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 clears 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	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

No.	Code	Course	POs	L	T*	P	C	
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	-	MC
			Sub-total	17	05	09	**19.5**	

Semester III

No.	Code	Course	POs	L	T*	P	C	
01	20BSX16	Discrete Mathematical Structures	1	3	1	0	3.0	BS
02	20CS302	Operating Systems	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	Operating Systems 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	-	MC
			Sub-total	18	04	11	**21.5**	

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* Suggested hours for tutorial
[1] By default all courses are mapped to PO 12 as they area weakly contributing

Semester IV

No.	Code	Course	POs	L	T	P	C	
01	20HSX03	Managerial Economics and Financial Analysis	11	3	0	0	3.0	HS
02	20CS402	Computer Networks	1, 2	3	0	0	3.0	PC
03	20CS403	Python Programming	1	3	1	0	3.0	PC
04	20CS404	Design and Analysis of Algorithms	1, 2, 3	3	1	0	3.0	PC
05	20CS405	Theory of Computation	1, 2	3	1	0	3.0	PC
06	20CS406	Computer Networks Lab	4, 2	0	0	3	1.5	PC
07	20CS407	Python Programming Lab	1	0	0	3	1.5	PC
08	20CS408	Design and Analysis of Algorithms 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

No.	Code	Course	POs	L	T	P	C	
01	20CS501	Java Programming	1	3	1	0	3.0	PC
02	20CS502	Data Ware Housing and Mining	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	Data Ware Housing and Mining 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	-	MC
10	-	Summer Internship #1[2]	5, 8, 9, 10, PSO 1	0	0	3	1.5	IN
11	-	Technical Paper Writing	-	0	0	2	-	AC
			Sub-total	17	02	15	**21.5**	

Semester VI

No.	Code	Course	POs	L	T	P	C	
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	-	MC
			Sub-total	18	0	11	**21.5**	

Semester VII

No.	Code	Course	POs	L	T	P	C	
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	IN
			Sub-total	19	0	02	**23.0**	

Semester VIII

No.	Code	Course	POs	L	T	P	C	
01	-	Full Semester Internship[3]	5-10, PSO 1, PSO 2	0	0	0	06	IN
02	-	Capstone Project[3]	5-10, PSO 1, PSO 2	0	0	0	06	IN
			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	20BSX17	Probability and Statistics with Python	-	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	20AI004	AI for 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 Service	-	3	0	0	3.0	OE
26	20CSO01	Data Structures and Algorithms	-	3	0	0	3.0	OE
27	20AIO01	Machine Learning for Engineers	-	3	0	0	3.0	OE
28	20DSO01	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, Environment and Resources	-	3	0	0	3.0	OE
34	20CS004	Internet of Things	-	3	0	0	3.0	OE
35	20AIO02	Fundamentals of Deep Learning	-	3	0	0	3.0	OE
36	20DSO02	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
40	20SHO02	Design the Thinking	-	3	0	0	3.0	OE
		Open Elective #3						
41	20CEO03	Disaster, Risk Mitigation and Management	-	3	0	0	3.0	OE
42	20CS302	Operating Systems	-	3	0	0	3.0	OE
43	20AIO03	Intelligent Robots and Drone Technology	-	3	0	0	3.0	OE
44	20DSO03	Introduction to Big Data	-	3	0	0	3.0	OE
45	20ECO03	Privacy and Security in IoT	-	3	0	0	3.0	OE
46	20EEO03	Low-cost Automation	-	3	0	0	3.0	OE
47	20MEO03	Industrial Automation	-	3	0	0	3.0	OE

		Open Elective #4						OE
		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	Graph Theory	-	4	0	0	4.0	HO
2	20CSH02	Advanced Operating System	-	4	0	0	4.0	HO
3	20CSH03	Mobile Computing	-	4	0	0	4.0	HO

Category II

4	20CSH04	Advanced Algorithms	-	4	0	0	4.0	HO
5	20CSH05	Computational Complexity	-	4	0	0	4.0	HO
6	20CSH06	Optimization Techniques	-	4	0	0	4.0	HO

Category III

7	20CSH07	Parallel and Distributed Algorithms	-	4	0	0	4.0	HO
8	20CSH08	Quantum Computing	-	4	0	0	4.0	HO
9	20CSH09	Fault Tolerant Computing	-	4	0	0	4.0	HO

Category IV

10	20CSH10	Advanced Computer Architecture	-	4	0	0	4.0	HO
11	20CSH11	Real Time Systems	-	4	0	0	4.0	HO
12	20CSH12	Advanced Java and J2EE	-	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

[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

| HS | **20HSX01 Communicative English** | | 3 0 0 3 |

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

Code	Course Outcomes	Mapping with POs		DoK
		PO10	PO12	
20HSX01.1	Appreciate and comprehend social as well as business dialogues spoken by the native speakers of english by identifying the topic, context and specific information	3	1	L1, L2
20HSX01.2	Question and respond to queries on familiar topics as well as to use appropriate expressions for various functions of language	3	1	L1, L2
20HSX01.3	Implement suitable strategies for scanning the idea of the text so as to be able to find exact information	3	1	L1, L2
20HSX01.4	Grasp paragraph structure and be able to implement the same in their writing	3	1	L1, L2
20HSX01.5	Articulate fluently and accurate as per the context and need	3	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: Presidential Address by Dr. A. P. J. Abdul Kalam 9 Hours
Chapter titled "Presidential Address by Dr. A. P. J. Abdul Kalam" from "Fluency in English– A Course Book for Engineering Students" published by Orient Black Swan, Hyderabad.
Listening: Listening to discussion on "Presidential Address by Dr. A.P.J. Abdul Kalam." Speaking: Elocution for short duration. Reading: Reading and Its Importance - Techniques for Effective Reading - Signal Words. Writing: Sentences - Techniques for Effective Writing – Paragraph Writing - Types, Structure and Features of a Paragraph. Vocabulary: Word Formation – Root Words –The Use of Prefixes and Suffixes – Collocations. Grammar: Punctuation – Parts of Speech. Non-Detail: *"Deliverance"* by Munshi Prem Chand from the book Individual Society

Intrapersonal skills and Interpersonal Skills

Unit II: Nehru's Letter to Daughter Indira on her Birthday 9 Hours
Chapter titled "Nehru's Letter to Daughter Indira on Her Birthday" from InfoTech English Language referred from JNTUK.
Listening: Interpretation of the motive behind the letter related to the subject. Speaking: Discussion in Pairs/Small Groups on specific topics. Reading: Identifying sequence of ideas; recognizing verbal techniques. Writing: Letter Writing –Format, Styles, Parts, Language to be used in Formal Letters- Letter of Apology – Letter of Complaint-Letter of Inquiry with Reply – Letter of Requisition. Vocabulary: Antonyms and Synonyms; Homonyms, Homophones, Homographs. Grammar: Articles & Prepositions. Non-Detail: "Bosom Friend" by Hira Bansode from the book Individual Society

Creative Thinking and Teamwork

Unit III: Satya Nadella - Email to Employees on his First Day as CEO 9 Hours
Chapter titled "Satya Nadella: Email to Employees on his First Day as CEO" from Fluency in English– A Course Book for Engineering Students" Published by Orient Black Swan, Hyderabad. Listening: Discussion on innovative methods of communication. Speaking: Change in the style of communication i.e., Face book, twitter, Instagram etc. Reading: Sub - skills of Reading - Skimming, Scanning and Skipping. Writing: Email Etiquette; Cover Letter; Resume writing. Vocabulary: One-word substitutes. Grammar: Verb & its kinds and Tenses. Non-Detail: "Shakespearean Sister "by Virginia Woolf from the book Individual Society

Communication Skills and Leadership Skills

Unit IV: Stay Hungry, Stay Foolish   **9 Hours**
Chapter titled "Stay Hungry, Stay Foolish"– from InfoTech English Language referred from JNTUK. Listening: Answering a set of questions (from the context of the lesson) in a group. Speaking: Formal oral Presentations on topics from Academic contexts. Reading: Intensive and extensive Reading. Writing: Psychological stressors; Summarizing & Paraphrasing. Vocabulary: Similar words, elaborate meaning of the words. Grammar: Reported Speech: Exercises; Reporting Verbs for academic purposes, Editing Texts. Non-Detail: "Telephone Conversation" by Wole Soyinka from the book Individual Society

Thinking Skills and Problem Solving

Unit V: Stephen Hawking – Positivity Benchmark   **9 Hours**
Chapter titled "Stephen Hawking – Positivity Bench Mark" from InfoTech English Language referred from JNTUK. Listening: Listening to discussions on "Stephen Hawking – positivity Bench Mark." Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed. Reading: Reading between the lines; Critical Reading for Evaluation. Writing: Precise writing & Essay Writing. Vocabulary: Connotation & Denotation. Grammar: Voice, Concord (Subject – Verb Agreement). Non-Detail: "Still I Rise" from Maya Angelou from the book Individual Society

Positive Attitude and Self Esteem

Text Books

1. "Infotech English Language" – A Text book referred by the JNTUK University Marathi, Publications, 2019
2. "Fluency in English– A Course book for Engineering Students" Published by Orient Black Swan, Hyderabad, 2017
3. "The Individual and Society" – Non-Detailed book referred by the JNTUK University, Pearson Publications, 2020

Reference Books

1. Bailey, Stephen, "Academic writing: A handbook for international students", Routledge, 2014
2. Chase, Becky Tarver, "Pathways: Listening, Speaking and Critical Thinking" Henley ELT; 2nd Edition, 2018
3. Skilful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational Publishers, 2013
4. Hewing's, Martin, "Cambridge Academic English" (B2), CUP, 2012

Web References

1. https://www.youtube.com/watch?v=Zd9mE0d2M9k
2. https://www.thenewleam.com/2019/11/the-letters-that-cultivated-indira-gandhi/
3. https://www.youtube.com/watch?v=PK2XvOs8e1s
4. https://www.youtube.com/watch?v=U36o3UzGY-I
5. https://blogs.microsoft.com/blog/2014/02/04/microsoft-employees-give-new-ceo-satya-nadella-a-12th-man-welcome

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 suggestions did Nehru give to Indira in his letter?
2. "The only way to do great work is to love what you do." Do you think that Steeve Job's statement is worthy in every one's life? Why?
3. What does the phrase 'great drama' refer to?
4. During the freedom movement, what did Gandhiji focus on? Answer with reference to the text
5. Steve Jobs said, "You have to trust in something – your gut, destiny, life, karma, whatever." can you explain a few instances where Steeve Jobs followed his philosophy in his life
6. Write about the early life and education of Stephen Hawking
7. Who did Virginia Woolf sketch the character of Judith?
8. What was the second story of Steve jobs is all about?
9. What was the work done by Steve Jobs in mobile industry?

