

13. Courses of Study and Scheme of Assessment
BE COMPUTER SCIENCE AND ENGINEERING
(2023 REGULATIONS)
(Minimum No. of credits to be earned: 164)

(Minimum No. of Credits to be earned: 10)										
S.No	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
SEMESTER I										
THEORY										
1	23Z101	Calculus and its Applications	3	1	0	4	40	60	100	BS
2	23Z102	Basics of Electrical and Electronic Systems	3	0	0	3	40	60	100	ES
3	23Z103	Applied Chemistry	3	0	0	3	40	60	100	BS
4	23Z104	Computational Thinking	3	1	0	4	40	60	100	ES
5	23G105	English Language Proficiency	3	1	0	4	40	60	100	HS
PRACTICALS										
6	23Z110	Python Programming Laboratory	0	0	4	2	60	40	100	ES
7	23Z111	Basic Science Laboratory	0	0	4	2	60	40	100	BS
MANDATORY COURSES										
8	23IP15	Induction Programme	-	-	-	Grade	-	-		MC
	Total 26 hrs		15	3	8	22	320	380	700	

S.No	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
SEMESTER II										
THEORY										
1	23Z201	Transforms and its Applications	3	1	0	4	40	60	100	BS
2	23Z202	Sensors for Engineering Applications	3	1	0	4	40	60	100	BS
3	23Z203	Digital Design	3	1	0	4	40	60	100	ES
4	23Z204	C Programming	3	0	0	3	40	60	100	ES
PRACTICALS										
5	23G____	Language Elective	0	0	4	2	40	60	100	HS
6	23Z211	Engineering Practices	0	0	4	2	60	40	100	EEC
7	23Z212	C Programming Laboratory	0	0	4	2	60	40	100	ES
MANDATORY COURSES										
8	23Z215	Activity Point Programme - 1	-	-	-	Grade	-	-		MC
9	23Q213	Foundations for Problem Solving	0	0	2	0	60	40	100	MC
	Total 29 hrs		12	3	14	21	380	420	800	

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S.No	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
SEMESTER III										
THEORY										
1	23Z301	Linear Algebra	3	1	0	4	40	60	100	BS
2	23Z302	Computer Organization and Architecture	3	1	0	4	40	60	100	ES
3	23Z303	Data Structures	3	0	0	3	40	60	100	PC
4	23Z304	Discrete Structures	3	1	0	4	40	60	100	BS
5	23O305	Engineering Economics	3	1	0	4	40	60	100	HS
PRACTICALS										
6	23Z310	Object Oriented Programming Laboratory	0	0	4	2	60	40	100	ES
7	23Z311	Data Structures Laboratory	0	0	4	2	60	40	100	PC
8	23Q313	Building Communication Skills	0	0	2	1	60	40	100	EEC
MANDATORY COURSES										
9	23K312	Environmental Science **	2	0	0	0	-	-	-	MC
10	23N315	Activity Point Programme	-	-	-	Grade	-	-	-	MC
	Total 31hrs		17	4	10	24	380	420	800	

S.No	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
SEMESTER IV										
THEORY										
1	23Z401	Probability, Stochastic Processes and Statistics	3	1	0	4	40	60	100	BS
2	23Z402	Database Management Systems	3	0	0	3	40	60	100	PC
3	23Z403	Design and Analysis of Algorithms	3	1	0	4	40	60	100	PC
4	23Z404	Theory of Computation	3	1	0	4	40	60	100	PC
5	23Z405	Software Engineering	3	1	0	4	40	60	100	PC
PRACTICALS										
6	23Z410	Database Management Systems Laboratory	0	0	4	2	60	40	100	PC
7	23Z411	Application Development Laboratory	0	0	4	2	60	40	100	EEC
8	23Q413	Problem Solving	0	0	2	1	60	40	100	EEC
MANDATORY COURSES										
9	23O414	Indian Constitution **	2	0	0	0	-	-	-	MC
10	23Z415	Activity Point Programme	-	-	-	Grade	-	-	-	MC
	Total 31 hrs		17	4	10	24	380	420	800	

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S.No	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
SEMESTER V										
THEORY										
1	23Z501	Operating Systems	3	0	0	3	40	60	100	PC
2	23Z502	Artificial Intelligence	3	1	0	4	40	60	100	PC
3	23Z503	Compiler Design	3	1	0	4	40	60	100	PC
4	23Z504	Computer Networks	3	0	0	3	40	60	100	PC
5	23Z	Professional Elective - 1	3	0	0	3	40	60	100	PE
PRACTICALS										
6	23Z510	Computer Networks Laboratory	0	0	4	2	60	40	100	PC
7	23Z511	System Software Laboratory	0	0	4	2	60	40	100	PC
8	23Q513	Aptitude Skills	0	0	2	1	60	40	100	EEC
MANDATORY COURSES										
9	23Z515	Activity Point Programme *	-	-	-	Grade	-	-	-	MC
	Total 27 hrs		15	2	10	22	380	420	800	

S.No	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
SEMESTER VI										
THEORY										
1	23Z601	Machine Learning	3	0	0	3	40	60	100	PC
2	23Z602	Graph Theory	3	1	0	4	40	60	100	PC
3	23Z603	Embedded Systems	2	2	0	4	40	60	100	ES
4	23Z	Professional Elective – 2	3	0	0	3	40	60	100	PE
5	23Z	Professional Elective - 3	3	0	0	3	40	60	100	PE
PRACTICALS										
6	23Z610	Machine Learning Laboratory	0	0	4	2	60	40	100	PC
7	23Z611	Innovation Practices	0	0	2	1	60	40	100	EEC
8	23Q614	Enhancing Arithmetic Problem Solving	0	0	2	1	60	40	100	EEC
MANDATORY COURSES										
9	23Z615	Activity Point Programme	-	-	-	Grade	-	-	-	MC
	Total 25 hrs		14	3	8	21	380	420	800	

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S.No	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
SEMESTER VII										
THEORY										
1	23Z701	Parallel and Distributed Systems	3	0	0	3	40	60	100	PC
2	23Z702	Cryptography and Network Security	3	1	0	4	40	60	100	PC
3	23Z	Professional Elective – 4	3	0	0	3	40	60	100	PE
4	23Z	Professional Elective – 5	3	0	0	3	40	60	100	PE
5	23ZO	Open Elective – 1	3	0	0	3	40	60	100	OE
PRACTICALS										
6	23Z710	Parallel and Distributed SystemsLaboratory	0	0	4	2	60	40	100	PC
7	23Z711	Project Work - I	0	0	4	2	60	40	100	EEC
	Total 24 hrs		15	1	8	20	320	380	700	

S.No	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			CAT
			Lecture	Tutorial	Practical		CA	FE	Total	
SEMESTER VIII										
THEORY										
1	23Z	Professional Elective - 6	3	0	0	3	40	60	100	PE
2	23ZO	Open Elective - 2	3	0	0	3	40	60	100	OE
3	23Z810	Project Work - II	0	0	8	4	60	40	100	EEC
	Total 14 hrs		6	0	8	10	140	160	300	

