

Computer Science and Engineering

Preamble: The curriculum of B.Tech. Computer Science and Engineering program offered by the Department of Computer Science and Engineering under Academic Regulation 2020 is prepared in accordance with the curriculum framework of AICTE, UGC and Andhra Pradesh State Council of Higher Education (APSCHE). Further this Outcome Based Curriculum (OBC) is designed with Choice Based Credit and Semester System (CBCSS) enabling the learners to gain professional competency with multi-disciplinary approach catering the minimum requirement (Program Specific Criteria) of Lead Societies like ACM and other Professional Bodies as per the Engineering Accreditation Commission (EAC) of ABET and NBA. In addition, the curriculum and syllabi are designed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Professional Bodies, Research Organizations and Parents to capture their voice of the respective stakeholders.

The Curriculum design, delivery, and assessment, the three major pillars of academic system is completely aligned in line with Outcome Based Education (OBE) to assess and evaluate the learning outcomes to facilitate the learners to achieve their Professional and Career Accomplishments.

The Vision

To become the Centre of Excellence for technically competent and innovative computer engineers

The Mission

- To provide quality education and spread professional & technical knowledge, leading to a career as computer professionals in different domains of industry, governance, and academia
- To provide state-of-the-art environment for learning and practices
- To impart hands on training in latest methodologies and technologies

Program Educational Objectives (PEOs)

The PEOs are the educational goals that reflect Professional and Career Accomplishments that a graduate should attain after 4 – 5 years of his/her graduation.

The graduates of Computer Science and Engineering of NSRIT will

1. Exhibit new age talents that use critical thinking and problem-solving skills in the rapidly changing tech landscape demands dynamism in addition to the application of fundamental and conceptual knowledge meeting client business requirements
2. Sustain their satisfactory professional career in their own start-ups or as a team member/team lead in an IT or allied industry
3. Engage in self-directed learning and advanced studies based on the demand driven need of the industries for their professional and career accomplishments

Program Outcomes (POs)

The POs are the transactional statements of graduate attributes (GAs) that each graduating engineer should possess in terms of knowledge, skill and behavior with a minimum target performance level at the time of graduation as fixed by the program of study seeking continuous improvement year on year.

The graduates of Computer Science and Engineering of NSRIT will be able to demonstrate the following outcomes in terms knowledge, skill and behavioral competencies at the time of graduation with the expected target performance level

1. Apply the knowledge of basic sciences and fundamental engineering concepts in solving engineering problems (Engineering Knowledge)
2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences (Problem Analysis)
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations (Design/Development of Solutions)
4. Perform investigations, design and conduct experiments, analyse and interpret the results to provide valid conclusions (Investigation of Complex Problems)
5. Select/develop and apply appropriate techniques and IT tools for the design & analysis of the systems (Modern Tool Usage)
6. Give reasoning and assess societal, health, legal and cultural issues with competency in professional engineering practices (The Engineer and Society)
7. Demonstrate professional skills and contextual reasoning to assess environmental/societal issues for sustainable development (The Environment and Sustainability)
8. Demonstrate Knowledge of professional and ethical practices (Ethics)
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary situations (Individual and Team Work)
10. Communicate effectively among engineering community, being able to comprehend and write effectively reports, presentation and give / receive clear instructions (Communication)
11. Demonstrate and apply engineering & management principles in their own / team projects in multidisciplinary environment (Project Finance and Management)
12. Recognize the need for, and have the ability to engage in independent and lifelong learning (Life Long Learning)

Program Specific Outcomes (PSOs)

1. Able to apply the theoretical knowledge of Computer Science and Engineering and the foundational principles of software development to provide sustainable solutions for the real world technical challenges in the tech landscape by maintaining professional standards, ethical values and integrity
2. Able to adopt to technological changes by initiating self-paced learning to meet the industry demands

Category-wise Credit Distribution of Courses

Category		AICTE	APSCHE	NSRIT (A)
HS	Humanities and Social Science	12.0	10.5	10.5
BS	Basic Science	25.0	18.0	18.0
ES	Engineering Science	24.0	22.5	19.5
PC	Professional Core	48.0	55.5	58.5
PE	Professional Elective	18.0	15.0	15.0
OE	Open Elective	18.0	12.0	12.0
IN	Internship (s), Project & Seminars	15.0	16.5	16.5
SC	Skill Oriented Courses	-	10.0	10.0
MC	Mandatory Courses	-	-	-
AC	Audit Course	-	-	-
Total no. of credits		160	160	160

Computer Science and Engineering

Credit requirement for the award of the degree under academic Regulation 2020 – 2021 for the candidates admitted from the academic year 2021 onwards

	Four Years	Three Years
B. Tech. (Regular Degree)	160	121
B. Tech. (Honors Degree)	180	141
B. Tech. (With Minor specialization other than Chosen Branch of Engg. & Tech.)	180	141

Semester I

No.	Code	Course	POs	Contact Hours				
				L	T*	P	C	
01	20HSX01	Communicative English	10	3	0	0	3.0	HS
02	20BSX11	Linear Algebra and Differential Equations	1, 12 ¹	3	1	0	3.0	BS
03	20BSX33	Applied Physics	1	3	1	0	3.0	BS
04	20ESX02	Programming for Problem Solving using 'C'	1	3	0	0	3.0	ES
05	20CS101	Fundamentals of Computer Science	1	3	0	0	3.0	ES
06	20HSX02	Communicative English Lab	1, 10	0	0	3	1.5	HS
07	20BSX34	Applied Physics Lab	1, 4	0	0	3	1.5	BS
08	20ESX07	Programming for Problem Solving using 'C' Lab	1, 4	0	0	3	1.5	ES
Sub-total				15	02	09	19.5	

Semester II

01	20BSX12	Partial Differential Equations and Vector Calculus	1	3	1	0	3.0	BS
02	20BSX23	Applied Chemistry	1	3	1	0	3.0	BS
03	20ESX05	Basic Electrical and Electronics Engineering	1	3	1	0	3.0	ES
04	20CS201	Data Structures Using 'C'	1	3	1	0	3.0	ES
05	20EC203	Digital Logic Design	1	3	1	0	3.0	ES
06	20BSX24	Applied Chemistry Lab	1, 4	0	0	3	1.5	BS
07	20CS202	Data Structures Using 'C' Lab	1, 4	0	0	3	1.5	ES
08	20ESX08	Basic Electrical and Electronics Engineering Lab	1, 4	0	0	3	1.5	ES
09	20MCX01	Environmental Science	1	2	0	0	-	
Sub-total				17	05	09	19.5	

Semester III

01	20BSX16	Mathematical Foundations of Computer Science	1	3	1	0	3.0	BS
02	20CS302	Design and Analysis of Algorithms	1	3	1	0	3.0	PC
03	20CS303	Database Management Systems	1, PSO 1	3	1	0	3.0	PC
04	20CS304	Object Oriented Programming through C++	1	3	1	0	3.0	PC
05	20CS305	Computer Organization	1	3	0	0	3.0	PC
06	20CS306	Design and Analysis of Algorithms Lab	1, 4	0	0	3	1.5	PC
07	20CS307	Database Management Systems Lab	1, 4, PSO 1	0	0	3	1.5	PC
08	20CS308	Object Oriented Programming through C++ Lab	1, 4	0	0	3	1.5	PC
09	20CSS01	Programming Basics	3	1	0	2	2.0	SC
10	20MCX02	Constitution of India	-	2	0	0	-	
Sub-total				18	04	11	21.5	

* Suggested hours for tutorial

¹ By default all courses are mapped to PO 12 as they are weakly contributing

Semester IV

No.	Code	Course	POs	Contact Hours				
				L	T	P	C	
01	20HSX03	Managerial Economics and Financial Analysis	11	3	0	0	3.0	HS
02	20CS402	Data Ware Housing and Mining	1, 2	3	0	0	3.0	PC
03	20CS403	Python Programming	1	3	1	0	3.0	PC
04	20CS404	Operating Systems	1, 2, 3	3	1	0	3.0	PC
05	20CS405	Theory of Computation	1, 2	3	1	0	3.0	PC
06	20CS406	Data Ware Housing and Mining Lab	4, 2	0	0	3	1.5	PC
07	20CS407	Python Programming Lab	1	0	0	3	1.5	PC
08	20CS408	Operating Systems Lab	3, 4	0	0	3	1.5	PC
09	20AIS02	Competitive Programming Essentials	3, 4, 5	1	0	2	2.0	SC
Sub-total				16	03	11	21.5	

Semester V

01	20CS501	Java Programming	1	3	1	0	3.0	PC
02	20CS502	Computer Networks	3, 5	3	0	0	3.0	PC
03	20AI502	Artificial Intelligence	1, 2, 3	3	1	0	3.0	PC
04	-	Professional Elective I	-	3	0	0	3.0	PE
05	-	Open Elective I	-	3	0	0	3.0	OE
06	20CS506	Java Programming Lab	4	0	0	3	1.5	PC
07	20CS507	Computer Networks Lab	4, 5	0	0	3	1.5	PC
08	-	MOOCs	12	0	0	4	2.0	SC
09	20MCX03	Intellectual Property Rights and Patents	-	2	0	0	-	PC
10	-	Summer Internship #1 ²	5, 8, 9, 10, PSO 1	0	0	3	1.5	SC
11	-	Technical Paper Writing	-	0	0	2	-	AC
Sub-total				17	02	15	21.5	

Semester VI

01	20CS601	Cryptography and Network security	1, 2, 3	3	0	0	3.0	PC
02	20CS602	Web Technologies	1, 2, 3	3	0	0	3.0	PC
03	20CS603	Modern Software Engineering	1, 2, 3	3	0	0	3.0	PC
04	-	Professional Elective II	-	3	0	0	3.0	PE
05	-	Open Elective II	-	3	0	0	3.0	OE
06	20CS606	Cryptography and Network Security Lab	4	0	0	3	1.5	PC
07	20CS607	Web Technologies Lab	4	0	0	3	1.5	PC
08	20CS608	Modern Software Engineering Lab	4	0	0	3	1.5	PC
09	20CSS04	Android App Development	5, PSO 1, PSO 2	1	0	2	2.0	SC
10	20MCX04	Indian Traditional Knowledge	-	2	0	0	-	PC
Sub-total				18	0	11	21.5	

Semester VII

01	-	Professional Elective III	-	3	0	0	3.0	PE
02	-	Professional Elective IV	-	3	0	0	3.0	PE
03	-	Professional Elective V	-	3	0	0	3.0	PE
04	-	Open Elective III	-	3	0	0	3.0	OE
05	-	Open Elective IV	-	3	0	0	3.0	OE
06	20HSX04	Professional Ethics	8	3	0	0	3.0	HS
07	20CSS05	Finishing School for CSE	-	1	0	2	2.0	SC
08	-	Summer Internship #2 ²	5, 8, 9, 10, PSO 1	0	0	0	3.0	SC
Sub-total				19	0	02	23.0	

Semester VIII

01	-	Full Semester Internship ³	5-10, PSO 1, PSO 2	0	0	0	06	SC
02	-	Capstone Project ³	5-10, PSO 1, PSO 2	0	0	0	06	SC
Sub-total				0	0	0	12.0	
Total Credits				-	-	-	160	

² The work pertaining to Summer Internship #1 and #2 shall be completed at the end of Semesters IV and VI respectively. The assessment shall be carried out during Semesters V and VII

³ The students opting for FSI in VII Semester should take up the courses of VII Semester in VIII Semester

List of Electives

Professional Elective #1

1	20CS001	Object Oriented Analysis and Design	-	3	0	0	3.0	PE
2	20BSX15	Probability and Statistics	-	3	0	0	3.0	PE
3	20AI302	Artificial Neural Networks	-	3	0	0	3.0	PE
4	20CS004	Internet of Things	-	3	0	0	3.0	PE
5	20CS005	Mobile Computing	-	3	0	0	3.0	PE

Professional Elective #2

6	20CS006	Software Quality Management	-	3	0	0	3.0	PE
7	20DS302	Foundations of Data Science	-	3	0	0	3.0	PE
8	20AI503	Machine Learning	-	3	0	0	3.0	PE
9	20CS009	Network Programming and Protocols	-	3	0	0	3.0	PE
10	20CS010	Cloud Computing	-	3	0	0	3.0	PE

Professional Elective #3

11	20CS011	Software Testing Methodologies	-	3	0	0	3.0	PE
12	20DS502	Big Data	-	3	0	0	3.0	PE
13	20AI603	Deep Learning Principles and Practices	-	3	0	0	3.0	PE
14	20CS014	Block Chain Technologies	-	3	0	0	3.0	PE
15	20CS015	XML and Web Services	-	3	0	0	3.0	PE

Professional Elective #4

16	20CS016	Software Project Management	-	3	0	0	3.0	PE
17	20DS603	Data Visualization	-	3	0	0	3.0	PE
18	20AI005	Cyber Security	-	3	0	0	3.0	PE
19	20CS019	Ethical Hacking	-	3	0	0	3.0	PE
20	20DS007	Digital Image Processing and Applications	-	3	0	0	3.0	PE

Professional Elective #5

The curriculum provides academic flexibility to choose any of the domain specific courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration (4-credits) and the assessment shall be as per the academic regulation 2020.

PE

Open Elective #1

25	20CEO01	Urban Environmental Health	-	3	0	0	3.0	OE
26	20CS001	Data Structures and Algorithms	-	3	0	0	3.0	OE
27	20AIO01	Machine Learning for Engineers	-	3	0	0	3.0	OE
28	20DS001	Introduction to Database Management Systems	-	3	0	0	3.0	OE
29	20ECO01	Architectures and Algorithms of IoT	-	3	0	0	3.0	OE
30	20EEO01	Introduction to Renewable Energy Sources	-	3	0	0	3.0	OE
31	20MEO01	Nano Technology	-	3	0	0	3.0	OE
32	20SHO01	Women and Society	-	3	0	0	3.0	OE

Open Elective #2

33	20CEO02	Ecology, Environmental & Resource Management	-	3	0	0	3.0	OE
34	20CS002	Designing the Internet of Things	-	3	0	0	3.0	OE
35	20AIO02	Fundamentals of Deep Learning	-	3	0	0	3.0	OE
36	20DS002	Introduction to Data Science	-	3	0	0	3.0	OE
37	20ECO02	IoT for Smart Grids	-	3	0	0	3.0	OE
38	20EEO02	Electrical Safety and Management	-	3	0	0	3.0	OE
39	20MEO02	Fundamentals of Automobile Engineering	-	3	0	0	3.0	OE

Open Elective #3

40	20CEO03	Disaster, Risk Mitigation and Management	-	3	0	0	3.0	OE
41	20CS302	Operating Systems	-	3	0	0	3.0	OE
42	20AIO03	Intelligent Robots and Drone Technology	-	3	0	0	3.0	OE
43	20DS003	Introduction to Big Data	-	3	0	0	3.0	OE
44	20ECO03	Privacy and Security in IoT	-	3	0	0	3.0	OE
45	20EEO03	Low-cost Automation	-	3	0	0	3.0	OE
46	20MEO03	Industrial Automation	-	3	0	0	3.0	OE
47	20SHO03	Design Thinking	-	3	0	0	3.0	OE

Open Elective #4

The curriculum provides academic flexibility to choose any of the inter-disciplinary courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration and the assessment shall be as per the academic regulation 2020.

OE

B. Tech. (Honors)

Category I

1	20CSH01	Advanced Computer Architecture	-	4	0	0	4.0	HO
2	20DSH01	Text Analytics	-	4	0	0	4.0	HO
3	20AIH03	Game Theory	-	4	0	0	4.0	HO

Category II

4	20CSH04	GPU Architecture and Programming	-	4	0	0	4.0	HO
5	20DSH04	Recommender Systems	-	4	0	0	4.0	HO
6	20AIH06	Game Programming	-	4	0	0	4.0	HO

Category III

7	20CSH07	Fault Tolerant Computing	-	4	0	0	4.0	HO
8	20DSH07	Data Analysis With Mat lab	-	4	0	0	4.0	HO
9	20AIH09	3D Graphics and Animation	-	4	0	0	4.0	HO

Category IV

10	20CSH10	Distributed and Parallel Computing	-	4	0	0	4.0	HO
11	20DSH10	Data Preparation and Cleaning	-	4	0	0	4.0	HO
12	20AIH12	Augmented Reality and Virtual Reality	-	4	0	0	4.0	HO

B. Tech. (Minor with Specialization)⁴

Category I

1	20CEM01	Air Pollution	-	3	0	0	3.0	MI
2	20CSM01	E- Commerce	-	3	0	0	3.0	MI
3	20MEM01	Biomaterials	-	3	0	0	3.0	MI
4	20EEM01	Basic Control Systems	-	3	0	0	3.0	MI
5	20ECM01	Fundamentals of Electronics	-	3	0	0	3.0	MI
6	20AIM01	Fundamentals of Neural Networks	-	3	0	0	3.0	MI
7	20DSO03	Introduction to R Programming	-	3	0	0	3.0	MI

Category II

8	20CEM02	Climate Change Mitigation and Adaptation	-	3	0	0	3.0	MI
9	20CSM02	Knowledge Discovery and Databases	-	3	0	0	3.0	MI
10	20MEM02	Micro Electromechanical Systems	-	3	0	0	3.0	MI
11	20EEM02	Design of Photovoltaic systems	-	3	0	0	3.0	MI
12	20ECM02	Digital Electronics	-	3	0	0	3.0	MI
13	20AIM02	Machine Learning with Python	-	3	1	0	3.0	MI
14	20DSM02	Data Management and Analysis	-	3	0	0	3.0	MI

Category III

15	20CEM03	Sustainability and Pollution Prevention Practices	-	3	0	0	3.0	MI
16	20CSM03	Database Security	-	3	0	0	3.0	MI
17	20MEM03	Surface Engineering	-	3	0	0	3.0	MI
18	20EEM03	Electrical Engineering Material Science	-	3	0	0	3.0	MI
19	20ECM03	Analog Electronic Circuits	-	3	0	0	3.0	MI
20	20AIM03	Interpretable Deep Learning	-	3	0	0	3.0	MI
21	20DSM03	Data Governance	-	3	0	0	3.0	MI

List of Honors offered by Computer Science & Engineering Program

1. High Performance Computing
2. Data Analytics
3. Game Programming

List of Minor with Specialization offered by Computer Science & Engineering Program

1. Database Engineering

⁴ The students who are pursuing U.G. program offered by the Department of Computer Science Engineering can opt Minors offered by the other departments

PC 20CS501 Java Programming**3 1 0 3.0**

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20CS501.1	Explain the features of java Programming	3	1	L2
20CS501.2	Illustrate the concept of Class, Object and Constructors	3	1	L1, L2
20CS501.3	Demonstrate the use of interfaces, Packages, Multithreading and exception handling	3	1	L1, L2, L3
20CS501.4	Demonstrate the use of Applets and Event handling	3	1	L1, L2, L3
20CS501.5	Demonstrate generic programming and templates	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Object Oriented Programming**9 + 3 hours**

Introduction to OOP: Introduction to Object Oriented Programming, History of JAVA, Java Virtual Machine, Java Features, Program structures, Primitive Data types, Variables, Operators, Type Conversion, Arrays- Declaration and Initialization of Arrays, Operations on Array Elements, Arrays as Vectors

Flow of control-Branching and Looping statements

Unit II: Classes ,Objects, Constructors, Inheritance**9 + 3 hours**

Classes and Objects: classes, Objects, Creating Objects, Methods, constructors, Nested Classes, static keyword, Command line arguments, Garbage collector, Inheritance: Types of Inheritance, super keyword, final keyword , Method overloading, Method Overriding, Abstract class.

Constructor Overloading, this Keyword.

Unit III: Interfaces, Packages, Exception Handling, Multithreading**9+3 hours**

Interfaces, Interface Vs Abstract classes, Packages-Creating packages, Using Packages, Access protection, Exceptions-Introduction, Exception handling techniques-try...catch, throw, throws, finally block, user defined exceptions, Assertions
Multithreading: introduction, Thread, the main Thread, thread life cycle, Creation of threads, Thread priority, thread synchronization, Inter thread communication.

Multi Catch, Thread priority.

Unit IV: Strings, Applets,**9+3 hours**

Input/Output: reading and writing data, File handling using streams.

String Handling in Java: String classes and methods, string buffer

Applets- Applet class, Applet structure, Applet Life Cycle, paint(),update() and repaint(),Sample Programs

String builder class

Unit V: Event Handling, Java AWT**9+3 hours**

Event Handling -Introduction, Event Delegation Model, Sources of Events, Event Listeners, Adapter classes, Inner classes

AWT: Why AWT? Components and Containers, Button, Label, Checkbox, List boxes, Choice boxes, Text field and Text area, Menu, Scroll bar, Layouts-BorderLayout, GridLayout,.

Radio buttons, GridBagLayout

Text Books

1. Herbert Schildt, "The complete Reference Java", 8th edition, TMH, 2011.
2. Sachin Malhotra and SaurabhChoudary, "Programming in JAVA", Oxford,2014
3. Daniel Liang Y., "Introduction to java programming", 7th edition, Pearson,2009.

Reference Books

1. P. Radha Krishna, "Object Oriented Programming through Java", Universities Press, 2016.
2. K.Rajkumar, "JAVA Programming", 1st Edition, Pearson, 2013.