L2: Understand

1. What have you admired most about Prof. Hawking?
2. According to pt. Nehru, how does a great leader help?
3. Steve Jobs frequently uses the words "drop out' and 'drop in' in his first story. How these words are closely related to his 'connecting dots theory'?
4. "Prof. Hawking's works are larger than his life." Comment briefly
5. What are the eight lessons that one can learn from Prof. Hawking's life?
6. What is a turning point? How does it affect one's life? Discuss it with reference to Prof. Stephen Hawking's life?
7. What things influenced you from the life of Satya Nadella?
8. Do you agree that 'Death is very likely the single best invention of Life'? Why? Think and note some cultures/life styles/gadgets/beliefs which have died in the past decades/ century giving place to new approaches
9. What has influenced you from the life of Abdul Kalam?
10. Why do we want to 'stay hungry, stay foolish', when we can 'stay full, stay smart'?

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Chairman
Board of Studies (Communicative English)

| BS | **20BSX11 Linear Algebra and Differential Equations** | **3** | **1** | **0** | **3** |

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX11.1	Solve homogenous & non- homogenous linear system of equations using rank of a matrix	3	1	L1, L2, L3
20BSX11.2	Apply Cayley Hamilton theorem to find inverse & powers of a matrix and identify the nature of the quadratic forms	3	1	L1, L2, L3
20BSX11.3	Solve linear differential equations of first order	3	1	L1, L2, L3
20BSX11.4	Solve higher order ordinary D.E's with constant coefficients related to various engineering fields	3	1	L1, L2, L3
20BSX11.5	Relate the mean value theorems and find Jacobian, Maxima and Minima of functions of several variables in calculus to engineering problems	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: Solving Systems of Linear Equations, Eigen Values and Eigen Vectors   11 + 1 Hour
Rank of a matrix-Echelon form - Normal form; solving homogeneous and non-homogeneous system of linear equations – Gauss Elimination for solving system of equations; Eigen values and Eigen vectors

Types of Matrices, Rank by using Minor Method, By using Elementary Transformation Method to find Inverse of the Matrix, Gauss- Jorden Method: Properties of Eigen Values and Eigen Vectors

Unit II: Cayley-Hamilton Theorem and Quadratic Forms   11 + 1 Hour
Cayley-Hamilton theorem (without proof) – Finding inverse and power of a matrix by Cayley-Hamilton theorem, Reduction to Diagonal form. Quadratic forms**:** Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to Canonical forms by diagonalization and Orthogonal transformation. Singular values of a matrix- singular value decomposition- Pseudo inverse by singular value decomposition

Symmetric and Skew-Symmetric Matrices, Orthogonal Matrix, Complex Matrix, Hermitian of a Matrix, Unitary of a Matrix

Unit III: Differential Equations of First Order and First Degree   11 + 1 Hour
Linear differential equations–Bernoulli's equations – Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay – Orthogonal Trajectories

Formation of Ordinary Differential Equation, Variable and Separable, Homogeneous and Non- Homogeneous Differential Equations by using Substitution Method

Unit IV: Linear Differential Equations of Higher Order   11 + 1 Hour
Homogeneous and Non-homogeneous equations of higher order with constant coefficients – with RHS term of the type e^{ax}, sinax, cosax, Polynomials in x, $e^{ax}V(x)$ and $xV(x)$ – Method of Variation of parameters. Applications: LC circuits - CR circuits - LCR circuits   .

Simple Harmonic Motion, Higher Order Differential Equation with Variable Coefficient

Unit V: Mean Value Theorems and Functions of Several Variables   11+1 Hour
Mean Value Theorems (without proof): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's series expansion of functions of one variable. Functions of Several Variables: Introduction – Partial differentiation - Homogeneous function – Euler's theorem –Jacobian – Functional dependence - Taylor's and Maclaurin's series expansion of functions of two variables. Applications: Maxima and Minima of functions of two variables with and without constraints - Lagrange's method of undetermined multipliers

The Chain Rule of Partial Differentiation, Total Derivative, Implicit Function and Jacobian Implicit Function

Text Books
1. Grewal B. S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2015

2. Ramana B. V., "Higher Engineering Mathematics",Tata McGraw Hill Education, 2018

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics",10th Edition, Wiley, India, 2015
2. Bali N. P., "Engineering Mathematics", 22th Edition, Lakshmi Publications, 2018
3. Peter o'Neil, "Advanced Engineering Mathematics" 7th Edition, Cengage Publications, 2012
4. Dr. Iyenger T. K. V., Dr. Prasad. M. V. S. S. N., Ranganatham S. and Dr. Krishna Gandhi B., "Engineering Mathematics I, II & III ", S. Chand Publications, 2019

Web References

1. http://nptel.ac.in/courses/
2. https://onlinecourses.nptel.ac.in
3. https://www.classcentral.com/course/swayam-basic-linear-algebra-13003
4. https://ocw.mit.edu/courses

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. State Cayley-Hamilton theorem
2. What is Bernoulli's equation?
3. State Euler' theorem
4. Write   Leibnitz's linear equation
5. Write Bernouli's differential equation in y
6. State Cayley–Hamilton theorem
7. What is an orthogonal transformation?
8. When a given non-homogenous system AX=B is consistent
9. What is the nature of the quadratic form?
10. State Rolle's Theorem

L2: Understand

1. Reduce the matrix $\begin{bmatrix} -2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$ into normal form and find the rank of the matrix
2. Represent $x^2y + 3y – 2$ in powers of $(x − 1)$ & (y+2) up to third degree terms using Taylor's theorem
3. Check the consistency of the system x+y+z=4, 2x+3y-2z=3, x+7y-7z=5
4. Find whether the homogenous system x+y-3z+2w=0,2x-y+2z-3w=0,3x-2y+z-4w=0,-4x+y-3z+w=0 possess non trivial solution
5. Represent x^2y+3y-z in powers of x & y using Maclaurin's series expansion
6. Verify Rolle's theorem for f(x) = (x+2)3(x-3)4 in (-2,3)
7. Solve (1+y^2) dx +(x-$e^{\tan^{-1}x}$) dy=0
8. Solve $\frac{2x}{y^3}$ dx +$\frac{y^2-3x^2}{y^4}$ dy=0
9. Solve (D2+3D+2)y=4 cos²x
10. If u= $\tan^{-1}(\frac{x^3+y^3}{x-y})$ prove that x$\frac{\partial u}{\partial x}$ + y$\frac{\partial u}{\partial y}$ = $\sin 2u$

L3: Apply

1. Apply Cayley –Hamilton theorem to find inverse and A^4 of the matrix A=$\begin{bmatrix} 2 & -1 & 2 \\ 1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ and also verify the Cayley-Hamilton theorem

2. The number N of bacteria in a culture grew at a rate proportional to N. The Value of N was initially 100 and increased to 332 in one hour. What is the value of N after $1\frac{1}{2}$ hours

3. A condenser of capacity C discharged through an induction L and resistance R in series and the charge q at time t satisfies the equation $L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{q}{C} = 0$, Given **L = 0.25** henries, **R = 250** ohms, **C =2×10^{-6}** farads and that when **t =0,** charge **q is 0.002** coulombs and the current $\frac{dq}{dt}$ **= 0.** Obtain the value of q in terms of t

4. Find the volume of the largest rectangular parallelepiped that can be inscribed in the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2}$ = 1

5. A body is originally at 80 ℃ and cools down to 60 ℃ in 20 minutes if the temperature of air is 40 ℃. Find the temperature of body after 40 minutes

6. Find the shortest distance from origin to the surface $xyz^2 = 2$

7. Prove that system of parabola $y^2 = 4a(x + a)$ is it self-orthogonal

8. Find the points on the surface $z^2 = xy + 1$ that are nearest to the origin

9. Find the orthogonal trajectories of the family of cardioids $r = a(1 - \cos\theta)$

10. A generator having emf 100 volts is connected in series with a 10 ohm resistor and an inductor of 2 henries. If the switch is closed at a time t = 0, find the current at time t >0

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Chairman Board of Studies
(**Mathematics**)

6

| BS | **20BSX33 Applied Physics** | | **3** | **1** | **0** | **3** |

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

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO3	PO12	
20BSX33.1	Illustrate the experimental evidence of wave nature of light and interference in thin films, Diffraction grating and Polarization	3	1	1	L1, L2
20BSX33.2	Classify various types of lasers & optical fibers	3	1	1	L1, L2
20BSX33.3	Explain the concepts and applications of magnetic and dielectric materials	3	1	1	L1, L2
20BSX33.4	Interpret the microscopic behaviour of Matter with quantum mechanics and explain the various electron theories	3	1	1	L1, L2
20BSX33.5	Summarise various types of solids based on band theory and identify the type of semiconductor using Hall effect	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: Wave Optics   11 + 1 Hour
Interference: Introduction, Interference in thin films by reflection – Newton's rings (Theory, Experimental study), applications (Wavelength of a source and refractive index of a liquid).
Diffraction: Concept of diffraction difference between Fresnel's and Fraunhofer diffraction -Fraunhofer diffraction at single slit (Quantitative), diffraction at double slit (Qualitative) Diffraction grating. Raleigh's criteria, Resolving power of grating.
Polarization: Types of polarization, polarization by reflection, refraction and Double refraction – Nicol's prism construction and working Wave plates: half wave plate and quarter wave plate.