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Summary of Credit Distribution

BE COMPUTER SCIENCE AND ENGINEERING										
S. No	Course Category	Credits Per Semester								Total Credits
		1	2	3	4	5	6	7	8	
1	HS	4	2	4	0	0	0	0	0	10
2	BS	9	8	8	4	0	0	0	0	29
3	ES	9	9	6	0	0	4	0	0	28
4	PC	0	0	5	17	18	9	9	0	58
5	PE	0	0	0	0	3	6	6	3	18
6	OE	0	0	0	0	0	0	3	3	6
7	EEC	0	2	1	3	1	2	2	4	15
8	MC	0	0	0	0	0	0	0	0	0
	TOTAL	22	21	24	24	22	21	20	10	164

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SEMESTER – I**23Z101 CALCULUS AND ITS APPLICATIONS****3 1 0 4**

DIFFERENTIAL CALCULUS: Functions of two variables, limits and continuity, partial derivatives, chain rule, extreme values and saddle points, Lagrange multipliers, Taylor's formula for two variables. (9+3)

INTEGRAL CALCULUS: Double and iterated integrals over rectangles, double integrals over general regions, Fubini's theorem, area and volume by double integration, reversing the order of integration, double integrals in polar form. (9+3)

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS: Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, modeling - mixing problems, Newton's law of cooling, decay and growth problems. (9+3)

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS: Homogeneous linear equations of second order, homogeneous linear ODEs with constant coefficients, Euler–Cauchy equations, solution by variation of parameters, free oscillations mass spring systems, electric circuits. (9+3)

VECTOR CALCULUS: Gradient and directional derivative of a scalar field, divergence and curl of a vector field. Integration in vector field – line integrals, path independence of line integrals, Green's theorem in the plane, divergence theorem of Gauss and Stokes' theorem. (9+3)

Total L: 45 +T: 15 = 60**TEXT BOOKS**

1. J. Hass, C. Heil, Maurice D.W "Thomas' Calculus", Pearson Education, New Delhi, 2018.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.

REFERENCES

1. H. Anton, I. Bivens, S. Davis, "Calculus", John Wiley and Sons, USA, 2016.
2. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Michael D. G, "Foundations of Applied Mathematics", Dover Publications, INC, New York, 2013.
4. Gilbert Strang, "Calculus", Wellesley Cambridge Press, USA, 2017.

23Z102 BASICS OF ELECTRICAL AND ELECTRONIC SYSTEMS**3 0 0 3**

DC CIRCUIT: current-voltage –power-energy, electrical circuit elements: resistors-inductor- capacitor, source of electrical energy. Ohm's law-Kirchhoff's laws, series and parallel circuits, Maxwell's loop current method, Network theorems: superposition theorem-thevenin's theorem-Norton's theorem-maximum power transfer theorem. (9)

AC CIRCUITS: Single phase AC circuits: Average and RMS values of sinusoidal wave form-RLC Circuit-Phasor representation-active, reactive apparent power –power factor, analysis of RLC Circuit, three phase circuit: star and delta connection-phase and line quantities-balance and unbalance systems (9)

ELECTROMAGNETISM AND MAGNETIC CIRCUITS: Electromagnetic induction; induced currents, Faraday's law, induction and energy, motional emf and Lenz's law. Magnetic field-magnetic circuit-inductance and mutual inductance-magnetic materials –ideal transformers and real transformers (8)

SEMICONDUCTOR DEVICES: Basic diode concepts-diode circuit: half wave rectifier-full wave rectifier-bridge rectifier-special purpose diodes-zener diode –transistor fundamentals –transistor biasing-bipolar junction transistors-basis amplifier concept-loading effect-power supplies and efficiency. (10)

OPERATIONAL AMPLIFIERS: Op-Amp Basics, Ideal characteristics of Op-Amp, practical Op-Amp circuits, differential and common mode operation, Inverting and non-inverting amplifiers, Op-Amp as Adder, Subtractor, integrator and differentiator. (9)

Total = L: 45**TEXT BOOKS**

1. Edward Hughes, John Hiley and Keith Brown, "Electrical and Electronic Technology", Pearson education, 2020
2. Murugesh Kumar K, Basic Electrical Science and Technology", Vikas Publishing House, 2016
3. Theraja B L, "Basic Electronic Solid State", S. Chand & Company Ltd., New Delhi, 2010

REFERENCES

1. Leach DP, "Digital Principles & Applications", Tata McGraw Hill, 2021
2. Hambley A R., "Electrical Engineering Principles and Applications", Pearson education, 2018
3. Boylestad R. L., and Nashelsky L., "Electronic Devices and Circuit Theory", Pearson Education, Noida, 2013

23Z103APPLIED CHEMISTRY**3 0 0 3**

ELECTRONIC MATERIALS: Inorganic semiconductors – Elemental – Si and Ge - band theory, doping, compound semiconductors – band gap engineering – applications. Organic semiconductors – conjugated polymers – mechanism of charge transport, doping, states of aggregation, material properties – thermal, mechanical, electrical, chemical, electrochemical. Applications – OLED, OPV – working principle. Liquid crystalline materials – display application. (9)

PROCESSES IN ELECTRONICS MANUFACTURE: Microchip fabrication – overview, photoresists – chemistry, types. Fabrication facilities – clean rooms - maintenance, ultrapure water– specification, production processes – ion exchange, reverse osmosis, continuous electrodeionisation. PCB fabrication – electroless and electroplating of copper – principle, bath chemistries and process parameters, formation of copper track on plastic board. (9)

ELECTRONICS PACKAGING AND PROTECTION: Packaging materials-encapsulants and underfills - adhesives – chemical types, application methods, factors influencing adhesion, soldering alloys – phase diagrams, lead free alloys, phase change materials for cooling. Conducting inks for printed electronics - metal and carbon based – graphene, CNT– synthesis, structure, electrical properties. Corrosion in electronics – types, protection – vapour phase inhibitors. (9)

ELECTROCHEMICAL POWER SOURCES: Electrochemical cells – emf, electrode potential, dependence of emf on electrolyte concentration – Nernst equation. Batteries–performance characteristics. Materials, construction, reactions, characteristics of leclanche cell, primary lithium batteries, lead - acid battery and lithium-ion batteries. Supercapacitors – EDLC – fundamentals, electrode materials, electrolytes, pseudocapacitors– materials. (9)

CHEMICAL SENSORS:– Sensors – basic components. Electrochemical sensors- potentiometrictransducers – principle, ion-selective electrodes – configurations, response functions and selectivity, applications –potentiometric titrations, water quality monitoring - pH, Hardness, fluoride ion sensors Amperometric transducers – principle, application - glucose biosensors, conductivity sensors – principle – application in conductometric titrations. Colorimetric sensors - Beer-Lambert's law, components, application - determination of ferric ion in water sample. Chemiresistive sensors - principle, application – environmental monitoring – CO₂ sensor. Microelectrodes for sensors – fabrication. (9)

Total L ; 45 hours**TEXT BOOKS:**

1. Shashi Chawla, "A Textbook of Engineering Chemistry", 1st Edition, New Delhi: Dhanpat Rai and Co. , 2005.
2. Cowie J.M.G,ValeriaArrighi "Polymers: Chemistry and Physics of modern materials", CRC Press., London, third edition, 2007.