Web References

1. <https://www.javatpoint.com/java-tutorial>
2. <https://www.geeksforgeeks.org/java>
3. <https://beginnersbook.com>
4. <https://www.tutorialspoint.com/java>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

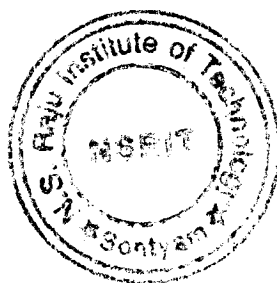
1. Write any four Applications of OOP
2. Define Class & object
3. What is constructor overloading?
4. What is use of Threads?
5. What is Exception handling?
6. What is a Container?

L2: Understand

1. Explain any four object oriented principles
2. Explain three types of constructors with example
3. Explain types of inheritance
4. Illustrate the use of super keyword with example
5. Explain the exception handling mechanism.
6. Explain Applet Life cycle with example
7. Explain Event handling with example
8. Write any four differences between application Programs and applets
9. Explain the following AWT components with example
i) Button ii) Check boxes iii) Radio buttons

L3: Apply

1. Implement employee class to get and print details.
2. Apply the concept of inheritance to read and print student information
3. Solve to find the area of different shapes using abstract class



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Chairman
Board of Studies (CSE)

PC 20CS502 Computer Networks**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO12	
20CS502.1	Describe the functions of each layer in OSI model	3	1	1	L1, L2
20CS502.2	Describe the functions of data link layer and the protocols	3	1	1	L1, L2
20CS502.3	Explain the functions of network layer and its protocols	3	1	1	L1, L2
20CS502.4	Illustrate the session layer issues and transport layer services	3	1	1	L1, L2
20CS502.5	Exemplify the functions of application layer and presentation layer and their protocols	3	1	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Networks**12 hours**

Network Topologies, Network Hardware, Network Software. Reference models- The OSI Reference Model- the TCP/IP Reference Model - Physical Layer: Guided Transmission Media, Digital Modulation & Multiplexing, Public Switched Telephone Network

Network Devices; The Mobile Telephone System

Unit II: Data Link Layer**12 hours**

Data Link Layer Design issues, Error Detection & Correction, Elementary Data Link protocols, Sliding window protocols
The Medium Access control sublayer: Multiple access protocols, Wireless LANs

Bluetooth, Data Link layer switching

Unit III: Network Layer**12 hours**

Design Issues- The Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, Quality of service, The Network Layer in the Internet.

Routing for mobile hosts, Routing in Ad Hoc Networks.

Unit IV: Transport Layer**12 hours**

The Transport service, Elements of Transport protocols, The Internet Transport Protocols: UDP, The Internet Transport Protocols: TCP, Performance issues.

Delay-Tolerant Networking: DTN Architecture, The Bundle protocols

Unit V: Application Layer**12 hours**

The Domain Name System: The DNS Name Space, Resource Records, Name Servers, Electronic Mail: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery

World Wide Web; Streaming Audio & Video

Text Books

1. Tanenbaum and David J Wetherall, "Computer Networks", 5th Edition, Pearson Education, 2010
2. Behrouz A. Forouzan, Firooz Mosharraf, "Computer Networks: A Top Down Approach", McGraw Hill, 1st Edition, 2012.

Reference Books

1. LL Peterson, BS Davie, Morgan-Kauffman, "Computer Networks: A Systems Approach", 5th Edition, 2011.
2. JF Kurose, KW Ross, Addison-Wesley, "Computer Networking: A Top-Down Approach", 5th Edition, 2009.
3. William Stallings, Pearson, "Data and Computer Communications", 8th Edition, 2007

Web Resources

1. <https://nptel.ac.in/courses/106/105/106105183/>
2. https://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network_pdf_version.htm
3. <https://www.javatpoint.com/computer-network-tutorial>

Internal Assessment Pattern

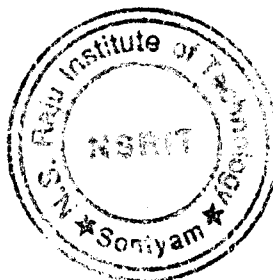
Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	30
L2	50	70
Total (%)	100	100


L1: Remember

1. List any 2 advantages and disadvantages of mesh topology
2. Define Maximum Data rate of a channel
3. Define Ethernet and Fast Ethernet
4. Define Congestion.
5. Write the general principles of congestion
6. Define TCP & UDP
7. Write the Application layer paradigms.
8. What are the problems with Congestion?
9. What are the design issues of data link layer?
10. What is the significance of DNS?

L2: Understand

1. Explain the structure of UDP Header format.?
2. Illustrate Routing of Packets within Virtual Circuit Subnet.?
3. Explain Traffic Aware Routing?
4. Compare the throughput of pure aloha and slotted aloha.?
5. Explain Channel Allocation strategies?
6. Explain about the sliding window protocol using Go-Back-NA.?
7. Explain Simplex Stop & Wait Protocol?
8. Compare and contrast synchronous time division multiplexing and statistical time division multiplexing.?
9. Explain Signal to Noise Ratio?
10. Explain different Network Topologies.?




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PC 20AI502 Artificial Intelligence**3 1 0 3**

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

Code	Course Outcomes	Mapping with POs		PO12	DoK
		PO1	PO2		
20AI502.1	Describe the foundational principles of artificial intelligence	3	2	1	L1, L2
20AI502.2	Formalise the given problem using different AI methods	3	2	1	L1, L2
20AI502.3	Explain different concepts of logic	3	2	1	L1, L2
20AI502.4	Describe the different methods of knowledge representation	3	2	1	L1, L2
20AI502.5	Explain the principles and applications of expert systems	3	2	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction to Artificial Intelligence**9+3 Hours**

Introduction – History - Intelligent systems - Foundations of AI – Applications – Tic-Tac-Tie game playing - Development of AI languages - Current trends in AI

Online agents

Unit II: Problem Solving**9+3 Hours**

Problem solving: State-Space search and Control strategies: Introduction - General problem solving - Characteristics of problem - Exhaustive searches - Heuristic search techniques - Iterative deepening A* - Constraint satisfaction - Problem reduction and game playing: Introduction - Problem reduction - Game playing - Alphabeta pruning - Two-player perfect information games

Unknown environment

Unit III: Logic concepts**9+3 Hours**

Introduction - Propositional calculus - Propositional logic - Natural deduction system - Axiomatic system - Semantic tableau system in propositional logic - Resolution refutation in propositional logic

Predicate Logic

Unit IV: Knowledge Representation**9+3 Hours**

Introduction - Approaches to knowledge representation - Knowledge representation using semantic network - Extended semantic networks for KR - Knowledge representation using frames - Advanced knowledge representation techniques: Introduction - Conceptual dependency theory - Script structure - Cyc theory - Case grammars

Semantic web

Unit V: Expert Systems**9+3 Hours**

Expert system and applications: Introduction - Phases in building expert systems - Expert system versus traditional systems - Rule-based expert systems - Blackboard systems - Truth maintenance systems - Application of expert systems

List of shells and tools

Text Books

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007

Reference Books

1. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
2. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
3. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013

Web Resources

1. <https://nptel.ac.in>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

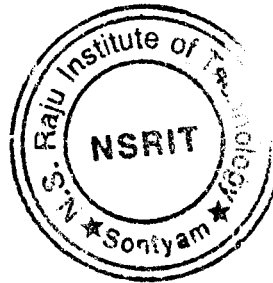
Sample Short and Long Answer Questions of Various Cognitive Levels


L1: Remember

1. State the tasks which are associated with A.I.
2. Give an example of script-arithmetic problem.
3. Define Script
4. Recall Intelligence

L2: Understand

1. Explain Turing Test.
2. Explain the characteristics of production system.
3. Write A* algorithm in detail and explain its functionality to solve 8-puzzle problem.
4. Explain the semantic analysis phase done through case grammars in Natural Language understanding




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 Board of Studies CSE (AI&ML)

PC 20CS506 Java Programming Lab**0 0 3 1.5**

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

Code	Course Outcomes	Mapping with POs
		PO4
20CS506.1	Illustrate the usage of classes & object	3
20CS506.2	Implement Inheritance, Method overloading, overriding & Abstract Classes	3
20CS506.3	Implement interfaces, packages, exception handling & Multithreading	3
20CS506.4	Demonstrate the usage of Applets & Event handling	3
20CS506.5	Implement AWT Components	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

List of Experiments

- Write a program to demonstrate the usage of Arrays
 - Write a program to illustrating Methods
- Write a program to demonstrate the usage of classes & object
- Write a C++ Program that illustrates the following:
 - Super
 - Final
 - Static
- Create a multilevel inheritance for classes vehicle, brand and cost. The vehicle class determines the type of vehicle which is inherited by the class brand which determines the brand of the vehicle. Brand class is inherited by cost class, which tells about the cost of the vehicle. Create another class which calls the constructor of cost class and method that displays the total vehicle information from the attributes available in the super classes.
 - Create an abstract class shape. Let rectangle and triangle inherit this shape class. Add necessary functions.
- Write a JAVA program illustrate class path
 - Write a case study on including in class path in your os environment of your package. c) Write a JAVA program that import and use the defined your package in the previous Problem
- Write a program to illustrate the usage of try, catch, throws and finally.
 - Write an application that shows how to create a user-defined exception
- Write a program to create the threads by extending Thread class.
 - Write a program that executes two threads. One thread displays every 1000 milliseconds and other displays every 3000 milliseconds.
- Write a program to demonstrate thread synchronization.
 - Write a program to demonstrate thread priorities.
- Write a Java program to count the number of occurrences of a character in a given string.
 - Write a Java program to merging of two strings
- Write Applet code for drawing line, rectangle, circle and setting color
 - Write a program to design a calculator by using Grid Layout
- Write a program to illustrate the usage of AWT Components

Reference

- Lab Manual for Java Programming Lab Department of Computer Science and Engineering, NSRIT

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PC 20CS507 Computer Networks Lab**0 0 3 1.5**

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

Code	Course Outcomes	Mapping with POs		
		PO1	PO4	PO12
20CS507.1	Illustrate the functions of different networking hardware.	3	3	1
20CS507.2	Implement different Data link layer protocols.	3	3	1
20CS507.3	Implement different Network layer protocols.	3	3	1
20CS507.4	Implement the various Routing protocols/Algorithms	3	3	1
20CS507.5	Implement different Application layer protocols.	3	3	1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create.

List of Experiments

- Study of Networking hardware and the network setup in the campus.
- Implement the data link layer framing methods such as character stuffing and bit stuffing.
- Write a program to simulate the sliding window protocol for Go Back-n
- Write a program to simulate the sliding window protocol for Selective Repeat
- Write a program to simulate the stop and wait protocol
- Write a client-server application for chat using UDP
- Implementation of one-to-one chat application.
- Implementation of Connection oriented concurrent service (TCP).
- Simulate the OPEN SHORTEST PATH FIRST routing protocol based on the cost assigned to the path.
- Implement Dijkstra's algorithm to compute the shortest path in a graph.
- Take an example subnet graph with weights indicating delay between nodes. Now obtain Routing table at each node using distance vector routing algorithm.
- Implementation of FTP.
- Implementation of SMTP.

References

- Lab Manual for Network Programming Lab, Department Computer Science & Engineering, NSRIT.

MC 20MCX03 Intellectual Property Rights and Patents**2 0 0 0**

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

Code	Course Outcomes	Mapping with POs		DoK
		PO11	PO12	
20MCX03.1	Acquire knowledge on intellectual property rights	-	-	L1, L2
20MCX03.2	Know about the acquisition of trademarks.	-	-	L1, L2
20MCX03.3	Identify the importance of copyrights, patents and transfer of Ownership.	-	-	L1, L2
20MCX03.4	Reciprocate on new developments of intellectual property rights	-	-	L1, L2
20MCX03.5	International overview of IPR	-	-	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Intellectual property:**4 Hours**

Concepts, types of intellectual property, international organizations, agencies and importance of intellectual property rights. Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR., IPR in India and Abroad

Unit II: Introduction to Trade Marks:**4 Hours**

Purpose and function of trademarks, acquisition of trade mark rights, selecting and evaluating trademark, trademark registration processes. Trade Secrets and Industrial Design registration in India and Abroad

Unit III: Registration of Copy Rights**4 Hours**

Fundamentals of copy right law, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copyright registration, international copyright laws.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

Unit IV: Latest development of intellectual property Rights**4 Hours**

New developments in trademark law; copy right law, patent law, intellectual property audits. Infringement of IPRs, Enforcement Measures, Emerging issues–

Unit V: Enforcement Of IPRs**4 Hours**

International overview on intellectual property, international – trade mark law, copy right law, international patent law international development in trade secrets law.

Text Books

1. Intellectual property right, Deborah, E. Bouchoux, cengage learning.
2. Intellectual property right - Unleashing the knowledge economy, Prabuddha Ganguli, Tata McGraw Hill Publishing Company Ltd.

3. Cornish, William Rodolph & Lewelyn, David. Intellectual property: patents, copyright, trademarks and allied rights. Sweet & Maxwell, 8/e, 2013.

Reference Books

1. Cornish, William Rodolph. Cases and materials on intellectual property. Sweet & Maxwell, 5/e, 2006.
2. Lo, Jack and Pressman, David. How to make patent drawings: a patentify yourself companion. Nolo, 5/e 2007.

Web References

1. <https://www.investopedia.com/terms/i/intellectualproperty.asp>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3217699/>
3. https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	60	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Industrial property?
2. What are the fundamentals of copy rights
3. Define patents and its approval process
4. Define copy right law.
5. Define transfer of trade marks.

L2: Understand

1. Explain the role trade secrets in company law.
2. Explain the concept ownership rights of patents with suitable examples
3. Explain the international patent law.
4. Distinguish between copy rights and patents.
5. Explain copyright registration.



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IN Summer Internship #1

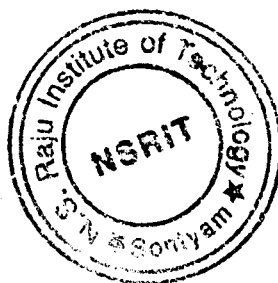
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At the end of the course, students will be able to

No. Course Outcomes

- 1 Demonstrate the theoretical learning outcomes
- 2 Integrate theory and practice during graduation
- 3 Comprehend the industry practices in the relevant and allied field of study
- 4 Develop communication skills in terms of oral, written, and graphical communications
- 5 Develop problem solving skills
- 6 Develop work habits and teamwork in a multidisciplinary setting for a successful career after graduation

Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes




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Board of Studies (CSE)

AC Technical Paper Writing

0 0 2 0

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

No.	Course Outcomes
1	Develop searching latest relevant literature pertaining to the topic of interest
2	Develop self-learning ability to become a lifelong independent learner
3	Develop the habit of writing technical manuscript as per the requirement
4	Develop presentation skills and speak with appropriate technical phrases
5	Explore the research topics and develop research interests
6	Comprehend the latest technologies, techniques, tools, and methodologies

Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes



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 Board of Studies (Civil Engineering)

PC 20CS601 Cryptography and Network Security**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PO12	
20CS601.1	Understand basics of cryptography and network security.	3	1	1	1	L1, L2
20CS601.2	Understand the concepts of Confidentiality, Integrity and Availability of a data	3	1	1	1	L1, L2
20CS601.3	Implement different Public key cryptography techniques	3	1	1	1	L1, L2, L3
20CS601.4	Apply various protocols for network security	3	1	1	1	L1, L2, L3
20CS601.5	Understand the concepts of Web and System Security	3	1	1	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

UNIT I: Introduction**9 hours**

Security Attacks, Services and Mechanism, Cryptography, Conventional Encryption Model, Classical Encryption Techniques, Substitution Ciphers and Transposition Ciphers, Cryptanalysis, Steganography, Stream and Block ciphers, Block ciphers principals, Data Encryption Standard(DES), Strength of DES, Differential and Linear Crypt Analysis of DES, Block cipher modes of operations, Triple DES, AES

Differences between DES and AES

Unit II: Confidentiality and Modular Arithmetic**9 hours**

Confidentiality using Conventional Encryption, Traffic confidentiality, Key distribution, Random number generation, Graph, Ring and field, Prime numbers, modular arithmetic, Fermat's and Euler's theorem, Primality testing, Euclid's Algorithm, Chinese Remainder theorem, Discrete algorithms

Relative prime numbers

Unit III: Public key cryptography and Authentication requirements**9 hours**

Principles of Public Key crypto systems, RSA algorithm, Security of RSA, Key management, Diffie-Hellman key exchange algorithm, Elliptic Curve cryptography, Authentication functions, Message authentication code Hash functions, Birthday attacks, Security of hash functions and MACS.

Authentication requirements

Unit IV: Integrity checks and Authentication algorithms**9 hours**

Message digest algorithm (MD5), Secure hash algorithm (SHA), Digital Signatures, Authentication protocols, Digital Signature Standards (DSS), Proof of digital signature algorithm, Kerberos and X.509, Directory authentication service, Electronic mail security, Pretty good privacy (PGP) - S/MIME.

Differences between MD5 and SHA

Unit V: Web and System Security**9 hours**

Web Security, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction (SET), System Security, Intruders, Viruses and related threats, Firewall design principals – Trusted Systems

Types of Viruses

Text Books

1. William Stallings, "Cryptography and Network security Principles and Practices", seventh edition, Pearson, 2017
2. Behrouz A Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", third edition, McGraw-Hill, 2007.

Reference Books

1. Mao M., "Modern Cryptography – Theory and Practice", Pearson Education, 2008
2. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", second edition, Pearson, 2005.

Web Resources

1. <http://nptel.ac.in/courses/106105031/>
2. <https://www.tutorialspoint.com/cryptography/index.htm>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

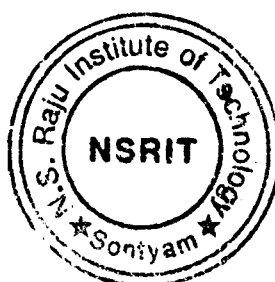
1. What is meant by intrusion detection system?
2. What is a web based attack?
3. State Euler's Theorem
4. Write a short note on Triple DES
5. List out any four disadvantages of double DES

L2: Understand

1. Explain the digital signature algorithm
2. Explain in detail the operation of Internet Key Exchange with an example
3. Discuss the various principles involved in private and public key cryptography
4. Explain Data Encryption standard (DES) in detail
5. Explain the Key Expansion process in AES

L3: Apply

1. Apply decryption and encryption using RSA algorithm with $p=3$, $q=11$, $e=7$ and $N=5$
2. What is the cipher text if the plain text is 63 and public key is 13? Use RSA algorithm
3. State the Chinese Remainder Theorem and find X for the given set of congruent equations $X \equiv 2 \pmod{3}$, $X \equiv 3 \pmod{5}$ and $X \equiv 2 \pmod{7}$
4. Explain the process of deriving eighty 64-bit words from 1024 bits for processing of a single blocks and also discuss single round function in SHA-512 algorithm. Show the values of W_{16} , W_{17} , W_{18} and W_{19}
5. How is GCD calculated with Euclid's algorithm? Calculate the GCD of (270, 192)



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PC 20CS602 Web Technologies**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PO12	
20CS602.1	Create a web page using HTML and Cascading Styles sheets	3	1	1	1	L1, L2
20CS602.2	Build dynamic web pages using JavaScript (Client side programming).	3	1	1	1	L1, L2
20CS602.3	Create XML documents and Schemas	3	1	1	1	L1, L2, L3
20CS602.4	Build web applications using PHP and MYSQL	3	1	1	1	L1, L2, L3
20CS602.5	Design Web Applications using Ruby and Rails	3	1	1	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: HTML and CSS**9 hours**

HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, Html styles, Elements, Attributes, Heading, Layouts, frames, Images, Hypertext Links, Lists, Tables, Forms, GET and POST method, HTML 5, Dynamic HTML.

CSS: Cascading style sheets, Levels of Style Sheets, Style Specification Formats, Selector Forms

Conflict Resolution, CSS Math functions

Unit II: JavaScript**9 hours**

The Basics of Java script: Objects, Primitives Operations and Expressions, Screen Output and Keyboard Input, Control Statements, Object Creation and Modification, Arrays, Functions, , Pattern Matching using Regular Expressions, Events and Event Handling, Handling Events from Body Elements, Handling Events from Button Elements, validations

Constructors, Errors in Scripts

Unit III: XML**9 hours**

The Syntax of XML, Document type Definition, XML schemas, XML Namespace, Document object model, XSLT, DOM and SAX Approaches, AJAX A New Approach: Introduction to AJAX, Basics of AJAX, XML Http Request Object

Implementing programs using DOM and SAX

Unit IV: PHP Programming**9 hours**

Introduction to PHP: Creating PHP script, Running PHP script. Working with variables and constants: Using variables, Using constants, Data types, Operators.