Concepts of Ray Optics, Young's Double Slit Experiment, Circular Aperture - Airy's Correction, Transverse Nature of Light by Polarization

Unit II: Lasers and Fiber Optics   11 + 1 Hour
Laser: Concept of laser, Characteristics of laser, Spontaneous and Stimulated emission of radiation, Einstein's Coefficients, pumping mechanisms, Ruby laser, Helium Neon Laser - Applications of Laser.
Fiber Optics: Introduction to Optical fiber, Principle and structure of optical fiber, classification of optical fibers (based on modes and refractive index profile). Acceptance angle, Acceptance cone Numerical Aperture - Applications of optical fiber.

Concepts of MASER, Working of 3 Level and 4 Level LASER Systems, Principles of Light

Unit III: Magnetic Materials and Dielectric Materials   11 + 1 Hour
Introduction, Magnetic dipole moment, Magnetic Susceptibility - Magnetic Permeability – Classification of Magnetic materials – Dia, Para, Ferro, Weiss Domain theory (Qualitative) Hysteresis curve, Soft and Hard magnetic materials – Applications.
Dielectric Materials: Dielectric polarization – Dielectric polarizability, Susceptibility and Dielectric constant - types of polarizations: Electronic, Ionic and Orientational polarizations (Qualitative), Lorentz internal field, Claussius - Mossoti Equation - Applications of dielectrics.

Basic Definitions of Magnetism, Curie's Law, Curie-Weiss Law, Relation between D, E and P, Dielectric Losses

Unit IV: Quantum Mechanics and Free Electron Theory   11 + 1 Hour
Quantum Mechanics: Introduction – De-Broglie's concept of matter waves – Physical significance of wave function - Schrodinger time independent and time dependent wave equations – Particle in a one-dimensional potential box.
Free Electron Theory: Introduction, Classical free electron theory (merits and demerits only) quantum free electron theory, Electrical Conductivity- Fermi-Dirac distribution function and temperature dependence.

Failures of Classical Mechanics-Origin of Quantum Mechanics, Basic Definitions of Free Electron Theory, Various Statistics

Unit V: Band Theory of Solids and Semiconductor Physics   11 + 1 Hour

Band Theory of Solids: Bloch's theorem (Qualitative), Kronig-Penny model (Qualitative), energy bands in crystalline solids, E vs K diagram, effective mass electron-concept of hole. Semiconductor Physics: Origin of energy band formation in solids, classification of materials into conductors, semiconductors and insulators using band diagram, Intrinsic and Extrinsic semiconductors. Hall Effect, Hall coefficient and applications of Hall Effect.

Concept of Brillouin Zones, Density of States-Fermi Energy, Carrier Concentration in Semiconductors

Text Books

1. Dekker A. J., "Solid State Physics", 1st Edition, McMillan India Ltd., 2000
2. Avadhanulu M. N. and K Shirasagar P.G., "A Ttext Book of Engineering Physics", 1st Edition, S. Chand Publications, 2011
3. Palanisamy P. K., "Engineering Physics", 4th Edition, SciTech Publishers, 2014
4. Srinivasan M. R., "Engineering Physics", 2nd Edition, New Age International Publishers, 2014

Reference Books

1. Charles Kittle, "Introduction to Solid State Physics", 5th Edition ,Willey, India Pvt. Ltd., 2012
2. Arumugam M., "Applied Physics", 4th Edition, Anuradha Agencies, 2013
3. Bhattacharya D. K., "Engineering Physics", 2nd Edition ,Oxford University Press, 2010
4. Sanjay D Jain and Girish G Sahasrabudhe "Engineering Physics", 1st Edition, University Press, 2010
5. Pandey B. K. and Chaturvedi S., "Engineering Physics", 1st Edition , Cengage Learning, 2012
6. Robert Rensnick, Jearl Walker and David Halliday, "Principles of Physics", 10th Edition, Wiley, 2015
7. Gour R. K. and Gupta S. L., " Engineering Physics", 1st Edition, Dhanpatrai Publications, 2011

Web References

1. http://link.springer.com/physics
2. http://www.thphys.physics.ox.ac.uk
3. http://www.sciencedirect.com/science
4. http://www.e-booksdirectory.com
5. 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 Principle of Superposition
2. Define types of polarization
3. State Dielectric polarization and Dielectric polarizability
4. What are Newton's rings? How are they formed?
5. What is meant by diffraction of light?

L2: Understand

1. Explain the construction and working principle of Nicol's prism
2. Demonstrate working principle of Ruby laser with energy level diagram
3. Outline de Broglie concept of matter waves
4. Discuss polarization by reflection
5. Explain the pumping mechanisms of lasers

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Chairman
Board of Studies (Physics)

| ES | **20ESX02 Programming for Problem Solving using 'C'** | | 3 | 0 | 0 | 3 |

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20ESX02.1	Demonstrate the process of problem-solving using algorithm, pseudo code and flowchart	3	1	L1, L2, L3
20ESX02.2	Demonstrate conditional and iterative statements to write programs	3	1	L1, L2, L3
20ESX02.3	Illustrate the use of arrays and strings	3	1	L1, L2, L3
20ESX02.4	Describe and use pointers & functions	3	1	L1, L2, L3
20ESX02.5	Understand and apply the file manipulation functions to handle data files	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 Problem Solving and Programming   11 + 1 Hour

Introduction to Problem Solving: Problem Solving Aspect, Top-down Approach, Algorithm, Flowchart, Pseudo code. Programming Fundamentals: C Language: Character set, C tokens – Data types, Identifiers, Keywords, Variables, Operators, Expressions, Precedence, Associatively, Type Conversion; Structure of C program: Program Development Process, Creating and Executing C Program, Input/output functions: Statements

Sizeof operator, escape sequences

Unit II: Bitwise Operators, Conditional Branching and Loops   11 + 1 Hour

Bitwise Operators: Exact Size Integer Types, Logical Bitwise Operators, Shift Operators, Tips and Common Programming Errors, Key Terms, Summary, Practice Set. Control Structures: Declaration, expression, control flow statements–Branching– if, if-else, if-else-if ladder, nested if, switch-case, Loop control – while, do-while, for; goto, Continue, Break, Exit Statements. Storage classes-extern, auto, register, static, scope rules, example C programs

Nested loop control structures

Unit III: Arrays and Functions   11 + 1 Hour

Arrays: Definition, declaration, accessing elements, storing elements, 2-Darrays, Multi dimensional arrays, Strings and string manipulations. Functions: Standard Library Functions: User Defined Functions-Function prototypes, Function definition, Function call, Example Programs, Passing Parameters-Call by value

Macros

Unit IV: Pointers and Structures   11 + 1 Hour

Pointers: Definition, Pointer Compatibility, Dynamic Memory Allocation, Pointer Arithmetic, Arrays and Pointers, Array of pointers, Pointers and Functions, Call by reference. Structure: Definition, Declaration, Initialization, Nested structures, Array of structures, Self-Referential Structures, Enumerated Data type, Structures and Functions, Structures and Pointers, Union
Pointers to Pointers

Unit V: Files   11 + 1 Hour

Files: Types of files, Modes of Operations, File input and output, File Handling Functions, Random Access Functions, Command Line Arguments, Preprocessor Directives

Error handling functions

Text Books

1. Byron Gottfried, "Programming with C", 3rd Edition, Tata McGraw Hill, 2017
2. Herbert Schildt, "C The Complete Reference", 4th Edition, TMH, 2017

3. Dromey R .G., "How to solve it by Computer", Pearson Education India, 2008

Reference Books

1. Kanetkar Y., "Let us C", 8th Edition, BPB Publication, 2004
2. ISRD Group, "Programming and Problem Solving Using C", Tata McGraw Hill, 2008
3. Prasad F. E. V., "C Programming: A Problem-Solving Approach", Giliberg, Cengage Learning, 2010
4. Balagurusamy E., "Programming in ANSI C" , 3rd Edition ,TMH, 2004

Web References

1. https://www.geeksforgeeks.org/c-programming-language
2. https://www.tutorialspoint.com/cprogramming/index.html
3. https://www.javatpoint.com/c-programming-language-tutorial

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 do you mean by flowchart? What are the components in the flowchart and explain with example?
2. List the steps involved in creating and running a C program
3. What are various storage classes in C? Discuss their uses and scope?
4. What is string? Explain about declaration and initialization of string in C. How strings are displayed with different formats with examples?
5. Write a C program to copy one string to another
6. Write a C program to read and display the content of a file
7. What is recursive function? What are the constraints for defining a recursive function with an example?
8. Why switch statement is more advantageous than nested if-else statement
9. What is meant by a variable in C programming? How a variable is initialized? What are the rules of defining c variable name? Give an example?
10. Write a c program to count number of vowels and consonants in a string using pointers