REFERENCES:

1. Bansi D. Malhotra "Handbook of Polymers in Electronics", Rapra Technology Ltd., UK, 1stedition, 2002.
2. Peter Van Zant "Microchip Fabrication: A Practical Guide to Semiconductor Processing", Mc Graw Hill., 6thedition, 2014.
3. Derek Pletcher and Frank C. Walsh. "Industrial Electrochemistry", 2nd Edition London: Chapman and Hall , 1993.
4. Florinel-Gabriel Banica, " Chemical Sensors and Biosensors – Fundamentals and Applications", 1st edition, John Wiley & Sons Ltd, 2012

23Z104 COMPUTATIONAL THINKING**3 0 0 3**

INTRODUCTION: Computational thinking - Logical thinking - Flow charts - Algorithmic thinking - Characteristics of algorithms – Pseudocode - Example problems (9)

PROBLEM SOLVING AND DECOMPOSITION: Defining the problem - Devising a solution - Decomposition - Other effective strategies - Patterns - Example problems (9)

ABSTRACTION AND MODELING: Generalization - Abstraction - Modeling– Examples (8)

ITERATIVE LOGIC: Iterator - Variable - Filtering - Dynamic filtering - Example problems (9)

CASE STUDIES: Text processing - Pattern search - Linear search - Sorting (10)

Total L : 45**TEXT BOOKS:**

1. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and programming", 1st Edition, BCS Learning & Development Limited, 2017.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.

REFERENCES:

1. R.G.Dromey, "How to Solve it by Computer", Pearson Education, Second Edition, 2008.
2. Peter J Denning, Matti Tedre, "Computational Thinking", The MIT Press, 2019
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2017
4. Peter William Mcowan (Author), Paul Curzon (Author), "Power of Computational Thinking, The: Games, Magic And Puzzles To Help You Become A Computational Thinker", World Scientific Europe Ltd, 2017

23G105 ENGLISH LANGUAGE PROFICIENCY**3 1 0 4**

VOCABULARY: Etymology-prefixes and suffixes-synonyms-antonyms-guessing meanings from context-word formation-single-word substitutes-different forms of a word-phrasal verbs-collocations. (9+3)

LISTENING AND SPEAKING: Understanding listening – listening techniques - introducing oneself and others –seeking and sharing information– description-conversation skills-extempore speaking– speech practice in varied formal contexts.(9+3)

GRAMMAR: Wh-questions-Yes/no questions-parts of speech-articles-prepositions-gerunds-conjunctions-degrees of comparison-tenses- modal verbs- adverbs - direct and indirect questions. (9+3)

READING: Reading strategies: skimming and scanning, predicting-reading comprehension: techniques – practice reading. (9+3)

WRITING: Discourse markers – dialogue writing - completing sentences – jumbled sentences –paragraph writing –writing compare & contrast paragraphs – Letter writing. (9+3)

TOTAL L: 45 +T: 15 = 60**TEXTBOOKS:**

1. Shoba K.N.and Lourdes JoavaniRayen,"Communicative English", Cambridge University press,Cambridge,2021.
2. Raymond Murphy,"Intermediate English Grammar", Cambridge University Press, New Delhi,2020.

REFERENCES:

1. Raymond Murphy, "English Grammar in Use", Cambridge University Press, New Delhi, 2020.
2. Sudharshana N P and Savitha C, "English for Engineers", Cambridge University Press, New York, 2018.
3. Anne Laws, "Writing Skills", Orient Black Swan, Hyderabad, 2011.
4. Helen Naylor with Raymond Murphy, "Essential English Grammar", Cambridge University Press, New Delhi, 2019.

23Z110 PYTHON PROGRAMMING LABORATORY**0 0 4 2**

1. Algorithm and Flowchart
2. Programs using Decision Making statements and Looping Statements
3. Applications using Set, Lists, Tuples, Dictionary
4. Applications using Functions
5. Iterative
6. Text processing
7. Sorting algorithms
8. Linear Searching
9. Application Debugging

TOTAL P: 60**REFERENCES:**

1. Romano, Fabrizio,"Learn Python Programming: A Beginner's Guide to Learning the Fundamentals of Python Language to Write Efficient, High-Quality Code", 2nd Edition. India, Packt Publishing, 2018.
2. R. Nageswara Rao, "Core Python Programming", Second edition, Dreamtech press, 2019
3. Vijay Kumar Sharma, Vimal Kumar, Swati Sharma, ShashwatPathak,"Python Programming: A Practical Approach", United States, CRC Press, 2021.
4. MeenuKohli, "Basic Core Python Programming: A Complete Reference Book to Master Python with Practical Applications", First edition, BPB Publications, 2021.
5. Cogliati, Josh,"Non-Programmers Tutorial For Python 3",Platypus Global Media, 2019.

23Z111 BASIC SCIENCE LABORATORY**0 0 4 2****Physics (Any eight experiments)**

1. Determination of Hysteresis loss of a ferromagnetic material
2. Determination of resistivity of metal and alloy using Carey Foster bridge
3. Determination of capacitance using LCR bridge
4. Study of reverse bias characteristics of Germanium diode and determination of its band gap
5. Study of I-V characteristics of solar cell and determination of its efficiency

6. Thermistor: Measurement of temperature and band gap
7. Study of characteristics of Photo Diode
8. Operational Amp. (741) – Inverting and non inverting modes
9. Determine the Planck's constant using Photo Electric method.
10. Determine the refractive index of given specimen using Brewster's angle apparatus.

Demonstration:

1. Determine the excitation potential of Argon using the Franck Hertz method.
2. Determine the number of turns & radius of the coil and magnetic field of 'Helmholtz' coil using Biot-Savart's Law – apparatus
3. Find the Hall voltage, Hall coefficient, mobility & charge density of the given 'Ge' crystal using Hall apparatus.
4. Determine e/m (charge to mass ratio) of the electron by Thomson's method.
5. Determine the charge of an electron by Millikan's oil drop method.
6. Determine the wavelength of the laser source by Michelson Interferometer.
7. Determine the thickness of the film by Mach Zehnder Interferometer.
8. Find the finesse and free spectral region of the Etalon.
9. Analyze the mercury spectrum and find wavelength using polynomial equation.

Total P: 30**REFERENCES:**

1. Department of Physics, "Physics laboratory observation", 2022.
2. Jerry D Wilson; Cecilia A Hernandez Hall, "Physics laboratory experiments", Boston, MA : Cengage Learning, 2016.