Controlling program flow: Conditional statements, Control statements, Arrays, functions, PHP-MYSQL Example

PHP Constructor, PHP Destructor, PHP Error Handling

Unit V: Web Frameworks**9 hours**

Web development frameworks – Introduction to Ruby, Ruby features, Ruby operators, Ruby Data types, Ruby on rails – Design, Web Servers

Ruby Arrays

Text Books

1. Robert W Sebesta, "Programming the World Wide Web", Seventh Edition, Pearson Education, 2013

2. Uttam K Roy, "Web Technologies", Illustrated edition, Oxford University Press, 2011
3. Sammulal Porika, "Web Technologies And Applications", First Edition, Bsp, January 2017
4. Steven Holzner, "The Complete Reference PHP" Indian Edition, Tata McGraw-Hill, 2017
5. Leonard Richardson, "RESTful web services", 1st Edition, Ruby, O'Reilly, 2007

Reference Books

1. Kogent Learning Solutions Inc, "Web Technologies", HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, Dream Tech, 2012
2. Deitel Deitel Goldberg, "Internet & World Wide Web How to Program", Third Edition, Pearson Education, 2006.
3. Bruce Tate, Curt Hibbs, "Ruby on Rails Up and Running, Lightning fast Web development", First Edition, Oreilly, 2006.
4. Paul Wang and Sanda Katila, "An Introduction to Web Design and Programming", First Edition, Cengage Learning, 2003

Web Resources

1. <https://www.javatpoint.com/php-tutorial>
2. <https://www.tutorialspoint.com/html/index.htm>
3. <https://www.geeksforgeeks.org/javascript-tutorial/>
4. <https://www.tutorialspoint.com/ruby/>
5. <https://www.w3schools.com/xml/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the protocols used by AJAX
2. List any four table tags
3. List any three types of CSS
4. Write any three advantages of XML
5. List any two advantages of java script
6. How to declare PHP variables?
7. How to create getter and setter methods in Ruby?
8. List the three control statements in PHP?

L2: Understand

1. Explain the difference between HTML, DHTML and XHTML
2. Explain about the following terms with examples (i) Unordered Lists (ii) Ordered Lists
3. Write all the basic html tags and explain with an example
4. Explain Form validation using Java script
5. Describe Arrays in Java script
6. Difference between DOM and SAX Parser
7. Explain XML Schema with an example
8. Explain conditional statements in PHP with an example

L3: Apply

1. Design a web page using HTML, CSS, and Java Script
2. Write a PHP program to print sum of digits.
3. JavaScript Program to Find the Square Root
4. Explain the creation of iterators in Ruby with examples.



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PC 20CS603 Modern Software Engineering**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PO12	
20CS603.1	Understand knowledge in practice of software engineering skills	3	2	2	1	L1, L2
20CS603.2	Implement software engineering models, methodologies, practices to fit the nature of software	3	2	2	1	L1, L2, L3
20CS603.3	Implement modern phases of software development with the agile process	3	2	2	1	L1, L2, L3
20CS603.4	Implement design and develop correct and robust software products	3	2	2	1	L1, L2, L3
20CS603.5	Implement right strategies in software testing, quality, risk mitigations	3	2	2	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Software Engineering 9 hours**9 hours**

The evolving of software - Nature of software - Software myths - Knowledge and Core Principles Software Engineering - Process framework - The capability maturity model (CMMI) process patterns - Process assessment - Personal and team process models - The waterfall model - Incremental process models - The unified process: Agility - Agile Process - Extreme Programming (XP) - The Role of tools in Agile process

Evolutionary process model

Unit II: Software Requirements Engineering and Modelling**9 hours**

Functional and non-functional requirements - User requirements - System requirements - Interface specification - The software requirements document. Feasibility studies - Requirements elicitation and analysis - Requirements validation - Requirements management - Context models - Behavioral models - Data models

Identify non-functional requirements in the software's that you used frequently

Unit III: Design, The Unified Process Model, Coding**9 hours**

The process in design - Quality - Design concepts - Design model - Data design - Software Architecture - Architectural Genres - Architectural styles and patterns - Architectural design - Assessing Alternative Architectural Designs - Architectural Mapping Using Data Flow - Conceptual model of UML - UML Models that Supplement the Use Case - Class diagrams - Sequence diagrams - Collaboration diagrams - Use case diagrams - Component diagrams - Structured coding Techniques- Coding Styles-Standards and Guidelines

Documentation Guidelines-Modern Programming Language Features

Unit IV: Testing and Quality Assurance**9 hours**

Elements of Software Quality Assurance - SQA Tasks - Goals & Metrics - Statistical SQA - Software Reliability - A Strategic Approach to Software Testing - Strategic Issues - Test Strategies for Conventional Software - Test Strategies for Object-Oriented Software - Validation Testing - System Testing - Software Testing Fundamentals - Internal and External Views of Testing - White-Box Testing - Basis Path Testing

Test Strategies for WebApps, The Art of Debugging

Unit V: Risk Mitigation and Maintenance**9 hours**

Risk management - Reactive Vs Proactive risk strategies - Software risks - Risk identification - Risk projection - Risk mitigation plan - Software Maintenance-Software Supportability- Reengineering- Business Process Reengineering- Software Reengineering- Reverse Engineering- Restructuring- Forward Engineering

Economics of Reengineering

Text Books

1. Roger S. Pressman, "Software Engineering a practitioner's approach", Eighth edition, McGraw Hill Higher Education, 2015.
2. Rajib Mall, "Fundamentals of Software Engineering", Fifth Edition, PHI, 2018
3. Ian Sommerville, "Software Engineering", Ninth edition, 2011
4. Rajiv Chopra, "Modern Software Engineering", Wiley, 2019

Reference Books

1. PankajJalote , "Software Engineering", A Precise Approach, Wiley India, 2010.
2. Ugrasen Ivor Jacobson and Harold Bud Lawson, "The Essentials of Modern Software Engineering", ACM Books, 2019
3. Murali D., Rajeswara Rao R. and Narayana V.S., "Software Engineering New Approach", BS publications, First Edition, 2018

Web Resources

1. https://en.wikipedia.org/wiki/Software_engineering
2. <https://www.compact.nl/en/articles/modern-software-development/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

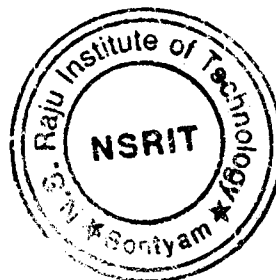
1. Describe two types of models available in SDLC
2. What is the need to learn Software Engineering concepts?
3. What is agile process?
4. How tools play important role in Agile Process?

L2: Understand

1. Describe key taken ways in the agile methodology
2. What is SQA role in software engineering?
3. Summarize the myths in software development
4. Demonstrate requirements eliciting

L3: Apply

1. Apply test Strategies for Object-Oriented Software
2. Illustrate Strategic approach in software testing
3. What are steps to be followed in requirement modeling of Web App?
4. Illustrate risk mitigation plan for a software development



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PC 20CS606 Cryptography and Network Security Lab**0 0 3 1.5**

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

Code	Course Outcomes	Mapping with POs
		PO4
20CS606.1	Implement classical encryption techniques to solve the problems.	3
20CS606.2	Implement encryption algorithms	3
20CS606.3	Implement authentication algorithms	3
20CS606.4	Implement symmetric and asymmetric key algorithms for cryptography	3
20CS606.5	Implement firewall design principles and identify various intrusion detection systems and be able to achieve highest system security	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

List of Experiments

- Perform encryption, decryption using the following substitution techniques
 - Ceaser cipher
 - Playfair cipher
 - Hill Cipher
 - Vigenere cipher
- Perform encryption and decryption using following transposition techniques
 - Rail fence
 - Row & Column Transformation
- Apply DES algorithm for practical applications.
- Apply AES algorithm for practical applications.
- Implement RSA Algorithm using HTML and JavaScript
- Implement the Diffie-Hellman Key Exchange algorithm for a given problem.
- Calculate the message digest of a text using the SHA-1 algorithm.
- Implement the SIGNATURE SCHEME - Digital Signature Standard.
- Demonstrate intrusion detection system (ids) using any tool eg. Snort or any other software.
- Automated Attack and Penetration Tools Exploring N-Stalker, a Vulnerability Assessment Tool
- Defeating Malware
 - Building Trojans
 - Rootkit Hunter

Reference

- Lab Manual for Cryptography and Network Security Lab, Department of Computer Science and Engineering, NSRIT


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PC 20CS607 Web Technologies Lab**0 0 3 1.5**

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

Code	Course Outcomes	Mapping with POs PO4
20CS607.1	Create and apply the role of languages like HTML, CSS	3
20CS607.2	Build dynamic web pages using JavaScript	3
20CS607.3	Create and apply the role of language like XML	3
20CS607.4	Develop Web Applications using PHP & MySQL	3
20CS607.5	Install & Use Frameworks	3

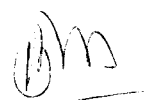
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

List of Experiments

- Design the static web pages required for an online book store web site.
 - HOME PAGE :The static home page must contain three frames.
 - LOGIN PAGE
 - CATALOGUE PAGE: The catalogue page should contain the details of all the books available in the web site in a table.
 - REGISTRATION PAGE
- Develop and demonstrate the usage of inline, internal and external style sheet using CSS
- Design a web page using CSS (Cascading Style Sheets) which includes the following: 1) Use different font, styles: In the style definition you define how each selector should work (font, color etc.). Then, in the body of your pages, you refer to these selectors to activate the styles
- Write a Java Script program by using variables
- Write a java script program to multiply two numbers and display the result in separate text box
- Write JavaScript to validate the following fields of the Registration page.
 - First Name (Name should contains alphabets and the length should not be less than 6 characters).
 - Password (Password should not be less than 6 characters length).
 - E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com)
 - Mobile Number (Phone number should contain 10 digits only).
 - Last Name and Address (should not be Empty)
- Design an HTML having a text box and four buttons viz Factorial, Fibonacci, Prime, and Palindrome. When a button is pressed an appropriate javascript function should be called to display
 - Factorial of that number
 - Fibonacci series up to that number
 - Prime numbers up to that number
 - Is it palindrome or not
- Create an XML document that contains 10 users information. Write a Java Program, which takes User Id as input and returns the user details by taking the user information from XML document using DOM parser or SAX parser.
- Develop and demonstrate PHP Script for the following problems:
 - Write a PHP Script to find out the Sum of the Individual Digits.
 - Write a PHP Script to check whether the given number is Palindrome or not
- Write a PHP to connect to the database, Insert the details of the student academic information with student academic info page.
- Implement the web applications with Database using PHP

Reference

- Lab Manual for Web Technologies ,Department of Computer Science and Engineering, NSRIT


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PC 20CS608 Modern Software Engineering Lab**0 0 3 1.5**

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

Code	Course Outcomes	Mapping with Pos P04
20CS608.1	Implement software engineering methodologies involved in the phases for project development.	3
20CS608.2	Develop a model Software Requirement Specification document for proposed system	3
20CS608.3	Implement high-level design of the system from the software requirements using knowledge of software design process	3
20CS608.4	Implement software models to cater business scenarios	3
20CS608.5	Implement test cases for various white box and black box testing techniques	3
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge		

List of Experiments

Implement the following exercises for any two projects below:

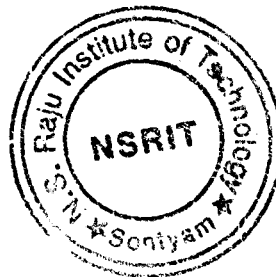
1. Development of problem statement from the user stories
2. Preparation of Software Requirements Document and convert in to use cases
3. Do requirement analysis and develop Software Requirement Specification document for proposed system.
4. Development of Entity Relationship(E-R) diagram
5. Design high-level design of the system
6. Draw Use case and Class diagrams
7. Draw Sequence and Activity diagrams
8. Develop the prototype of the product
9. Write unit and function test cases for the requirements

Sample Projects:

1. Online Exam Registration
2. E-book management System.
3. Recruitment system
4. Banking System
5. Airline Reservation System
6. Library Management System

Reference

1. Lab Manual for Modern Software Engineering Department of Computer Science and Engineering, NSRIT
2. Software Engineering- Sommerville, Pearson Education, 7th edition.
3. The unified modelling language user guide Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Education.



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20CSS04 Android App Development**1 0 2 2.0**

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

Code	Course Outcomes	Mapping with POs and PSOs			DoK
		PO5	PSO1	PSO2	
20CSS04.1	To illustrate the different components of Android OS in detail	3	3	3	L1, L2
20CSS04.2	To develop a mobile application using different components of Android	3	3	3	L1, L2
20CSS04.3	To choose appropriate controls to design the GUI to meet desired needs	3	3	3	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Android SDK Features, The Dalvik Virtual Machine, Downloading and Installing the Android SDK, Developing with Eclipse, Application Manifest File, Creating resources, Drawables, Layouts, Animations, Menus, Building user Interfaces-Assigning user interfaces to Activities, Layouts-Linear, Relative and Grid Layout, Working with fragments, Android widget Toolbox-Creating New Views, Introducing adapters, Intents and Broadcast receivers, Databases and content providers-SQLite Databases and content Providers, Introducing services, Using background threads, using alarms, Customizing toasts, Introducing Notifications, Maps

References

1. Reto Meier, "Professional Android 4 Application Development", Wrox, 2018
2. Dave MacLean, Satya Komatineni, Grant Allen, "Pro Android 5", Apress 2015
3. John Horton, "Android Programming for Beginners", PACKT 2015
4. Wallace Jackson, "Android Apps for Absolute Beginners", Apress, 2013


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20MCX04 Indian Traditional Knowledge**0 0 3 0****Course Objectives, Outcomes, Mapping and Depth of Knowledge (DoK – RBT)****COURSE OBJECTIVES:**

COB 1: To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.

COB 2: To make the students understand the traditional knowledge and analyse it and apply it to their day-to-day life

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO6	PO7	PO12	
20MCX03.1	Identify the concept of Traditional knowledge and its importance	1	3	3	2	L1, L2
20MCX03.2	Explain the need and importance of protecting traditional knowledge	1	2	3	2	L1, L2
20MCX03.3	Illustrate the various enactments related to the protection of traditional knowledge	1	3	3	2	L1, L2
20MCX03.4	Interpret the concepts of Intellectual property to protect the traditional knowledge	1	2	3	2	L1, L2
20MCX03.5	Explain the importance of Traditional knowledge in Agriculture and Medicine	1	3	3	2	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create

UNIT-I: Introduction to traditional knowledge**6hours**

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

UNIT-2: Protection of traditional knowledge**6hours**

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT-3: Legal framework and TK:**6hours**

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

UNIT-4: Traditional knowledge and intellectual property:

6hours

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

UNIT-5: Traditional Knowledge in Different Sectors:

6hours

Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

Text Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.

Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. "Knowledge Traditions and Practices of India" Kapil Kapoor¹, Michel Danino².

Web Links:

1. <https://www.youtube.com/watch?v=LZP1StpYEPM>
2. <http://nptel.ac.in/courses/121106003/>

PE 20CS001 Object Oriented Analysis and Design**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with POs	DoK
20CS001.1	Compare and contrast object oriented analysis and design	-	L1, L2
20CS001.2	Create class diagrams that model both the domain model and design model of a software system.	-	L1, L2
20CS001.3	Analyze the conceptual model of UML	-	L1, L2, L3
20CS001.4	Create interaction diagrams and other diagrams that model the dynamic aspects of a software system	-	L1, L2, L3
20CS001.5	Detailed case study experience with architecture, analysis and design.	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing. for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction**9 hours**

The Structure of Complex systems, The Inherent Complexity of Software, Attributes of Complex System, Organized and Disorganized Complexity, Designing Complex Systems, Foundation of Object Model, Elements of Object Model, Applying the Object Model

Object Model with Case Study

Unit II: Classes and Objects**9 hours**

Nature of Object, Nature of Class, Identifying Classes and Objects, Relationships among objects, Relationship among Classes, Interplay of Classes and Objects, Importance of Proper Classification, Key abstractions and Mechanisms

Difference between Class and Object

Unit III: Introduction to UML**9 hours**

Why we model, Conceptual model of UML, Architecture, Class diagrams, Object diagrams

Examples of object diagrams

Unit IV: Behavioural Modelling**9 hours**

Interactions, Interaction diagrams, Use cases, Use case Diagrams, Activity Diagrams, processes and Threads, state chart diagrams

Examples of state chart diagrams

Unit V: Architectural Modelling**9 hours**

Component, Deployment, Component diagrams and Deployment diagrams.

Case Study: Any Software Application covering all Analysis and Design Diagrams

Case study examples

Text Books

1. Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Jim Conallen and Kellia Houston, "Object-Oriented Analysis and Design with Applications", 3rd edition, Pearson, 2013
2. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Language User Guide", 12th Impression, Pearson, 2012

Reference Books

1. Mahesh P. Matha, "Object-oriented analysis and design using UML", PHI, 2008
2. Brett D. McLaughlin, Gary Pollice, Dave West, "Head first object-oriented analysis and design", O'Reilly, 2006
3. John W. Satzinger, Robert B. Jackson, Stephen D. Burd, "Object-oriented analysis and design with the Unified process", Cengage Learning
4. James Rumbaugh, Ivar Jacobson, Grady Booch, Addison-Wesley, "The Unified modelling language Reference manual", 2005

Web Resources

1. <https://www.geeksforgeeks.org/classes-objects-java/>
2. <https://www.youtube.com/watch?v=sQgoFjxSdxo>
3. https://www.tutorialspoint.com/software_architecture_design/architecture_models.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

L1: Remember

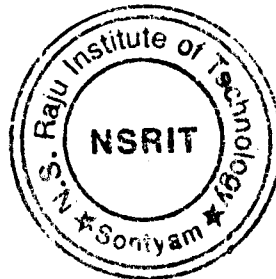
1. Define Class and object
1. What is Use case diagram?
2. List 2 Architecture building blocks

L2: Understand

1. Explain Class diagram and object diagram
2. Explain Process and Thread
3. Explain Four kinds of relationships in UML
4. Explain the Elements in object model

L3: Apply

1. Describe about Concurrency and Persistence
2. Explain about Encapsulation and Modularity
3. Describe Multiplicity and Realization in UML



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BS 20BSX15 Probability and Statistics**3 1 0 3**

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

	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX15.1	Classify the concepts of Statistics and its importance and Interpret Measures of Central Tendency and Dispersion of Data	3	1	L1, L2, L3
20BSX15.2	Identify the suitable discrete and continuous probability distributions to solve various engineering problems	3	1	L1, L2, L3
20BSX15.3	Identify the estimation errors in sampling distributions	3	1	L1, L2, L3
20BSX15.4	Apply the proper test statistics to test the hypothetical data by Tests of Hypothesis	3	1	L1, L2, L3
20BSX15.5	Apply the method of least squares, correlation and regression analysis to fit the curves	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Descriptive statistics methods**11 + 1 Hour**

Introduction to Statistics- Population vs Sample -Collection of data primary and secondary data- Data visualization, Measures of Central tendency, Measures of Variability (spread or variance)- Skewness-Kurtosis.

*Measures of Dispersion – Range – Quartile Deviation***Unit II: Probability and Probability Distributions****11 + 1 Hour**

Review of probability- Conditional probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

*Moment generating function***Unit III: Sampling Theory****11 + 1 Hour**

Introduction – Population and samples – Sampling distribution of Means and variances(Definitions only) – Central limit theorem (without proof) -Introduction to Student's t- Distribution, Chi-square Distribution and F- Distribution Point and Interval Estimations Maximum error of estimate.

*Introduction to Sampling, parameters, statistics.***Unit IV: Tests of Hypothesis****11 + 1 Hour**

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Large samples: Tests concerning one mean and two means - Small samples: Student t-distribution (test for single mean, two means and paired t-test) - Chi-square test for Single variance- Chi-square - Test for goodness of fit

*Test for single proportion, Difference of proportions (Large Samples)***Unit V: Curve Fitting, Correlation and Regression****11 + 1 Hour**

Curve fitting: Method of least squares – Straight line – Parabola – Exponential – Power curves.

Correlation: Correlation – correlation coefficient – rank correlation – regression coefficients and properties – regression lines.

*Power curves by the method of least squares***Text Books**

1. Miller and Freund J. E., "Probability & Statistics for Engineers", 9th Edition, Prentice Hall of India, 2011
2. Iyenger T. K. V., Prasad M. V. S. S. N., Ranganatham S., KrishnaGandhi.B., "Probability & Statistics", 2nd Edition, S. Chand Publications, 2019

Reference Books

1. Arnold O. Allen, "Probability & Statistics", Academic Press, 2nd Edition, 2005
2. Shahnaz Bathul, "A Text Book of Probability & Statistics", 2nd Edition, V. G. S. Book Links, 2nd Edition, 2007
3. Murugesan and Gurusamy, "A Text Book of Probability & Statistics", 2nd Edition Anuradha Publications, 2011

Web References

1. <https://nptel.ac.in/courses/111106112/>
2. <https://nptel.ac.in/courses/111105090/>
3. <https://nptel.ac.in/courses/111101004/>
4. <https://nptel.ac.in/courses/111102111/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	10
L2	50	50
L3	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define conditional probability
2. Define Population and Sample
3. Write about Skewness and Kurtosis
4. State Correlation and Regression
5. State Mean and Variance in Sampling Distribution

L2: Understand

1. State and prove Bayes theorem
2. Write the differences of collection of primary and secondary data type of variable
3. Find out the Kurtosis of the data

Class Interval	0 -10	10 - 20	20 – 30	30 - 40
Frequency	1	3	4	2

4. The mean height of students in a college is 155cms and S.D. is 15. What is the probability that mean height of 36 students is less than 157 cms
5. The number of auto mobile accidents per week in a certain community are as follows: 12, 8, 20, 2, 14, 10, 15, 6, 9, 4. Are these frequencies in agreement with the belief that accident conditions were the same during this 10 weeks period

L3: Apply

1. Calculate the regression equation Y on X from the data given below taking deviations from the actual means of X and Y

Price(Rs)	10	12	13	12	16	15
Amount Demanded	40	38	43	45	37	43

2. The coefficient of Rank Correlation between marks in Statistics and Mathematics obtained by a certain group of students is 0.8. If the sum of the squares of the difference in ranks to be 33. Find the number of students in the group
3. A normal population has a mean of 0.1 and S.D. of 2.1 then find the probability that mean of a sample of size 900 will be negative



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**Chairman
Board of Studies (Mathematics)**

PC 20AI302 Artificial Neural Networks**3 1 0 3**

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

Code	Course Outcomes	Mapping with POs		PO12	DoK
		PO1	PO3		
20AI302.1	Explain the building blocks and operations of artificial neural networks	3	2	1	L1, L2
20AI302.2	Explain architecture, taxonomy and functions of several neural networks	3	2	1	L1, L2
20AI302.3	Describe the structure, function, and applications of single layered feed forward networks	3	2	1	L1, L2
20AI302.4	Describe the structure, function, and applications of multi layered feed forward networks	3	2	1	L1, L2
20AI302.5	Describe the principles and implementations of associative memories	3	2	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction to Artificial Neural Networks**9 + 2 Hours**

Introduction, Artificial Neural Networks, Historical Development of Neural Networks, Model of a Neuron, Biological Neural Networks, Comparison Between Biological and Neural Network, Basic Building Blocks of Artificial Neural Networks, Artificial Neural Network (ANN) Terminologies, Basic Learning Laws (Hebb's Law, Perceptron Learning Law, Delta Learning Law, Widrow and Hoff LMS, Correlation Learning Law), Knowledge Representation.