L2: Understand

1. Explain about enumerated types with example
2. Explain counter controlled and exit controlled loops with examples
3. Write a program to compare2 strings for equality without using strcmp() function
4. What is string? Demonstrate about declaration and initialization of string in C. How strings are displayed with different formats? Explain with examples?
5. Illustrate a C program to find the sum of first and last digit of a number
6. Illustrate a C program to merge two files into single file
7. Explain different looping statement with syntax and example
8. Classify looping statement with syntax and example
9. Explain function prototype and explain different methods to call the function
10. Explain in detail about array of structure and pointer to structure with example
11. Discuss the usage of bitwise logical operators used in C? Compare them from logical operators with suitable program
12. Explain about call by value and call by reference with reference to functions with example
13. Explain the term dynamic memory allocation and the terms malloc(), calloc() and realloc() functions

L3: Apply

1. Write a C program to check whether the given number is palindrome or not
2. Write a C program to solve the factorial of a given number using for loop

3. Write an algorithm, flowchart and pseudo code to identify largest of given 3 numbers using conditional operator
4. Write a C program to perform the operation of multiplication of two matrices
5. Write a C program to interchange the largest and smallest elements in an array
6. Write a C program by applying pointers to count number of vowels and consonants in a string
7. Write a C program to select any arithmetic operations using switch cases
8. Write a C program to find given number is Armstrong or not
9. Write a C program to check whether the given string is palindrome or not
10. List File handling functions. Utilize file handling functions with an example

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Chairman
Board of Studies (CSE)

| ES | **20CS101 Fundamentals of Computer Science** | **3** | **0** | **0** | **3** |

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20CS101.1	Summarize the basics of computer peripherals devices	3	1	L1
20CS101.2	Demonstrate the basics of problem solving and programming using algorithm and flow chart	3	1	L1, L2
20CS101.3	Explain the basics of computer networks and operating systems	3	1	L1
20CS101.4	Illustrate the usage of data bases	3	1	L1
20CS101.5	Summarize the basics of AI and machine Learning	3	1	L1

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
A Simple Computer System: Central processing unit, the further need of secondary storage, Types of memory, Hardware, Software and people. Peripheral Devices: Input, Output and storage, Data Preparation, Factors affecting input, Input devices, Output devices, Secondary devices, Communication between the CPU and Input/ Output devices

Other Secondary Storage Devices

Unit II: Problem Solving and Programming 9 Hours
Problem Solving and Programming: Algorithm development, Flowcharts, Looping, some programming features, Pseudo code, the one-zero game, some structured programming concepts, documents. Programming Languages: Machine Language and assembly language, high-level and low-level languages, Assemblers, Compilers, and Interpreters

Different types of programming languages

Unit III: Computer Networks and Operating Systems 9 Hours
Computer Networks: Introduction to computer Networks, Network topologies-Bus topology, star topology, Ring topology, Mesh topology, Hybrid topology, Types of Networks: Local area Network, Wide Area Networks, Metropolitan Networks, Campus/ Corporate Area Network, Personal Area Network, Network Devices-Hub, Repeater, Switch, Bridge, Router, Gateway, Network interface Card, Open System Inter Connection Model. Operating systems: Introduction, Evolution of operating systems, Process Management-Process control block, Process operations, Process scheduling, Command Interpreter, Popular operating systems-Microsoft DOS, Microsoft Windows, UNIX and Linux

Definitions of Wireless Networks, Sensor Networks, Kernel

Unit IV: Data Bases 9 Hours
Database Systems: File-Oriented Approach, Database-oriented Approach-Components of Database system, Advantages & Disadvantages of Database approach, Applications of Database systems, Database views, Three-schema architecture, Database models-Hierarchical model, Network Model, relational Model, Object-oriented Data Model, Components of database management systems, Retrieving Data through Queries

Mobile operating systems: features and examples

Unit V: Artificial Intelligence and Machine Learning 9 Hours
Introduction to artificial intelligence: Introduction, history, intelligent systems, foundations of AI, applications, development of AI languages, current trends in AI. 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, Machine learning types

Applications of machine learning

.

Text Books

1. Anita Goel, "Computer Fundamentals" 1st Edition, Pearson Education, 2010
2. Kenneth C. Mensfield jr, James L. Antonakos, "PC Hardware Trouble Shooting Made Easy", TMH, 2000
3. Noel Kalicharan, "An Introduction to Computer studies", Cambridge University Press, 1988
4. Reema Thareja, "Fundamentals of Computers", 1st Edition, Oxford Higher Education, 2014
5. Rajendra Akerkar, "Introduction to Artificial Intelligence", PHI earning Private Limited, 2012
6. Flach P., "Machine Learning: The Art and Science of Algorithms That Make Sense of Data", 1st Edition, Cambridge University Press, 2012

Reference Books

1. Introduction to Information Technology – ITL education Solution Limited, 2nd Edition, Pearson Education India, 2012
2. Glenn Brooks Hear J., Dennis Brylow, "Computer Science and overview", 13th Edition, Pearson Education, 2014
3. Dr. Venkateswarlu N. B., "Essential Computer and IT Fundamentals for Engineering and Science Students", S. Chand, 2012

Web References

1. https://explorersposts.grc.nasa.gov/post631/20062007/computer_basics/ComputerPorts.doc
2. https://explorersposts.grc.nasa.gov/post631/20062007/bitsnbyte/Digital_Storage_Basics.doc

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	75	80
L2	25	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List any four input /output devices
2. What is computer network?
3. Define database
4. List out any four machine learning techniques
5. Define operating system
6. List out six applications of Artificial intelligence
7. Define Topology, List out two types of topologies
8. List out two types of operating systems
9. What are the two features in machine learning?
10. Define assembler, compiler

L2: Understand

1. Explain different peripheral devices in detail
2. Explain about process control block
3. Describe any two languages that support AI
4. Describe the ingredients of machine learning in detail
5. Illustrate the E-R model with suitable example

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Chairman
Board of Studies (CSE)

| HS | **20HSX02 Communicative English Lab** | | **0   0   3   1.5** |

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

Code	Course Outcomes	Mapping with POs	
		PO10	PO12
20HSX02.1	Developed better understanding nuances of English Language through audio – visual experience and group activities	3	3
20HSX02.2	Learnt to use neutralization of accent for intelligibility	3	3
20HSX02.3	Improved communicative competence that include clarity and confidence which in turn enhances their employability skills and ability to communicate in formal and informal situations	3	3
20HSX02.4	To Cultivate communicative Competence	3	3
20HSX02.5	To make them ready for Industry	3	3
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos		

List of Experiments

1. Understand: Listening Skill- Its importance – Purpose – Process – Types - Barriers
   Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants – Minimal Pairs - Consonant Clusters
2. Understand: Spoken vs Written language - Formal and Informal English
3. Practice: Ice - Breaking Activity and JAM Session - Dialogues – Greetings – Taking Leave – Introducing Oneself and Others
4. Understand: Structure of Syllables – Word Stress – Sentence Stress – Intonation
5. Practice: Basic Rules of Word Accent - Stress Shift - Sentence Stress – Intonation
6. Understand: Features of Good Conversation – Strategies for Effective Communication. Practice: Situational Dialogues – Role-Play - Expressions in various Situations
7. Understand: Descriptions- Picture Description - Story Narrations - Giving Directions. Practice: Giving Instructions – Seeking Clarifications– Making Suggestions, Describing people, places and things
8. Understand: Public Speaking – Exposure to Structured Talks – Non-verbal Communication-Presentation Skills
9. Practice: Making a short speech – Extempore - Making a Presentation
10. Understand: Group Discussion - Interview Skills. Practice: Participation in Group Discussion and Mock Interviews

References

1. Lab Manual for Communicative English, Department of Basic Science and Humanities, NSRIT

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Chairman
Board of Studies (English)

BS   **20BSX34 Applied Physics 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
20BSX34.1	Relate the principle of physics in engineering field and compare the results with theoretical calculations	3	3	1
20BSX34.2	Understand modern engineering physics techniques and tools in real time applications in engineering studies	3	3	1
20BSX34.3	Distinguish the characteristics of materials in a practical manner and gain knowledge of its usage	3	3	1
20BSX34.4	Develop the laboratory skills in handling of electrical and optical instruments	3	3	1
20BSX34.5	Demonstrate the interference and diffraction phenomena of light	3	3	1

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

List of Experiments

1. Measurement of magnetic susceptibility by Gouy's method
2. Determination of wavelength of a source using Diffraction Grating Normal incidence method
3. Newton's rings -Determination of Radius of Curvature of Plano Convex Lens
4. Determination of thickness of thin Object- Air wedge method
5. Determination of wavelength of Laser Source-single slit diffraction
6. Determination of Resolving power of a telescope
7. Determination of Hall coefficient and Hall voltage using Hall effect
8. Verify Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus
9. Determination of dispersive power of prism
10. Calculate the energy loss in a given ferromagnetic material by plotting B-H Curve
11. To find the Energy Band gap of a Semiconductor using p - n junction
12. Study the Characteristics of a Thermistor and obtain its temperature coefficient
13. Determination of dielectric constant using charging discharging method
14. Determination of resolving power of a grating