CHEMISTRY (Any eight experiments)

1. Determination of total hardness of water by EDTA method.
2. Demineralisation of water using ion-exchange resins and determination of water quality - pH, TDS and conductivity.
3. Electroplating of copper and Nickel and determination of cathode efficiency of electroplating.
4. Construction of phase diagram for a simple eutectic system.
5. Demonstration of different forms of metallic corrosion using ferroxyl indicator test and determination of rate of galvanic corrosion using zero-resistance ammeter.
6. Designing a battery and determination of its characteristics.
7. Potentiometric estimation of ferrous iron.
8. Preparation of a chloride ion sensor and ascertaining nerstian response by construction of calibration curve.
9. Conductometric estimation of a mixture of strong and weak acids.
10. Photocolorimetric estimation of Ferric ion in a water sample.

Total P : 30**REFERENCE:**

1. Laboratory Manual Prepared by the Department.

23IP15 INDUCTION PROGRAMME**0 0 0 0**

AS PER AICTE GUIDELINES

SEMESTER – II**23Z201 TRANSFORMS AND ITS APPLICATIONS****3 1 0 4**

LAPLACE TRANSFORMS: Laplace transform, inverse transform, linearity, s-shifting, transforms of derivatives and integrals, unit step function, t – shifting, Dirac's delta function, periodic functions, differentiation and integration of transforms. (9+3)

APPLICATION OF LAPLACE TRANSFORMS: Convolution, solving differential equations with constant coefficients and variable coefficients, integral equations, systems of ODEs by using Laplace transform technique. (9+3)

Z TRANSFORM: Z-transform, the relationship of the Z-transforms to the Laplace transform, some useful properties, inverse Z-transforms, solution of difference equations. (6+2)

FOURIER SERIES: Fourier series – even and odd functions, half range expansion, convergence of Fourier series, basic concepts of PDE's, wave equation, solution of one dimensional heat equation and steady state two dimensional heat equation. (12+4)

FOURIER TRANSFORMS: Fourier integral, Fourier cosine and sine integrals, Fourier transform, Discrete Fourier transform, Fast Fourier transform – DIT algorithm. (9+3)

Total L: 45 + T: 15 = 60

TEXT BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, New Delhi, 2018.
2. Dean G. D., "Advanced Engineering Mathematics with MATLAB", CRC Press, USA, 2017.

REFERENCES

1. Peter V.O. Neil, "Advanced Engineering Mathematics", Cengage, New Delhi, 2018.
2. Wylie C. R. and Barrett L. C., "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Jain. R. K. and Iyenger, S. R. K., "Advanced Engineering Mathematics", Narosa Publishing House, New Delhi, 2018.
4. Alexander D Poularikas, "Transforms and applications primer for engineers with examples and MATLAB", CRC press, USA, 2010.

23Z202 SENSORS FOR ENGINEERING APPLICATIONS

3 1 0 4

STRAIN AND PRESSURE MEASUREMENT: Resistance strain gauge, piezoelectric pressure sensor, characteristics. Electronic circuits for strain gauge, load cells. Interferometer, Fibre-optic pressure sensor. capacitance pressure sensor. (9+3)

ELECTRONIC SENSORS: Inductive, capacitive and ultrasonic based proximity sensors Reed switch, Hall-effect switching sensors, capacitive based humidity sensor, liquid level detectors, flow sensors, smoke sensors. (9+3)

MOTION SENSORS: Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, rotation sensors, piezoelectric devices for motion sensing, Hall effect-based speed sensor. (9+3)

LIGHT Sensors: Color temperature, light flux, photo sensors, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber-optic sensors and their applications. LIDAR working principle and automotive applications. (9+3)

Thermal Sensors: Bimetallic strip, semiconductor-based temperature sensor, thermocouples, Resistance thermometers, thermistors, PTC and NTC thermistors and their applications. Infrared sensors: bolometer, Pyroelectric detector, photodiodes and phototransistor. (9+3)

Total L: 45 + T: 15 = 60

TEXTBOOKS:

1. Ian R Sinclair, —Sensors and Transducers, Third Edition, Newnes publishers, 2011.
2. Krzysztof Iniewski, Smart sensors for industrial applications, CRC Press Taylor and Francis, 2019.
3. Doebelin E O, —Measurement Systems, Application and Design, McGraw Hill, seventh Edition, 2019.

REFERENCES:

1. Jack P Holman, —Experimental Methods for Engineers, Eighth Edition, McGraw Hill, USA, 2011.
2. Jacob Fraden, Handbook of modern sensors: Physics, design, and applications, Springer, 5th Edition, 2016.

23Z203 DIGITAL DESIGN

3 1 0 4

NUMBER SYSTEM: Number Systems and Number-Base Conversion - Complements of Numbers (Diminished Radix Complement, Radix Complement) - Signed Binary Numbers - Arithmetic Operation with the Binary Numbers - fixed and floating point representation, Binary Codes (BCD, 2421 Code, Gray Code, ASCII) (10+4)

BOOLEAN ALGEBRA: Boolean Algebra - Basic Theorems and Properties of Boolean Algebra - Simplification of Boolean Functions - Canonical and Standard Forms - Other Logic Operation (8+3)

DESIGN OF COMBINATIONAL CIRCUITS: Introductory Digital Concepts - Digital Logic Gates - Karnaugh Map Method - Don't Care Conditions - The Tabulation Method - NAND and NOR Implementation - Design Procedure - Adder - Subtractor - Magnitude Comparator - Decoders - Encoders - Priority Encoder - Multiplexers - Demultiplexers - Three State Gates - Design Example. (10+3)

DESIGN OF SEQUENTIAL CIRCUITS: Introduction - Storage Elements: - Latch(S-R Latch, D-Latch) - Flip-Flops(S-R Flip Flop, D-Flip Flop, J-K Flip Flop, T-Flip Flop) - Master Slave Configuration of J-K Flip Flop - Shift Registers - Design of Asynchronous and Synchronous Counter. Mealy and Moore Models of Finite State Machines(FSM) - Synchronous Sequential Logic - State Reduction and Assignment - Design Procedure Algorithmic (11+3)

MEMORY AND PROGRAMMABLE LOGIC: Introduction - Random Access Memory - Memory Decoding - Read Only Memory - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Sequential Programmable Devices (6+2)

TOTAL L: 45 + T: 15 = 60

TEXT BOOKS

1. M. Morris Mano, Michael D. Ciletti. Digital Design: With an Introduction to the Verilog HDL, VHDL and System Verilog Sixth Edition USA: Pearson Education, 2018.
2. M. Morris Mano. Digital Logic and Computer Design India: Pearson Education, 2017.
3. Thomas L. Floyd. Digital Fundamentals USA: Pearson Education, 2015.