ANS data structures

Unit II: Fundamental Models of Artificial Neural Networks**9 + 3 Hours**

Introduction, McCulloch-Pitts Neuron Model Architecture, Learning Rules, Hebb Net Architecture.

Supervised Learning & Unsupervised Learning

Unit III: Single Layered Feed Forward Networks**9 + 3 Hours**

Introduction, Adaptive Filtering Problem, Linear Least-Square Filters, Least-Mean-Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron, Perceptron Convergence Theorem, Relation Between the Perceptron and Bayes Classifier for a Gaussian Environment.

Types of Feed Forward Networks

Unit IV: Multi-Layered Feed Forward Networks**9 + 4 Hours**

Introduction, Preliminaries, Back-Propagation Algorithm, Summary of the Back-Propagation Algorithm, XOR Problem, Heuristics for Making the Back-Propagation Algorithm Perform Better, Output Representation and Decision Rule, Feature Detection, Back-Propagation and Differentiation, Generalization, Approximations of Functions, Cross-Validation, Virtues and Limitations of Back-Propagation Learning, Convolution Networks.

Recurrent Neural Networks

Unit V: Associative Memory Networks**9 + 3 Hours**

Introduction, Algorithms for Pattern Association, Hetero Associative Memory Neural Networks, Auto Associative Memory Network, Bi-directional Associative memory.

Short term Memory & Long-Term Memory

Text Books

1. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks Using MATLAB 6.0", Tata McGraw-Hill Companies, 2006
2. Simon Haykin, "Neural Networks: A Comprehensive Foundation", Second Edition, Pearson Education, Asia
3. James A. Freeman, David M. Skapura, "Neural Networks: Algorithms, Applications, and Programming Techniques", Addison-Wesley Publishing Company

Reference Books

1. B. YagnaNarayana, "Artificial Neural Networks", PHI
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.
3. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education

Web Resources

1. https://www.tutorialspoint.com/artificial_neural_network/index.htm
2. <https://nptel.ac.in/courses/117/105/117105084/>
3. http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture4.pdf
4. <https://freebiesglobal.com/artificial-neural-networks-ann-with-keras-in-python-and-r-6>
5. <http://www.nptelvideos.in/2012/12/neural-networks-and-applications.html>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

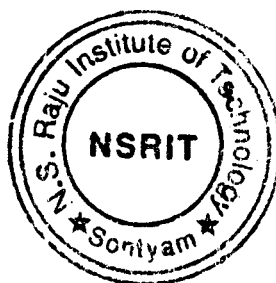
Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Neural Computing
2. Define ANN and Neural Computing
3. List any 4 design parameters in the design of Artificial Neural Network
4. What kinds of transfer functions can be used in each layer?
5. Define Pattern Association
6. What is Adaline Model?
7. What are the types of Learning?
8. What is simple artificial neuron?
9. List any 4 applications of Artificial Neural Network
10. Define Delta Learning rule

L2: Understand

1. Describe on the process of assigning and updating weights in a artificial neural network
2. What are the design steps to be followed for using ANN for your problem?
3. Describe least square algorithm with example
4. Why XOR Problem cannot be solved by a single layer perceptron? Write an alternative solution for it
5. Explain Back Propagation Network with necessary diagrams and equations
6. Write the differences between Hetero Associative Memories and Interpolative Associative Memories



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PE 20CS004 Internet of Things**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with POs	DoK
20CS004.1	Outline the IOT Systems in different contexts	-	L1, L2
20CS004.2	Illustrate the Design Principles for Connected Devices	-	L1, L2, L3
20CS004.3	Outline the Design Principles for Web Connectivity	-	L1, L2, L3
20CS004.4	Illustrate the Internet Connectivity Principles, Application protocols & Data Analytics	-	L1, L2, L3
20CS004.5	Design a simple IoT system made up of sensors, wireless network connection	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing. for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Internet of Things: An Overview**9 hours**

The Internet of Things, IoT Conceptual Framework, IoT Architectural View, Technology behind IoT, Sources of IoT, Machine to Machine Communication

Examples OF Internet of Things

Unit II: Design Principles for Connected Devices**9 hours**

IoT/M2M systems layers and designs standardizations, Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway, Ease of designing and affordability

Modified OSI Stack for the IoT /M2M Systems

Unit III: Design Principles for Web Connectivity**9 hours**

Introduction, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices

Web sockets

Unit IV: Internet Connectivity Principles**9 hours**

Introduction, Internet connectivity, Internet Based Communication, IP Addressing in the IoT, Media Access Control, Application Layer Protocols: HTTP, HTTPS

Data Acquiring, Organising, Processing and Analytics: Introduction, Data Acquiring and Storage, Organizing the Data, Transactions, Business Processes, Integration and Enterprise Systems, Analytics, Knowledge Acquiring, Managing and Storage processes

FTP, TELNET

Unit V: Sensors, Participatory Sensing, RFIDs, and Wireless Sensor Networks**9 hours**

Introduction, Sensor Technology, Participatory Sensing, Industry IoT and Automotive IoT, Actuator, Sensor Data Communication Protocols, Radio Frequency Identification Technology, and Wireless, Sensor Network Technology

Case Study: IoT Applications for Smart Homes, Cities

Text Books

1. Rajkamal, "Internet of Things: Architecture and Design Principles", McGraw Hill Higher Education, 2017
2. A. Bahgya and V. Madiseti, "Internet of Things", University Press, 2015

Reference Books

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", Wiley, 2013
2. Rahul Dubey, "An Introduction to Internet of Things", Connecting devices, Edge Gateway and Cloud with Applications, Cengage, 2019
3. David Hanes, Gonzalo Salgueiro, Patrick Grossetette, Rob Barton and Jerome Henry, "IoT Fundamentals, Networking Technologies", Protocols and Use Cases for the Internet of Things, CISCO, Pearson, 2018.

Web Resources

1. https://www.tutorialspoint.com/internet_of_things/index.htm
2. <https://www.javatpoint.com/iot-internet-of-things>
3. <https://www.guru99.com/iot-tutorial.html>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Radio Frequency Identification system? How does it work? Explain
2. Define File Transfer Protocol & Services
3. State Internet-Based Communication does in IoT? Explain in detail
4. Define Actuator
5. Define Media Access Control

L2: Understand

1. Explain Web Connectivity for connected-Devices
2. Explain the Application layer Protocols
3. Explain Communication Technologies in detail
4. Explain about Message Communication protocols for Connected Devices
5. Explain about Participatory Sensing

L3: Apply

1. Explain Sensor Network Technology in IoT
2. Discuss the role of Data Analytics in Internet of Things (IoT)
3. Identify the different Sensor Data Communication Protocols



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PE 20CS005 Mobile Computing**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with POs	DoK
20CS005.1	Explain the concepts of Mobile Communication.	-	L1, L2
20CS005.2	Describe the concept of GSM in real time applications	-	L1, L2
20CS005.3	Analyze various protocols of all layers for mobile and ad hoc wireless communication networks	-	L1, L2, L3
20CS005.4	Illustrate the IP and TCP layers of Mobile Communication	-	L1, L2, L3
20CS005.5	Explain the different data delivery mechanisms	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction**9 hours**

Mobile Communications, Mobile Computing – Paradigm, Promises/Novel Applications and Impediments and Architecture; Mobile and Handheld Devices
GSM – Services, System Architecture, Radio Interfaces, Protocols, Localization, Calling, Handover, Security, New Data Services, GPRS

Limitations of Mobile and Handheld Devices

Unit II: (Wireless) Medium Access Control(MAC)**9 hours**

Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, CDMA, TDMA, Wireless LAN/(IEEE 802.11)

Differences between SDMA,FDMA,CDMA,TDMA

Unit III: Mobile Network Layer**9 hours**

IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation, Route Optimization, DHCP,

Entities and Terminologies of Mobile IP

Unit IV: Mobile Transport Layer & Database Issues**9 hours**

Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks

Database Hoarding & Caching Techniques, Client-Server Computing & Adaptation, Transactional Models, Query processing, Data Recovery Process & QoS Issues

Comparison of Indirect TCP, Snooping TCP, Mobile TCP

Unit V: Data Dissemination and Synchronization**9 hours**

Communications Asymmetry, Classification of Data Delivery Mechanisms, Data Dissemination, Broadcast Models, Selective Tuning and Indexing Methods, Data Synchronization – Introduction, Software, and Protocols.

Types of Synchronization

Text Books

1. Jochen Schiller, "Mobile Communications", Second Edition, Addison-Wesley, 2009.
2. Raj Kamal, "Mobile Computing", Oxford University Press, 2007

Reference Books

1. Asoke K Talukder, Hasan Ahmed and Roopa R Yavagal, "Mobile Computing, Technology Applications and Service Creation" Second Edition, Mc Graw Hill, 2010
2. UWE Hansmann, LotharMerk, Martin S. Nocklous, Thomas Stober, "Principles of Mobile Computing," Second Edition, Springer, 2006

Web Resources

1. https://www.tutorialspoint.com/mobile_computing/mobile_computing_quick_guide.htm
2. <https://www.slideshare.net/srivaniadudodla/mobile-transport-layer-91529492>
3. <https://www.slideshare.net/asistithod/mobile-computing-39102507>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

L1: Remember

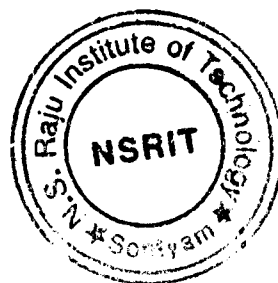
1. Define MAC
2. What is Multiplexing?
3. What is Foreign Network?
4. What is Mobile node?
5. What is Exposed station problem?

L2: Understand

1. Write any two Wireless LAN Advantages
2. Write two Limitations of Mobile Computing.
3. Write three Goals of GPRS
4. What is the reason for implementing CSMA with CA strategy in Wireless networks?
5. List the specifications of physical medium dependent and its sub layers in IEEE802.11

L3: Apply

1. Write two Design goals of Mobile IP
2. Name the two requirements of Mobile IP and justify them
3. Enlist the three applications of Mobile computing
4. Differentiate guided and unguided media transmission
5. Give the basic packet structure of an IEEE 802.11MAC



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PE 20CS006 Software Quality Management**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with Pos	DoK
20CS006.1	Understand Software quality procedures and work instructions in software organizations.	-	L1, L2
20CS006.2	Understand about quality standards and certifications.	-	L1, L2
20CS006.3	Describe measure of software quality and how to use measurements to improve the software development process.	-	L1, L2, L3
20CS006.4	Define quality assurance plans, tasks and metrics.	-	L1, L2, L3
20CS006.5	Apply quality assurance tools & techniques.	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Software Quality**9 hours**

What is Software Quality, Software errors, faults and failures, Classification of the causes of software errors, Definition of Software Quality, Software quality assurance – definition and objectives, Software quality assurance and software engineering, The need for comprehensive quality factors

Software Quality Challenges.

Unit II: Software Quality Assurance (SQA)**9 hours**

Software Quality Assurance (SQA), Role of SQA, Management and its role in Software Quality Assurance, SQA unit and other actors in SQA system, Software quality model, Components of the SQA, Development and Quality Plans, SQA Process and Activities, Common SQA standards, quality tools & techniques Documentation, Reviews and Audits.

The uniqueness of software quality assurance

Unit III: Reliability and Tools**9 hours**

Tools for Quality, Ishikawa's basic tools, CASE tools, Defect prevention and removal, Reliability models, Rayleigh model and Reliability growth models for quality assessment.

A model for SQA defect removal effectiveness

Unit IV: Quality Management System**9 hours**

Software quality – definition, Elements of QMS, Rayleigh model framework, Reliability Growth models for QMS, Complexity metrics and models, Customer satisfaction analysis.

Software compliance with quality factors, Measurement Of Metrics.

Unit V: Quality Standards**9 hours**

Need for standards, ISO 9000 Quality Assurance and Companion ISO Standards, CMM, CMMI, PCMM, Six Sigma concepts. Six Sigma methods: 5 Whys, Fishbone diagrams and software.

Compare ISO vs CMM vs Six sigma

Text Books

1. Allan C. Gillies, "Software Quality: Theory and Management", Third Edition, Thomson Learning, 2003
2. Daniel Galin, "Software Quality Assurance: From Theory to Implementation", First Edition, Addison Wesley, 2003
3. Stephen H. Kan, "Metrics and Models in Software Quality Engineering", Second Edition, Pearson Education (Singapore) Pte Ltd, 2002

Reference Books

1. Dr. S. Rinesh, "Software Quality Management", First Edition, Mayas Publication, 2018

2. Stephen H. Kan, "Metrics and Models in Software Quality Engineering", Second edition, Addison-Wesley Professional, 2002
3. Mordechai Ben – Menachem and Garry S. Marliss, "Software Quality", Thomson Asia Pte Ltd, First Edition, 2003

Web References

1. https://www.tutorialspoint.com/software_quality_management/index.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

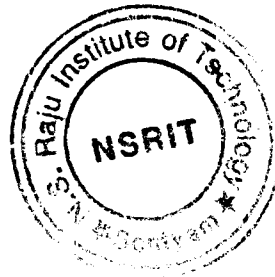
1. Describe any two processes related to Software Quality
2. Explain about Boehm model
3. Describe about McCall model
4. Explain any two CMMI practices

L2: Understand

1. Classify any two different tools in Software Quality Management
2. Explain any two views of the quality
3. Explain about ISO 9000/9001 series, which serves as generic quality
4. What are the objectives of Software Quality?

L3: Apply

1. Implement the Quality Management System templates for a Software Development
2. Implement stack using arrays and linked lists
3. Discuss CMM models
4. Apply SQA plan for Software development project



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PC 20DS302 Foundations of Data Science**3 1 0 3.0**

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO3	
20DS302.1	Illustrate the Data Science Methodology.	3	2	L1, L2
20DS302.2	Demonstrate different computing tools involved in data handling.	3	2	L1, L2
20DS302.3	Articulate clustering, decision tree concepts.	3	2	L1, L2, L3
20DS302.4	Demonstrate data visualization techniques.	3	2	L1, L2
20DS302.5	Apply domain expertise to solve real world problems using data science	3	2	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Getting Started with Data Science**9 + 3 Hours**

Analysing the Pieces of the Data Science Puzzle, Exploring the Data Science Solution Alternatives, Defining Big Data by the Three Vs, Grasping the Difference between Data Science and Data Engineering, Making Sense of Data in Hadoop, Identifying Alternative Big Data Solutions, Converting Raw Data into Actionable Insights with Data Analytics, Distinguishing between Business Intelligence and Data Science, Defining Business-Centric Data Science.

Identifying Data Science Users; Data Engineering in Action: A Case Study.

Unit II: Computing for Data Science**9 + 3 Hours**

Using Python for Data Science, Using Open Source R for Data Science, Using SQL in Data Science, Doing Data Science with Excel and Knime.

Sorting Out the Python Data Types; R's Basic Vocabulary.

Unit III: Using Data Science to Extract Meaning from Your Data**9 + 3 Hours**

Machine Learning: Learning from Data with Your Machine, Math, Probability, and Statistical Modeling, Using Clustering to Subdivide Data, Modeling with Instances, Building Models That Operate Internet-of-Things Devices.

Exploring common applications of k-nearest neighbor algorithms; Conceptual schematic of the IoT network.

Unit IV Data Visualization**9 + 3 Hours**

Following the Principles of Data Visualization Design, Using D3.js for Data Visualization, Using D3.js for DataWeb-Based Applications for Visualization Design, Exploring Best Practices in Dashboard Design, Making Maps from Spatial Data.

Data storytelling; Querying spatial data

Unit V Applying Domain Expertise to Solve Real-World Problems Using Data Science**9 + 3 Hours**

Data Science in Journalism, Delving into Environmental Data Science, Data Science for Driving Growth in E-Commerce, Using Data Science to Describe and Predict Criminal Activity.

Applying statistical modeling to natural resources in the raw; Deploying web analytics to drive growth.

Text Books

1. Lillian Pierson, Jake Porway, "Data Science For Dummies", 2nd Edition, For Dummies, 2017

Reference Books

1. Joel Grus, "Data Science from Scratch", 2nd Edition, O'Reilly Media, 2015
2. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020.

Web Resources

1. <https://www.simplilearn.com/tutorials/data-science-tutorial/>
2. <https://www.w3schools.com/datascience/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	30
L3	20	30
L4	0	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

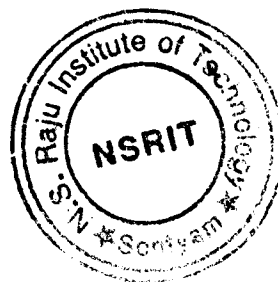
1. What is data science? Identify three areas or domains in which data science is being used.
2. Give three examples of structured data formats.
3. Name three measures of centrality and describe how they differ.
4. What is supervised learning? Give two examples of data problems where you would use Supervised learning.

L2: Understand

1. How do data analysis and data analytics differ?
2. Relate likelihood of a model given data, and probability of data given a model. Are these two the same? Different? How?
3. How does random forest address the issue of bias or over fitting?

L3: Apply

1. If you are allocated 1 TB data to use on your phone, how many years will it take until you run out of your quota of 1 GB/month consumption? Identify the situations for pre-emption of a process
2. You are given a data set consisting of variables with more than 30 percent missing values. How will you deal with them?
3. You are given a dataset on cancer detection. You have built a classification model and achieved an accuracy of 96 percent. Why shouldn't you be happy with your model performance? What can you do about it?



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PC 20AI503 Machine Learning**3 1 0 3**

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

Code	Course Outcomes	Mapping with POs		PO3	PO12	DoK
		PO1	PO2			
20AI503.1	Describe the essential elements of machine learning	3	2	1	1	L1, L2
20AI503.2	Explain the learning algorithms for tree-based models and rule-based models	3	2	1	1	L1, L2
20AI503.3	Describe the algorithms for linear models and distance-based models	3	2	1	1	L1, L2
20AI503.4	Describe various probabilistic models	3	2	1	1	L1, L2
20AI503.5	Explain ensemble learning and feature engineering methods	3	2	1	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction**9 Hours**

The ingredients of machine learning: Tasks - the problems that can be solved with machine learning – Models - the output of machine learning – Features - the workhorses of machine learning. Binary classification and related tasks: Classification, Scoring and ranking – Beyond binary classification – handling more than two classes – Unsupervised learning – Regression – Descriptive learning – Concept learning – Hypothesis space

Class probability estimation

Unit II: Tree models and Rule models**9 Hours**

Decision trees – Random and Probability estimation trees – Tree learning as variance reduction – Rule based models: Learning ordered lists – learning unordered rule set – Descriptive rule learning

First-order rule learning

Unit III: Linear models and distance-based models**9 Hours**

The Least Squares method – The Perceptron – Support Vector Machine – Kernel methods – Neighbours and exemplars – Nearest-neighbour classification – Distance-based clustering – Hierarchical clustering

Kernels to distances

Unit IV: Probabilistic models**9 Hours**

Normal distribution and its geometrical interpretation – Probabilistic model for categorical data – Discriminative learning – Probabilistic model for hidden variables – Compression based models

Comparison of all models

Unit V: Features, Ensemble and Reinforcement learning**9 Hours**

Kinds of features – Feature transformations – Feature construction and selection – Model ensembles – Bagging – Random forests – Boosting – Mapping Ensemble landscapes – bias, variance, other ensemble models – Reinforcement learning – Introduction – Q learning - Example

Meta learning

Text Books

1. Peter Flach, "Machine Learning – The art and science of algorithms that make sense of data", Cambridge Press, 2012
2. Tom Michell, "Machine Learning", McGraw Hill, 2014

Reference Books

1. Peter Harington, "Machine Learning in Action", Cengage Publications, 2012
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012

Web Resources

1. <https://nptel.ac.in>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Machine Learning.
2. List the types of Machine Learning.
3. State Bayes Theorem.
4. What is Regularization?