References

1. Lab Manual for Applied Physics, Department of Basic Science and Humanities, NSRIT

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Chairman
Board of Studies (Physics)

| ES | **20ESX07 Programming for Problem Solving Using 'C' 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
20ESX07.1	Demonstrate the process of problem-solving using algorithm, pseudo code , flowchart, Compile and Debug programs	3	3	1
20ESX07.2	Summarize the concepts of control statements, pointers & functions and solvethe problem using C programming	3	3	1
20ESX07.3	Implement the concepts of Arrays, Strings & functions	3	3	1
20ESX07.4	Demonstrate the use of Pointers & Structures	3	3	1
20ESX07.5	Demonstrate the use of Files	3	3	1
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos			

List of Experiments

1. Demonstrate to usage of computer system, installation of operating systems
2. Write programs to illustrate the usage of operators and input-output statements
3. Write programs to demonstrate the use of selective flow control statements
4. Write programs to demonstrate the use of loop control statements
5. Write programs to demonstrate the use of one-dimensional arrays
6. Write programs to demonstrate the use of multi-dimensional arrays
7. Write programs to demonstrate the usage of strings
8. Write programs to demonstrate the usage of user-defined functions
9. Write programs to demonstrate the usage of structures and array of structures
10. Write programs to demonstrate the usage of pointers
11. Write programs to demonstrate the usage of files

References

1. Lab Manual for Programming for Problem Solving using 'C', Department of Computer Science and Engineering, NSRIT

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Chairman
Board of Studies (CSE)

| BS | **20BSX12 Partial Differential Equations and Vector Calculus** | **3** | **1** | **0** | **3** |

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX12.1	Solve linear and non linear partial differential equations	3	1	L1, L2, L3
20BSX12.2	Identify solution methods for second and higher order partial differential equations	3	1	L1, L2, L3
20BSX12.3	Find double, triple integrals and improper integrals using Beta-Gamma functions	3	1	L1, L2, L3
20BSX12.4	Apply Gradient, Divergence, Curl and Laplacian to various functions of several variables	3	1	L1, L2, L3
20BSX12.5	Apply Greens, Stokes and Gauss divergence theorems to calculate line ,surface and volume integrals	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: Partial Differential Equations of First Order   11 + 1 Hour

Formation of Partial Differential Equations by Elimination of Arbitrary Constants and Arbitrary Functions; Solutions of First Order Linear Equation by Lagrange's Method and Non-Linear Equations of Standard Types

Solution of Equation by Direct Method, Charpit's Method

Unit II: Second Order Partial Differential Equations   11 + 1 Hour

Second Order PDE: Solutions of Homogenous and Non-Homogeneous Linear Partial Differential Equations with Constant Coefficients – RHS term of the type e^{ax+by} , Sin(ax+by), Cos(ax+by), $x^m y^n$; Classification of Second Order Partial Differential Equations - Method of Separation of Variables

Monge's Method, Classification of One Dimensional Wave, Heat and Two-Dimensional Laplace Equation

Unit III Gamma, Beta Functions and Multiple Integrals   11 + 1 Hour

Gamma, Beta Functions and their Properties - Relation between Beta and Gamma Functions - Evaluation of Improper Integrals. Multiple Integrals: Double Integrals - Change of Variables- Change of Order of Integration - Triple Integrals - Change of Variables.

Area and Volume using Double and Triple Integral

Unit IV: Vector Differentiation   11 + 1 Hour

Gradient – Divergence - Curl –Potential function - Laplacian and Second Order Operators - Vector Identities (Without Proof).

Geometrical meaning of Gradient, Physical Interpretation of Divergence and Curl

Unit V: Vector Integration   11 + 1 Hour

Line Integral, Surface and Volume Integrals, Vector Integral Theorems (without proof) - Green's, Stoke's and Gauss Divergence Theorems.

Green's, Stoke's and Gauss Divergence Theorems with Proofs

Text Books

1. Grewal B. S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2018
2. Ramana B. V., "Higher Engineering Mathematics", Tata McGraw Hill Education, 2018

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley, India, 2015
2. Bali N. P., "Engineering Mathematics", 22th Edition, Lakshmi Publications, 2018
3. Peter O' Neil," Advanced Engineering Mathematics", 8th Edition, Cengage Learning, 2017
4. Iyenger T. K. V., Dr. Prasad M. V. S. S. N., Ranganatham S. and Krishna Gandhi B., "Engineering Mathmematics III", 2nd Edition, S. Chand Publications, 2020

Web References

1. http://nptel.ac.in/courses/
2. https://onlinecourses.nptel.ac.in
3. https://nptel.ac.in/courses/111/108/111108144/
4. https://ocw.mit.edu/courses

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define PDE
2. Solve the PDE $z=px+qy-2\sqrt{pq}$
3. Solve $(D^2-2DD^1+1)z=0$
4. Find P.I of $(D^2-DD^1+D^1-1)z=e^{x+y}$
5. Define Gamma and Beta function

L2: Understand

1. Solve $(D^2-DD1+D1-1)z= \cos(x+2y)+ey-x$
2. Solve $\dfrac{\partial u}{\partial x} = 2\dfrac{\partial u}{\partial t} + u$ where $u(x,0) = 6e^{-3x}$ by the method of separation of variables
3. Find the directional derivative of the function $\emptyset = xy^2 + yz^3$ at the point (2,-1,1) in the direction of the normal to the surface $x\log z - y^2 + 4 = 0$ at (-1,2,1)
4. If $F=x^2yz, G= xy^{-3}z^2$ Then find div(grad F x grad G)
5. Find $\iint \bar{f}.\bar{n}\,ds$ if $F = xy\bar{\imath} + z^2\bar{\jmath} + 2yz\bar{k}$ over the tetrahedron bounded by x=0, y=0, z=0 and the plane $x + y + z = 1$

L3: Apply

1. Solve $(1 + q)p = qz$
2. Solve $z^2 (p^2x^2 + q^2) = 1$
3. Find the area of the circle using double integral
4. Find by double integration the area lying between the curve $y = x^2 - 2x - 8$
5. Evaluate by Gauss divergence theorem $F = (x^3 - yz)i - 2 x^2y\,J - z\,K$ taken over the surface of the cube formed by the planes $x = y = z = a$

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**Chairman Board of Studies
(Mathematics)**

BS	**20BSX23 Applied Chemistry**		**3**	**1**	**0**	**3**

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX23.1	Explain the different types of polymers and their applications of Bakelite, Nylon-6, 6 and carbon fibers	3	1	L1, L2
20BSX23.2	Differentiate between pH metry, potentiometric and conductometric titrations	3	1	L1, L2
20BSX23.3	Illustrate the molecular orbital energy level diagram of different molecular species	3	1	L1, L2
20BSX23.4	Explain the different types of spectral series in electromagnetic spectrum	3	1	L1, L2
20BSX23.5	Demonstrate the application of Rotaxanes and Catenands as artificial molecular machines	3	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: Polymer Chemistry   11 + 1 Hour

Introduction to polymers, polymer functionality and choice of monomer, physical and mechanical, glass transition temperature properties of polymer, synthesis of polymers, addition and condensation polymerization, copolymerization, mechanism of polymerization, coordination polymerization, stereospecific polymerization with specific examples (PVC, polyester). Plastics - Thermoplastic and Thermosetting plastics, preparation, properties and applications of Bakelite, Urea - Formaldehyde, Nylon-6, 6 and carbon fibers (GCF), Elastomers – Buna-S, Buna-N – preparation, properties and applications. Conducting polymers – polyacetylene, polyaniline, polypyrroles, mechanism of conduction and applications.

Advanced polymer characterisation, Heterogeneous polymersiations, Controlled radical polymersiation, Biodegradable polymers

Unit II: Electrochemistry and Applications   11 + 1 Hour

Concept of conductivity, electrolytes and electrolytic conductance, conductivity cell, conductometric titrations (acid-base titrations) Concept of galvanic cells, electrodes – concepts, reference electrodes (SHE, Calomel electrode, Ag | AgCl electrode) and glass electrode; electrochemical cell, Nernst equation, cell potential calculations, numerical problems, potentiometry, potentiometric titrations (redox titrations), Electrochemical sensors– potentiometric sensors with examples, Primary cells– Zinc-air battery, Fuel cells, hydrogen-oxygen and methanol-oxygen fuel cells – working of the cells. Secondary cells – lead acid battery, lithium ion battery- working of the batteries including cell reactions. Photovoltaic cell-working and applications, photogalvanic cells with specific examples.

Fundamentals and applications of electrochemistry, Nano electrochemical sensor, Storage cells

Unit III: Structure and Bonding Models   11 + 1 Hour

Planck's quantum theory, Wave-Particle Duality, Schrodinger Equation, significance of Ψ and $\Psi2$, applications to hydrogen, particle in a 1-D box and its applications for conjugated molecules; LCAO, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of O_2, NO and CO. Molecular orbitals of butadiene and benzene (HOMO & LUMO), calculation of bond order; Multi electron systems (introductory ideas virial theory, variation theorem and perturbation theory); Bonding in coordination compounds- crystal field theory – salient features – splitting in octahedral and tetrahedral geometry, magnetic properties and colour; Band theory of solids – band diagrams for conductors, semiconductors and insulators, role of doping on band structures (n-type & p-type semiconductors).

Shapes and significance of atomic orbitals, Electron configurations, Ionic and covalent bonding, Hybridization, The structure and geometry of the compounds methane and ethane

Unit IV: Instrumental Methods and Applications   11 + 1 Hour

Optical methods: Electromagnetic spectrum, Interaction of radiation with matter, Absorption and Emission of radiation, Beer-Lambert's law, UV-Visible and FT-IR Spectroscopies, Magnetic resonance methods (1H-NMR and 13C-NMR of simple molecules), Electro analytical methods-Applications of pHmetry, potentiometry and conductometry, Chromatographic methods-Principles of Gas Chromatography (GC) and High Performance Liquid Chromatography

(HPLC), separation of gaseous mixtures and liquid mixtures.

The fundamental principles of instrumental measurements, S*pecific types of chemical measurements use of instruments*, *Problem steps in a method of chemical analysis*

Unit V: Advance Topics in Chemistry   11+1 Hour

Supra Molecular Systems-Concepts and terms of supramolecular chemistry complementarity, Basic Lock and Key principle, examples of Supramolecules (catenands, rotaxanes, spherands, cyclodextrins) Molecular Machines-Molecular recognition- cation binding, anion binding, simultaneous cation and anion binding, supramolecular reactivity and catalysis Self-assembly in biological systems, metal ion assisted assemblies, template synthesis of macrocyclic ligands, Molecular Electronics: molecular memory devices, molecular switches and quantum light emitting diodes (QLEDs), Computational chemistry- Introduction, molecular modelling and molecular docking.

Host-Guest Systems and Interactions, M*etal Organic Complexes*, *DFT Calculations*, *Hirshfeld Calculations*, *X-Ray Structure Analysis*

Text Books

1. Jain and Jain, "Engineering Chemistry", 16th Edition, Dhanpatrai Publications, 2013
2. Peter Atkins, Julio de Paula and James Keeler, Atkins "Physical Chemistry", 10th Edition, Oxford University Press, 2010
3. Robert Silbey J., Robert Alberty A. and Mounngi Bawendi G., "Physical Chemistry", Wiley, 2004
4. Das A., "An Introduction to Supramolecular Chemistry", CBS Publishers, 2020

Reference Books

1. Lee J. D., "Concise Inorganic Chemistry", 5th Edition, Oxford University Press, 2008
2. Skoog and West, "Principles of Instrumental Analysis", 6th Edition, Thomson, 2007
3. Lehn J. M., "Supramolecular Chemistry",3rd Edition, VCH Publications, 1995
4. Steed J. W. and Atwood J. L., "Supramolecular Chemistry", 2nd Edition, Wiley, 2013

Web References

1. http://link.springer.com/chemistry
2. http://www.thphys.chemistry.ox.ac.uk
3. http://www.sciencedirect.com/science
4. http://www.e-booksdirectory.com

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 a polymer?
2. What is meant by degree of polymerization?
3. How do polymers dissolve in solvents?
4. Define thermoplastic polymers and give two examples
5. What is primary Battery?
6. What are single electrode potentials?
7. Define Heisenberg's uncertainty principle
8. What is Chromatography?
9. How is supramolecular chemistry useful?
10. What is electromagnetic spectrum?

L2: Understand

1. Explain the free radical polymerization mechanism

2. Differentiate between addition polymerization and condensation polymerization
3. Explain the standard electrode potential by taking calomel electrode as an example
4. Write the construction & working of hydrogen-oxygen fuel cell
5. What is Schrodinger wave equation? Explain the significance of Ψ and $\Psi 2$
6. Derive the Nernst equation for a single electrode potential and write one specific application
7. Demonstrate the construction, working principle and one or two applications of electrochemical sensor with a neat schematic diagram
8. Cite an example that uses the principle of pH-metry
9. Demonstrate one or two applications of Zinc-air cell with chemical equations
10. Cite an example that uses the principle of conductometry

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Chairman
Board of Studies (Chemistry)

| ES | 20ESX05 Basic Electrical and Electronics Engineering | 3 | 1 | 0 | 3 |

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

| Code | Course Outcomes | Mapping with POs | | DoK |
		PO1	PO12	
20ESX05.1	Apply Network laws to Electrical cCrcuits, and solving A.C. Networks	3	1	L1, L2, L3
20ESX05.2	Explain the working of D.C. Machines	3	1	L1, L2
20ESX05.3	Illustrate the working of Alternators and Induction Motor	3	1	L1, L2, L3
20ESX05.4	Interpret the working of a Transformer and its operation in different conditions	3	1	L1, L2, L3
20ESX05.5	Classify basic operation of Rectifiers and Integrated Circuits operate for different applications	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 Electric Circuits
11 + 1 Hour

Basic Definitions, Electrical Circuit Elements (R, L And C), Ohm's Law, Voltage and Current Sources, Series & Parallel Circuits, Kirchhoff's Laws, Star-Delta and Delta-Star Transformations, Simple Problems with D.C. Excitation
A.C. Circuits: Representation of Sinusoidal Waveforms, Peak and Rms Values, Phasor Representation, Analysis of Single-Phase A.C. Circuits Consisting of R, L, C, RL, RC, RLC Combinations (Series Only), Real Power, Reactive Power, Apparent Power, Power Factor, Sample Problems.

Real Time Applications of D.C. and A.C. Circuits, Source Transformation, Concept of Impedance and Reactance

Unit II: D.C. Machines
11 + 1 Hour

Generator-Principle of Operation, Construction, E.M.F. Equation, Classification, O.C.C, Internal and External Characteristics of Shunt Generator, Motor-Principle of Operation, Torque Equation, Speed Control Methods, Brake Test on D.C. Shunt Motor, Swinburne's Test on D.C. Shunt Machine, Operation of 3 Point Starter.

Electromechanical Energy Conversion, Application of Generators in Domestic Purposes, Application of Motors in Toys

Unit III: A.C. Machines
11 + 1 Hour

Alternators: Construction and Induced EMF, Voltage Regulation by Synchronous Impedance Method (Simple Problems).
Induction Motors: Principle of Operation of 3-ϕ Induction Motor, Power and Torque Equations, Speed-Torque Characteristics of 3- ϕ Induction Motor.

Types of A.C. Machines, Application of Alternators, Application of Induction Motors

Unit IV: Transformers
11 + 1 Hour

Operation of a Single Phase Transformer, Construction Features of Single Phase Transformer, E.M.F. Equation, Losses, Regulation and Efficiency of a Single Phase Transformer, O.C. And S.C. Tests, Numerical Problems.

Application of Transformers in Substations, Step up and Step Down Transformers

Unit V: Rectifiers & Linear ICs
11 + 1 Hour

PN Junction Diodes – Diode Applications (Half Wave and Bridge Rectifiers), Zener Diode, Characteristics of Operation Amplifiers (OP-AMP) – Application of OP-Amps (Inverting, Non-Inverting, Integrator and Differentiator) - Numerical Problems.

Basic Semiconductor Devices, Thyristors, Advanced Applications of Operational Amplifiers

Text Books

1. Mehta V. K., "Principles of Electrical and Electronics Engineering", 2nd Edition S. Chand & Co., 2015
2. Kothari D. P. and Nagrath I. J., "Basic Electrical Engineering", 4th Edition, Tata McGraw Hill, 2010

Reference Books

1. Wadhwa C. L., "Basic Electrical Engineering", 4th Edition, New Age Publications, 2007

2. Kulshreshtha D. C., "Basic Electrical Engineering", 1st Edition, McGraw Hill, 2017
3. Naidu M. S. and Kamakshaiah S., "Introduction to Electrical Engineering", 2nd Edition, TMH Publications, 2017
4. Theraja B. L. and Theraja A. K., "Basic Electrical Engineering" 23rd Edition, S. Chand, 1959

Web References

1. https://nptel.ac.in/courses/108/108/108108076/
2. https://nptel.ac.in/courses/117/106/117106108/

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. What is Ohm's Law?
2. Define RMS and Peak values
3. What is Form Factor?
4. Define Time Period
5. What is the purpose of Commutator in D.C. Machines?

L2: Understand

1. Explain in detail about Kirchhoff's Current and Voltage Law
2. Explain working principle of D.C. Shunt Generator
3. Explain the operation of Single Phase Transformer
4. Explain Speed Torque characteristics of 3 Phase Induction Motor
5. Explain the VI characteristics of PN Junction Diode with neat diagram

L3: Apply

1. Three resistances 750 Ω, 600 Ω and 200 Ω are in parallel. The total current is 1 A. Determine the voltage applied and current in each branch
2. Using Δ-Y or Y-Δ conversion, find the current I in the circuit shown in figure
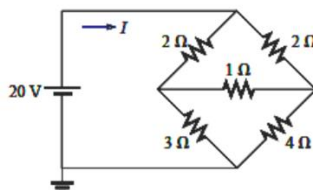
3. Determine the efficiency of a 15 KVA transformer for the following conditions:
   (i)full-load, unity power factor
   (ii) 0.8 full-load, unity power factor
   (iii) half full-load, 0.8 power factor
   Assume that iron losses are 200 W and the full-load copper loss is 300 W
4. A 3-phase star connected alternator is rated at 100 kVA. On short-circuit a field current of 50 amp gives the full load current. The e.m.f. generated on open circuit with the same field current is 1575 V/phase. Calculate the voltage regulation at (a) 0.8 power factor lagging, and (b) 0.8 power factor leading by synchronous impedance method. Assume armature resistance is 1.5 Ω

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Chairman
Board of Studies (EEE)

ES **20CS201 Data Structures Using 'C'**   3   0   0   3

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

| Code | Course Outcomes | Mapping with POs | | DoK |
		PO1	PO12	
20CS201.1	Apply fundamental data structure strategies to solve problems	3	1	L1, L2, L3
20CS201.2	Illustrate the usage of linked lists and their applications	3	1	L1, L2. L3
20CS201.3	Demonstrate the usage of Stacks and Queues with their applications	3	1	L1, L2, L3
20CS201.4	Make use of Tree concept & their applications	3	1	L1, L2, L3
20CS201.5	Implement graphs data structure algorithms and analyze their performance	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   11 + 1 Hour
Data Structures: Definition, Classification of Data Structures, Operations on Data Structures Abstract Data Type (ADT), Preliminaries of Algorithms. Time and Space Complexity. Searching: Linear Search, Binary Search. Sorting: Insertion Sort, Selection Sort, Exchange (Bubble Sort, Quick Sort), and Merge Sort (Recursive & Non-Recursive) Algorithms.

Fibonacci Search, Radix Sort, Bucket Sort, Shell Sort

Unit II: Linked Lists   11 + 1 Hour
Linked Lists: Introduction, Single Linked List, Representation of Linked List in Memory, Operations on Single Linked List, Reversing Single Linked List, Double Linked List, Circular Linked List, and Operations on it, Applications of Lists - Polynomial Expression Representation, Addition and Multiplication, Sparse Matrix Representation using Linked List.

Doubly Linked Circular List, Header Linked List, Multi Linked List

Unit III: Stack and Queue   11 + 1 Hour
Stacks: Definitions, Operations and Applications, Array & Linked List Representation of Stacks, Applications of Stack-Evaluation of Expressions, Expression- Postfix Notation- Infix to Postfix. Queues: Definitions and Operations, Array & Linked List Representation of Queues, Circular Queues, Dequeue, Applications of Queue.

Priority Queue, Multiple Queues

Unit IV: Trees   11 + 1 Hour
Binary Trees: Definition and Traversals: Terminology, Representation of Trees, Binary Trees, Properties of Binary Trees, Binary Tree Traversal-Pre Order, Post Order, In Order. Binary Search Trees: Definition, Searching a Binary Search Tree, Insertion into a Binary Search Tree, Deletion from a Binary Search Tree, Height of Binary Search Tree, Heap Sort.

AVL Tree, Representation of Binary Trees using Arrays and Linked Lists, Binary Tree Traversals, B -Trees, B+ Trees

Unit V: Graphs   11 + 1 Hour
Graphs: Basic Concepts, Representations of Graphs - Adjacency Matrix and using Linked List, Graph Traversals (BFT & DFT), Applications- Minimum Spanning Tree using Prim's & Kruskal's Algorithm.

Spanning Tree, Planar Graph, Directed Graph, Eulerian Graph, Hamiltonian Graph, Connected Graph

Text Books

1. Reema Thareja, "Data Structures Using C", 2nd Edition, Oxford Press, 2014
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2002

Reference Books

1. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press, 2014

2. Richard F. Gilberg, Behrouz A. Forouzon, "Data Structures: A Pseudo Code Approach", 2nd Edition, Cengage Learning, 2014
3. Seymour Lipschutz , "Data Structures with C", Special Indian Edition, Tata McGraw Hill, 2014

Web References

1. https://www.w3schools.in/data-structures-tutorial/
2. https://www.tutorialspoint.com/data_structures_algorithms/index.html
3. http://www.btechsmartclass.com/data_structures/linear-non-linear-data-structures.html
4. https://www.geeksforgeeks.org/data-structures/

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. List the operations in single linked list
2. What is the principle of Stack?
3. What are the operations of Queue?
4. Define single linked list with suitable example
5. List any two linear data structure

L2: Understand

1. Explain the iterative merge sort and recursive merge sort algorithms with an example
2. Write an algorithm to insert new node at the beginning, at middle position and at the end of a Singly Linked List
3. Explain the queue ADT with an example
4. Write the algorithm to insert new node at the beginning, at middle position and at the end of a Double Linked list with an example
5. Describe insertion sort algorithm and trace the steps of insertion sort for sorting the list - 12, 19, 33, 26, 29, 35, 22, and 37. Find the total number of comparisons made

L3: Apply

1. Convert the given infix Expression ((A+B)*C-(D-E)^(F+G)) into its Equivalent Prefix and Postfix Notations
2. Write an algorithm for evaluating a postfix expression using stack. Evaluate the following postfix Notation 123*+5-
3. Write an Algorithm along with example to find the Minimum Spanning Tree using Prim's Algorithm
4. Illustrate the given infix expression A+B^C+(D*E/F)*G into its postfix expression, and evaluate the same using stack. Here A=3, B=5, C=2, D=7, E=4, F=1, G=8
5. Employ the benefits of dynamic and static data structures implementations

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Chairman
Board of Studies (CSE)

| ES | **20EC203 Digital Logic Design** | | 3 | 1 | 0 | 3 |

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20EC203.1	Utilize theory of Boolean algebra & the underlying features of various number systems	3	1	L3
20EC203.2	Choose the concepts of Boolean algebra for the minimization of switching functions	3	1	L3
20EC203.3	Design of various combinational logic circuits using basic gates	3	1	L2
20EC203.4	Design various simple programmable logic devices to complex programmable logic devices & arrays	3	1	L6
20EC203.5	Develop of various sequential logic circuits	3	1	L6
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: Review of Number Systems and Codes   11 + 1 Hour
Representation of Numbers of Different Radix, Conversation from One Radix to Another Radix, r - 1's Compliments and r's Compliment of Signed Members, Problem Solving, 4 Bit Codes, BCD, Excess - 3, 2421, 84 – 2 - 1 9's Compliment Code, Gary Code etc. Error Detection & Correction Codes, Parity Code, Parity Checking, Even Parity, Odd Parity, Hamming Code. Basic Logic Operations - NOT, OR, AND, Universal Building Blocks, EX - OR, EX - NOR - Gates, NAND - NAND and NOR - NOR realizations.

Logic Families, Characteristics of Logic Families: CMOS, TTL, ECL Families, C - Program : Decimal to Binary Conversion, Hexadecimal to Binary Conversion, Octal to Binary Conversion

Unit II: Minimization Techniques   11 + 1 Hour
Boolean Theorems, Principle of Complementation & Duality, De - Morgan Theorems, Minimization of Logic Functions using Boolean Theorems, Standard SOP And POS, Forms, Minimization of Switching Functions using K-Map Up to 5 Variables, Problem Solving (Code - Converters using K – Map, Etc.)

K-Map with 6 Variables, Quine - McCaskey Method, Hazards

Unit III: Combinational Logic Circuit Design   11 + 1 Hour
Design of Half Adder, Full Adder, Half Subtractor, Full Subtractor, Applications of Full Adders, 4 - Bit Binary Subtractor, Adder - Subtractor Circuit, BCD Adder Circuit, Excess 3 Adder Circuit, Look – A - Head Adder Circuit, Design of Decoder, De - Multiplexer, 7 Segment Decoder, Higher Order De - Multiplexer, Encoder, Multiplexer, Higher Order Multiplexing, Realization of Boolean Functions using Decoders and Multiplexers, Priority Encoder, 4 - Bit Digital Comparator.

Carry Select Adder, Arithmetic and Logic Unit (ALU), Priority Encoder

Unit IV: Introduction to Programmable Logic Devices (PLDs)   11 + 1 Hour
PROM, PAL, PLA - Basics Structures, Realization of Boolean Function with PLDs, Programming Tables of PLDs, Merits & Demerits of PROM, PAL, PLA Comparison, Realization of Boolean Functions using PROM, PAL, PLA, Programming Tables of PROM, PAL.

Complex Programmable Logic Devices, Field Programmable Gate Arrays, Memory Devices, Buffers, Tristate Buffers

Unit V: Sequential Logic Circuit Design   11+1 Hour
Classification of Sequential Circuits (Synchronous And Asynchronous); Basic Flip - Flops, Truth Tables and Excitation Tables (NAND RS Latch, NOR RS Latch, RS Flip - Flop, JK Flip - Flop, T Flip - Flop, D Flip - Flop with Reset and Clear Terminals). Conversion of Flip - Flops. Design of Ripple Counters, Design of Synchronous Counters, Johnson Counter, Ring Counter. Design of Registers - Buffer Register, Control Buffer Register, Shift Register, Bi - Directional Shift Register, Universal Shift Register.

Finite State Machines, Mealy and Moray Machines, Synchronous Sequential Circuits, Asynchronous Sequential Circuits

Text Books

1. Morris Mano, "Digital Design", 3rd Edition, Prentice Hall of India, 2001
2. Fredriac J Hill, Gerald R Peterson, "Introduction to Switching Theory and Logic Design", 3rd Edition, John Willey and Sons Inc.,1974
3. Anand Kumar A., "Switching Theory and Logic Design", 3rd Edition, PHI Learning, 2016

Reference Books

1. Zvi Kohavi, "Switching and Finite Automata Theory", 2nd Edition, Tata McGraw Hill , 2008
2. Jain R. P., "Modern Digital Electronics" 3rd Edition, Tata McGraw Hill , 2003
3. Charles H. Roth, Jr. Larry L. Kinney "Fundamentals of Logic Design", 7th Edition, Cengage Learning, 2014

Web References

1. https://nptel.ac.in/courses/117/105/117105080/
2. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
3. http://webstor.srmist.edu.in/web_assets/srm_mainsite/files/2017/15CS20
4. https://easyengineering.net/digital-system-design-with-vhdl-by-mark-zwolins

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Find the decimal number equivalent of fractional binary number 0.1011
2. List any two postulates of Boolean algebra
3. What you mean by weighted code?
4. Name any two functions of decoders
5. What is Flip flop?

L2: Understand

1. Explain how combinational logic circuit 8:1 multiplexer works
2. Represent the following Boolean expression to min terms and max terms A+BC'+ABD'+ABCD
3. Represent a JK flip flop using SR flip flop
4. Explain binary subtractor
5. Show the logic diagram of SR flip-flop with four NAND gate

L3: Apply

1. Build the Boolean function T=F (w, x, y, z)= $\sum$ m (0,1,2,4,5,7,8,9,12,13) by using 8 to 1mux
2. Develop a half adder using NAND – NAND
3. Construct a 16:4 decoder using 8:3 decoders
4. Solve the following Boolean functions, using four-variable maps:
   F(w, x, y, z) = $\sum$ (1, 4, 5, 6, 12, 14, 15)
5. Develop 4-bit mod-10 counter using T-flip-flop

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Chairman
Board of Studies (ECE)

| BS | **20BSX24 Applied Chemistry 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
20BSX24.1	Estimate of Vitamin-C	3	3	1
20BSX24.2	Determine the cell constant and conductance of solutions	3	3	1
20BSX24.3	To Prepare advanced polymer materials	3	3	1
20BSX24.4	Calculate the hardness of water	3	3	1
20BSX32.5	Determine the functioning of the instruments such as pH and Potentiometric meters	3	3	1
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				

List of Experiments

1. Determination of HCl using standard Na_2CO_3 solution (Acid-Base Titration)
2. Determination of Mn using standard oxalic acid solution (Redox Titration)
3. Determination of ferrous iron using standard $K_2Cr_2O_7$ solution (Redox Titration)
4. Determination of copper (II) using standard hypo solution (Iodimetric Titration)
5. Determination of temporary and permanent hardness of water using standard EDTA solution
6. Determination of iron (III) by a colorimetric method
7. Estimation of Vitamin C
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method)
9. Determination of the concentration of strong acid vs strong base (by Conductometric method)
10. Determination of strong acid vs strong base (by Potentiometric method)
11. Determination of Viscosity of lubricating oil by Red Viscometer
12. Determination of percentage Moisture content in a coal sample
13. Determination of acid value and saponification value of a given lubricant
14. Adsorption of acetic acid by charcoal
15. Preparation of a polymers: Nylon-6,6 and phenol-formaldehyde (Bakelite)
16. Preparation of Nanomaterials (ex: Fe/ Zn/ Ferrite)

Text Books

1. Arthur J Vogel, "A Textbook of Quantitative Analysis", 2nd Edition, 1909

References

1. Mendham J., Denney R. C., Barnes J. D., Thosmas M. and Sivasankar B., "Vogel's Quantitative Chemical Analysis" 6th Edition, Pearson Publishers, 2000
2. Bhasin N. K. and Sudha Rani, "Laboratory Manual on Engineering Chemistry" 3rd Edition, Dhanpat Rai Publishing Company, 2007
3. Lab Manual for Applied Chemistry, Department of Basic Science and Humanities, NSRIT, 2017

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Board of Studies (Chemistry)

| ES | **20CS202 Data Structures Using 'C' 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
20CS202 .1	Apply data Structure Mechanisms to sort and search the given data	3	3	1
20CS202.2	Ability to develop C programs for computing and real-life applications using basic data structures such as linked list	3	3	1
20CS202.3	Illustrate the usage of stacks & queues and their applications	3	3	1
20CS202.4	Programs to demonstrate fundamental algorithmic problems including binary search Tree	3	3	1
20CS202.5	Illustrate and solve minimum spanning tree of given graph, graph traversals	3	3	1
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos			

List of Experiments

1. Write C program that implement Bubble sort, quick sort, for a given list of integers in ascending order
2. Write C program that implement merge sort, Insertion sort, for a given list of integers in ascending order
3. Implement Linear Search ,Binary Search to find a value from given list of array elements
4. Write a C program to perform operations on Single linked list
5. Write a C program to perform operations on Double linked list
6. Write C program that implement Queue and its operations using linked lists & arrays
7. Write C program that implement stack and its operations using arrays & linked lists
8. Write a C program that uses Stack to evaluate postfix expression & to convert infix to postfix expressions
9. Write a C program to perform operations on Binary Search Tree
10. Implementation of Breadth First Search Techniques & Implementation of Depth First Search Techniques
11. Implementation of Prim's Algorithm & Krushkal's Algorithm

Text Books

1. Reema Thareja, "Data Structures Using C", 2nd Edition, Oxford Press, 2014

References

1. Lab Manual for "Data Structures Using C" , Department of Computer Science Engineering, NSRIT

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Chairman
Board of Studies (EEE)

ES **20ESX08 Basic Electrical and Electronics Engineering 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
20ESX08.1	Analyse the characteristics of DC shunt motors	3	3	1
20ESX08.2	Understand speed torque characteristics of 3 phase induction motor	3	3	1
20ESX08.3	Analyse the efficiency and regulation of transformers and assess their performance	3	3	1
20ESX08.4	Understand operating characteristics of diodes	3	3	1
20ESX08.5	Understand operating characteristics of different rectifiers	3	3	1
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos			

List of Experiments

1. Speed Control of D.C. Shunt Motor
2. O.C. and S. C. Test on a Single Phase Transformer
3. Brake Test on 3 - Phase Induction Motor
4. Regulation of Alternator by Synchronous Impedance Method
5. Swinburne's Test on D.C. Shunt Machine (Predetermination of Efficiency of a given D.C. Shunt Machine working as Motor and Generator)
6. Brake Test on 1 - Phase Induction Motor
7. Diode Characteristics - Cut-In Voltage, Static Resistance, Dynamic Resistance Calculations
8. Zener Diode Characteristics - Breakdown Voltage, % Regulation
9. Half Wave Rectifier with and without Filters - Ripple Factor, % Regulation, Load Regulation
10. Full Wave Rectifier with and without Filters - Ripple Factor, % Regulation, Load Regulation
11. Common emitter Characteristics - Current Gain Calculation

Text Books

1. Bhattacharya S .K., "Basic Electrical Engineering", 1st Edition, Pearson, 2019

References

1. Lab Manual for Basic Electrical Engineering, Department of Electrical and Electronics Engineering, NSRIT

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| MC | **20MCX01 Environmental Science** | | 0 | 0 | 3 | 0 |

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	**PO12**	
20MCX01.1	Gain in-depth knowledge on importance of environment, natural resources utilization and exploitation	3	1	L1, L2
20MCX01.2	Understand the concept of an ecosystem and Identify their interconnections	3	1	L1, L2
20MCX01.3	Develop an understanding on values, threats and conservation of biodiversity	3	1	L1, L2
20MCX01.4	Illustrate the impacts of ever increasing environmental pollution and understand the issues on global environment	3	1	L1, L2
20MCX01.5	Understand various acts formulated by Govt. of India and apply the knowledge gained in conserving energy and environmental protection	3	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: Natural Resources   **12 Hours**
Introduction: Definition, Scope and Importance-Need for Public Awareness
Natural Resources: Classification of resources–Forest resources: Use and Over-exploitation, Deforestation- Mining, Water resources –Use and over utilization of surface and ground water–Floods, Drought, Conflicts over water, Dams-Benefits and Problems – Mineral resources: Use and exploitation, Environmental effects of extracting and using mineral resources–Energy resources: Renewable and Non- Renewable sources of energy- Solar energy, Wind energy.

Unit II: Ecosystems   **12 Hours**
Concept of an Ecosystem–Structural features of ecosystem- Producers, Consumers and Decomposers–-Biogeochemical cycles- Carbon cycle and Nitrogen cycle-Ecological succession-Food chains, Food webs and Ecological pyramids–Energy flow in the ecosystem-Types of ecosystems (a) Forest ecosystem (b) Aquatic ecosystems.

Unit III: Biodiversity and its Conservation   **12 Hours**
Introduction, Definition, Genetic, Species and Ecosystem diversity, India as a mega-diversity nation, Hot spots of biodiversity, Values of biodiversity, Threats to biodiversity, Endemic, Endangered and Extinct species of India, In-Situ and Ex-situ conservation of biodiversity.

Unit IV: Environmental Pollution and Global Environmental Issues   **12 Hours**
Environmental Pollution: Air pollution, Water pollution, Noise pollution, Effects-Global warming, Acid Rain and Ozone layer depletion and controlling measures.
Global Environmental Issues: Population Growth, Urbanization, Climate change and impacts on human environment.
Solid Waste Management: Causes, Effects and Control measures of Municipal solid wastes – E - Waste Management, Role of an individual in prevention of pollution.

Unit V: Environmental Legislation, Laws, Policies for Sustainable Development **12 Hours**
Environmental Legislation, Environmental Protection act – Air Prevention and Control of Pollution act–Water Prevention and control of Pollution act– Wildlife protection act – Forest conservation act.
From Unsustainable to sustainable development, Role of IT in Environment-Remote Sensing and GIS methods for Sustainable development

Text Books

1. Erach Bharucha, "Text Book of Environmental Studies", 1st Edition, University Grants Commission, University Press (India) Pvt. Ltd., 2010
2. Kaushik A. and Kaushik C. P., "Environmental Sciences", 5th Edition, New Age International Publishers, 2015
3. Anji Reddy M., "Text Book of Environmental Science and Technology", 3rd Edition, B. S. Publications, 2010

Reference Books

1. Anil Kumar and Arnab Kumar De, "Environmental Studies", 3rd Edition, New Age International Publishers, 2015
2. Trivedi R. K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", 2nd Edition, Voume I and II, Enviro Media, 2012
3. Rajagopalan R., "Environmental Studies-From Crisis to Cure", 2nd Edition, Oxford University Press, 2005

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