REFERENCES

1. Charles H. Roth, Jr., Larry L. Kinney. Fundamentals of Logic Design USA: Cengage Learning, 2014.
2. John F. Wakerly. Digital Design: Principles and Practices USA: Pearson Education, 2018.
3. Roger L. Tokheim. Digital Electronics: Principles and Applications USA: McGraw-Hill Education, 2013.
4. Ronald Tocci, Neal Widmer, Greg Moss. Digital Systems USA: Pearson Education, 2016.
5. Donald D. Givone. Digital Principles and Design USA: McGraw-Hill Education, 2003.

23Z204C PROGRAMMING**3 0 0 3**

C PROGRAMMING BASICS: Introduction to C programming - C Program Structure - Program Compilation & Execution - Character Set - Keywords - Data Types - Library functions - Control Statements :Branching and Looping. (6)

ARRAYS AND STRINGS: Single Dimensional Array, Two Dimensional Arrays, Multidimensional Array: Initialization, Unsized Array Initialization. - Strings : Defining, initializing of strings, Processing strings, Array of Strings - (8)

FUNCTIONS: Definition of Function - Prototypes - Storage Classes - Scope Rules - Recursion - Command Line Argument. (9)

POINTERS: Pointer Declaration - Operations on Pointer - Passing Pointers to a Function - Calling Function: Call by Value, Call by Address - Return Statement - Passing Arrays to Function - Pointers and One Dimensional, two dimensional Array - Array of Pointers - Dynamic Memory Allocation. (11)

STRUCTURES, UNION AND FILES: Definition - Processing a Structure - Typedef - Array of Structure, and Pointer to Structure - Passing Structure to Functions. - Self-Referential Structures - Nested Structures - Union - Introduction to Files - File Access - File Organization - File Operations. (11)

Total L: 45**TEXT BOOKS:**

1. Byron S. Gottfried, Jitendar Kumar Chhabra "Programming with C", Tata McGraw Hill Publishing Company., New Delhi, 2018., fourth edition
2. Kernighan B. W., Ritchie D. M. "C Programming Language (ANSI C)", Prentice Hall of India Private Limited., New Delhi, 2010, second edition

REFERENCES:

1. Herbert Schildt "C – The Complete Reference", Tata McGraw Hill Publishing Company., New Delhi, 2010, fourth edition
2. Pradip Dey and Manas Ghosh "Programming in C", Oxford University Press., New Delhi, 2018
3. Yashavant P. Kanetkar "Let Us C", BPB Publications., 2017, 16th edition
4. H. M. Deitel, P. J. Deitel "C How to Program", Pearson Education., New Delhi, 2013., seventh edition

23Z211 ENGINEERING PRACTICES**0 0 4 2**

1. Study of PC Components
2. Assembling and disassembling of PC.
3. Study of passive and active components (resistors, capacitors, inductors, diodes and transistor).
4. Generation of Signals (DSO, Function generator).
5. Construction of series and parallel circuits using resistors.
6. Study of Digital IC Technologies.
7. Verification of Logic Gates and Implementation of Boolean equations
8. Design and Implementation of Arithmetic Circuits.
9. Design and Implementation of Registers.
10. Design and Implementation of Counters

TOTAL P: 60**REFERENCES**

1. Hambley A.R., "Electrical Engineering Principles and Applications", PHI Learning Pvt. Ltd., New Delhi, 2017.
2. Thomas L. Floyd, "Digital Fundamentals", Pearson Education, USA, 2015.
3. Wikibooks Contributors, "How to assemble your Desktop PC", Platypus Global Media, 2011.

- Govindarajulu B, "IBM PC and CLONES: Hardware, Troubleshooting and Maintenance", TATA McGraw-Hill Education, 2008.

23Z212C PROGRAMMING LABORATORY

0 0 4 2

- Formatted I/O statements.
- Decision Making statements: Simple If, If – else, Switch- case.
- Looping Statements: For, While, Do – while.
- Single dimensional arrays and multi-dimensional arrays.
- Operations on Strings.
- Pass by value and pass by address, Recursion using functions.
- Structures and nested structures.
- String handling operations using pointers.
- Operations on arrays using pointers.
- File operations using command line arguments

TOTAL P:60

REFERENCES:

- Byron S. Gottfried, Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company., New Delhi, 2018, Fourth edition
- Herbert Schildt, "C – The Complete Reference", Tata McGraw Hill Publishing Company., New Delhi, 2010, Fourth edition
- Pradip Dey and Manas Ghosh, "Programming in C", Oxford University Press., New Delhi, 2018
- Yashavant P. Kanetkar, "Let Us C", BPB Publications., 2017, Sixteenth edition
- H. M. Deitel, P. J. Deitel, "C How to Program", Pearson Education., New Delhi, 2013, Seventh edition

23Q213 FOUNDATIONS FOR PROBLEM SOLVING

0 0 20

- Speed Mathematics (SAW, Oz, Mirror methods)
- Speed Mathematics (High5, Minion, Butterfly methods)
- Speed Mathematics (Inception, Goldeneye methods)
- Thinking with Numbers
- Problem Solving with Visual information
- Words Puzzles
- Resume Writing Essential

TOTAL P: 30

REFERENCES:

- R.S. Aggarwal, "Quantitative Aptitude for Competitive Examination", S Chand Publishing, New Delhi, 2017.

SEMESTER – III

23Z301 LINEAR ALGEBRA

3 1 0 4

VECTOR SPACES: General vector spaces - real vector spaces - Euclidean n-space - subspaces – linear independence-coordinates and basis - dimension – change of basis - row space, column space and null space – consistency of linear systems - rank and nullity. (9+3)

LINEAR TRANSFORMATIONS: General linear transformation - matrix transformations- geometry of linear operators on \mathbb{R}^2 -matrices for general linear transformations – similarity. (9+3)

INNER PRODUCT SPACES: Inner products - angle and orthogonality in inner product spaces, Gram - Schmidt process: QR decomposition, best approximation: least squares - least squares fitting to data. (9+3)

EIGENVALUES AND EIGENVECTORS: Eigenvalues and eigenvectors, diagonalization - orthogonal diagonalization - quadratic forms. (9+3)

MATRIX DECOMPOSITION AND OPTIMIZATION: Spectral decomposition - singular value decomposition - reduced singular value decomposition - optimization using quadratic forms. (9+3)

Total L: 45+T:15 =60

TEXT BOOKS

- Howard Anton, Chris Rorres, Anton Haul "Elementary Linear Algebra", Wiley India, New Delhi, 2019.
- David C Lay, Judi J. McDonald, Steven R. Lay "Linear Algebra and its Applications", Pearson Education, New Delhi, 2021.

REFERENCES

1. Gareth Williams, "Linear Algebra with Applications", Narosa Publishing House, New Delhi, 2017.
2. Gilbert Strang, "Linear Algebra and Learning from Data", Wellesley-Cambridge Press, USA, 2019.
3. Friedberg, Insel and Spence, "Linear Algebra", Pearson Education, USA, 2015.
4. Steven J Leon, "Linear Algebra with Applications", Pearson Education, USA, 2015.

23Z302 COMPUTER ORGANIZATION AND ARCHITECTURE**3 1 0 4**

COMPUTER ORGANIZATION & DESIGN: Stored program organization (Von Neumann architecture) - Computer Registers - Computer Instructions - Timing and Control (Hardwired and Micro programmed) - Instruction Cycle - Memory reference instructions - Input / Output Instructions - Quantitative Principles of computer design. (10+3)

PROCESSOR DESIGN: Stack organization - Instruction Formats - Addressing modes - Fixed point arithmetic: addition, subtraction, multiplication (booth's algorithm) and division (restoring and non restoring division algorithm) - RISC Vs CISC (9+3)

MEMORY AND I/O SYSTEMS: Memory Hierarchy - Associative Memory - Cache Memory - Mapping policies - Cache optimization; I/O Systems: Introduction-Interrupts-Modes of Transfer -DMA. (8+3)

PARALLELISM: Pipelining - Pipelining Hazards - Overcoming Hazards - Instruction Level Parallelism - Dependencies (10+3)

MULTIPROCESSOR SYSTEMS: Symmetric and Distributed shared memory architectures - Challenges - Cache Coherence - Snooping protocol (8+3)

Total L: 45 +T: 15 = 60**TEXT BOOKS:**

1. Morris Mano, "Computer System Architecture", Prentice Hall of India, Prentice Hall of India, 2007.
2. John L. Hennessey, David A. Patterson, "Computer Architecture: A Quantitative Approach", Elsevier India Pvt. Ltd, New Delhi, 2015.

REFERENCES:

1. Carl Hamacher, "Computer Organization", Tata McGraw Hill Publishing, New Delhi, 2002.
2. Kai Hwang, "Advanced Computer Architecture Parallelism, Scalability, Programmability", Tata Mc Graw Hill, New Delhi, 2010.
3. William Stallings, "Computer Organization and Architecture", Pearson Education / Prentice Hall of India, New Delhi, 2006.
4. Kai Hwang, Faye A Briggs, "Computer Architecture and Parallel Processing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.

23Z303 DATA STRUCTURES**3 0 0 3**

INTRODUCTION:Need for Data Structures - Types of Data Structures - Abstract Data Type -AlgorithmComplexity Analysis - Best case and worst-case complexities - Asymptotic notations (6)

ARRAYS AND LISTS:Array Representation and Operations - Matrix representation using Multi-dimensional arrays - Linked List Representation - Operations on a Singly Linked List - Types of Linked List - Polynomial Addition - Sparse Matrices (11)

STACKS AND QUEUES:Stack ADT - Representation and Operations - Expression Handling - Role of Stack in implementing recursive algorithms - Queue ADT - Representation and Operations - Types of Queues - Circular Queue - Deque - Priority Queue (8)

TREES: Terminologies - Binary Tree - Traversal - Expression Trees - Binary Heap - Priority Queue implementation using Binary Heap - Binary Search Tree - AVL Tree - m-way search trees - B Tree - B+ Tree - Applications - Trie Structure (11)

HASHING AND GRAPHS: - Hash Table - Hash Functions - Resolving Collisions - Rehashing.**GRAPHS:** Graph Terminologies - Types of Graphs - Representation - Breadth First Search - Depth First Search - Topological Sort (9)

TOTAL L: 45**TEXT BOOKS:**

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2016.
2. Venkatesan R, Lovelyn Rose S, "Data Structures", 2nd Edition, Wiley India Pvt Ltd, 2019.

REFERENCES:

1. Jean Paul Tremblay, Sorenson, "An Introduction to Data Structures with Applications", McGraw Hill Publishing Company, New Delhi, 2017.

2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, Universities Press, 2019.
3. Salaria R S, "Data Structures and Algorithms using C", 5th Edition, Khanna Book Publishing, New Delhi, 2017.
4. Amol M. Jagtap, Ajit S. Mali, "Data Structures Using C - A Practical Approach for Beginners", Chapman and Hall/CRC; 1st edition, 2021
5. Aaron M Tanenbaum, Moshe J Augenstein and Yedidyah Langsam, "Data structures using C and C++", Prentice Hall, 2016.

23Z304 DISCRETE STRUCTURES

3 1 0 4

LOGIC AND PROPOSITIONAL CALCULUS: Propositional logic - connectives- compound propositions - logic and bit operations - propositional equivalences - normal forms - rules of inference. (9+3)

PREDICATE CALCULUS AND PROOF STRATEGY: Predicates - quantifiers - quantifiers with restricted domain - logical equivalences involving quantifiers - rules of inference for quantified statements - introduction to proofs - direct proof - contraposition - contradiction - mathematical induction - program correctness. (9+3)

RELATIONS AND LATTICES: Relations and their properties – representing relations – types of relations - closures of relations – partial orderings - lattices as posets – Hasse diagram - properties of lattices. (9+3)

ALGEBRAIC STRUCTURES: Semi groups and monoids - groups – subgroups – group homomorphism - permutation groups - rings - integral domain – fields. (9+3)

CODING THEORY: Encoding and decoding functions - Hamming distance - error correction and detection - group codes - maximum likelihood decoding technique - polynomial rings and codes. (9+3)

Total L: 45 +T: 15 =60

TEXT BOOKS:

1. Kenneth H Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill, New Delhi, 2021.
2. Tremblay J P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill, New Delhi, 2017.

REFERENCES:

1. Bernard K, Robert C B and Sharon C R, "Discrete Mathematical Structures", Prentice Hall, New Delhi, 2018.
2. Ralph P G, "Discrete and Combinatorial Mathematics - An Applied Introduction", Addison Wesley, USA, 2019.
3. Richard J, "Discrete Mathematics", Pearson Education, New Delhi, 2018.
4. Herstein I N, "Topics In Algebra", Wiley India, New Delhi, 2013.

23O305 ENGINEERING ECONOMICS

3 1 0 4

Fundamentals of Economic Analysis: Introduction – Scope of Engineering Economics – Circular Flow in an Economy – Demand and Supply– Types of Efficiency. (7+2)

Cost and Inventory Control: Cost Concepts – Types of Cost – Short-run and Long-run - Cost-Output Relationship - Make or Buy Decision – Criteria – Approaches - Inventory Models – Purchase Model – Manufacturing Model - With or Without Shortages- Depreciation Methods – Problems in Straight Line and Diminishing Balance Method. (9+4)

Pricing, Revenue and Value Engineering: Pricing Practices and Strategies -Revenue Concepts – CVP Analysis- Problems in Break-Even Analysis – Value Analysis - Value Engineering. (9+2)

Project Management: Capital Budgeting – Decisions – Steps Involved in Capital Budgeting – Methods of Project Appraisal – Pay-back Period – Net Present Value and Internal Rate of Return - Project Management - Techniques – PERT – CPM Models – Case Analysis. (10+5)

Economic Growth and Development: Concepts of Macro Economics – National Income – Inflation – Control Measures - Monetary Policy – Fiscal Policy – Technological Innovation in Banking and Economic Development - Sustainable Development Goals – Circular Economy. (10+2)

Total L: 45 + T: 15 =60

TEXT BOOKS

1. Panneerselvam. R., "Engineering Economics", PHI Learning Private Limited, 2012.
2. Metha P.L, "Managerial Economics – Analysis, Problems and Cases", Sultan Chand & Sons, 2016.

REFERENCES

1. Zahid A. Khan., Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi, "Principles of Engineering Economics with Applications, Cambridge University Press, 2018.

2. Varshney, R.L and K.L. Maheshwari, "Managerial Economics", Sultan Chand & Sons, 2014.
3. McEachern and Indira., "Macro ECON", Cengage India Private Limited, 2017.
4. Shalini Goyal Bhalla, "Circular Economy (Re) Emerging Movement", Invincible Publishers, 2020.

23Z310 OBJECT ORIENTED PROGRAMMING LABORATORY

0 0 4 2

1. Study of JDK,JRE,JVM, IDE and REPL
2. Classes and Methods
3. Inheritance
4. Interfaces and packages
5. Exception Handling
6. I/O and Files
7. Collection classes
8. Generics and Lambda Expressions

TOTAL P: 60

REFERENCES:

1. Schildt H, "Java: The Complete Reference", Eleventh Edition, McGraw-Hill Education, 2018.
2. Deitel P and Deitel H, "Java: How to Program", Eleventh Edition, Prentice Hall, 2018.
3. Hortsman CS and Cornell G, "Core Java: Volume 1 - Fundamentals", Eleventh Edition, Prentice Hall, 2018.
4. James Gosling, Bill Joy, Guy Steele, Gilad Bracha, Alex Buckley and Daniel Smith, "The Java Language Specification – Java SE", Thirteenth Edition, Oracle America Inc., USA, 2019.
5. Daniel Liang L, "Introduction to Java Programming", Tenth Edition, Pearson Education, New Delhi, 2015.
6. Matt Weisfeld, "The Object Oriented Thought Process", Fifth Edition, Addison-Wesley Professional, US, 2019

23Z311 DATA STRUCTURES LABORATORY

0 0 4 2

1. Solving Problems using arrays
2. Searching and Sorting algorithms
3. Implementation of Linked List
4. Applications of Linked List
5. Implementation Stack and queue
6. Applications of Stack
7. Operations on Binary Search Trees
8. Applications of Binary Search Tree, AVL tree
9. Graphs - Depth First Search and Breadth First Search
10. Hashing and Collision Resolution

TOTAL P: 60

REFERENCES:

1. Ellis Horowitz, SartajSahni and SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", Second Edition, Universities Press, 2011.
2. Jean Paul Tremblay and Sorenson, "An Introduction to Data Structures with Applications", McGraw Hill Publishing Company, New Delhi, 2012.
3. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press, England, 2009.
4. Salaria R S, "Data Structures and Algorithms using C", 5th Edition, Khanna Book Publishing, New Delhi, 2017.
5. Amol M. Jagtap, Ajit S. Mali, "Data Structures Using C - A Practical Approach for Beginners", Chapman and Hall/CRC; 1st edition , 2021

23Q313 BUILDING COMMUNICATIONS SKILLS

0021

1. Introduction to Workplace Communication
2. Profile Building for Internships
3. English in the Workplace (Grammar & Vocabulary)
4. Professional Communication (Speaking & Writing)
5. Workplace Communication Tools
6. Career Exploration
7. Resume Update

TOTAL P: 30

REFERENCES:

1. P.C.Wren and H.Martin, "High school English grammar & composition", S Chand Publishing, New Delhi, 2017.

2. Norman Lewis, "Word Power Made Easy", Goyal Publisher, New Delhi, 2011

23K312 ENVIRONMENTAL SCIENCE

2 0 0 0

INTRODUCTION TO ENVIRONMENT: Environment-Definition, scope and importance. Types and composition of atmosphere - particles, ions and radicals. Ozone layer - significance, formation and depletion. Ecosystems- Structure and functions, components, energy flow, food chains, food web, Biodiversity-levels, values and threats - India as a mega-diversity nation - hotspots of biodiversity - endangered and endemic species of India - conservation of biodiversity. (6)

ENERGY RESOURCES: Introduction -National and International status- exploitation -sustainable strategies- Fossil fuels-classification, composition, physico-chemical characteristics and energy content of coal, petroleum and natural gas; solar energy - introduction, harnessing strategies. Wind energy - availability, wind power plants, wind energy conversion systems, site characteristics, and types of wind turbines. Supporting renewable energy resources - tidal- geothermal- hydroelectric. (6)

ENVIRONMENTAL POLLUTION: Definition -Sources, causes, impacts and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards (h) RF hazards - Role of an individual in prevention of pollution. Disaster Management: Floods, earthquake, cyclone and landslides -Case studies, consequences and rescue measures. (6)

WASTE MANAGEMENT: Wastewater-Characteristics of domestic and industrial wastewater-COD and BOD - Various stages of treatment -primary, secondary, tertiary treatment-Biological and advanced oxidation processes. Solid waste management -Characteristics of municipal solid waste (MSW), biomedical, automobile and e-wastes and their management -landfills, incineration, pyrolysis, gasification and composting. (6)

SOCIAL ISSUES AND THE ENVIRONMENT: Environmentally Sustainable work practices -Rainwater harvesting -Role of non-governmental organizations. Human ethics and rights -impact on environment and human health -role of information technology on environment and human kind. Green IT policies, Process of EIA - ISO 14000. Legislation- Environment protection act -Air (Prevention and Control of Pollution) act -Water (Prevention and Control of Pollution) act - Wildlife protection act -Forest conservation act. (6)

TOTAL L: 30

TEXT BOOKS

1. Gilbert M. Masters, "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi, 2004.
2. De A K, "Environmental Chemistry", New Age International P Ltd, New Delhi, 2006.

REFERENCES

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. Koteswara Rao MVR, "Energy Resources: Conventional & Non-Conventional", BSP Publications, New Delhi, 2006.
3. Deswal S and Deswal A, "A Basic Course in Environmental Studies", Dhanpat Rai and Co, New Delhi, 2004.

SEMESTER – IV

23Z401 PROBABILITY, STOCHASTIC PROCESSES AND STATISTICS

3 1 0 4

PROBABILITY AND DISCRETE RANDOM VARIABLES: Probability, axioms, conditional probability, law of total probability, Baye's theorem, discrete random variables, probability mass function, cumulative distribution function, binomial, Poisson and geometric random variables, expected values. (9+3)

CONTINUOUS RANDOM VARIABLES: Cumulative distribution function, probability density function, uniform, exponential and Gaussian random variables, expected values. (9+3)

PAIRS OF RANDOM VARIABLES: Joint cumulative distribution function, joint probability mass function, marginal probability mass function, joint probability density function, marginal probability density function, independent random variables, expected values, covariance, correlation and independence, central limit theorem, weak law of large numbers. (9+3)

STOCHASTIC PROCESSES: Types of stochastic processes, Bernoulli process, Poisson process, discrete time Markov chains, classification of states, limiting state probabilities. (9+3)

STATISTICAL INFERENCE: Point estimation, Bayesian estimation, interval estimation. Hypothesis testing: one and two tailed tests, tests concerning mean, proportion, and variance, single and two samples, tests for goodness of fit and independence of attributes. (9+3)

Total L: 45 + T: 15 = 60

TEXT BOOKS

1. Roy D Yates and David J Goodman, "Probability and Stochastic Processes", Wiley India, New Delhi, 2021.
2. Ronald E. Walpole, Raymond H Myers, Sharon L Myers and Keying Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, New Delhi, 2016.

REFERENCES

1. Saeed Ghahramani, "Fundamentals of Probability with Stochastic Processes", CRC Press, USA, 2018.
2. Douglas C Montgomery and George C Runger, "Applied Statistics and Probability for Engineers", Wiley India, New Delhi, 2018.
3. Athanasios P and Unnikrishna P S, "Probability, Random Variables and Stochastic Processes", Tata McGraw Hill, New Delhi, 2017.
4. D. Bertsekas and J. Tsitsiklis, "Introduction to Probability", Athena Scientific, USA, 2008.

23Z402 DATABASE MANAGEMENT SYSTEMS**3 0 0 3**

INTRODUCTION TO DATABASE: Purpose of Database System - Data Models - Database System Architecture – DBMS Components Conceptual design with Entity-Relationship model - Enhanced-ER Model - Traps

(9)

Relational model: E-R to relational model - Codd's rules- Integrity constraints- Relational Algebra- SQL Basics. Normalization: Armstrong rules - Functional Dependencies – First Normal Form to Fifth Normal Form - Denormalization

(9)

DATA STORAGE AND QUERYING: RAID - File Organization - Organization of Records in Files – Indexing and Hashing – Ordered Indices - B+ tree Index Files - B tree Index Files - Static Hashing - Dynamic Hashing - Query Processing stages – Query Optimization using Heuristics and Cost Estimation

(9)

TRANSACTION MANAGEMENT: Transaction Concepts - ACID Properties - Schedules - Serializability - Concurrency Control - Need for Concurrency - Locking Protocols - Two Phase Locking - Deadlock - Transaction Recovery-Savepoints-Isolation Levels – SQL Facilities for Concurrency and Recovery-Backup and Recovery System.

(9)

ADVANCED TOPICS: Parallel Database - Multidimensional Database - Datawarehouse-Multimedia Database - Web Database - Mobile Database- NoSQL database.

(9)**TOTAL L: 45****TEXT BOOKS:**

1. Abraham Silberchatz, Henry F Korth and Sudarshan S, "Database System Concepts", Seventh Edition, Tata McGraw-Hill, New Delhi, 2021.
2. Ramez Elmasri and Shamkant B Navathe, "Fundamentals of Database Systems", Seventh Edition, Addison Wesley, USA, 2010.

REFERENCES:

1. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", Fourth edition, Tata McGraw-Hill, New Delhi, 2008.
2. Gupta G K, "Database Management System", Tata McGraw-Hill, New Delhi, 2011.
3. Jeffrey A. Hoffer, Ramesh Venkataraman, Heikki Topi, "Modern Database Management", 12th Edition, Pearson, New Delhi, 2016.
4. Atul Kahate, "Database Management Systems", 1st Edition, Pearson, New Delhi, 2011.

23Z403 DESIGN AND ANALYSIS OF ALGORITHMS**3 1 0 4**

DIVIDE AND CONQUER: Introduction to Algorithm Design techniques - Divide and Conquer Methodology - Solving recurrence relations - Finding Maximum and Minimum Element - Quick sort - Merge sort - Convex Hull.

(9+3)

GREEDY METHOD: Greedy Strategy - Knapsack Problem - Minimum Spanning Trees - Single Source Shortest Path Method - Huffman Trees

(9+3)

DYNAMIC PROGRAMMING: Principle of Optimality - Knapsack Problem - All Pairs Shortest Path - Optimal Binary Search Tree - Multistage Graphs

(9+3)

BACKTRACKING: State Space Tree - Knapsack Problem - The Eight Queens Problem - Sum of subsets - Graph Coloring

(9+3)

BRANCH AND BOUND: Bounding Functions - 0/1 Knapsack Problem - Traveling Sales Person Problem - Assignment Problem

(9+3)**TOTAL L: 45 +T: 15 = 60**

TEXT BOOKS:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Prentice Hall of India, New Delhi, 2017.
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Galgotia Publications, New Delhi, 2010.

REFERENCES:

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, MIT Press, England, 2009.
2. Donald E. Knuth, —The Art of Computer Programming II, Volumes 1 & 3 Pearson Education, 2009.
3. Jeffrey J McConnell, "Analysis of Algorithms", Jones and Bartlett Publishers, 2008.
4. Parag Himanshu Dave, Himanshu Bhalchandra Dave, "Design and Analysis of Algorithms", Pearson Education, 2008.

23Z404 THEORY OF COMPUTATION**3 1 0 4**

FINITE AUTOMATA: Need for automata theory - Finite Automaton – DFA and NFA- Finite Automaton with ϵ - moves - Regular Languages- Properties - Regular Expression -Equivalence of NFA and DFA-Equivalence of NFA's with and without ϵ -moves - Equivalence of finite Automaton and regular expressions –Minimization of DFA - Pumping Lemma for Regular sets . (9+4)

GRAMMARS: Types of Grammar - Chomsky's hierarchy of languages - Context Free Grammars and Languages– Properties - Derivations and Languages – Ambiguity- Relationship between derivation and derivation trees –Simplification of CFG- Greibach Normal form–Chomsky normal form–pumping lemma for CFL. (8+2)

PUSH DOWN AUTOMATA: Definitions - Moves - Instantaneous descriptions - Deterministic and non deterministic pushdown automata – Equivalence of Pushdown automata and CFL. (8+4)

TURING MACHINE: Definitions of Turing machines - Models - Computable languages and functions –Turing machine construction- Multihead and Multitape Turing Machines- The Halting problem (8+3)

UNSOLVABLE PROBLEMS AND COMPUTABLE FUNCTIONS : Unsolvable Problems and Computable Functions – Primitive recursive functions –PCP-MPCP- Recursive and recursively enumerable languages – Properties - Universal Turing machine - Measuring and classifying complexity- Tractable and intractable problems- Tractable and possibly intractable problems – complexity classes - Polynomial time reductions – P and NP completeness – SAT--problem - Clique problem - Space complexity. (12+2)

TOTAL L: 45 +T: 15 = 60**TEXT BOOKS:**

1. John C Martin , "Introduction to Languages and the Theory of Computation", 4th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2011.
2. