems

2. **Course Learning Objectives:**
   i.   To develop an understanding of modern network architectures from a design and performance perspective.
   ii.   To understand the concept of layered network models and the functions of each layer (physical, data link, network, transport, application)
   iii.   To become familiar with common network devices (e.g., routers, switches, firewalls) and their functionalities.
   iv.   To understand fundamental protocols that enable data communication and resource sharing between devices,

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Data Communication & Computer Network
   Course Code: CS601
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	Lectures
1	Data communication Components: Representation of data and its flow Networks,Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.	9
2	Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA	8
3	Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.	14
4	Transport Layer: Process to Process Communication, User Protocol (UDP), Datagram Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.	8
5	Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.	8

6. References:

Text & References Books:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH
2. A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP

7. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS601.CO1	Describe the fundamental concepts of computer networking, Data Communications System and learn its components.	Describe	K1
CS601.CO2	Explain the concept of function(s) of each layer of the OSI model and learn about TCP/IP.	Explain	K2
CS601.CO3	Identify the different types of network topologies, protocols, networking devices and make concepts about their functions within a network.	Identify	K3
CS601.CO4	Simplify building the skills of subnetting and routing mechanisms.	Simplify	K4
CS601.CO5	Justify the different system component parts of the network.	Justify	K5
CS601.CO6	Develop an expertise in some specific areas of networking such as the design and learn about maintenance of individual network.	Develop	K6

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	3	-	-
4	-	-	-	3	3	-
5	-	-	-	-	-	3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	2	2	-	-	-	-	3	3	2
CO2	3	2	1	2	2	-	-	-	-	3	3	2
CO3	3	2	-	2	2	-	-	-	-	3	2	2
CO4	3	3	2	2	3	-	-	-	1	3	2	3
CO5	2	3	2	2	3	-	-	-	2	3	2	2
CO6	2	3	2	2	3	-	-	-	2	3	2	2
AVG.	2.66	2.33	1.75	2	2.5	0	0	0	0	0	1.67	3.0

10. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	3
CO2	3	3	-	-
CO3	3	-	-	3
CO4	3	3	-	-
CO5	3	-	-	3
CO6	-	3	3	-

*** End of Syllabus***

Course Name: Machine Learning
Course Code: CS602
(Semester- 6th)
Category: Major
Course Broad Category: Professional Core Course
[For Computer Science and Engineering]

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I. **Course Prerequisite:**
    A. Mathematics: (Linear Algebra, Probability and Statistics, Calculus)
    B. Data Structures and Algorithms
    C. Programming (Python, R, or MATLAB)
    D. Optimization Techniques

II. **Course Learning Objectives:**

This course aims to introduce students to the fundamental concepts of machine learning, focusing on how patterns and concepts can be learned from data without explicit programming. It provides a comprehensive understanding of various machine learning algorithms and techniques, with an emphasis on recent advancements in the field. Students will explore both supervised and unsupervised learning paradigms, gaining practical insights into their applications. Additionally, the course covers deep learning techniques and various feature extraction strategies, enabling students to develop advanced models for real-world problems.

III. **Teaching methodology and evaluation system for the course:**
    Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
    Evaluation System –
    A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
    B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
    C. End-Semester Exam (60 Marks)- Summative Assessment.

IV. **Course Content:**
    Course Name: Machine Learning
    Course Code: CS602
    Hours per Week: 3L: 0T: 0P
    Credits: 3

Module	Topics	Lectures
1	Supervised Learning (Regression/Classification) Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods Beyond Binary Classification: Multi-class/Structured Outputs, Ranking	10
2	Unsupervised Learning Clustering: K-means/Kernel K-means Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models)	7
3	Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	6
4	Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning	9
5	Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference	9
6	Recent trends in various learning techniques of machine learning and classification methods	5

6. References:

Text & References Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
4. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018

7. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS602.CO1	Understand the concept of how to learn patterns and concepts from data without being explicitly programmed.	Understand	L2
CS602.CO2	Characterize, design and analyze the machine learning algorithms as supervised, unsupervised and reinforcement learning paradigms of machine learning.	Design and Analyze	L4
CS602.CO3	Evaluate, select and apply the appropriate ML model/s for real life problems.	Evaluate	L5
CS602.CO4	Understand the scalable ML like Semi-supervised learning and Bayesian Inference learning..		L2
CS602.CO5	Explore, and learn Deep learning techniques and various feature extraction strategies.	Explore & Learn	L2

8. Mapping of course outcomes to module / course content

Module	CO2	CO3	CO4	CO1	CO5
1	3	3	-	3	-
2	3	3	-	3	-
3	3	3	-		-
4	-	-	-	-	3
5	-	-	3	-	-
6	-	3	-	3	-

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	3
CO2	-	3	2	-	-	-	-	-	-	-	-	3
CO3	-		2	2	2	-	-	-	-	-	-	3
CO4	2	2	-	-	-	-	-	-	-	-	-	3
CO5	2	-	-	-	-	-	-	-	-	-	-	3
AVG.	2.3	2.5	2	2	2	-	-	-	-	-	-	3

10. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1
CO2	3	3	2	1
CO3	3	3	3	1
CO4	2	3	2	1
CO5	2	3	2	1
AVG	2.6	2.8	2.2	1

*** End of Syllabus***

Course Name: IOT
Course Code: CS603
(Semester-)
Category: Major
Course Broad Category:
[For Computer Science and Engineering]

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1. **Course Prerequisite:**

2. **Course Learning Objectives:**
    I.   Able to understand the application areas of IOT
    II.   Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
    III.   Able to understand building blocks of Internet of Things and characteristics

3. **Teaching methodology and evaluation system for the course:**
    Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies.
    Evaluation System –
    A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
    B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
    C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
    Course Name: IOT
    Course Code: CS603
    Hours per Week: 3L:0T:0P
    Credits: 3

Module	Topics	Lectures
1	Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT	7
2	Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc	8
3	Important Characteristics of Sensors: Determination of the Characteristics Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors Importance and Adoption of Smart Sensors	11
4	Architecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapor, Anodization, Sol-gel	10
5	5: Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor And Future scope of research in smart sensor	7
6	Recent trends in smart sensor for day to day life, evolving sensors and their architecture.	5

6. **References:**

Text & References Books:

7. **Course Outcomes:**

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level

8. **Mapping of course outcomes to module / course content**

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	3	-	-	-	-
7	-	-	-	-	-	3

9. **Mapping of the Course outcomes to Program Outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	2	-	-	-	-	-	-	-	-
CO3	3	-	2	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	2	2	-	-	-	-	-
CO5	-	3	-	-	3	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	3	-	-	3
AVG.	1.0	1.33	0.33	0.33	0.5	0.33	0.33	0.0	0.5	0.0	0.0	0.5

10. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	-	-	-	-
CO5	-	-	-	-
CO6	-	-	-	-

*** End of Syllabus***

Course Name: Web and Internet Technology
Course Code: CS604
(Semester-6)
Category: Major
Course Broad Category:
[For Computer Science and Engineering]

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1. **Course Prerequisite:** Programming Fundamentals (e.g., C, Java, Python), Data Structures and Algorithms, Database Management Systems (DBMS), Computer Networks, Operating Systems, Software Engineering

2. **Course Learning Objectives:**
   - Understand the fundamentals of networking and the Internet.
   - Analyze TCP/IP and IP addressing schemes.
   - Explore Internet routing and electronic communication protocols.
   - Develop structured web pages using HTML and XML.
   - Implement dynamic web applications.
   - Understand client-server communication in Java.
   - Identify and mitigate network security threats.
   - Understand emerging technologies and applications.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Web and Internet Technology
   Course Code: CS604
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	Lectures
1	Introduction(1L): Overview,NetworkofNetworks,Intranet,Extranet 6 andInternet. WorldWideWeb(1L): DomainandSubdomain,AddressResolution,DNS, Telnet,FTP,HTTP. ReviewofTCP/IP(1L): Features,Segment,Three-WayHandshaking,Flow Control,ErrorControl,Congestioncontrol,IP Datagram,IPv4 andIPv6. IPSubnettingandaddressing(1L): ClassfulandClasslessAddressing,Subnetting.NAT, IPmasquerading,IPtables. InternetRoutingProtocol(1L): Routing-IntraandInterDomainRouting,Unicastand MulticastRouting,Broadcast. ElectronicMail(1L): POP3,SMTP.	6
2	HTML(3L): Introduction,Editors,Elements,Attributes,Heading, Paragraph.Formatting,Link,Head,Table,List,Block, Layout,CSS.Form,Iframe,Colors,Colorname, Colorvalue. ImageMaps(1L): map,area,attributesofimagearea. ExtensibleMarkupLanguage(XML)(4L): Introduction,Tree,Syntax,Elements,Attributes, Validation,Viewing.XHTMLinbrief. CGIScripts(1L): Introduction,EnvironmentVariable,GETandPOST Methods.	9
3	PERL(3L): Introduction,Variable,Condition,Loop,Array, Implementingdatastructure,Hash,String,Regular Expression, Filehandling,I/Ohandling. JavaScript(4L): Basics,Statements,comments,variable,comparison, condition,switch,loop,break.Object–string,array, Boolean,reg-ex.Function,Errors,Validation. Cookies(1L): Definitionofcookies,CreateandStoreacookiewith example. JavaApplets(2L): Container Class, Components, Applet Life Cycle, Update method; Parameter passing applet, Applications. 1	10
4	Client-ServerprogrammingInJava(2L): 4. JavaSocket,JavaRMI. Threats(1L): Maliciouscode-viruses,Trojanhorses,worms; eavesdropping,spoofing,modification,denialof serviceattacks. Networksecuritytechniques(2L):Passwordand Authentication;VPN,IPSecurity,securityin electronictransaction,SecureSocketLayer(SSL), SecureShell(SSH). Firewall(1L): Introduction,Packetfiltering,Stateful,Application layer,Proxy.	4
5	InternetTelephony(1L): Introduction,VoIP. MultimediaApplications(2L): MultimediaoverIP:RSVP,RTP,RTCPandRTSP. Streamingmedia,CodecandPlugins,IPTV. SearchEngineandWebCrawler(2L): Definition,Metadata,WebCrawler,Indexing,Page rank,overviewof SEO.	5