L2: Understand

1. Demonstrate Linear Regression.
2. Explain Back Propagation Algorithm.
3. Illustrate Decision Tree Induction process
4. Explain Genetic Operations with examples



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PE 20CS009 Network Programming and Protocols**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with POs	DoK
20CS009.1	Demonstrate knowledge of networking & Protocols	-	L1, L2
20CS009.2	Create sockets and Analyse different Socket types	-	L1, L2
20CS009.3	Analyze different TCP Sockets	-	L1, L2
20CS009.4	Discuss the UDP sockets , UDP client-server programs & DNS	-	L1, L2
20CS009.5	Apply the applications of sockets and demonstrate skill to design simple applications like FTP, TELNET etc.	-	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing. for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introducing Networks & Protocols**9 hours**

OSI Layer Model, TCP/IP Layer Model, Data Encapsulation, Internet Protocol, Domain Names, Internet Routing, Port Numbers, Clients & Servers

Networks Adapters from C

Unit II: Socket APIs**9 hours**

What are Sockets, Sockets Setup, Socket Types, Socket Functions, Anatomy of Socket Program, Berkley Sockets versus Winsock Sockets

Working with IPV6, IPV4

Unit III: Overview of TCP Sockets**9 hours**

Multiplexing TCP Connections, Synchronous Multiplexing with select(), TCP Client, TCP Server, Blocking on send()

TCP-Stream Protocol

Unit IV: Establishing UDP Connections**9 hours**

How UDP Sockets differ, UDP Client/Server

Host Name Resolution & DNS: How Hostname Resolution works, Name/Address translation functions, DNS Protocol

DNS Query Program

Unit V: Application Layer Protocols**9 hours**

Building a Simple Web Client, What's in an URL, Implementing a Web Client, HTTP POST Requests

Enhanced emails

Text Books

1. Lewis Van Winkle, Hands, "Network Programming with C", Packt Publishing Ltd, 2019
2. William Stallings, "Computer Networking With Internet Protocols and Technology", Pearson Education, 2003

Reference Books

1. Bruce Hallberg, "Networking: A Beginner's Guide", McGraw Hill, 6th Edition, 2003
2. Jan Newmarch, "Network Programming with Go: Essential Skills for Using and Securing Networks", Apress; 1st ed. edition, 2017

Web Resources

1. <https://tutorialspoint.dev/language/cpp/socket-programming-cc#:~:text=What%20is%20socket%20programming%3F,reaches%20out%20to%20the%20server.>
2. <https://www.geeksforgeeks.org/socket-programming-cc/>
3. <https://www.ibm.com/docs/en/zos/2.2.0?topic=interface-sample-c-socket-programs>

Internal Assessment Pattern

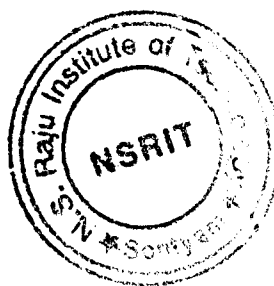
Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	30
L2	50	70
Total (%)	100	100

L1: Remember

1. List some layers in OSI Model
2. List out OSI layers
3. Define Encapsulation
4. What is Socket programming
5. Write a short notes on HTTP

L2: Understand

1. Compare OSI Model & TCP/IP Model
2. Illustrate Internet Protocol in detail
3. Explain Internet Routing
4. Compare Berkley Sockets & Winsock Sockets
5. Explain Socket Functions in detail
6. Explain about Multiplexing TCP Connection
7. Explain TCP Client & Server
8. Explain Name/Address translation functions
9. Explain HTTP POST Requests



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PE 20CS010 Cloud Computing**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with POs	DoK
20CS010.1	Identify the architecture and infrastructure of cloud computing	-	L1, L2
20CS010.2	To understand the concept of Virtualization and cloud data storage	-	L1, L2
20CS010.3	Explore the PaaS & SaaS Services.	-	L1, L2
20CS010.4	To understand the IaaS and Cloud Data Storage	-	L1, L2
20CS010.5	Develop applications for cloud computing.	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction**9 hours**

Cloud computing components, Infrastructure services, Storage applications, Database services – introduction to SAAS, PAAS, IAAS, IDaaS, Data storage in cloud

Software Engineering Concepts, Cloud computing components

Unit II: Virtualization**9 hours**

Enabling technologies, Types of virtualizations, Server virtualization, Desktop virtualization, Memory virtualization, Application and storage virtualization-tools and products available for virtualization

Desktop Virtualization

Unit III: SaaS & PaaS**9 hours**

Getting started with SaaS, SaaS solutions, SOA, PaaS, and benefits

Public and Private clouds, Storage as a Service

Unit IV: IaaS and Cloud Data Storage**9 hours**

Understanding IaaS, improving performance for load balancing, Server types within IaaS, utilizing cloud-based NAS devices, Cloud based data storage, and Backup services, Cloud based block storage and database services

Understanding IaaS

Unit V: Cloud Application Development**9 hours**

Client server distributed architecture for cloud designing cloud-based solutions, coding cloud-based applications, traditional Apps vs cloud Apps, client-side programming, server-side programming overview-fundamental treatment of web application frameworks.

Inside Cloud- Introduction to MapReduce and Hadoop-overview of big data and its impact on cloud

Case Study- Amazon Web Services- Compute Services, Storage Services, Communication Services and Additional Services. Google AppEngine-Architecture and Core Concepts, Application Lifecycle, cost model. Microsoft Azure- Azure Core Concepts, SQL Azure.

Web Application Frameworks, Big Data

Text Books

1. RajkumarBuyya, James Broberg, Andrzej Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, New York, USA, 2011
2. Kris Jamsa, Jones, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More", Bartlett Publishers, Paperback edition, 2013
3. George Reese, "Cloud Application Architectures", First Edition, O'Reilly Media 2009

Reference Books

1. RajkumarBuyya, Christian Vecchiola, S ThamaraiSelvi, "Mastering Cloud Computing".
2. RaghuramYeluri, "Building the Infrastructure for Cloud Security", Published March 2014.
3. Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture", May 2013.
4. Srinath Perera and Thilina Gunarathne, "Hadoop Map Reduce cookbook", Packt publishing

20CS010_V1.0_ACY 2020-2021

Web Resources

1. https://onlinecourses.nptel.ac.in/noc18_cs16/preview
2. <https://www.w3schools.in/cloud-computing/cloud-computing/>
3. <http://freevideolectures.com/blog/2015/04/guide-to-learn-cloud-computing/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

L1: Remembering

1. Define virtual machine.
2. Define Hybrid cloud.
3. Define Big Data Cloud.
4. What is service-oriented architecture?
5. Define Cloud Computing.

L2: Understanding

1. Define Cloud Computing. What are the characteristics of Cloud Computing?
2. What are the benefits of virtualization in cloud computing?
3. What are the advantages of "PAAS"? Explain with example.
4. What are pros and cons in comparison of Public Vs Hybrid cloud?
5. Describe the IBM smart cloud architecture and core Services.
6. Write a short note on importance of Quality and Security in Cloud.

L3: Applying

1. Give the entity relationship diagram for Meta CDN database and explain its architecture.
2. Write a detailed note on SaaS Integration products.
3. Briefly explain the SLA management in cloud with flow chart.
4. Explain how Cloud Computing is different from Outsourcing and Provision of Application Services.

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OE 20CE001 Urban Environmental Health**3 0 0 3**

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

Code	Course Outcomes	Mapping with POs	DoK
20CE001.1	Identify urban – health relationships		L1, L2
20CE001.2	Demonstrates the connection between urban built form and health outcomes		L1, L2
20CE001.3	Discuss the distribution of health risks of urban transportation grid		L1, L2
20CE001.4	Assess and plan for community needs in health-care infrastructure		L1, L2
20CE001.5	Identify preliminary opportunities for advancing urban health outcomes		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Health and Planning**9 Hours**

Introduction: The Historical Link, Dividing Health and Planning, Urban Health – Basic Conceptions in the Literature, Urban Form, Physical Activity.

Health Promotion

Unit II: Built Urban Form and Health**9 Hours**

Renewing the Health-Urban Link, the Urban Form, the Metropolitan Sprawl Index, Using Measured Urban Forms to Assess Health Effects, Environmental Factors and Physical Activity

Alternatives to Metropolitan Sprawl Index

Unit III: Transportation Systems**9 Hours**

Transport Planning, Private Motor Vehicles as Health Risks, Private Motor Vehicles and Obesity, Public Transport, Mixed-use Medium-density and Pedestrians Travel, Proximity and Individual Factors.

Residential and Travel Preferences

Unit IV: Spatial Access to Health Services**9 Hours**

Introduction, The Concept of Access, Dimensions of Spatial Access, Primary Care Supply and Access, Spatial Access and Travel Behavior, Access and Mortality.

Access to health care Aligned with Transport

Unit V: Challenges and Opportunities**9 Hours**

Introduction, Challenges, Conceptual Frameworks, Investigative Methods and Data Collection, Limited Policy Capacity, Fragmented Initiatives, Opportunities, Interdisciplinary Engagement, Major Conceptual Programs, Priorities for future Research.

Promotion of physical activity in daily routines

Text Books

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. George Luber and Jay Lemery, "Global Climate Change and Human Health", 1st Edition Jossey-Bass, 2015

Reference Books

1. Pataki, Diane E., et al. "Coupling biogeochemical cycles in urban environments: ecosystem services, green solutions, and misconceptions" *Frontiers in Ecology and the Environment*, 2011
2. Frank, L., Engelke, P., and Schmid, T., "Health and Community Design: The Impact of The Built Environment on Physical Activity", Island Press, Washington, D.C., 2003
3. Eiichi Taniguchi, Tien Fang Fwa and Russell G Thompson, "Urban Transportation and Logistics", CRC Press, 2014

Web References

1. <https://www.oecd.org/health/health-systems/32006565.pdf>
2. <https://www.pdfdrive.com/urban-environment-proceedings-of-the-10th-urban-environment-symposium-e157051203.html>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. How is natural environment different from urban environment?
 2. How does the urban environment affect health and well-being?
 3. How can urban areas improve health?

L2: Understand

1. Explain the most important problem related to health in urban area
2. Describe the differences between physical activity for transportation and physical activity for recreation
3. Consider a study that evaluates the health of people in two communities, one with sidewalks and one without. The study authors find that the rate of lung cancer is higher in the community without sidewalks, and conclude that sidewalks protect against lung cancer. What concerns would you have about accepting this conclusion?

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Board of Studies(CE)

OE 20CSO01 Data Structures and Algorithms**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with POs	DoK
20CSO01.1	Understand the advanced data structures and algorithms	-	L1, L2, L3
20CSO01.2	Demonstrate through abstract properties of various data structures such as stacks, queues and lists to implement efficient programs using data structures.	-	L1, L2, L3
20CSO01.3	Demonstrate through various searching & sorting techniques	-	L1, L2, L3
20CSO01.4	Apply data structures and algorithms to solve real world problems.	-	L1, L2, L3
20CSO01.5	Apply algorithm analysis techniques to evaluate the performance of an algorithm.	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Data Structures & Algorithms**9 hours**

Introduction to Data Structure, Data Organization, Abstract Data Types, Elementary data types; Basic concepts of data Structures; performance measures for data structures, Time and Space Complexity. Introduction to Algorithms, Asymptotic notations and common functions. Algorithm Specifications: Performance Analysis and Measurement

Efficiency of an Algorithm

Unit II: Arrays and Linked Lists**9 hours**

Arrays- Definition, Different types of Arrays, Application of arrays, Sparse Matrices and their representations. Linked lists- Definition, Implementation of Singly Linked Lists, Doubly Linked List, Operations on a Linked List. Insertion, Deletion and Traversal. Stack-Basic Concept of Stack, Stack as an ADT and operations in stack. Queue-Basic Concept of Queue, Queue as an ADT and Operations in Queue

Generalized Linked List, Applications of Stack and Queue

9 hours**Unit III: Trees and Graphs**

Trees- Basic concept of Binary tree, Operations in Binary Tree, Tree Height, Level and Depth, Binary Search Tree, Insertion, Deletion, Traversals, Search in BST, 2-4 trees. Graph-Matrix Representation Of Graphs, Elementary Graph operations(Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree)

Applications of Tress and Graph

Unit IV: Algorithm Design Techniques I**9 hours**

Divide and Conquer-General method, Merge sort, Quick sort. Brute force- approach, bubble sort, Linear Search techniques.

Preferences of Merge and quick sort techniques.

Unit V: Algorithm Design Techniques II**9 hours**

Greedy Technique, General method, Knapsack problem, Job sequencing with deadlines, Minimal cost spanning tree algorithms (Prim's and Kruskal's), Dynamic Programming: General method, 0/1 knapsack problem, All pair shortest path algorithm

Usages of Greedy algorithms.

Text Books

1. Reema Thareja, "Data Structures Using C", Second Edition, Oxford, 2014
2. Horowitz, Sahni and Anderson Freed, "Fundamentals of Data Structures in C", Second Edition, 2008
3. Mark Allen Weis, "Data Structures and Algorithm Analysis in C", Second edition, Pearson, 1997

Reference Books

1. Salaria R.S., "Data Structures and Algorithms using C", Fifth Edition, Khanna Publishing, 2018
2. Richard F Gilberg, "Data Structures: A PseudoCode Approach With C++" Fifth edition, Thomson Press(India), 2004
3. Amitava Nag and Jyothi Prakash Singh, "Data Structures and Algorithms Using C", Second Edition, Vikas Publishing, 2009

Web References

1. <https://www.springboard.com/library/software-engineering/data-structures-and-algorithms/>
2. <https://www.geeksforgeeks.org/data-structures/>
3. <https://www.programiz.com/dsa>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

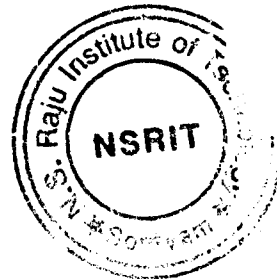
1. Describe Data Structure and Algorithm
2. Illustrate some applications of stack
3. Describe about a Queue
4. List two applications of Data Structures

L2: Understand


1. Classify data structures
2. Explain about asymptotic notations
3. Differentiate Linked List, Stack and Queue
4. Explain about different sorting algorithms

L3: Apply

1. Implement the append method, which should add a new element onto the tail of the linked list
2. Implement stack using arrays and linked lists
3. Implement Queue using arrays and Linked Lists
4. Illustrate the importance of recursion



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OE 20AIO01 Machine Learning for Engineers

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20AIO01.1	Describe different types of learning's	-	L1, L2
20AIO01.2	Explain different supervised learning algorithms		L1, L2
20AIO01.3	Explain different unsupervised learning algorithms		L1, L2
20AIO01.4	Describe various types of machine learning models		L1, L2
20AIO01.5	Choose appropriate machine learning model and algorithm for given task		L1, L2
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction to learning

9 hours

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression

Examples of regression

Unit II: Linear Models

9 hours

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

Applications of perceptron

Unit III: Trees and Probabilistic Models

9 hours

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbour Methods – Unsupervised Learning – K means Algorithms – Vector Quantization

Self-Organizing Feature Map

Unit IV: Dimensionality Reduction and Evolutionary Models

9 hours

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic Algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms

Markov decision process

Unit V: Graphical Models

9 hours

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models

Tracking Methods

Text Books

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2013

Reference Books

1. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", 1st Edition, Cambridge University Press, 2012.
2. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", 1st Edition, Wiley, 2014

3. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)", 3rd Edition, MIT Press, 2014

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

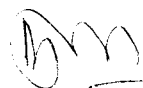
Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. Define Machine Learning.
2. List the types of Machine Learning.
3. State Bayes Theorem.
4. What is Regularization?

L2: Understand

1. Demonstrate Linear Regression.
2. Explain Back Propagation Algorithm.
3. Illustrate Decision Tree Induction process
4. Explain Genetic Operations with examples




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20DSO01 Introduction to Database Management Systems**3 0 0 3**

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

Code	Course Outcomes	Mapping with Pos	DoK
20DSO01.1	Describe the basic concepts of DBMS And different data models	L1,L2	
20DSO01.2	Apply Constrains on relations	L2,L2,L3	
20DSO01.3	Apply SQL commands on relations	L1,L3	
20DSO01.4	Understand PL/SQL operations	L1,L2,L3	
20DSO01.5	Understand the principles of database normalization and Transaction management system.	L1,L2	

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction to Databases**9 Hours**

Overview of Data Base Systems, Database System Applications, File System VS Database System, Data Abstraction, Levels of Abstraction, Data Independence Instances and Schemas, Different Data Models, Database Languages, Data Base Users and Administrator, Database System Structure, N-tier Architecture, Database design and ER diagrams, Design Entities, Attributes and Entity sets, Relationships and Relationship Sets, Advanced Features of ER Model

History of DBMS

Unit II: Relational Model, Relational Algebra and Relational calculus**9 Hours**

Relational Model: Introduction to the Relational Model, Integrity Constraint and key constraints over relations, Logical data base Design, Views, Destroying / Altering Tables and Views - Relational Algebra: Selection and Projection, Set Operations, Aggregate Operations, Renaming, Joins, Division, Additional Relational Algebraic operations - Relational calculus: Tuple Relational Calculus, Domain Relational Calculus

Expressive Power of Algebra and Calculus

Unit III: Structured Query Language**9 Hours**

SQL: Concept of different Database Languages over SQL - DDL, DML, DCL, Set operations, SQL Commands, Nested queries, Aggregate Functions, Null Value, Referential Integrity Constraints, views.

Compare all Database Languages

Unit IV: Schema Refinement and Normalization**9 Hours**

Understand PL/SQL block, components of PL/SQL block, Control statements and conditional statements in PL/SQL Embedded SQL, Triggers, Cursors, Stored procedures packages

Compare all Normal Forms

Unit V: Normalization**8 Hours**

Understand the principles for Relational Database Design, Functional Dependencies, Trivial and Nontrivial Dependencies, Closure Set of Functional Dependencies, Closure Set of Attributes. - Normalization: 1NF, 2NF, 3NF, BCNF, Lossless Join and Dependency Preserving decomposition, 4NF and 5N.

Transaction Concept, ACID Properties, States of Transaction, Implementation of Atomicity & Durability, Schedules,

Concurrency Control without Locking

Text Books

1. Abraham Silber Schatz, Henry F Korth, S Sudarshan, "Database System Concepts", 6th Edition, McGraw-Hill International Edition, 2013
2. Date CJ, Kannan A, Swamynathan S, "An Introduction to Database Systems", 8th Edition, Pearson Education, 2006
3. Raghurama Krishnan, Johannes Gehrke, "Data base Management Systems", 3rd Edition, TATA McGraw Hill, 2008

Reference Books

1. Elmasri Navrate, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016
2. Peter Rob & Carlos Coronel, "Data base Systems design, Implementation, and Management", 10th Edition, Pearson Education, 2013

Web References

1. <https://www.javatpoint.com/dbms-tutorial>
2. <https://www.geeksforgeeks.org/introduction-of-dbms-database-management-system-set-1/?ref=lbp>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	30	40
L3	40	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. List types of database users
2. List out all types of data models present
3. Give syntaxes to Create and Alter a table
4. What is Redundancy?
5. List out the properties of transactions

L2: Understand

1. Compare the database system with conventional file system
2. Demonstrate the use of DISTINCT keyword in SQL select statement
3. Explain the following SQL constructs with examples:
(1) Order by (2) group by and having (3) as select (4) schema
4. Explain the difference among Entity, Entity Type & Entity Set
5. Illustrate ACID properties

L3: Apply

1. Choose a relation R with 5 attributes ABCDE and the following FDs: A → B, BC → E, and ED → A. Is R in 3NF? Justify?
2. Apply Normalization technique for the following relation up to 3NF:
Bank (acno, cust_name, ac_type, bal, int_rate, cust_city, branchld, branch_nm, br_city)
3. Construct a transaction state diagram and describe each state that a transaction goes through during its execution?
4. Demonstrate serializability concept



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OE 20ECO01 Architectures and Algorithms of IoT**3 0 0 3**

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

Code	Course Outcomes	Mapping with POs	DoK
20ECO01.1	Demonstrate the Architecture and applications of IoT		L1, L2
20ECO01.2	Explain the protocol concept and data bases of IoT		L1, L2, L3
20ECO01.3	Construct the IoT device design space and Platform design		L1, L2, L3
20ECO01.4	Explain the IoT network model and Eventanalysis	-	L1, L2, L3
20ECO01.5	Demonstrate the Industrial Internet of Thingsand its Architecture		L1, L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: The IoT Landscape**09 Hours**

What Is IoT?, Applications , Architectures , Wireless Networks, Devices, Security and Privacy , Event-Driven Systems.

Ethernet

Unit II: IoT System Architectures**09 Hours**

Introduction, Protocols Concepts, IoT-Oriented Protocols, Databases, Time Bases, Security.

Message Queuing Telemetrytransport (MQTT)

Unit III: IoT Devices**09 Hours**

The IoT Device Design Space, Cost of Ownership and Power Consumption, Cost per Transistor and Chip Size, Duty Cycle andPower Consumption.

Platform Design

Unit IV: Event-Driven System Analysis**09 Hours**

IoT Network Model - Events, Networks, Devices and Hubs, Single-Hub Networks, Multi-hub Networks, Network Models andPhysical Networks, IoT Event Analysis - Event Populations, Stochastic Event Populations, Environmental Interaction Modeling.

Event Transport and Migration

Unit V: Industrial Internet of Things**09 Hours**

Introduction, Industrie 4.0, Industrial Internet of Things (IIoT), IIoT Architecture, Basic Technologies, Applications and Challenges.

Integrated IIoT

Textbooks

1. Dimitrios Serpanos and Marilyn Wolf, "Internet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies", Springer, Cham, 2018
2. Vijay Madiseti and Arshdeep Bahga, " Internet of Things (A Hands-on Approach)", Universities Press, 2015

Reference Books

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons Ltd, UK, 2014
2. Olivier Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", John Wiley and Sons Ltd., UK, 2012

Web Resources

1. <https://books.google.co.in/books?isbn=1119969093>
2. <https://books.google.co.in/books?isbn=135123093X>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	35	35
L3	35	35
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

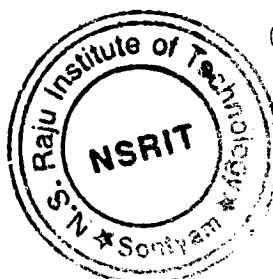
1. What is IoT?
2. List any three applications of IoT
3. Define protocol concept of IoT
4. Define data base
5. What is Duty cycle?

L2: Understand

1. Explain the Architecture of IoT
2. Explain the Security and privacy of IoT
3. Illustrate the Protocol Concept of IoT
4. Explain the Data bases of IoT
5. Demonstrate the IoT Device Design Space

L3: Apply

1. Identify the Wireless Networks for IoT
2. Model the Event-Driven Systems for IoT
3. Construct the IoT-Oriented Protocols
4. Construct the Platform Design for IoT



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Board of Studies (ECE)

OE 20EE001 Introduction to Renewable Energy Sources**3 0 0 3**

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

Code	Course Outcomes	Mapping with PO's	DoK
20EE001.1	Understand the significance of solar energy		L1, L2
20EE001.2	Provide the importance of Wind Energy		L1, L2
20EE001.3	Understand the role of ocean energy in the Energy Generation		L1, L2
20EE001.4	Explain the utilization of Biogas plants and geothermal energy		L1, L2
20EE001.5	Explain the concept of energy Conservation		L1, L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create, DoK: Depth of Knowledge			

Unit I: Solar Energy**09 Hours**

Solar Radiation, Measurements of Solar Radiation, Flat Plate And Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar , Photo Voltaic Conversion, PV Characteristics Solar Cells, Solar PV Power Generation, Solar PV Applications.

Thermal analysis of flat plate collectors

Unit II: Wind Energy**09 Hours**

Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Wind Turbine Generator

Betz Criteria

Unit III: Ocean Energy**09 Hours**

Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants, Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants

Open and closed OTEC Cycle

Unit IV: Bio Mass**09 Hours**

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gasdigesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.

I.C Engine Operation

Unit V: Geo Thermal Energy and Energy Conservation**09 Hours**

Resources, types of wells, methods of harnessing the energy, scope in India. Principles of energy conservation, the different energy conservation appliances, cooking stoves, Benefits of improved cooking stoves over the traditional cooking stoves

Hydro Thermal, Geo-pressured, Hot dry rocks

Text Books

1. R K Gupta and S C Bhatia "Renewable Energy" Woodhead publishing India Pvt. Ltd., 2019
2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Second Edition, IEEE Press, Wiley, 2013
3. Ranjan Rakesh, Kothari D. P. & Singal K. C., "Renewable Energy Sources And Emerging Technologies", 2 nd Edition, PHI, 2013
4. Mukund R. Patel, "Wind and Solar Power Systems – Design, Analysis and Operation", 2nd Edition, Taylor & Francis, 2006

Reference Books

1. S Sukhatme, J Nayak, "Solar Energy: Principles of Thermal Collection and Storage", 3rd Edition, Tata Mcgraw Hill, 2003.
2. Tiwari and Ghosal, "Renewable energy resources", 2nd edition, Narosa Publishing house, 2001
3. B H Khan, "Non conventional energy resources", 2 nd Edition, Tata Mcgraw Hill, 2001

Web References

1. <https://nptel.ac.in/courses/121/106/121106014/>
2. <https://www.edx.org/learn/renewable-energy>
3. <https://www.coursera.org/learn/renewable-energy-resources-and-technologies>

Internal Assessment Pattern

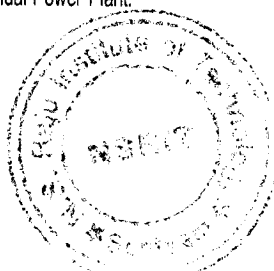
CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	40	30
L2	60	70
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. What is meant by Solar Thermal Energy?
2. Give the classification of small hydro power stations.
3. What are the various losses occurring in the fuel cell?
4. List various Biomass resources.
5. What is the basic principle of Tidal Power?

L2: Understand

1. Explain in detail about flat plate collectors and give its advantage and disadvantages.
2. Explain the principle of working of a H₂ - O₂ fuel cell.
3. Explain about Dry, Wet and Hot water Geo thermal systems.
4. Compare between Geo thermal power plant and Conventional thermal power plant.
5. Explain about the site requirements to construct a Tidal Power Plant.



For *Chairman*

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OE 20ME001 Nano Technology**3 0 0 3**

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

Code	Course Outcomes	Mapping with PO's	DoK
20ME001.1	Describe the fundamental science of nano materials		L2
20ME001.2	Demonstrate the preparation of nano materials		L1,L2
20ME001.3	Explain of the challenges on safe nano technology	-	L1,L2
20ME001.4	Develop knowledge in characteristic nano material		L1,L2,L3
20ME001.5	Apply Nano science for industrial applications		L1,L2,L3
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction**09 Hours**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nano structured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.

*Introduction to properties and motivation for study (qualitative only)***Unit II: General Methods Of Preparation****09 Hours**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation.

*Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE***Unit III: Nano materials****09 Hours**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO₂, MgO, ZrO₂, NiO, nanoalumina, CaO, AgTiO₂, Ferrites, Nanoclays- functionalization and applications-Quantum wires.

*Quantum dots-preparation, properties and applications***Unit IV: Characterization Techniques****09 Hours**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA.

*SIMS-Nano-indentation***Unit V: Applications****09 Hours**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechnology: nanoprobe in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition.

*Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery***TEXT BOOKS:**

1. Edelstein A.S and Cammearata R.C, Eds., "Nanomaterials: Synthesis, Properties And Applications", Institute Of Physics Publishing, Bristol And Philadelphia, 1996.
2. John Dinardo N, "Nanoscale Characterization Of Surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley- VCH, 2000
3. Murthy B.S and Shankar P, " Nanoscience and NanoTechnology", 1st Edition, Springer Publications, 2013
4. Louis Hornyak and Tibbals H F, " Introduction to Nanoscience and NanoTechnology", 1st Edition, Tailor Francis CRC Press, 2008

REFERENCE BOOKS:

1. Timp G, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations".Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Web references:

1. <http://www.nano.gov>
2. <http://mrsec.wisc.edu/edetc/IPSE/links.html>
3. <http://nptel.ac.in/courses/112105182/9>
4. IOPSCIENCE—Nanotechnology

Internal Assessment Pattern

CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	40	20
L2	60	40
L3		40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Nano technology?
2. How does Nano Technology Works?
3. What are Nano Materials?
4. Who is Developing Nano technology?

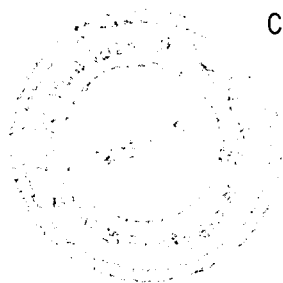
L 2: Understand

1. What Are Some Of The Most Interesting Nanoparticles Found In Nature (Not Manufactured In The Lab)?
2. Given The Nano-Size Of The Particles, Are There Any Effective Respirator Filters To Guard Against Inhalation?
3. What Do You Feel The Repercussions Are For Extended Life Through Utilization Of Nanotechnology?
4. What Is The Risk Of Not Developing Nanotech (In Health Care, Environmental Protection, And Economic Development)?

L 3: Applying

1. How are safety tests carried out in nano tech?
2. Seems that (nano)tech is moving fast. Is there a risk that results of safety testing will be out-of-date as soon as printed? How to keep up pace?
3. Discuss about targeted drug delivery using nanoparticles.

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Board of Studies (ME)

OE 20CE002 Ecology, Environmental & Resource Management**3 0 0 3**

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

Code	Course Outcomes	Mapping with POs	DoK
20CE002.1	Discuss the role that humans play in affecting the characteristics of the environment		L1, L2
20CE002.2	Understand the interrelationships between land, sea, the atmosphere and the living things that occupy these environments		L1, L2
20CE002.3	Distinguish between economic growth and economic development and outline the nature of a sustainable economy		L1, L2
20CE002.4	Identify the environmental attributes to be considered for the EIA study		L1, L2
20CE002.5	Develop a thorough understanding of Environmental Policies and legislations practiced in India		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction**9 Hours**

Meaning, scope and evolution of ecology. Man, environment and ecosystem. Components of nature, Structure and Function, Flow of material, Ecological Succession, Trophic levels, Food chain, Food web, Ecological pyramids.

*Adaptation, Environmental Zones***Unit II: Ecosystem and its relevance to Environment****9 Hours**

Resources and human settlements impact of advanced agricultural methods, Impact of urbanization and industrialization on nature. Urban ecosystem approach evolution and significance. Settlement planning.

*Energy Conservation***Unit III: Resource Management and Sustainable Development****9 Hours**

Sustainable Development, Fundamentals concerning Environment and Sustainable Development, Economy, Poverty, Human Settlement Issues, Land Resources, Forests, Mountains, Agriculture, Biodiversity, Protection of Oceans, Industry and Business.

*Planning for environmentally sensitive areas***Unit IV: Environmental Impact Assessment****9 Hours**

Meaning, Significance and framework. Methodologies, Checklist, Matrices, Network and social cost-benefit analysis. Sources and acquisition of environmental information. Environment impact studies of development projects.

*EIA Case Studies***Unit V: Environmental Policies and Legislations in India****9 Hours**

Major environment policies and legislations in India - The Ministry of Environment & Forests, The Central Pollution Control Board. Policies to protect environment in India - Environment Protection Act, 1986, National Conservation Strategy and Policy Statement on Environment and Development, 1992, Policy Statement for the abatement of Pollution, 1992, National Environment Policy, 2006, Vision Statement on Environment and Health. Legislations and Rules for the protection of Environment in India.

*Five year plans in relation to environmental aspects***Text Books**

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. Walter E. Westman, "Ecology, Impact Assessment and Environmental Planning", John Wiley & Sons, 1985
3. Chadwick A., "Introduction to Environmental Impact Assessment", Taylor & Francis, 2007

Reference Books

1. Charles H. Southwick D., "Ecology and the Quality of Our Environment", Van Nostrand Co New York, 1976
2. Barthwal, R.R., "Environmental Impact Assessment", New Age International, New Delhi, 2002

Web References

1. http://iced.cag.gov.in/?page_id=256
2. <http://econdse.org/wp-content/uploads/2016/07/chapter-1-gupta.pdf>
3. https://www.researchgate.net/publication/341521590_Chapter_5_Environmental_Policy_in_India
4. https://www.preventionweb.net/files/15417_nationalenvironmentpolicyandstrateg.pdf

Internal Assessment Pattern

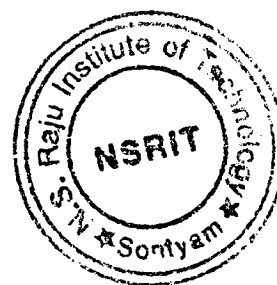
Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. What is Ecology?
 2. List any three ways in which humans directly influence environmental conditions
 3. What is the goal of sustainable development?
 4. List the three sequential phases of EIA
 5. Enlist any four principles of National Environmental Policy of India

L2: Understand

1. Explain the key principles of the ecosystem approach to conserving natural resources
2. Explain the impact of urbanization on nature
3. How does sustainable development make economic sense for society?
4. Discuss the importance of EIA activities for developing countries
5. Discuss the objectives and founding principles of India's National Environmental Policy



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Board of Studies

OE 20CSO02 Designing the Internet of Things**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with POs	DoK
20CSO02.1	Illustrate the IoT in different contexts		L1, L2
20CSO02.2	Outline the Design Principles for Connected Devices		L1, L2
20CSO02.3	Explain the Internet Principles & Application Layer Protocols	-	L1, L2
20CSO02.4	Apply the Prototyping concepts in IoT		L1, L2
20CSO02.5	Analyse the Prototyping Embedded Devices		L1, L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Overview of Internet of Things**9 hours**

The flavour of the Internet of Things, The "Internet" of "Things", Technology of IoT, Enhanced Objects, Who is making the Internet of things.

*Applications of IoT***Unit II: Design Principles for Connected Devices****9 hours**

Calm & Ambient Technology, Magic as Metaphor, Privacy: Keeping secrets, Web Thinking for Connected Devices

*Examples of Connected Devices***Unit III: Internet Principles****9 hours**

Internet Communications-IP, TCP, The IP protocol suite(TCP/IP), UDP, IP Addresses-DNS, static IP Address assignment, Dynamic IP Address assignment, IPv6, MAC Addresses, TCP & UDP Ports, Application Layer Protocols

*HTTPS: Encrypted HTTP***Unit IV: Thinking About Prototyping****9 hours**

Sketching, Familiarity, Costs versus Ease of prototyping, Prototypes & Production, Open Source versus Closed Source

*Embedded Platforms***Unit V: Prototyping Embedded Devices****9 hours**

Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, BeagleBone Black, Electric Imp

*Arduino Components***Textbooks**

1. Adrian, McEwen & Hakim Casimally, "Designing The Internet of Things", John Wiley and Sons, 2014
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Wiley, 2019

Reference Books

1. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms", Morgan Kaufmann, 2016
2. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, "Internet Of things With Raspberry Pi And Arduino", CRC Press/Taylor & Francis Group, 2019

Web Resources

1. <https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/>
2. <https://tutorialspoint.dev/computer-science/computer-network-tutorials/the-new-internet-internet-of-everything>
3. <https://www.javatpoint.com/iot-internet-of-things>

Internal Assessment Pattern

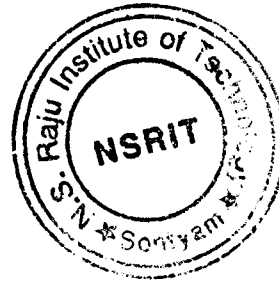
Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
Total (%)	100	100

L1: Remembering

1. Define IoT
2. What are the Enhanced objects for IoT?
3. What is a Prototype?
4. Define Sketching
5. Define DNS

L2: Understanding

1. Explain the following terms related to Protocols: UDP, TCP
2. Discuss in detail about MAC Addresses
3. Define Prototyping? Describe the Embedded Computing Basics
4. Explain Application Layer Protocols
5. Discuss the Costs versus Ease of prototyping



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 Chairman
 Board of Studies (CSE)

OE 20AIO02 Fundamentals of Deep Learning

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20AIO02.1	Describe the fundamental concept of artificial neural networks	-	L1, L2
20AIO02.2	Describe the function of different deep neural networks		L1, L2
20AIO02.3	Explain different deep learning algorithms		L1, L2
20AIO02.4	Describe the functioning of convolution and recurrent neural networks		L1, L2
20AIO02.5	Choose appropriate deep neural network for given application		L1, L2
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit 1: Introduction to Deep Learning

9 hours

Basics: Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

Logic gates with perceptron

Unit 2: Feedforward Networks

9 hours

Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization – Regularization, autoencoders

Applications of multilayer perceptron

Unit 3: Convolution Networks

9 hours

Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs – Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet

Applications of CNN

Unit 4: Recurrent Neural Networks

9 hours

Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks –The Long Short-Term Memory

Applications of RNN

Unit 5: Applications of Deep Neural Networks

9 hours

Applications: Large-Scale Deep Learning - Computer - Speech Recognition - Natural Language Processing

Healthcare applications

Text Books

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, UK, 2017
2. Antonio Gulli and Sujit Pal, "Deep Learning with Keras ", Packt Publishing Ltd, Birmingham, UK, 2017

Reference Books

1. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Web References

1. <https://www.coursera.org/specializations/deep-learning>

Internal Assessment Pattern

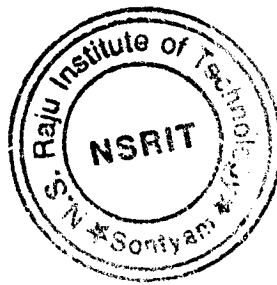
Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100


Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. List any 4 benefits of artificial neural networks
2. List any 4 features of ANN
3. What are deep neural networks?
4. Define supervised and unsupervised learning
5. Define generalization

L2: Understand

1. Explain the design parameters of deep neural networks
2. Describe the dimensionality reduction techniques
3. Explain backpropagation algorithm
4. Describe any 2 applications of deep networks for image processing
5. Write about any 5 applications of deep networks




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OE 20DSO02 Introduction to Data Science**3 0 0 3**

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

Code	Course Outcomes	Mapping with POs	DoK
20DSO02.1	Understand Fundamentals of Data Science Terminology.		L1, L2
20DSO02.2	Demonstrate different computing tools involved in data handling.		L1, L2
20DSO02.3	Understand Knime Tool.		L1, L2
20DSO02.4	Understand Machine Learning Concepts		L1, L2
20DSO02.5	Apply domain expertise to solve real world problems using data science		L1, L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction to Data Science**9 Hours**

Analysing the Pieces of the Data Science Puzzle, Exploring the Data Science Solution Alternatives, Defining Big Data by the ThreeVs, Grasping the Difference between Data Science and Data Engineering, Making Sense of Data in Hadoop, Identifying Alternative Big Data Solutions, Converting Raw Data into Actionable Insights with Data Analytics, Distinguishing between Business Intelligence and Data Science, Defining Business-Centric Data Science

Identifying Data Science Users; Data Engineering in Action: A Case Study

Unit II: Computing for Data Science - 1**9 Hours**

Using Python for Data Science, Using Open Source R for Data Science.

Sorting Out the Python Data Types; R's Basic Vocabulary

Unit III: Computing for Data Science - 2**9 Hours**

Using SQL in Data Science, Doing Data Science with Excel and Knime

Basic SQL Commands; Knime Basics

Unit IV Machine Learning, Probability and Statistical Modelling**9 Hours**

Defining Machine Learning and Its Processes, Considering Learning Styles, Seeing What You Can Do, Exploring Probability and Inferential Statistic, Quantifying Correlation, Reducing Data Dimensionality with Linear Algebra, Modeling Decisions with Multi-Criteria Decision Making, Introducing Regression Methods

Linear Regression

Unit V Applying Domain Expertise to Solve Real-World Problems Using Data Science**9 Hours**

Data Science in Journalism, Delving into Environmental Data Science, Data Science for Driving Growth in E-Commerce, Using Data Science to Describe and Predict Criminal Activity

Applying statistical modeling to natural resources in the raw; Deploying web analytics to drive growth

Text Books

1. Lillian Pierson and Jake Porway, "Data Science For Dummies", 2nd Edition, For Dummies, 2017

Reference Books

1. Joel Grus, "Data Science from Scratch", 2nd Edition, O'Reilly Media, 2015
2. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020

Web Resources

1. <https://www.simplilearn.com/tutorials/data-science-tutorial/>
2. <https://www.w3schools.com/datascience/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. What is data science? Identify three areas or domains in which data science is being used
2. Give three examples of structured data formats
3. Name three measures of centrality and describe how they differ
4. What is supervised learning? Give two examples of data problems where you would use Supervised learning

L2: Understand

1. How do data analysis and data analytics differ?
2. Relate likelihood of a model given data, and probability of data given a model. Are these two the same? Different? How?



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OE 20ECO02 IoT for Smart Grids**3 0 0 3**

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

Code	Course Outcomes	Mapping with POs	DoK
20ECO02.1	Demonstrate the Smart Grid concept ,Need for smart grid		L1, L2
20ECO02.2	Explain the Energy Management system functions		L1, L2, L3
20ECO02.3	Describe how modern power distribution system functions	-	L1, L2
20ECO02.4	Explain the Advanced metering infrastructureand AMI protocols		L1, L2, L3
20ECO02.5	Identify suitable communication networks forSmart Grid applications		L1, L2, L3
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction to Smart Grid**09 Hours**

Introduction - Evolution of Electric Grid, Smart Grid Concept - Definitions and Need for Smart Grid – Functions – Opportunities – Benefits and challenges, Difference between conventional & Smart Grid.

Technology Drivers

Unit II: Energy Management System**09 Hours**

Energy Management System (EMS) - Smart substations - Substation Automation – Feeder Automation, SCADA – Remote Terminal Unit – Intelligent Electronic Devices – Protocols, Phasor Measurement Unit – Wide area monitoring protection and control, Smart integration of energy resources – Renewable, intermittent power sources.

Energy Storage

Unit III: Distribution Management System**09 Hours**

Distribution Management System (DMS) – Volt / VAR control – Fault Detection, Isolation and Service Restoration, Outage management System, Customer Information System, Geographical Information System, Effect of Plug in Hybrid Electric Vehicles.

Network Reconfiguration

Unit IV: Smart Meters**09 Hours**

Introduction to Smart Meters – Advanced Metering infrastructure (AMI), AMI protocols – Standards and initiatives, Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing.

Peak Time Pricing

Unit V: Communication Networks & IoT**09 Hours**

Elements of communication and networking – architectures, standards, PLC, Zigbee, GSM, BPL, Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) – Broadband over Power line (BPL) - IP based Protocols - Basics of Web Service and CLOUD Computing.

Cyber Security for Smart Grid

Textbooks

1. Stuart Borlase, "Smart Grid: Infrastructure, Technology and Solutions", CRC Press, 2012
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu and Akihiko Yokoyama, "Smart Grid:Technology and Applications", Wiley, 2012

Reference Books

1. Mini S. Thomas and John D McDonald, "Power System SCADA and Smart Grids", CRC Press, 2015
2. Kenneth C. Budka, Jayant G. Deshpande and Marina Thottan, "Communication Networks for Smart Grids", Springer, 2014

Web Resources

1. <https://books.google.co.in/books?isbn=1119969093>
2. <https://books.google.co.in/books?isbn=135123093X>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	35	35
L3	35	35
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

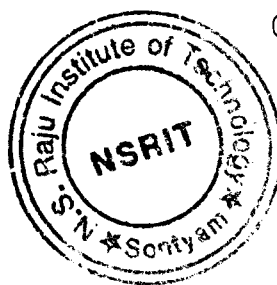
1. Define a Smart grid
2. List any three Benefits of Smart grid
3. What is SCADA?
4. List any three Intelligent Electronic Devices
5. Define a Fault Detection

L2: Understand

1. Explain the need of Smart Grid
2. Demonstrate the Smart Grid Concept
3. Explain the Energy Management System (EMS)
4. Classify and explain the Smart integration of energy resources
5. Illustrate Effect of Plug in Hybrid Electric Vehicles

L3: Apply

1. Identify the Outage management System
2. How to utilize the Distribution Management System (DMS)? explain



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OE 20EE02 Electrical Safety and Management**3 0 0 3**

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

Code	Course Outcomes	Mapping with PO's	DoK
20EE02.1	Understand the Indian electricity rules and their significance		L1, L2
20EE02.2	Explain the safety standard in residential, commercial, and agricultural		L1, L2
20EE02.3	Learn about electrical safety installation, testing and commission	-	L1, L2
20EE02.4	Understand about electrical safety in distribution system		L1, L2
20EE02.5	Explain flash-overs and corona discharge		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Indian Electricity Regulations and Acts and their Significance**09 Hours**

Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage – earthing of system neutral – Rules regarding first aid and fire fighting facility.

The Electricity Act 2003 (Part 1, 2, 3, 4 & 5) and Control Authority Safety Regulations

Unit II: Electrical Safety in Residential, Commercial and Agriculture Installations**09 Hours**

Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

System grounding and Equipment grounding

Unit III: Safety During Installation, Testing and Commissioning, Operation and Maintenance**09 Hours**

Preliminary preparations – safe sequence – risk of plant and equipment – safety documentation – field quality and safety - personal protective equipment – safety clearance notice – safety precautions – safeguards for operators – safety

Magnetic Hot sticks, protective clothing and industrial clothing

Unit IV: Electrical Safety in Hazardous Areas**09 Hours**

Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours.

Hazards associated with currents and voltages

Unit V: Electrical Safety Shocks and their Prevention**09 Hours**

Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

Objectives of Safety and Security Measures

Text Books

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. Pradeep Chaturvedi, "Energy Management Policy, Planning and Utilization", Concept Publishing Company, 1997
3. John M Madden, "Electrical Safety and Law, Planning and Utilization", 5th Edition, Routledge, 2017

Reference Books

1. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
2. Martha J Boss and Gayle Nicoll, "Electrical Safety", 1st Edition, CRC Press, 2014
3. Gupta, B.R., "Electrical Safety", 1st Edition, American Technical Publishers, 2018

Web References

1. <https://nptel.ac.in/courses/108/104/108104087/>
2. <https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/syllabus/>
3. <https://www.edx.org/course/electricity-and-magnetism-maxwells-equations>

Internal Assessment Pattern

CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	30	40
L2	70	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. Give the classification of electrical installations.
2. State the disadvantages of low power factor.
3. What is safety documentation system?
4. State preliminary preparations before commencing the installation.

L2: Understand

1. Write the objectives and scope of Indian Electricity Act and Indian Electricity Rule.
2. Explain the importance of earthing system neutral.
3. Write a note on Do's and Don't for safety in the use of domestic electrical appliances.
4. Explain the classification of equipment/enclosure for hazardous locations.



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Board of Studies (EEE)

OE 20ME002 Fundamentals of Automobile Engineering**3 0 0 3**

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

Code	Course Outcomes	Mapping with PO's	DoK
20ME302.1	Introduction to fundamentals of automobiles, lubrication, Tires and safety.		L1, L2
20ME302.2	Classify and identify the steering system		L2, L3
20ME302.3	Classify and identify the Transmission system		L2, L3
20ME302.4	Define and compare the suspension, breaking and electrical system.		L2, L4
20ME302.5	Identify and Interpret the specifications and safety precautions..		L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction**09 Hours**

Components of four wheeler automobile – chassis and body – power unit – types of automobile engines, engine construction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation –. Types – wheels and tyres. Safety Introduction, safety systems – seat belt, airbags, bumper, anti lock brake system (ABS), windshield, suspension sensors, traction control, mirrors, central locking and electric.

windows, speed control.

Unit II: TRANSMISSION SYSTEM**09 Hours**

Power transmission – rear wheel drive, front wheel drive, 4 wheel drive Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchromesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft – Hotch – Kiss drive.

Torque tube drive, universal joint, differential rear axles.

Unit III: STEERING SYSTEM**09 Hours**

Steering geometry – camber, castor, king pin rake, combined angle toe in, center point steering. types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears, – types *steering linkages.*

Unit IV: SUSPENSION, BREAKING AND ELECTRICAL SYSTEM**09 Hours**

SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system. BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylinder tandem master cylinder requirement of brake fluid ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism, solenoid switch, lighting systems, horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

pneumatic and vacuum brakes.

Unit V: ENGINE SPECIFICATION AND MAINTENANCE**09 Hours**

Introduction – engine specifications with regard to power, speed, torque, no. of cylinders and arrangement, lubrication and cooling etc. engine service, reboying, decarburlization, Nitriding of crankshaft. service details of engine cylinder head, valves and valve mechanism, piston-connecting rod assembly, cylinder block, crank shaft and main bearings, engine reassembly-precautions. Types of pollutants, mechanism of formation, concentration measurement, methods of controlling- engine modification, exhaust gas treatment-thermal and catalytic converters-use of alternative fuels for emission control

National and International pollution standards.

Text Books

1. AutomotiveMechanics--Vol.1&Vol.2/KirpalSingh/standardpublishers
2. AutomobileEngineering/WilliamCrouse/TMHDistributors
3. AutomobileEngineering/P.S.Gill/S.K.Kataria&Sons/NewDelhi.
4. AutomobileEngineering/CSrinivasan/McGrawHill

Reference Books

1. Automotive EnginesTheoryandServicing/JamesD.HaldermanandChaseD.MitchellJr.,/Pearso neducationinc.
2. Automotive Engineering/KNewton,W.Steeds&TKGarrett/SAE
3. Automotive Mechanics: PrinciplesandPractices/ JosephHeitner/VanNostrandReinhold

Web References

1. <https://nptel.ac.in/noc>

Internal Assessment Pattern

CognitiveLevel	InternalAssessment#1(%)	InternalAssessment#2(%)
L2	40	30
L3	40	30
L4	20	40
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive LevelsL1: Remember

1. What are the differences between two and four stroke engines.
2. Define the Octane number & Cetane number
3. Explain the significance of governor in automobiles?
4. What is an automotive differential and how does it work?
5. Why are car steering wheels round?
6. Why entropy decreases with the increase in temperature?

L2: Understand

1. Describe the Atkinson cycle..
2. Explain the flywheel with neat sketch.
3. What is an injector pressure in heavy vehicles? Why it is used?
4. Discuss the service the piston – connecting rod assembly with neat sketch.
5. Discuss the magneto ignition.
6. What is 3-way converter?

L3: Classify

1. .Name the different cooling methods with neat sketches.
2. Describe with P-V diagrams the two used cycles for internal combustion engines.

L4: Interpret

1. In a 4-stroke, 4-stroke cylinder diesel engine running 5000 r.p.m., how many times the fuel will be injected per second.
2. Name the car with engine having 4-valves and 5- valves per cylinder.gas at a pressure of 1.5Mpa ,the gas expands according to the process. Which represented by a straight line on a pressure volume. The final pressure is 0.15MPa. Calculate the work done on a gas by the piston



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For Mr.
Chairman

Board of Studies (ME)

HO 20CSH01 Advanced Computer Architecture**4 0 0 4.0**

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

Code	Course Outcomes	Mapping with Pos	DoK
20CSH01.1	Understand the parallelism concepts in programming	-	L1, L2
20CSH01.2	Analyse processors, memory technologies and virtual memory	-	L1, L2, L3
20CSH01.3	Understand the bus systems and analyse the working of pipelining	-	L1, L2, L3
20CSH01.4	Understand about multiprocessors, multicomputer and SIMD computers	-	L1, L2, L3
20CSH01.5	Analyse the techniques to explore instruction level parallelism	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing. for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Theory of Parallelism:**9 hours**

Parallel Computer Models, The State of Computing, Multiprocessors and Multi-computer, Multi vector and SIMD Computers, PRAM and VLSI Models, Program and Network Properties, Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures, Principles of Scalable Performance, Performance Metrics and Measures, Parallelism profile in programs, Mean performance, Harmonic Mean Performance, Amdahl's law

Arithmetic Mean Performance

Unit II: Processors and Memory Hierarchy:**9 hours**

Processors and Memory Hierarchy, Advanced Processor Technology, Super scalar and Vector Processors, Memory Hierarchy Technology-hierarchical memory technology, inclusion, coherence and locality, Virtual Memory Technology-Virtual memory models, TLB, Paging and segmentation

FIFO & Circular FIFO

Unit III: Bus, Cache and Shared memory, Pipelining and Superscalar Techniques:**9 hours**

Bus Systems, Backplane bus specification, Arbitration, transaction and interrupt, Cache Memory Organizations, cache addressing models, Direct mapping and associative caches, Sector-cache, Shared Memory Organizations, Memory interleaving, Pipelining and Super scalar Techniques, Linear Pipeline Processors, Instruction Pipeline Design, Instruction execution phases, mechanisms for instruction pipelining, Dynamic instruction scheduling, branch handling techniques

Set-Associative cache

Unit IV: Multiprocessors, Multicomputer, Multivector and SIMD computers:**9 hours**

Multiprocessors and Multicomputer, Multiprocessor System Interconnects, Hierarchical bus system, cross bar switch and multiport memory, Cache Coherence and Synchronization Mechanisms, Cache coherence problem, snoopy bus protocols, Three Generations of multicomputer, Message-Passing Mechanisms, message routing schemes Multivector and SIMD Computers, Vector Processing Principles, Vector Instruction types, Vector Memory Access schemes, Compound Vector Processing, compound vector operations, SIMD Computer Organizations, Implementation models

Flow control strategies

Unit V Instruction and System level parallelism:**9 hours**

Instruction Level Parallelism, Introduction, basic design issues, Problem definition, Resource dependence Compiler, detected Instruction Level Parallelism, Operand Forwarding, Reorder Buffer, Register Renaming, Tomasulo's Algorithm, Branch Prediction

Limitations in Exploiting Instruction Level Parallelism

Text Books

1. Kai Hwang and Naresh Jotwani, "Advanced Computer Architecture-Parallelism, Scalability, Programmability", Third Edition, McGraw Hill Education Private Limited, 2015
2. Sima D. and Fountain T., "Advanced Computer Architectures: A Design Space Approach", First Edition, Pearson Education India, 2002

Reference Books

1. John L. Hennessy and David A. Patterson, "Computer Architecture: A quantitative approach", 5th edition, Morgan Kaufmann Elsevier, 2013
2. Shiva S.G., "Advanced Computer Architectures", First Edition, CRC Press, 2018

Web Resources

1. <https://nptel.ac.in/courses/106/103/106103206/>
2. <https://www.mhhe.com/hwang/aca3>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	35	40
L3	35	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define the following terms
(i) Computer architecture (ii) Response time
2. What is cache coherence problem?
3. What is pipelining?
4. What is virtual memory?
5. Write a short note on instruction level parallelism

L2: Understand

1. Describe the program flow mechanism
2. Explain the hierarchical memory technology with a neat diagram
3. Give a brief note on inclusion, coherence and locality
4. Explain briefly about basic VLIW approach
5. Explain briefly about basic compiler techniques for exposing ILP

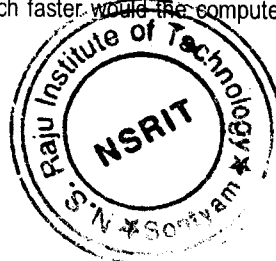
L3: Apply

1. A 400-MHz processor was used to execute a benchmark program with the following instruction mix and clock cycle counts:

Instruction type	Instruction count	Clock cycle count
Integer arithmetic	45,000	1
Date transfer	32,000	2
Floating point	15,000	2
Control transfer	8,000	2

Determine the effective CPI, MIPS rate and execution time for this program.

2. Derive an expression for CPU clock as a function of instruction count, clocks per instruction and clock cycle time
3. Assume we have a computer where the cycles per instruction (CPI) is 1.0 when all memory accesses hit in the cache. The only data accesses are loads and stores, and these total 50% of the instructions. If the miss penalty is 25 clock cycles and the miss rate is 2%, how much faster would the computer be if all instructions were cache hits?



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HO 20DSH01 Text Analytics**4 0 0 4.0**

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

Code	Course Outcomes	Mapping with POs	DoK
20DSH01.1	Understand the basic concepts of Natural Language Processing		L1, L2
20DSH01.2	Understand the text analytics framework.		L1, L2
20DSH01.3	Understand the concepts of Text Summarization.		L1, L2
20DSH01.4	Apply different techniques on Text Similarity		L1, L2, L3
20DSH01.5	Analysing the concepts of Semantic and Sentiment Analysis		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Natural Language Basics**9 hours**

Natural Language: Philosophy of Language, Acquisition and Usage, Language Syntax and Structure, Language Semantics, Natural Language Processing: Machine Translation, Speech Recognition Systems, Question Answering Systems, Contextual Recognition and Resolution, Text Categorization, Text Summarization, Text Analytics

Speech Recognition System versus Contextual Recognition system

Unit II: Text Classification**9 hours**

Automated Text Classification, Classification Algorithms: Multinomial Naïve Bayes, Support Vector Machines, Evaluating Classification Models, Building a Multi-Class Classification System, Applications and Uses, Feature Extraction: Bag of Words Model, TF-IDF Mode, Advanced Word Vectorization Models, Understanding Text Syntax and Structure: Parts of Speech (POS) Tagging, Dependency-based Parsing, Shallow Parsing, Constituency-based Parsing

Decision tree

Unit III: Text Summarization**9 hours**

Text Summarization and Information Extraction: Text Normalization, Feature Extraction: Keyphrase Extraction, Weighted Tag-Based Phrase Extraction, Topic Modelling: Latent Semantic Indexing, Latent Dirichlet Allocation, Matrix Factorization, Automated Document Summarization, Latent Semantic Analysis

Non-negative Matrix Factorization

Unit IV: Text Similarity and Clustering**9 hours**

Information Retrieval (IR), Feature Engineering, Similarity Measures: Analysing Term Similarity, Manhattan Distance, Euclidean Distance, Analyzing Document Similarity: Cosine Distance and Similarity, Document Clustering: K-means Clustering, Ward's Agglomerative Hierarchical Clustering

Hamming Distance, K-NN Clustering

Unit V: Semantic and Sentiment Analysis**9 hours**

Semantic Analysis: Analyzing Lexical Semantic Relations, Word Sense Disambiguation, Named Entity Recognition, Propositional Logic, First Order Logic, Sentiment Analysis: Supervised Machine Learning Technique, Unsupervised Lexicon-based Techniques, Comparing Model Performances

Semantic Representations

Text Books

1. Dipanjan Sarkar, "Text Analytics with Python : A Practitioner's Guide to Natural Language", 2nd Edition, Apress, 2019
2. Akshay Kulkarni, Adarsha Shivananda, "Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning Using Python", 1st Edition, Apress, 2019

Reference Books

1. Birds., Klien E. and E. Loper, "Natural Language Processing with python", 1st Edition, O'Reilly Media Inc, 2009

Web Resources

1. https://www.tutorialspoint.com/big_data_analytics/text_analytics.htm
2. <https://towardsdatascience.com/getting-started-with-text-analysis-in-python-ca13590eb4f7>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	35
L2	40	35
L3	20	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Natural Language Processing?
2. List out the three phases of transfer model in Machine Translation.
3. What is POS tagging?
4. Define k-means clustering
5. What do you mean by natural language and computer language?

L2: Understand

1. Explain the process of multi-document summarization.
2. Discuss about NLP and NLU
3. Describe two evaluation metrics available for text classification
4. Explain text summarization and multiple document text summarization with neat diagram
5. Explain about Ward's Agglomerative Hierarchical Clustering

L3: Apply

1. Apply the naive Bayes classifier approach to Word Sense Disambiguation in NLP
2. Apply the significance of Word Sense Disambiguation in NLP
3. Evaluate the architecture of an Information Retrieval system with a neat diagram



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HO 20AIH03 Game Theory**4 0 0 4**

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

Code	Course Outcomes	Mapping with POs	DoK
20AIH03.1	Understand the fundamentals of game theory		L1, L2
20AIH03.2	Describe the principles of computer graphics		L1, L2
20AIH03.3	Explain the basic principles of game designing	-	L1, L2
20AIH03.4	Explain game engine design methods		L1, L2
20AIH03.5	Design and develop simple games		L1, L2, L3

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction**9 hours**

Elements of Game Play – Artificial Intelligence – Getting Input from the Player - Sprite Programming – Sprite Animation - Multithreading – Importance of Game Design – Game Loop

Unit 2: 3D Graphics for Game Programming**9 hours**

Coordinate Systems, Ray Tracing, Modelling in Game Production, Vertex Processing, Rasterization, Fragment Processing and Output Merging, Illumination and Shaders, Parametric Curves and Surfaces

Unit 3: Game Design Principles**9 hours**

Character Development, Story Telling, Narration, Game Balancing, Core mechanics, Principles of level design, Genres of Games, Collision Detection, Game Logic, Game AI, Path Finding, Case study : Tetris

Unit 4: Game Engine Design**9 hours**

Renderers, Software Rendering, Hardware Rendering, and Controller Based Animation, Spatial Sorting, Level of Detail, Collision Detection, Standard Objects

Unit 5: Game Development**9 hours**

Developing 2D and 3D Interactive Games Using OpenGL, DirectX – Isometric and Tile Based Games, Puzzle Games, Single Player Games, Multi-Player Games

Text Books

1. David H. Eberly, "3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics", Second Edition, Morgan Kaufmann, 2010.
2. Jung Hyun Han, "3D Graphics for Game Programming", First Edition, Chapman and Hall/CRC, 2011

Reference Books

1. Jonathan S. Harbour, "Beginning Game Programming", Course Technology, Third Edition PTR, 2009.
2. Ernest Adams and Andrew Rollings, "Fundamentals of Game Design", Third Edition, Pearson Education, 2014.
3. Scott Rogers, "Level Up: The Guide to Great Video Game Design", First Edition, Wiley, 2010.
4. Jim Thompson, Barnaby Berbank-Green, and Nic Cusworth, "Game Design: Principles, Practice, and Techniques - The Ultimate Guide for the Aspiring Game Designer", First Edition, Wiley, 2008

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100



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**20CEM01 Air Pollution****3 0 0 3**

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

Code	Course Outcomes	Mapping with POs	DoK
20CEM01.1	Identify different types of pollution and their sources		L1,L2
20CEM01.2	Identify the meteorological components		L1,L2
20CEM01.3	Outline the impact on local and global effects of air pollution on human, materials, properties and vegetation	-	L1,L2
20CEM01.4	Explain various types of air pollution control equipment and their working principles		L1,L2
20CEM01.5	Understand sampling methods and monitoring of air pollution		L1,L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction**9 Hours**

Definition of air pollution, Sources and causes of air pollution, Types and classification of air pollution - Natural contaminants, Particulate, Gases and Vapors, Primary and secondary air pollutants

Unit II: Meteorology**9 Hours**

General atmospheric circulation, Atmospheric stability, Effect of meteorology on Plume dispersion, Inversion, Wind profiles and stack plume patterns

Unit III: Effects of Air Pollution**9 Hours**

Effects of air pollution on human beings, plants and animals and properties. Global effects-Green house effect, Ozone depletion, heat island, dust storms, Automobile pollution sources and control, Photochemical smog

Unit IV: Air Pollution Control**9 Hours**

Particulate matter and gaseous pollutants - Settling chambers, Cyclone separators, Scrubbers, Filters & Electrostatic precipitator

Unit V: Air Quality Sampling and Monitoring**9 Hours**

Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants

Text Books

- Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, "Environmental Engineering", Mc Graw Hill, International Edition, 2017
- Rao M. N., Rao H. V. N., "Air Pollution", 1st Edition, Mc Graw Hill, 2004

Reference Books

- Martin, Crawford, "Air Pollution Control Theory", Tata McGraw Hill, New Delhi, 1986
- Bulkeley, H., "Cities and Climate Change", Routledge, London, 2013
- Rao C. S., "Environmental Pollution Control Engineering", Wiley Eastern Limited, New Delhi, 1992
- Gurjar, B. R., Molina, L., Ojha, C. S. P., "Air Pollution: Health and Environmental Impacts", CRC Press, 2010

Web References

- <http://www.epa.gov>
- <http://www.indiaenvironmentportal.org.in>
- <http://nptel.iitm.ac.in>
- <http://www.filtersource.com>
- <https://dgserver.dgsnd.gov>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

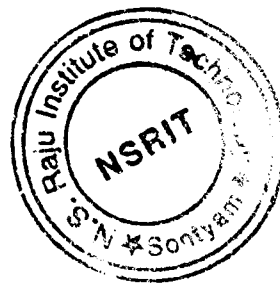
Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Mention various sources of air pollution.
2. Define Atmospheric stability
3. Write a note on Ozone depletion
4. What are Filters & Electrostatic precipitators?

L2: Understand

1. What are Primary and secondary air pollutants?
2. Write the effect of effect of meteorology on Plume dispersion
3. Explain briefly about effects of air pollution on human beings, plants and animals and properties



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Chairman
Board of Studies

MI 20CSM01 E-Commerce**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with POs	DoK
20CSM01.1	Explain the role of new internet economy in E-Commerce		L1,L2
20CSM01.2	Explain the architecture of World Wide Web		L1,L2
20CSM01.3	Describe the E-Commerce process models and E-Payment System	-	L1,L2
20CSM01.4	Illustrate the network models in customization and internal commerce		L1,L2
20CSM01.5	Explain the E-commerce models in advertising and marketing of business		L1,L2
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction**9 hours**

Electronic Commerce- Architectural Frame work, anatomy of E-commerce applications, E-Commerce consumer applications, E-commerce organization applications

E-Commerce and media convergence

Unit II: World Wide Web & Network security**9 hours**

Client-Server Network security, World Wide Web(WWW) as the architecture, Web background: Hypertext Publishing, Technology behind the web, Security and the web

Emerging Client-Server Security Threats

Unit III: E-Payment Systems**9 hours**

Consumer Oriented Electronic Commerce- Mercantile Process models, E-Payment systems- Digital Token-Based, smart cards, credit cards, risk and E-Payment systems.

Designing E-Payment Systems

Unit IV: EDI Implementation and Intraorganizational E-Commerce**9 hours**

Standardization and EDI, EDI Software implementation, Value added networks, Intra organizational E-Commerce- Workflow Automation and Coordination, Customization and Internal Commerce, Supply chain management (SCM).

EDI Envelope for Message Transport

Unit V: Advertising and Marketing on the Internet**9 hours**

Corporate Digital Library- Document Library, digital document types, corporate data warehouses, Advertising and marketing-Information based marketing, Advertising on Internet, online marketing process, market research.

Charting the Online Marketing Process

Text Books

1. Ravi Kalakota and Andrew B. Whinston., "Frontiers of electronic commerce", First Edition, Pearson Education .2011
2. Jaiswal S., " E-Commerce", Second Edition, Galgotia, 2010

Reference Books

1. Dave Chaffey., "E-business & E- commerce management- strategy, implementation and Practice", Fifth edition, Pearson Education, 2015.
2. Kenneth C, "E-Commerce: Business.Technology.Society", First Edition, Pearson Education, 2008

Web References

1. <https://www.techopedia.com/definition/18226/corporate-data-warehouse-cdw>
2. <http://ecmrce.blogspot.com>
3. <http://data.conferenceworld.in>

Internal Assessment Pattern

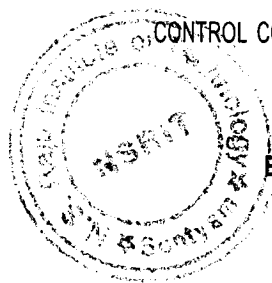
CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. Write any four important E-Commerce organization Applications
2. Write about any four requirements of EDI
3. Write short notes on Risks in E-Payment systems
4. Write short notes on Market research
5. What are the factors for design of electronic payment system?

L2: Understand

1. How enterprise resource planning and supply chain management software differs in their goals and implementations
2. How product or service customization is adopted in intraorganizational commerce?
3. Explain Merchantile's model from the Merchant's perceptive
4. Explain in detail about E-Payment systems
5. Discuss about mercantile transaction using credit cards



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 Chairman
 Board of Studies (CSE)

**20MEM01 Biomaterials****3 0 0 3**

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

Code	Course Outcomes	Mapping with POs	DoK
20MEM01.1	Classify various biomaterials		L1,L2
20MEM01.2	Identify the Metallic implant materials		L1,L2, L3
20MEM01.3	Describe the failure modes of implant materials	-	L1,L2
20MEM01.4	Apply Ceramic implant materials		L1,L2, L3
20MEM01.5	Develop the Biocompatibility & Toxicological properties in of biomaterials		L1,L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction**09 Hours**

Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra- vascular system). Surface properties of materials.

physical properties of materials, mechanical properties.

Unit II: Metallic implant materials**09 Hours**

Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress-corrosion cracking. Host tissue reaction with bio metal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant: Orthopedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants.

Vascular implants, Heart valve implants-Tailor made composite in medium.

Unit III: Polymeric implant materials**09 Hours**

Polyolefin's, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetyls. (Classification according to thermo sets, thermoplastics and elastomers). Viscoelastic behavior: creep-recovery, stress-relaxation, strain rate sensitivity. Importance of molecular structure, hydrophilic and hydrophobic surface properties, migration of additives (processing aids), aging and environmental stress cracking. Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes, Biopolymers in controlled release systems.

Synthetic polymeric membranes and their biological applications.

Unit IV: Ceramic implant materials**09 Hours**

Definition of bio ceramics. Common types of bio-ceramics: Aluminum oxides, Glass ceramics, Carbons. Bio resorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction).

Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out).

Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions.

Unit V: Biocompatibility & Toxicological screening of biomaterials**09 Hours**

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situ implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization.

carcinogenicity, mutagenicity and special tests.

Text Books

1. Biomaterials Science: An Introduction to Materials in Medicine, By Buddy D. Ratner, et. al. Academic Press, San Diego, 1996.
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3. J B Park, Biomaterials – Science and Engineering, Plenum Press, 1984.
4. Comprehensive structural integrity, Vol.9: Bioengineering Editors: Mithe, Ritchie and Karihalo, Elsevier Academic Press, 2003.

Reference Text books

1. Biomaterials Science: An introduction to Materials in Medicine, Edited by Ratner, Hoffman, Schoet and Lemons, Second Edition: Elsevier Academic Press, 2004.

Web References

1. https://nptel.ac.in/content/syllabus_pdf/113104009.pdf
2. RBM603 BIOMATERIALS Syllabus free download
3. UP Technical University BE BM Syllabus
4. RBM603 Syllabus, BM Unit-wise Syllabus – BE 6th Semester

Internal Assessment Pattern

CognitiveLevel	InternalAssessment#1(%)	InternalAssessment#2(%)
L1	10	10
L2	30	30
L3	60	60
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. Write about classification of biomaterials?
2. State the applications of biomaterials?
3. List the advantages and disadvantages biomaterials?
4. Write about Effects of physiological fluid on the properties of biomaterials?
5. Define Importance of stress-corrosion cracking?

L2: Understand

1. Surface properties of materials
2. Comparison of properties of some common biomaterials
3. Corrosion behavior and the importance of passive films for tissue adhesion
4. Visco elastic behavior: creep-recovery, stress-relaxation, strain rate sensitivity

L3: Apply

1. Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions



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Board of Studies(ME)

MI 20EEM01 Basic Control Systems**3 0 0 3**

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

Code	Course Outcomes	Mapping with PO's	DoK
20EEM01.1	Determine time response specifications of second order systems		L1-L2
20EEM01.2	Determine error Constants for different types of input signals		L1-L2
20EEM01.3	Understand various levels of illuminosity produced by different illuminating sources.		L1-L3
20EEM01.4	Design different lighting systems by taking inputs and constraints in view for different layouts.		L1-L3
20EEM01.5	Understand the speed/time characteristics of different types of traction motors.		L1-L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction to Control Systems**09 Hours**

Classification of control systems, open loop and closed loop control systems and their differences, Feedback characteristics, transfer function of linear system, differential equations of electrical networks, translational and rotational mechanical systems

Differences between Closed loop and Open Loop Control Systems

Unit II: Time Response Analysis**09 Hours**

Standard test signals time response of first and second order systems time domain specifications, steady state errors and error constants

Definitions of Time domain Specifications

Unit III: Stability**09 Hours**

The concept of stability, Routh's stability criteria – Limitations of Routh's stability, effect of addition of poles and zeros, introduction to root locus.

Basics of Routh's Criteria

Unit IV: Frequency response**09 Hours**

Introduction to frequency domain specifications, basics of bode plot, Phase margin, Gain Margin. Introduction to Polar plots, its phase margin and gain margin. Introduction to Nyquist stability criteria

Definitions of Frequency domain Specifications

Unit V: State Space Analysis**09 Hours**

Concepts of state, state variables and state model, state space representation of transfer function, diagonalization, solving the time invariant state equations, State Transition Matrix and its Properties, concepts of controllability and observability.

Basics of Matrix operations

Text Books

1. I.J.Nagarath and M.Gopal, "Control Systems Engineering", Newage International Publications, 5th Edition, 2014.
2. Kotsuhiko Ogata, Modern Control Engineering, Prentice Hall of India, 5th edition, 2014

Reference Books

1. S.Palani, "Control Systems Engineering", Tata Mc Graw Hill Publications, 3rd Edition, 2012.

Web References

1. <https://nptel.ac.in/courses/107/106/107106081/>
2. https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	30	30
L2	40	30
L3	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

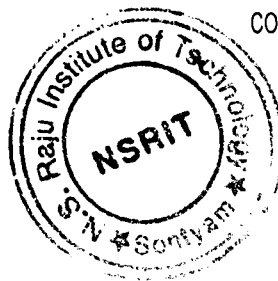
- L1: Remember**
1. What are the various standard test signals?
 2. Define concept of observability.
 3. What is state transition matrix? Write its properties.

L2: Understand

1. Explain how Routh Hurwitz criterion can be used to determine the absolute stability of a system
2. Explain about feedback characteristics.
3. Describe the effect of addition of poles and zeros.

L3: Apply

1. The characteristic polynomial of a system is $s^5 + 2s^4 + 3s^3 + s^2 + 5s + 7 = 0$. Determine the stability of the system using Routh's stability criteria.
2. Determine range of K for stability of unit feedback system whose open loop transfer function is $G(s) = K/s(s+1)(s+2)$.
3. For a system having $G(s) = 25/s(s+10)$ and unit negative feedback, find its time response specifications.



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Board of Studies (EEE)

**20ECM01 Semiconductor Devices and Circuits****3 0 0 3**

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

Code	Course Outcomes	Mapping with POs	DoK
20ECM01.1	Classify different types of semiconductors with energy band diagrams		L1, L2
20ECM01.2	Explain the operation and characteristics of PN junction diode and special diodes		L1, L2
20ECM01.3	Classify and Analyze different types of rectifiers		L1, L2, L3
20ECM01.4	Demonstrate the flow of current in different configurations of the transistor & the concept of DC biasing and transistor stabilization		L1, L2, L3
20ECM01.5	Analyze and Design the small signal low frequency amplifiers		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Semiconductor Physics**09 Hours**

Atomic structure, Neil Bohr's atomic theory, definition of conductors, insulators and semiconductors, energy level diagrams. Semiconductors: Classification and types, intrinsic and extrinsic, P-type and N-type semiconductors, majority and minority carriers, recombination, effect of temperature.

Fermi Level, Charge Densities in Semiconductors

Unit II: Semiconductor Diodes and Special Diodes**09 Hours**

Formation of depletion region, barrier potential, reverse breakdowns, PN junction as diode, symbol, biasing modes, V-I characteristics, diode current equation, effect of temperature on diode current, ideal diode. Special Diodes: Zener diode, Photo Diode, LED - Working, characteristics and applications.

Diode Switching times, Varactor diode, Tunnel Diode

Unit III: Rectifiers and Filters**09 Hours**

Half wave Rectifier, Full wave rectifier, Bridge Rectifier - Operation, Input and output wave forms. Filters: Inductor filter, Capacitor filter, π filter, Comparison of various filter circuits in terms of ripple factors.

LC filter, Multi section π filter

Unit IV: Transistors and Biasing Techniques**09 Hours**

Junction transistor, Transistor current components, Transistor configurations, Transistor as an amplifier, characteristics of transistor in CB and CE configurations. Need for biasing, operating point, Load line analysis, fixed bias and self bias, Stabilization against variations in V_{BE} , I_c , and β , Stability factor, Thermistor and Sensistor bias compensation techniques, Thermal runaway.

Ebers-Moll model of a transistor, Punch through/reach through, Thermal stability

Unit V: Small Signal Low Frequency Transistor Amplifier Models**09 Hours**

BJT: Two port network, Transistor hybrid model, Determination of h-parameters, Generalized analysis of transistor amplifier model using h-parameters, Exact and approximate analysis of CB and CE amplifiers, Comparison of transistor amplifiers.

Effects of emitter bypass capacitor (C_e) on low frequency response

Textbooks

1. Lal Kishore K., "Electronic Devices and Circuits", 4th Edition, Bright Sky Publications, 2016
2. Millman J. and Christos C. Halkias, "Electronic Devices and Circuits", 4th Edition, Tata Mc-Graw Hill, 2010
3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2009
4. Boylestad R. L. and Louis Nashelsky, "Electronic Devices and Circuits", 10th Edition, Pearson Publications, 2009

Reference Books

1. Salivahanan S., Suresh Kumar and Vallavaraj N. A., "Electronic Devices and Circuits", 2nd Edition, Tata Mc-Graw Hill, 2012
2. Donald A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2010
3. Millman J. and Halkias C., "Integrated Electronics", 2nd Edition, Tata Mc-Graw Hill, 2009
4. Singh B. P. and Rekha, "Electronic Devices and Integrated Circuits", 3rd Edition, Pearson publications, 2009
5. Mittal G. K., "Electronic Devices and Circuits", 3rd Edition, Khanna Publishers, 2008

Web Resources

1. www.elprocus.com/p-n-junction-diode-theory-and-working/
2. <http://fourier.eng.hmc.edu/e84/lectures/ch4/node3.html>
3. <http://nptel.ac.in/courses/117103063/11>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	35
L2	40	35
L3	20	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

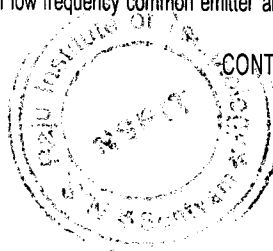
1. Define Semiconductor
2. What is ideal diode?
3. List any three applications of Zener diode
4. What is rectifier?
5. Define ripple factor
6. What is BJT?
7. What is thermal runaway?
8. Define stability

L2: Understand

1. Describe the formation of P type semiconductor
2. Draw and explain V-I characteristics of PN junction diode
3. Describe the construction and operation of Photo diode
4. With neat circuit diagram describe the operation of bridge rectifier
5. Explain, why Zener diode is used in reverse bias with the help of characteristics
6. Draw and explain the input and output Characteristics of Common base configuration
7. With neat sketches explain the V-I characteristics of NPN transistor in common emitter configuration
8. Write a short note on Thermal Runaway
9. Explain thermister compensation technique

L3: Apply

1. Show that the efficiency of half wave rectifier is 40.6%
2. Show that the efficiency of full wave rectifier is 81.2%
3. Obtain an expression of stability factor for fixed bias
4. With suitable expressions explain self bias of BJT
5. Obtain the expressions for voltage gain and current gain of small signal low frequency common emitter amplifier



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20AIM01 Fundamentals of Neural Networks

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20AIM01.1	Describe the concepts of artificial neural networks	-	L1, L2
20AIM01.2	Compare functions of biological and artificial neural networks		L1, L2
20AIM01.3	Explain the architecture and functioning of Single Layer feed forward networks		L1, L2
20AIM01.4	Describe architecture and functioning of Multi-layer networks		L1, L2
20AIM01.5	Explain associative memory networks		L1, L2

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction to Neural Networks

9 hours

Introduction - Humans and Computers - Organization of the Brain – Biological Neuron - Biological and Artificial Neuron Models - Characteristics of ANN - McCulloch-Pitts Model - Historical Developments - Potential Applications of ANN

Unit 2: Essentials of ANN

9 hours

Artificial Neuron Model - Operations of Artificial Neuron - Types of Neuron Activation Function - ANN Architectures - Classification Taxonomy of ANN – Connectivity - Learning Strategy (Supervised, Unsupervised, Reinforcement) - Learning Rules

Unit 3: Single Layer Feedforward Networks

9 hours

Introduction - Perceptron Models: Discrete - Continuous and Multi-Category - Training Algorithms: Discrete and Continuous Perceptron Networks – Limitations of the Perceptron Model

Unit 4: Multi - Layer Feedforward Networks

9 hours

Generalized Delta Rule - Derivation of Backpropagation (BP) Training - Summary of Backpropagation Algorithm - Kolmogorov Theorem, Learning Difficulties and Improvements

Unit 5: Associative Memory Networks

9 hours

Paradigms of Associative Memory - Pattern Mathematics - Hebbian Learning - General Concepts of Associative Memory - Bidirectional Associative Memory (BAM) Architecture - BAM Training Algorithms: Storage and Recall Algorithm - BAM Energy Function

Text Books

1. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks Using MATLAB 6.0", Tata McGraw-Hill Companies, 2006
2. Simon Haykin, "Neural Networks: A Comprehensive Foundation", Second Edition, Pearson Education, Asia
3. James A. Freeman, David M. Skapura, "Neural Networks: Algorithms, Applications, and Programming Techniques", Addison-Wesley Publishing Company

Reference Books

1. B. Yagna Narayana, "Artificial Neural Networks", Prentice Hall India, 2013
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.
3. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education

Web Resources

1. https://www.tutorialspoint.com/artificial_neural_network/index.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

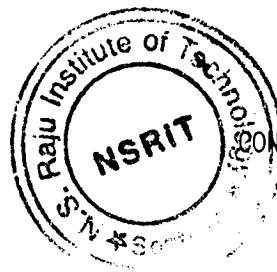
Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

5. Define Neural Computing
6. Define ANN and Neural Computing
7. List any 4 design parameters in the design of Artificial Neural Network
8. What kinds of transfer functions can be used in each layer?
9. Define Pattern Association
10. What is Adaline Model?
11. What are the types of Learning?
12. What is simple artificial neuron?
13. List any 4 applications of Artificial Neural Network
14. Define Delta Learning rule

L2: Understand

4. Describe on the process of assigning and updating weights in a artificial neural network
5. What are the design steps to be followed for using ANN for your problem?
6. Describe least square algorithm with example
7. Why XOR Problem cannot be solved by a single layer perceptron? Write an alternative solution for it
8. Explain Back Propagation Network with necessary diagrams and equations
9. Write the differences between Hetero Associative Memories and Interpolative Associative Memories



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

Code	Course Outcomes	Mapping with POs	DoK
20DSO03.1	Understand the basic concepts of R programming		L1, L2
20DSO03.2	Understand about Scalars and Vectors		L1, L2,
20DSO03.3	Implement Lists and data Frames		L1, L2, L3
20DSO03.4	Implement Tables and Statistical Distributions		L1, L2, L3
20DSO03.5	Implement Functions in R programming		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction

9 Hours

Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

Variable Scope & Default Arguments

Unit II: Control Structures And Vectors

9 Hours

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes

Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations

Higher-Dimensional Arrays

Unit III: Lists

9 Hours

Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, Data Frames, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations

Merging Data Frames

Unit IV: Factors and Tables

9 Hours

Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables

, Extracting a Sub table, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

Aggregate () Function, Set Operations

Unit V: Functions

9 Hours

Scripts to Functions, Making the Script, Transforming the Script, Using the Function, Reduce the number of Lines, Adding more Arguments, Dots, Using Functions as Arguments, Crossing the Borders, Choices with If-Else Statements, vectorizing Choices, Looping Through Values

Coping and Scoping of Functions

Text Books

1. Norman Matloff, "The Art of R Programming- A Tour of Statistical Software Design ", 2011
2. Roger D. Peng, "R Programming for Data Science ", 2012

Reference Books

1. Garrett Golemund, Hadley Wickham, "Hands-On Programming with R: Write Your Own Functions and Simulations", 1st Edition, 2014
2. Andrie de Vries, Joris Meys, "R For Dummies", 2nd Edition, 2015

Web References

1. https://swayam.gov.in/nd1_noc19_ma33/preview
2. <https://data-flair.training/blogs/object-oriented-programming-in-r/>
3. <http://www.r-tutor.com/elementary-statistics>
4. <https://www.tutorialspoint.com/r/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

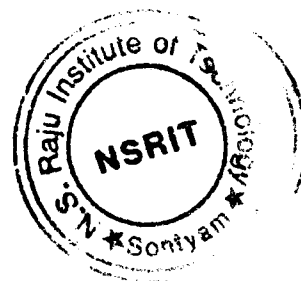
1. Write about vectors in R
2. Write any three type conversions in R
3. What is a data structure in R?
4. Write any two Boolean operators in R
5. Write any two linear vector algebra operations

L2: Understand

1. Explain the importance of data frame
2. How to apply same functions to all rows and columns of a matrix? Explain with example
3. Explain about Finding Stationary Distributions of Markov Chains
4. Describe R functions for Reading a Matrix or Data Frame from a File
5. Explain different matrix operation function in R

L3: Apply

1. Implement binary search tree with R
2. Write R script to create a line graph
3. Create a R language code to generate first n terms of a Fibonacci series
4. Apply R program to implement quicksort
5. Apply R code to the function by using if else command $f(x) = x$ if $x < 1/2$
 $= (1-x)$ if $1/2 < x < 1$
 $= 0$ otherwise



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