6. References:

Text & References Books:

1. WebTechnology:ADeveloper'sPerspective,N.P.GopalanandJ.Akilandeswari,PHI Learning,Delhi, 2013.(Chapters1-5,7,8,9).

2. InternetworkingTechnologies,AnEngineeringPerspective,RahulBanerjee,PHILearning, Delhi,2011. (Chapters5,6,12)

7. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
1	Understand the fundamentals of networking and the Internet	Understand	L2
2	Demonstrate knowledge of IP addressing and routing	Demonstrate	L3
3	Develop web-based applications using HTML, XML, and CGI scripting	Develop	L6
4	Apply scripting languages for web development	Apply	L3
5	Implement client-server communication and security mechanisms	Implement	L3

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5
1	Introduction(1L): Overview,Networko fNetworks,Intranet, Extranet 6 andInternet. WorldWideWeb(1L): DomainandSubdom ain,AddressResoluti on,DNS, Telnet,FTP,HTTP. ReviewofTCP/IP(1 L): Features,Segment,T hree-WayHandshaki ng,Flow Control,ErrorContr ol,Congestioncontro l,IP Datagram,IPv4 andIPv6. IPSubnettingandadd ressing(1L): ClassfulandClassles sAddressing,Subnet ting.NAT, IPmasquerading,IPt ables. InternetRoutingProt ocol(1L): Routing-IntraandInt erDomainRouting, Unicastand MulticastRouting,B roadcast. ElectronicMail(1L): POP3,SMTP.	HTML (3L): Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue. Image Maps (1L): map, area, attributes of image area. Extensible Markup Language (XML) (4L): Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief. CGI Scripts (1L): Introduction, Environment Variable, GET and POST Methods.	PERL (3L): Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling. JavaScript (4L): Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object – string, array, Boolean, reg-ex. Function, Errors, Validation. Cookies (1L): Definition of cookies, Create and Store a cookie with example. Java Applets (2L): Container Class, Components, Applet Life Cycle, Update method; Parameter passing applet, Applications.	Client-Server programming In Java (2L): Java Socket, Java RMI. Threats (1L): Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks. Network security techniques (2L): Password and Authentication; VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH). Firewall (1L): Introduction, Packet filtering, Stateful, Application layer, Proxy.	Internet Telephony (1L): Introduction, VoIP. Multimedia Applications (2L): Multimedia over IP: RSVP, RTP, RTCP and RTSP. Streaming media, Codec and Plugins, IPTV. Search Engine and Web Crawler (2L): Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	3	1	-	-	-	-	-	-
CO2	3	3	2	-	3	1	-	-	-	-	-	-
CO3	2	1	3	-	3	-	-	-	-	2	-	-
CO4	2	1	3	-	3	-	-	-	-	2	-	-
CO5	2	3	3	-	2	3	-	-	-	2	-	-
AVG.	2.4	2.0	2.4	0.0	2.8	1.66	0.0	0.0	0.0	2.0	0.0	0.0

10. Mapping to PSO

	PSO1	PSO 2	PSO 3	PSO 4
CO1	2	3	1	1
CO2	2	3	1	1
CO3	3	2	3	3
CO4	3	1	3	3
CO5	2	3	2	2

*** End of Syllabus***

Course Name: Image Processing
Course Code: CS605
(Semester-6)
Category: Major
Course Broad Category: Professional Elective Course
[For Computer Science and Engineering]

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1. **Course Prerequisite: Basics of linear algebra, Basics of calculus, Fundamentals of computer programming, Basic understanding of signals and systems.**

2. **Course Learning Objectives:**
   - **Focuses on building a strong theoretical foundation.**
   - **Emphasizes image analysis and enhancement techniques.**
   - **Covers advanced methods for solving complex problems.**
   - **Highlights hands-on experience and real-world application.**

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Image Processing
   Course Code: CS605
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	Lectures
1	Introduction, Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.	9
2	Digital Image Formation, A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.	4
3	Mathematical Preliminaries, Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & SineTransform.	9
4	Image Enhancement, Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. Highpass Filtering, High- boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.	8
5	Image Restoration, Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation - Spatial Transformation, Gray Level Interpolation.	7
6	Image Segmentation, Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection - Local Processing, Global Processing via The Hough Transform; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.	7
		44

6. References:

Text & References Books:

1. **Digital Image Processing** by Rafael C. Gonzalez & Richard E. Woods, Pearson Education
2. **Fundamentals of Digital Image Processing** by Anil K. Jain, Prentice-Hall
3. **Digital Image Processing** by William K. Pratt, John Wiley & Sons
4. **Image Processing: Analysis and Machine Vision** by Milan Sonka, Vaclav Hlavac, and Roger Boyle, Cengage Engineering

7. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Understand the fundamental concepts and techniques of digital image processing, including image acquisition, representation, and basic image operations.	Understand	L2
CO2	Apply image enhancement techniques in the spatial domain to improve image quality and contrast.	Apply	L3
CO3	Analyze and implement various image transformation techniques, including histogram processing and spatial filtering.	Analyzing, Applying	L4, L3
CO4	Utilize frequency domain techniques for image processing, enabling analysis and manipulation of images in the frequency domain.	Applying	L3
CO5	Implement image restoration and segmentation techniques to address image degradation and extract meaningful regions from images.	Applying	L3
CO6	Develop practical skills in digital image processing through hands-on implementation of algorithms and techniques.	Applying/Creating	L3,L6

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3					
2	3					
3	3		3	2		
4	2	3	2	3		3
5	2		2	2	3	3
6	2		2		3	3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	2	-	-	-	-	-	-	-	-
CO3	3	-	2	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	2	2	-	-	-	-	-
CO5	-	3	-	-	3	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	3	-	-	3
AVG.	1.0	1.33	0.33	0.33	0.5	0.33	0.33	0.0	0.5	0.0	0.0	0.5

10. Mapping to PSO

	PSO1	PSO 2	PSO 3	PSO 4
CO1	3	2	1	1
CO2	3	3	2	1
CO3	3	3	2	1
CO4	3	3	2	1
CO5	3	3	2	1
CO6	3	3	2	1

*** End of Syllabus***

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1. **Course Prerequisite:**

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2. **Course Learning Objectives:**

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3. **Teaching methodology and evaluation system for the course:**

   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.

   Evaluation System –

   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)

   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]

   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**

   Course Name: Human Computer Interaction

   Course Code: CS606

   Hours per Week: 3L: 0T: 0P

   Credits: 3

Module	Topics	Lectures
Unit 1:	Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; 9Interaction: Models – frameworks – Ergonomics – styles – elements –interactivity-Paradigms.	9L
Unit 2:	Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.	11L
Unit 3:	Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.	8L
Unit 4:	Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.	8L
Unit 5:	Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.	8L
Unit 6:	Recent Trends: Speech Recognition and Translation, Multimodal System	3L

6. **References:**

Text & References Books:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett 2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise SoftwareSecurity, Addison Wesley.

7. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Understand the core concepts, theories, and principles of HCI, including usability, user experience, and user-centered design	Understand	L2
CO2	Learn about different types of user interfaces, design principles, and best practices for creating effective and usable interfaces	Remember	L1
CO3	Understand the cognitive, perceptual, and behavioral aspects of human interaction with technology	Understand	L2
CO4	Become familiar with various methods for evaluating the usability and user experience of interactive systems, including usability testing, heuristic evaluation, and surveys	Analyze	L4
CO5	Understand the lifecycle model of interaction design	Understand	L2
CO6	Understand the social and ethical implications of technology design	Understand	L2

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-
AVG.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

10. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	-	-	-	-
CO5	-	-	-	-
CO6	-	-	-	-

*** End of Syllabus***

Course Name: Blockchain Technology
Course Code: CS607
(Semester-VI)
Category: Major
Course Broad Category:
[For Computer Science and Engineering]

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5. **Course Prerequisite:**

6. **Course Learning Objectives:**

7. **Teaching methodology and evaluation system for the course:**
   Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   D. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   E. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   F. End-Semester Exam (60 Marks)- Summative Assessment.

8. **Course Content:**
   Course Name: Blockchain Technology
   Course Code: CS607
   Hours per Week: 3L:0T:0P
   Credits: 3

Module	Topics	Lectures
	Attacks on Computers & Computer Security Introduction, Need for Security, Security approaches, Principles of Security, Types of attack	5
	Cryptography: 2 Concepts & Techniques- Introduction, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Symmetric & Asymmetric key Cryptography, Key Range & Key Size	7
	Symmetric Key Algorithm - Introduction, Algorithm types & Modes, Overview of Symmetric Key Cryptography, DES(Data Encryption Standard) algorithm, IDEA(International Data Encryption Algorithm) algorithm, RC5(Rivest Cipher 5) algorithm.	8
	Asymmetric Key Algorithm, Digital Signature and RSA - Introduction, Overview of Asymmetric key Cryptography, RSA algorithm, Symmetric & Asymmetric key Cryptography together, Digital Signature, Basic concepts of Message Digest and Hash Function (Algorithms on Message Digest and Hash function not required).	5
	Internet Security Protocols, User Authentication - Basic Concepts, SSL protocol, Authentication Basics, Password, Authentication Token, Certificate based Authentication, Biometric Authentication.	6
	Electronic Mail Security - Basics of mail security, Pretty Good Privacy, S/MIME.	4
	Firewall - Introduction, Types of firewall, Firewall Configurations, DMZ Network	3

11. **References:**

Text & References Books:

1. "Cryptography and Network Security", William Stallings, 2nd Edition, Pearson Education Asia
2. "Cryptography and Network Security" by V.K. Jain, Khanna Publishing House,
3. "Network Security private communication in a public world", C. Kaufman, R. Perlman and M. Speciner, Pearson
4. Cryptography & Network Security: Atul Kahate, TMH.
5. "Network Security Essentials: Applications and Standards" by William Stallings, Pearson.
6. "Designing Network Security", Merike Kaeo, 2nd Edition, Pearson Book
7. "Building Internet Firewalls", Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, 2nd Edition, Oreilly .
8. "Practical Unix & Internet Security", Simson Garfinkel, Gene Spafford, Alan Schwartz, 3rd Edition, Oreilly

12. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level

13. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	3	-	-	-	-
7	-	-	-	-	-	3

14. Mapping of the Course outcomes to Program Outcomes

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

CO5	-	3	-	-	3	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	3	-	-	3
AVG.	1.0	1.33	0.33	0.33	0.5	0.33	0.33	0.0	0.5	0.0	0.0	0.5

15. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	-	-	-	-
CO5	-	-	-	-
CO6	-	-	-	-

*** End of Syllabus***

Course Name: Data Science
Course Code: CS613
(Semester-VI)
Category: Core Elective III
Course Broad Category: Professional Elective Course
[For Computer Science and Engineering]

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1. **Course Prerequisite:**
   Probability and statistics, data structure, calculus, linear algebra

2. **Course Learning Objectives:**
   1. Be able to perform statistical analysis and exploratory data analysis.
   2. Be able to gain experience in supervised and unsupervised learning techniques.
   3. Be able to form works with regression models, clustering, and network analysis.
   4. Be able to analyze and interpret large datasets for real-world applications.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Data Science
   Course Code: CS613
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	Lectures
Unit 1: Introduction	Introduction: Objective, scope, and outcome of the course, Types of data: textual, numeric, audio/visual	3
Unit 2: Toolboxes	Python, fundamental libraries for Data Scientists. Integrated development environment (IDE). Data operations: Reading, selecting, filtering, manipulating, sorting, grouping, rearranging, ranking, and plotting.	7
Unit 3: Exploratory Data Analysis	Univariate, bivariate analysis, correlation analysis, rank correlation Pre-processing: i) imputing missing values, ii) identify anomalies Time-series data: extraction of trends, periodicity etc Decomposition techniques: PCA, etc.	8
Unit 4: Modes of Data	Image data analysis, Text data analysis, Speech data analysis	5
Unit 5: Supervised Learning	Introduction, learning curves, training-validation, and test. Learning models generalities, K-Nearest-Neighbor, support vector machines, random forest. Examples	7
Unit 6: Regression	Regression analysis, simple linear regression, multiple & Polynomial regression, logistic regression, Sparse model.	5
Unit 7: Unsupervised Learning	Unsupervised learning, clustering, K-Means, DB-Scan, similarity and distances, quality measures of clustering, case study	5

6. References:

Text & References Books:

1. "Data Science from Scratch" by Joel Grus.
2. Essential Math for Data Science by Thomas Nield, O'Reilly Media, Inc. (May 2022)
3. Practical Statistics for Data Scientists by Peter Bruce, Andrew Bruce, O'Reilly Media, Inc (May 2017)
4. The Art of Data Science by Roger D. Peng and Elizabeth Matsui, lulu.com (2016)
5. "Python for Data Analysis" by Wes McKinney.

7. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS613.1	Understand the fundamental concepts, scope, and applications of Data Science.	Understand	K2
CS613.2	Utilize Python and essential libraries for data manipulation and visualization.	Apply	K3
CS613.3	Perform descriptive statistics, data preparation, and exploratory data analysis.	Analyze	K4
CS613.4	Perform multi-modal data analysis.	Apply, Evaluate	K3, K5
CS613.5	Implement supervised learning models, including SVMs and Random Forests, Conduct regression analysis.	Apply, Analyze	K3, K4
CS613.6	Implement Un-supervised learning models, including K-Means, DB-Scan, etc, apply clustering techniques for unsupervised learning.	Analyze, Evaluate	K4, K5

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	3
6	-	-	-	-	3	3
7						3

9. Mapping of the Course Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									
CO2	3	3	3	2	2	1						
CO3	2	3	3	3	3	2	1					
CO4	1	2	3	3	3	3	3	1	1			
CO5	1	2	3	3	3	3	3	2	1			
CO6	1	2	3	3	3	3	3	3	3	2	1	1
AVG.	1.83	2.66	2.66	2.8	2.8	2.4	2.5	2	1.66	2	1	1

10. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	0
CO2	3	3	2	1
CO3	3	3	3	2
CO4	2	3	3	3
CO5	1	2	3	3
CO6	1	2	3	3

*** End of Syllabus***

Course Name: Cryptography & Network Security
Course Code: CS614
(Semester-)
Category: Major
Course Broad Category:
[For Computer Science and Engineering]

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9. **Course Prerequisite:**

10. **Course Learning Objectives:**

11. **Teaching methodology and evaluation system for the course:**
    Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies.
    Evaluation System –
    G. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
    H. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
    I. End-Semester Exam (60 Marks)- Summative Assessment.

12. **Course Content:**
    Course Name: Cryptography & Network Security
    Course Code: CS614
    Hours per Week: 3L:0T:0P
    Credits: 3

Module	Topics	Lectures
	Attacks on Computers & Computer Security Introduction, Need for Security, Security approaches, Principles of Security, Types of attack	5
	Cryptography: 2 Concepts & Techniques- Introduction, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Symmetric & Asymmetric key Cryptography, Key Range & Key Size	7
	Symmetric Key Algorithm - Introduction, Algorithm types & Modes, Overview of Symmetric Key Cryptography, DES(Data Encryption Standard) algorithm, IDEA(International Data Encryption Algorithm) algorithm, RC5(Rivest Cipher 5) algorithm.	8
	Asymmetric Key Algorithm, Digital Signature and RSA - Introduction, Overview of Asymmetric key Cryptography, RSA algorithm, Symmetric & Asymmetric key Cryptography together, Digital Signature, Basic concepts of Message Digest and Hash Function (Algorithms on Message Digest and Hash function not required).	5
	Internet Security Protocols, User Authentication - Basic Concepts, SSL protocol, Authentication Basics, Password, Authentication Token, Certificate based Authentication, Biometric Authentication.	6
	Electronic Mail Security - Basics of mail security, Pretty Good Privacy, S/MIME.	4
	Firewall - Introduction, Types of firewall, Firewall Configurations, DMZ Network	3

16. **References:**

Text & References Books:

9. "Cryptography and Network Security", William Stallings, 2nd Edition, Pearson Education Asia
10. "Cryptography and Network Security" by V.K. Jain, Khanna Publishing House,
11. "Network Security private communication in a public world", C. Kaufman, R. Perlman and M. Speciner, Pearson
12. Cryptography & Network Security: Atul Kahate, TMH.
13. "Network Security Essentials: Applications and Standards" by William Stallings, Pearson.
14. "Designing Network Security", Merike Kaeo, 2nd Edition, Pearson Book
15. "Building Internet Firewalls", Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, 2nd Edition, Oreilly .
16. "Practical Unix & Internet Security", Simson Garfinkel, Gene Spafford, Alan Schwartz, 3rd Edition, Oreilly

17. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level

18. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	3	-	-	-	-
7	-	-	-	-	-	3

19. Mapping of the Course outcomes to Program Outcomes

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

CO5	-	3	-	-	3	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	3	-	-	3
AVG.	1.0	1.33	0.33	0.33	0.5	0.33	0.33	0.0	0.5	0.0	0.0	0.5

20. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	-	-	-	-
CO5	-	-	-	-
CO6	-	-	-	-

*** End of Syllabus***

Course Name: Soft Computing
Course Code: CS615
(Semester – VI)
Category: Major
Course Broad Category: Engineering Science Course
[For Computer Science and Engineering]

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1. **Course Prerequisite:**
   i. A strong mathematical background.
   ii. Proficiency with algorithms.
   iii. Programming skills in C, C++, or Java, MATLAB, etc.
   iv. Fundamental knowledge of Artificial Intelligence

2. **Course Learning Objectives:**
   i. Artificial neural networks and its applications.
   ii. Solving single-objective optimization problems using GAs.
   iii. Solving multi-objective optimization problems using Evolutionary
       algorithms (MOEAs).
   iv. Applications of Soft computing to solve problems in varieties of application
       domains.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case
   Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous
      Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Soft Computing
   Course Code: CS615
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	Lectures
Unit 1	Introduction: Introduction to soft computing; introduction to fuzzy sets and fuzzy logic systems; introduction to biological and artificial neural network; introduction Genetic Algorithm	8L
Unit 2	Fuzzy sets and Fuzzy logic systems: Classical Sets and Fuzzy Sets and Fuzzy relations: Operations on Classical sets, properties of classical sets, fuzzy operations, properties of fuzzy sets,cardinality,operations, and properties of fuzzy relations. Membership Functions: Features Of membership functions, standard forms and boundaries, different fuzzification methods. Fuzzy To Crisp conversions: Lambda Cuts for fuzzy sets, fuzzy Relations, Defuzzification Methods. Classical Logic and Fuzzy Logic: Classical Predicate Logic, Fuzzy Logic, Approximate Reasoning and Fuzzy Implication Fuzzy Rule based Systems: Linguistic Hedges, Fuzzy Rule base system- Aggregation of fuzzy Rules, Fuzzy Inference System- Mamdani Fuzzy Models– Sugeno Fuzzy Models. Applications of Fuzzy Logic: How Fuzzy Logic is applied in Home Appliances, General Fuzzy Logic controllers, Basic Medical Diagnostic systems and Weather forecasting	10L
Unit 3	Neural Network Introduction to Neural Networks: Advent of Modern Neuroscience, Classical AI and Neural Networks, Biological Neurons and Artificial neural network; model of artificial neuron. Learning Methods: Hebbian, competitive, Boltzman etc., Neural Network models: Perceptron, Adaline and Madaline networks; single layer network; Backpropagation and multi layer networks. Competitive learning networks: Kohonen self organizing networks, Hebbian learning; Hopfield Networks. Neuro-Fuzzy modelling: Applications of Neural Networks: Pattern Recognition and classification	10L
Unit 4	Genetic Algorithms: Simple GA, crossover and mutation, Multi-objective Genetic Algorithm (MOGA). Applications of Genetic Algorithm: genetic algorithms in search and optimization, GA based clustering Algorithm, Image processing and pattern Recognition	10L
Unit 5	Other Soft Computing techniques: Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).	4L

6. References:

Text & References Books:

T1. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI

T2. Principles of Soft Computing , S N Sivanandam, S. Sumathi, John Wiley & Sons

T3. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg

R1. Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, PHI

R2. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg, Pearson/PHI

R3. Fuzzy Sets and Fuzzy Logic: Theory and Applications, George J. Klir and Bo Yuan, Prentice Hall

7. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS615-1	Describe The Basic Concepts of Soft Computing; fuzzys sets and fuzzy logic systems, artificial neural network and Genetic Algorithm.	Remember	L1
CS615-2	Explain Fuzzy sets and Fuzzy logic systems including relationship between the Classical Sets and Fuzzy Sets, Membership functions, fuzzification and defuzzification methods, Fuzzy Inference System and Applications of Fuzzy Logic.	Understand	L2
CS615-3	Analyze the different Learning Methods and Neural Network models and Competitive Learning Networks	Analyze	L4
CS615-4	Understand the components of GA, crossover and mutation, Multi-objective Genetic Algorithm (MOGA).	Understand	L2
CS615-5	Apply the soft computing techniques such as fuzzy logic, neural network and genetic algorithm in different problem domains.	Apply	L3
CS615-6	Evaluate other popular soft computing techniques such as Simulated Annealing, Tabu Search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).	Evaluate	L5

8. **Mapping of course outcomes to module / course content**

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	1	–	-	-	-
2	1	3	1	-	1	1
3	1	2	3	-	2	2
4	-	-	1	3	-	-
5	-	-	1	-	3	3

9. **Mapping of the Course outcomes to Program Outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	-	-	-	-	-	-	2
CO2	3	3	2	3	2	-	-	-	-	-	-	1
CO3	3	3	2	3	2	-		-			-	2
CO4	3	3	2	3	2	-	-	-	-	-	-	2
CO5	3	3	2	3	2	-	-	-	-	-	-	1
CO6	3	3	2	3	2	-	-	-	-	-	-	1
AVG.	3	3	2	3	2	-	-	-	-	-	-	1.5

10. **Mapping to PSO**

	PSO1	PSO 2	PSO 3	PSO 4
CO1	3	3	2	2
CO2	3	3	2	2
CO3	3	3	2	2
CO4	3	3	2	2
CO5	3	3	2	2
CO6	3	3	2	2

*** End of Syllabus***

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1. **Course Prerequisite:**
   Machine Learning

2. **Course Learning Objectives:**

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Core Elective III: Pattern Recognition
   Course Code: CS616
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	Lectures
Unit 1: Basics of pattern recognition	Basics of pattern recognition	2L
Unit 2: Bayesian decision theory	Classifiers, Discriminant functions, Decision surfaces Normal density and discriminant functions Discrete features	8L
Unit 3 Parameter estimation methods	Maximum-Likelihood estimation Gaussian mixture models Expectation-maximization method Bayesian estimation	6L
Unit 4: Hidden Markov models for sequential pattern classification	4.1. Discrete hidden Markov models 4.2. Continuous density hidden Markov models	8L
Unit 5: Dimension reduction methods	5.1. Fisher discriminant analysis 5.2 Principal component analysis . Parzen-window method K-Nearest Neighbour method	3L
Unit 6	Non-parametric techniques for density estimation	2L
Unit 7: Linear discriminant function based classifier	7.1. Perceptron 7.2. Support vector machines	5L
Unit 8: Non-metric methods for pattern classification	8.1. Non-numeric data or nominal data 8.2. Decision trees	4L
Unit 9: Unsupervised learning and clustering	9.1. Criterion functions for clustering 9.2. Algorithms for clustering: K-means, Hierarchical and other methods	2L

6. References:

Text & References Books:

1. R. O. Duda, P. E. Hart and D. G. Stork: Pattern Classification, John Wiley, 2001.

2. S. Theodoridis and K. Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.

3. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

7. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	Understand the Fundamentals of Pattern Recognition	Understand	L2
CO2	Implement and Evaluate Classification Models	Analyze	L4
CO3	Analyze feature selection algorithms in pattern recognition	Analyze	L4
CO4	Apply Hierarchical and Partition clustering techniques in pattern recognition applications	Apply	L3
CO5	Discuss the applications of pattern recognition in various applications	Analyze	L4

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-
AVG.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

10. Mapping to PSO

	PSO1	PSO 2	PSO 3	PSO 4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	-	-	-	-
CO5	-	-	-	-
CO6	-	-	-	-

*** End of Syllabus***

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1. **Course Prerequisite:**
   Basic Programming Knowledge, Data Structures and Algorithms, Computer
   Architecture, Fundamental Operating system and Networking Concepts.

2. **Course Learning Objectives:**
   Acquire hands-on experience in programming parallel and distributed systems, using concepts such as message passing, pipelining, shared memory, and load balancing. Demonstrate the ability to evaluate and debug parallel programs, optimizing their performance and ensuring correctness. Apply parallel and distributed computing techniques to solve real-world problems in scientific computing, big data, and high-performance computing. Develop the skills to program with parallel computing frameworks (e.g., OpenMP) and distributed shared memory systems. Understand the theoretical foundations and practical challenges involved in designing scalable and efficient parallel algorithms.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Parallel & Distributed Computing
   Course Code: CS617
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	Lectures
Unit 1:	UNIT-I :Basic Techniques, Parallel Computers for increase Computation speed, Parallel & Cluster Computing	8L
Unit 2:	UNIT-II :Message Passing Technique- Evaluating Parallel programs and debugging, Portioning and Divide and Conquer strategies examples	8L
Unit 3:	UNIT-III :Pipelining- Techniques computing platform, pipeline programs examples	8L
Unit 4:	UNIT-IV:Synchronous Computations, load balancing, distributed termination examples, programming with shared memory, shared memory multiprocessor constructs for specifying parallelist sharing data parallel programming languages and constructs, open MP	11L
Unit 5:	UNIT-V :Distributed shared memory systems and programming achieving constant memory distributed shared memory programming primitives, algorithms – sorting and numerical algorithms.	9L

6. References:

Text & References Books:

1. Parallel Programming, Barry Wilkinson, Michael Allen, Pearson Education, 2nd Edition.

2. Introduction to Parallel algorithms by Jaja from Pearson, 1992.

7. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS617.1	Understanding and Application of Parallel Computing Techniques	Understanding	L2
CS617.2	Proficiency in Message Passing and Parallel Programming Techniques	Applying and Evaluating	L5
CS617.3	Proficiency in using pipelining techniques to improve the efficiency of parallel computation	Applying and Analyzing	L3
CS617.4	The ability to implement and optimize parallel programs using shared memory multiprocessors, focusing on synchronization, load balancing, and managing shared resources in parallel systems.	Creating, Applying, and Analyzing	L6
CS617.5	Ability to program and work with distributed shared memory systems, including understanding and implementing distributed memory programming primitives.	Understanding, Applying, and Creating	L6

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5
1	Basic Techniques, Parallel Computers for increase Computation speed, Parallel & Cluster Computing	Message Passing Technique- Evaluating Parallel programs and debugging, Portioning and Divide and Conquer strategies examples	Pipelining- Techniques computing platform, pipeline programs examples	Synchronous Computations, load balancing, distributed termination examples, programming with shared memory, shared memory multiprocessor constructs for specifying parallelist sharing data parallel programming languages and constructs, open MP	Distributed shared memory systems and programming achieving constant memory distributed shared memory programming primitives, algorithms – sorting and numerical algorithms.

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	1	1	1	2	2	1	1
CO2	3	3	3	2	3	1	1	1	1	2	2	1
CO3	3	3	3	2	2	1	1	1	1	2	1	1
CO4	3	3	3	3	3	2	1	1	1	2	2	2
CO5	3	3	3	3	3	2	1	1	1	2	2	2
AVG.	3	3	2.8	2.6	2.6	1.4	1	1	1.2	2	1.6	1.4

10. Mapping to PSO

	PSO1	PSO 2	PSO 3	PSO 4
CO1	3	2	1	1
CO2	3	3	2	3
CO3	3	2	2	2
CO4	3	3	3	3
CO5	3	3	2	1
	3	2.6	2	2

*** End of Syllabus***

Course Name:Optimization Techniques & Operational Research
Course Code: CS623
(Semester VI)
Course Broad Category: B. Tech CSE

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13. Course Prerequisite:
Concept of Mathematics in the previous semesters of B. Tech curriculum.

14. Course Learning Objectives:
The primary objective of this course is to introduce students to the fundamental concepts, techniques, and applications of optimization in engineering and decision-making. The course aims to equip students with the knowledge and skills necessary to model, analyze, and solve complex optimization problems across diverse domains. By covering classical and advanced optimization methods, the course ensures a solid understanding of both theoretical concepts and practical applications.

15. Teaching methodology and evaluation system for the course:
Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

Evaluation System –
J. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
K. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
L. End-Semester Exam (60 Marks)- Summative Assessment.

16. Course Content:
Course Name:Optimization Techniques & Operational Research
Course Code: CS623
Hours per Week: 3L: 0T: 0P
Credits: 3

Module	Topics	45L
1.	**Introduction:** Historical Development, Engineering applications of optimization, Statement of an optimization problem, Classification of optimization problems.	4L
2.	**Linear Programming:** Standard form of a linear programming problem,Graphical Method, Simplex method,Charnes' Big-M Method, Duality in linear programming, Quadratic programming, Transportation Problems and Assignment Problems, Stochastic linear programming, Relevant applications. **Nonlinear Programming:** Unimodal function, Interpolation methods, Direct and indirect methods, Relevant applications	15L
3.	**Geometric Programming:** Unconstrained and constrained geometric programming problems, Geometric programming with mixed inequality. **Integer Programming:**Integer linear programming, Integer nonlinear programming, Relevant applications	8L

Module	Topics	45L
4.	**Game Theory:** Introduction, Characteristics of Game Theory, Two Person, zero sum games, Pure strategy. Dominance theory. **Genetic Algorithms:** Introduction, Representation methods, Selection methods, Operators, Replacement methods, Relevant applications.	8L
5.	**Network Analysis:**Critical Path analysis- PERT-CPM. **Inventory Control:**Introduction to EOQ Models of Deterministic and Probabilistic. **Queuing Theory:** Introduction; Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure (Poisson Queue). Poisson Queue Models: (M/M/1) and problems.	10L

5.

References:

Text Book:
- J.K. Sharma- Operations Research: Theory and Applications, Macmillan India Limited
- H. A. Taha- Operations Research, Pearson Education India.
- P. M. Karak – Linear Programming and Theory of Games, ABS Publishing House
- Ghosh and Chakraborty- Linear Programming and Theory of Games, Central Book Agency
- Hira, Gupta- Operations Research,

Reference Books:
- Rao, S. S., & Rao, S. S., Engineering optimization: theory and practice. John Wiley & Sons.
- Hadley, G., Linear programming, Narosa Publishing house.
- Deb. K, Optimization for engineering design: Algorithms and examples. PHI Learning Pvt. Ltd.
- Kumar, D. N., Multicriteria analysis in engineering and management. PHI Learning Pvt. Ltd.
- Ravindran, Philips and Solberg - Operations Research, Wiley India

6. CourseOutcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS623.1	Understand optimization fundamentals, problem classification in relation with real life problems of engineering and applied sciences.	Identify	Remember
CS623.2	Solve optimization problems using linear and nonlinear programming techniques and their applications.	Explain	Understand
CS623.3	Apply geometric and integer programming methods to solve constrained and unconstrained linear and non- linear problems.	Implement	Apply
CS623.4	Utilize game theory and genetic algorithms for strategic decision-making and complex problem-solving.	Organize	Analyze
CS623.5	Analyze and optimize networks, inventory systems, and queuing models in practical scenarios.	Assess	Evaluate
CS623.6	Build up logical and analytical skills to create a new idea appreciated by	Construct	Create

		academics, research & emerging trends in industry.		

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	-	-	-	1
2	3	3	2	-	-	1
3	2	3	3	1	-	1
4	1	1	2	3	-	1
5	1	-	-	1	3	1

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	-	-	-	-	-	-	1
CO2	1	2	3	1	-	-	-	-	-	-	-	1
CO3	1	2	2	1	1	-	-	-	-	-	-	1
CO4	1	2	1	1	2	-	-	-	-	-	-	2
CO5	2	2	2	2	3	-	-	-	-	-	-	1
CO6	1	1	1	1	-	-	-	-	-	-	-	1

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2	PSO3	PSO4
CO1				
CO2				
CO3				
CO4				
CO5				
CO6				

*** End of Syllabus***

Course Name: Mobile Application Development
Course Code: CS625
(Semester- 6th)
Category: Minor
Course Broad Category: Open Elective Course
[For Computer Science and Engineering]

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I. **Course Prerequisite:**
   Core JAVA.

II. **Course Learning Objectives:**

III. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)
   B. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]
   C. End-Semester Exam (60 Marks)- Summative Assessment.

IV. **Course Content:**
   Course Name: Mobile Application Development
   Course Code: CS 625
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Given below is the list of topics you have to study to cover the entire course curriculum of Android:

S.No.	Subjects/ Topic	Overview
1.	Java	In this section, you have to study the core concepts of Java and its essential functions.
2.	SQL	stands for the Structured Query Language. In this section, you have to study the basics of database management.
3.	Introduction to Android	The basics of Android are covered in this section.
4.	Application Structure	The basic structure of an Android app is covered in this section.
5.	Emulator Android Virtual Device	The emulator is a testing tool in which you can test the app you have developed. Its interface is just like an Android phone.
6.	Basics UI Design	UI stands for user interface means how the application will be represented in front of the user.
7.	Preferences	Preference group in XML is studied in this section
8.	Menu	Types of the menu to be created in the Android app and how to create it.
9.	Intents	Type of Intents and their examples are covered in this section
10.	Advanced UI Design	Here you will learn to design the user interface in detail.
11.	Tabs and Tab Activity	Different types of Tabs with example
12.	Styles and Themes	Different types of Styles in UI design, for example.

13.	Content Providers	The Backend support needed for the Android app is covered in this section
14.	Android Debug Bridge Tool	This tool helps in communicating with a device. It is a very important part of Android development.
15.	Linkify	It is a tool used for the filter.
16.	Adapters and Widgets	Different types of adaptors and their use in Android app development.
17.	Notifications	How Notifications appear in the Android app
18.	Custom Components	It includes the Tab and Popup.
19.	Threads	It is a very important part of Android app development. The types of threads for example are covered in this part.

20.	Advanced	The advanced features in an Android application, like creating a new folder are covered in this section
21.	Services	How to implement any service in the Android application
22.	Multimedia in Android	It covers the types of audio and video formats supported and its coding. It is an essential feature in an Android application.
23.	Location-Based Services and Google Map	How to integrate Location-Based Services in the Android application is covered in this section
24.	Sensors	There are multiple sensors in smartphones that have to be coordinated with the operating system.
25.	Wi-Fi	How to monitor and manage the internet connectivity in the Android device and its integration with the application software
26.	Telephony Services	Making a phone call and managing the detailed call log
27.	Camera	Coordination of camera application software with the hardware of the phone.
28.	Bluetooth	Controlling and managing Bluetooth connections
29.	Testing and Debugging Android Application	Final testing of the app and removing the errors if any
30.	Android Application Deployment	Running the developed app on the physical device as the emulator was used till now
31.	Android Secure Coding.	Creating a security cover for the device and the software both

Detailed Android Syllabus

Now, we will dig into the detailed and technical aspects of the Android Syllabus. You will be able to understand the syllabus in detail, like what topics are covered in each part of the syllabus.

S. No.	Subject/ Topic	Detailed and Technical Aspects
1.	Java	Here, you have to study: 1. The Object-Oriented Programming concepts and their various models. 2. A detailed study of Inheritance. 3. How to handle the Exceptions in programming. 4. Different types of Interfaces and Packages 5. What is the use of Java Virtual Machine and .jar file extension? 6. The types of Thread Class and Runnable Interface.
2.	SQL	Here, you have to briefly study the Data Manipulation Language and Data Definition Language queries.
3.	Android Introduction	What is an Android App? How to set up the development Environment What is the .apk file extension and Dalvik Virtual Machine.
4.	Application Structure	Important topics covered in this section are: 1. AndroidManifest.xml 2. Uses-SDK 3. R.java and Resources 4. Layouts and & Drawable Resources 5. Activities and Active Life Cycle
5.	Emulator- Android Virtual Device	Important topics covered in this section are: • How to edit emulator settings • How to Launch emulator • What are the shortcuts for Emulator • What is the use of Logcat • what is DDMS • Creation of First Project • The manifesting File • What is the Layout resource • Running your app on Emulator • Second App: (switching between activities. • Develop an app for demonstrating the communication between Intents
6.	Basic UI Design	Topics covered in this section are: • Form widgets • Text Fields • Layouts • [dip, dp, sip, sp] versus px
7.	Preferences	Shared Preferences • Preferences from XML
8.	Menu	Topics covered in this section are: • Option menu • Context menu • Sub menu • menu from XML • menu via code • Examples

9.	Intents	Two types of Intents are covered in this section:
		    1. Explicit Intents
		    2. Implicit intents

10.	Advanced User Interface Design	Topics Covered in this section are: • Time and Date • Images and media • Composite • Alert Dialogs & Toast • Popup • Examples
11.	Tabs & Tab Activity	Only Examples
12.	Styles & Themes	Topics covered in this section are: • styles.xml • drawable resources for shapes, gradients (selectors) • style attribute in layout file • Applying themes via code and manifest file • Examples
13.	Content Providers	Topics covered in this section are: • SQLite Programming • SQLiteOpenHelper • SQLiteDatabse • Cursor • Reading and updating Contacts • Reading bookmarks
14.	Android Debug Bridge(ADB) Tool	
15.	Linkify	Topics covered in this section are: • Web URLs, Email addresses, text, map addresses, • Phone numbers • MatchFilter & TransformFilter
16.	Adapters and Widgets	In this section some important topics are covered: • Adapters: • a. ArrayAdapters • b. BaseAdapters • ListView and ListActivity • Custom listview • GridView using adapters • Gallery using adapters
17.	Notifications	This is also an important part of android programming. The topics covered in this section are: • Broadcast Receivers • Services and notifications • Toast • Alarms
18.	Custom Components	• Custom Tabs • Custom animated popup panels • Other components

19.	Threads	Topics Covered are: • Running on UI thread (runOnUiThread) • Worker thread • Handlers & Runnable • AsyncTask (in detail) • Examples

20.	Advanced Android Features	Some very useful topics are covered in this section which has advanced features like: • Live Folders • Using cards • XML Parsing • JSON Parsing • Maps, GPS, Location-based Services • Accessing Phone services (Call, SMS, MMS) • Network connectivity services • Sensors
21.	Services	Topics Covered in this section are: ● Android Service Overview ● How to implement a service ● Life Cycle of Service ● Communication: Inter-Process
22.	Multimedia in Android	Topics Covered in this section are: ● Audio File Supported by Multimedia ● Playback Media-Simple ● Video Formats that are supported ● Video Playback- Simple
23	Location-Based Services & Google Map	Google Maps is an essential feature of Android, and you have to master this skill Using Location-Based Services: ■ How to find the current location • Proximity alerts • Google Maps Working • In an activity how to integrate Google Map • Overlaying of Map • Overlaying of Items • Geocoder • Route Display on Map
24.	Sensors	Topics Covered in this section are: • How Sensors work • Using Orientation and Accelerometer sensors • Best practices for performance
25.	WiFi	Topics Covered in this section are: • Monitoring and managing Internet connectivity • Managing active connections • Managing WiFi networks

26.	Telephonic Services	Topics covered in this section are: • Making calls • Monitoring data connectivity and activity • Accessing phone properties and status • Controlling the phone • Sending messages
27.	Camera	Topics Covered in this section are: • Taking pictures • Media Recorder • Rendering previews
28.	Bluetooth	Topics Covered in this section are: • Controlling local Bluetooth devices • Discovering and bonding with Bluetooth devices • Managing Bluetooth connections • Communicating with Bluetooth
29.	Testing and Debugging Android Application	Topics Covered in this section are: • Dalvik Debug Monitor Server- It's Role and Use (DDMS), Android Application Debugging • what is the use of Filters, Breakpoints, Suspend and Resume.
30.	Android Application Development	Topics Covered in this section are: • Android Application Deployment on a device with • Linux and Windows • Android Application Deployment on Android • Market
31	Basics of Android Secure Coding	Topics Covered in this section are: • Security Tips • Storing Data • Using Networking • Android Permissions • Intents • Broadcast Receiver • Activities • Content Providers • Files

6. References:

Text & References Books:

Books and Authors related to Android Course

There are many books available in the market for learning android programming and developing your apps. However, we often tend to get confused as to which book to buy.

Therefore we have sorted out some best books for you that will help you grow your android skill, and you will learn a lot by reading these books. A short list of such books is given below:

S. N o	Subject	Book Title	Author	Description
1.	Android Programming	"Android Programming with Kotlin for Beginners"	John Horton	This book covers all the aspects of Kotlin Programming. After finishing the book, you will have good understanding of topics like Animation & Sour User Interaction, and Data Gathering.
2.	Android Development	"Head First Android Development-A Brain-Friendly Guide"	Dawn Griffiths and David Griffiths	This book will help you understand SQLite Databas Layouts, and Intent. You will also learn to design an app that will work on multiple android devices.
3.	App Development	"Android App Development for Dummies"	Michael Burton	You don't require any basic knowledge of Android a development before reading this book. This book w help you set up an IDE for creating an Android app functioning. This book will give you complete knowledge of the SDK framework.
4.	Advanced Android	"Android Programming: The Big Nerd Ranch Guide"	Bill Phillips & Chris Stewart	This book is good for only those people who have sound knowledge of Kotlin in advance. The speciali of this book is MVVM architecture. This book also covers all the key concepts of the Application Program Interface.
5.	Studio For Android	"Android Studio 3.0 Development Essentials"	Neil Smith	This book covers both the basic and advanced features. This book also explains the process of ma implementation and how to submit the apps to the Google Play Store. After reading this book, you will learn about the Layout Editor Tool, Code Editor, and the Android Studio.
6.	The SQLite Database	"Android Cookbook: Problems and Solutions for Android Developers"	Ian Darwin	An important feature of this book is that it contains 200 plus tested projects that will help you in learning multi-touch gestures, awareness of the location, camera, and accelerometer.

6. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledg e Level
CS625.CO1	Learn and understand the fundamental concepts of Android Architecture.	Understand	
CS625.CO2	Understand the application concept of SQL and AVD and Emulator.	Understand	
CS625.CO3	Be able to design GUI of Android App using Android Studio.	Design	

CS625.CO4	Apply the learned concepts to design moderate to large Android Application.	Apply	
CS625.CO5	Understand and apply smartphone services like Wifi, Bluetooth, Notification Handle, Camera and different types of sensors, etc.	Apply	
CS625.CO6	Be able to build Android apps and hosting procedures to Google Play Store.	Build	

7. Mapping of course outcomes to module / course content

Module	CO2	CO3	CO4	CO1	CO5
1					
2					
3					
4					
5					
6					

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							-	-	-	-	-	-
CO2							-	-	-	-	-	-
CO3							-	-	-	-	-	-
CO4							-	-	-	-	-	-
CO5							-	-	-	-	-	-
AVG.							-	-	-	-	-	-

9. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1				
CO2				
CO3				
CO4				
CO5				
AVG				

*** End of Syllabus***

Course Name: AD HOC AND SENSOR NETWORKS
Code: CS626
(Semester – VI)
Category: Major
Course Broad Category: Engineering Science Course
[For Computer Science and Engineering]

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Course Title:: Ad Hoc and Sensor Networks	Code:OEC-CS601D
Type of Course: Theory	Course Designation: Elective
Semester:6	Contact Hours: 3 Hours/week
Credit: 3	
Continuous Assessment: 30 Marks	Final Exam:70 Marks

PREREQUISITES:

Course Title	Code
1. Nil	Nil

1. Course Prerequisite:

Course Objectives:
- Learn Ad hoc network and Sensor Network fundamentals
- Understand the different routing protocols
- Have an in‑depth knowledge on sensor network architecture and design issues
- Understand the transport layer and security issues possible in Ad hoc and Sensor networks
- Have an exposure to mote programming platforms and tools

COURSE OUTCOMES (COs)

Oncompletionofthecourse studentswillbeableto

Course Outcomes	Details	ActionVerb	Bloom'sLevel
CS626.CO1	Introduction to Adhoc network and demonstration	Explain and Demonstrate	L2
CS626.CO2	Sensor Architecture	Discuss	L4
CS626.CO3	Wireless Network Protocol	Discuss Implement	L2
CS626.CO4	Sensor network Security	Explain	L1
CS626.CO5	Sensor network platform and tools	Implement	L2

	PO1	P02	P03	P04	P05	P06	P07	P08	P09	P020	P011	P012	PS1	PSO2	PS03
CO1	1	1	-	-	-	-	-	-	-	-	-	1	-	-	2
CO2	1	1	-	-	-	-	-	-	-	-	-	1	-	-	2
CO3	1	1	-	-	-	-	-	-	-	-	-	1	-	-	2
CO4	1	1	-	-	-	-	-	-	-	-	-	1	-	-	2
C05	1	1	-	-	-	-	-	-	-	-	-	1	-	-	2
AVG	1	1	-	-	-	-	-	-	-	-	-	1	-	-	2

SYLLABUS:

Unit	Content	Hrs/ Unit	Text/ Reference book serial no.
1	AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS: Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).	6	T1
2	SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES: Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture – Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.	6	T2
3	WSN NETWORKING CONCEPTS AND PROTOCOLS: MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts – S-MAC, The Mediation Device Protocol, Contention based protocols – PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols, Energy Efficient Routing, Challenges and Issues in Transport layer protocol.	8	T3
4	SENSOR NETWORK SECURITY: Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.	6	T4
5	SENSOR NETWORK PLATFORMS AND TOOLS: Node‑level Simulators – NS2 and its extension to sensor networks, COOJA.	6	

Textbooks/References:

Text Books:

e‑Resources: https://nptel.ac.in/courses/106105160/

Reference Books:

1. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Prentice Hall, PTR, 2004.
2. Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks‑Technology, Protocols, and Applications", John Wiley, 2007.
3. Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006.
4. Holger Karl, Andreas Willig "Protocols and Architecture for Wireless Sensor Networks" John Wiley and Sons, Ltd.

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17. **Course Prerequisite:**

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18. **Course Learning Objectives:**

19. **…**

20. **Teaching methodology and evaluation system for the course:**

    Teaching methodology –Lectures and Presentations, Interactive Discussions and Case Studies.

    Evaluation System –

    M. Mid-Term Exam (20 Marks)- Summative Assessment (CIA-1)

    N. Internal Assessment (20 Marks)- Formative Continuous Assessment [Continuous Assessment 1 (CIA-2)]

    O. End-Semester Exam (60 Marks)- Summative Assessment.

21. **Course Content:**

    Course Name: Robotics

    Course Code: CS627

    Hours per Week: 3L:0T:0P

    Credits: 3

Module	Topics	Lectures
Unit 1:	Introduction: Basic concepts- Robot anatomy- Manipulatorskinematics: Forward and inverse kinematics- Precision movement, robot specifications and Work volume, Types of Robot drivesBasic robot motions- Point to point control, continuous path contour	8L
Unit 2:	End Effectors: End effectors- classification- mechanical, magnetic, vacuum and adhesive gripper- gripper force analysis and design. Robot control- Unit control system concept- servo and non-servo control of robot joints, adaptive and optimal control.	7L
Unit 3:	Sensors: Sensor devices, Types of sensors- contact, position and displacement sensors, Force and torque sensors- Proximity and range sensors- acoustic sensors- Robot vision systems- Sensing and digitizing- Image processing and analysis.	6L
Unit 4:	Robot Programming: Robot language classification- programming methods- off and on line programming- Lead through methodTeach pendent method- VAL systems and language, simple program.	8L
Unit 5:	Industrial Application: Application of robots- Material handlingMachine loading and unloading, Assembly, Inspection, Welding, Spray painting, Mobile robot, Microbots- Recent developments in robotics- safety consideration.	7L

21. **References:**

   Text & References Books:

1. S.R. Deb, Robotics technology and flexible automation, McGraw Hill publishing company limited, New Delhi, 1994.

2. M.P. Groover. Industrial Robotics Technology Programming and Applications, McGraw Hill Book Co, Singapore, 1987.

22. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
	To familiarize the Basics of robots Control system.		
	To familiarize the end effectors, Sensor technology and Industrial application of robot.		

23. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-

24. Mapping of the Course outcomes to Program Outcomes

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

CO6	-	-	-	-	-	-	-	-	-	-	-	-
AVG.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

25. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	-	-	-	-
CO5	-	-	-	-
CO6	-	-	-	-

*** End of Syllabus***

Course Name: Data Communication & Computer Networks Lab
Course Code: CS691
(Semester- 6th)
Category: Major
Course Broad Category: Professional Core Courses
[For Computer Science and Engineering]

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1. **Course Prerequisite:**
   Concepts of C Programming, Concepts of Linux Operating System
2. **Course Learning Objectives:**
   1. **Network Configuration: Install and configure NICs, understand IP addressing, subnetting, and manage network devices (cables, connectors, hubs, switches).**
   2. **Socket Programming: Implement TCP/UDP socket-based applications, multicast, broadcast, and design a multithreaded server.**
   3. **Data Link Layer Mechanisms: Apply flow control (Stop & Wait, Sliding Window) and error handling (CRC, Selective Repeat, Go-Back-N) at the Data Link layer.**
   4. **Server Setup & Security: Configure network services (FTP, Telnet, NFS, DNS) and firewalls, and manage server security.**
3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies.
   Evaluation System – For each laboratory course there shall be a CIA during the semester for 60 marks and 40 marks for ESE.
   ❖ Continuous Internal Assessment of laboratory courses (PCIA) [60 Marks]
   - Regular Laboratory Performance (20 Marks)
   - Experiment Execution and Results (15 Marks)
   - Laboratory Record/Report (10 Marks)
   - Viva Voce/Quiz (5 Marks)
   - Attendance (10 Marks)
   ❖ End Semester Examination of Laboratory Course (PESE) [40 marks]
   - Write-Up about the given Experiment/Program [10 marks]
   - Execution of the Experiment/Program [10 marks]
   - Evaluation of the outcome or results of the Experiment/Program [10 marks]
   - Viva-Voce (on the concerned Experiment/Programming) [10 marks]

4. **Course Content:**
   Course Name: Computer Networks Lab
   Course Code: CS691
   Hours per Week: 4P: 0T: 0P
   Credits: 2

Module	Topics	Lab Hour
	Laboratory Experiments:	
1	NIC Installation & Configuration (Windows/Linux)	4
2	Understanding IP address, subnet etc Familiarization with Networking cables (CAT5, UTP) ▟ Connectors (RJ45, T-connector) ▟ Hubs, Switches	4
3	TCP/UDP Socket Programming ▟ Simple, TCP based, UDP based Multicast & Broadcast Sockets ▟ Implementation of a Prototype Multithreaded Server	10
4	Implementation of Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window) Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check) Data Link Layer Error Control Mechanism (Selective Repeat, Go Back N)	8
5	Server Setup/Configuration FTP, TelNet, NFS, DNS, Firewall	4
		30

6. **References:**
    1. **Lab Manual and content as provided in lab hour.**

7. **Course Outcomes:**

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Knowledge Level
CS691.1	Understand different networking cables, connectors and networking devices.	L2
CS691.2	Understand IP addressing, subnetting	L2
CS691.3	Implement UDP and TCP based socket programming in Linux environment.	L3
CS691.4	Implement data link layer flow control and error control mechanisms.	L3
CS691.5	Apply server setup and configuration of FTP, TELNET, DNS etc.	L3

8. **Mapping of course outcomes to module / course content**

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3					
2		3				
3			3			
4				3		
5					3	

9. **Mapping of the Course outcomes to Program Outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS691.1	2	2	2	3	3	2	-	-	-	-	-	3
CS691.2	2	2	3	2	3	2	-	-	-	-	-	3
CS691.3	2	2	2	3	3	2	-	-	-	-	-	3
CS691.4	3	3	3	2	3	3	-	-	-	-	-	3
CS691.5	2	2	3	3	3	2	-	-	-	-	-	3
AVG.	**2.2**	**2.2**	**2.6**	**2.6**	**3**	**2.2**						**3**

10. **Mapping to PSO**

	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-
CO2	-	-	-	-
CO3	-	-	-	-
CO4	-	-	-	-
CO5	-	-	-	-

*** End of Syllabus***

Course Name: **Machine Learning Lab**
Course Code: CS692
(Semester-VI)
Category: Major
Course Broad Category:
[For Computer Science and Engineering]

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A. Course Prerequisite:

Linear Algebra and Probability,Programming Fundamentals, Data Structures and Algorithms,Basic Statistics

B. Course Learning Objectives:

I. To implement supervised learning algorithms like Decision Trees, Logistic Regression, SVM, and Multilayer Perceptron for classification tasks.
II. To explore ensemble methods (AdaBoost, Random Forest) and unsupervised learning techniques (K-Means, Hierarchical, and K-Mode Clustering) for data analysis.
III. To apply association rule mining (FP Growth) and compare ML models using evaluation techniques for balanced and unbalanced datasets.
IV. To develop and experiment with instance-based learning techniques like K-Nearest Neighbors (KNN) and Gaussian Mixture Models (GMM) for real-world applications.

C. Teaching methodology and evaluation system for the course:
Teaching methodology – Interactive practical laboratory based.
Evaluation System –

For each laboratory course there shall be a CIA during the semester for 60 marks and 40 marks for ESE.

❖ Continuous Internal Assessment of laboratory courses (PCIA) [60 Marks]
- Regular Laboratory Performance (20 Marks)
- Experiment Execution and Results (15 Marks)
- Laboratory Record/Report (10 Marks)
- Viva Voce/Quiz (5 Marks)
- Attendance (10 Marks)

❖ End Semester Examination of Laboratory Course (PESE) [40 marks]
- Write-Up about the given Experiment/Program [10 marks]
- Execution of the Experiment/Program [10 marks]
- Evaluation of the outcome or results of the Experiment/Program [10 marks]
- Viva-Voce (on the concerned Experiment/Programming) [10 marks]

D.

Course Name: Machine Learning Lab
Course Code: CS692
Hours per Week: 0L: 0T: 4P
Credits: 3
Course Content:

Module	Topics	Lectures
1	Implement Decision Tree learning	2 hours
2	Implement Logistic Regression	2 hours
3	Implement classification using Multilayer perceptron	2 hours
4	Implement classification using SVM	2 hours
5	Implement Adaboost	2 hours
6	Implement Bagging using Random Forests	2 hours
7	Implement K‑means Clustering to Find Natural Patterns in Data	2 hours
8	Implement Hierarchical clustering	2 hours
9	Implement K‑mode clustering	2 hours
10	Implement Association Rule Mining using FP Growth	2 hours
11	Classification based on association rules	2 hours
12	Implement Gaussian Mixture Model Using the Ex ectation Maximization	2 hours
13	Evaluating ML algorithm with balanced and unbalanced datasets	2 hours
14	Comparison of Machine Learning algorithms	2 hours
15	Implement k‑nearest neighbour algorithm	2 hours
	Total lecture hours	30 hours

6. References:

Text & References Books:

7. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	**Implement** various **classification** algorithms such as Decision Trees, Logistic Regression, SVM, and Multilayer Perceptron to **analyze** real-world datasets.	Implement, Analyze	L3, L4
CO2	**Apply** ensemble learning techniques like AdaBoost and Random Forest to **enhance** classification accuracy in machine learning models.	Apply, Enhance	L3, L5
CO3	**Demonstrate** clustering techniques, including K-means, Hierarchical Clustering, and K-mode Clustering, to **identify** natural data patterns.	Demonstrate, Identify	L2, L3
CO4	**Utilize** association rule mining techniques like FP Growth and **evaluate** classification based on association rules for pattern discovery.	Utilize, Evaluate	L3, L5
CO5	**Compare** and **analyze** different machine learning models using evaluation metrics for both balanced and unbalanced datasets.	Compare, Analyze	L4, L5
CO6	**Develop** and **experiment** with instance-based learning algorithms like K-Nearest Neighbors and Gaussian Mixture Models using Expectation Maximization for real-world applications.	Develop, Experiment	L6, L3

8. Mapping of course outcomes to module / course content

Module No.	Module Name	CO1	CO2	CO3	CO4	CO5	CO6
M1	Implement Decision Tree Learning	3				3	
M2	Implement Logistic Regression	3					
M3	Implement classification using Multilayer Perceptron	3				3	
M4	Implement classification using SVM	3				3	
M5	Implement AdaBoost		3			3	
M6	Implement Bagging using Random Forests		3			3	
M7	Implement K‑means Clustering to Find Natural Patterns in Data			3		3	
M8	Implement Hierarchical Clustering			3		3	
M9	Implement K‑mode Clustering			3		3	
M10	Implement Association Rule Mining using FP Growth				3		
M11	Classification based on Association Rules				3		
M12	Implement Gaussian Mixture Model using Expectation Maximization			3		3	3
M13	Evaluating ML algorithms with balanced and unbalanced datasets					3	
M14	Comparison of Machine Learning Algorithms	3	3	3	3	3	
M15	Implement k‑nearest neighbor algorithm					3	3

9. Mapping of the Course outcomes to Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	1	-	-	-	1	2	2
CO2	3	2	3	3	3	1	-	-	-	1	2	2
CO3	3	3	2	3	3	2	-	-	-	1	2	2
CO4	3	2	3	3	3	2	-	-	-	1	2	2
CO5	3	3	3	3	3	2	-	-	-	1	2	3
CO6	3	2	3	3	3	2	-	-	-	1	2	3
Avg	3	2.33	2.83	3	2.83	1.67	-	-	-	1	2	2.33

10. Mapping to PSO

COs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1
CO2	3	3	2	1
CO3	3	3	3	1
CO4	3	3	2	2
CO5	3	3	3	2
CO6	3	3	3	2
Avg	3	2.83	2.5	1.5

*** End of Syllabus***

Course Name: Research Methodology (Project I)
Code: CS681
(Semester – VI)
Category: Major
Course Broad Category: Engineering Science Course
[For Computer Science and Engineering]
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1. **Course Prerequisite:**
   i. Fundamental knowledge on English language and technical communication.
   ii. Fundamental knowledge on recent scientific, technology and engineering developments.

2. **Course Learning Objectives:**
   i. Create a detailed literature review on a selected topic.
   ii. Identify the gap and the scope to work on the defined topic.
   iii. Learn the ethical issues involved in the work.
   iv. Students will come out with a detailed report and a presentation.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Presentations, Interactive Discussions and Case Studies.
   Evaluation System –
   A. Cumulative Presentation (at least 3 times for each group) (40 Marks)- Summative Assessment.
   B. Final Term Presentation (60 Marks)- Summative Assessment.

4. **Course Content:**
   Course Name: Introduction to Computer Hardware and Software Course
   Course Code: CS681
   Hours per Week: 0L:0T:4P
   Credits: 2

Module	Topics	Lectures
Unit 1:	RESEARCH FORMULATION AND DESIGN - Motivation and objectives– Research methods vs. Methodology. Typesof research–Descriptivevs. Analytical, Appliedvs. Fundamental, Quantitativevs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining And Formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews,monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.	10
Unit 2:	RESEARCH ETHICS, IPR AND SCHOLARLY PUBLISHING Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copyright, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability	8
Unit 3:	INTERPRETATION AND REPORT WRITING - Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Project Report, Layout of the Project/Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Project/Research Report, Precautions for Writing Research Reports, Conclusions.	8
Unit 4:	DOCUMENT PREPARATION SYSTEM AND IDEs- Necessities of documents preparation system. Identify various online and offline document preparation systems (Overleaf, LaTex, etc). Needs of Integrated Development Environment, Identify different IDEs for various languages like Visual Studio Code, etc.	10

6. References:

Text & References Books:
i. Research Methodology and Scientific Writing, C. George Thomas, Springer
ii. Research Methodology: A Step by Step Guide for Beginners, 4th Edn, Ranjit Kumar, SAGE Publications Pvt. Ltd.

7. Course Outcomes:

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CS681-1	Define and understand the motivation and objectives of research work	Remember	L1
CS681-2	Explain how to define and formulate a research problem	Apply	L3
CS681-3	Identify the importance of literature review in a research work	Analyze	L4
CS681-4	Explain the ethical issues involved while undertaking research	Apply	L3
CS681-5	Develop the skill set to correctly present a research work by following the protocols of writing standard research reports.	Create	L6
CS681-6	Identify the appropriate tools to write a report, create project and presentation	Apply	L3

8. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	3	3	1	1	-
2	1	1	1	3	1	-
3	-	1	2	2	3	3
4	-	-	-	1	3	3

9. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	1	-	-	-	-	-	3
CO2	3	3	-	3	-	2	-	-	-	-	-	3
CO3	3	3	3	3	3	2	-	-	-	3	-	3
CO4	3	-	-	-	-	2	-	3	-	-	-	3
CO5	3	-	-	-	-	2	-	-	-	3	-	3
CO6	3	-	-	-	-	2	-	-	-	-	-	3
AVG.	3	3	3	3	3	1.83	-	3	-	3	-	3

10. Mapping to PSO

	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	1
CO2	2	2	3	1
CO3	2	2	3	1
CO4	2	2	3	1
CO5	2	2	3	1
CO6	2	2	3	1

*** End of Syllabus***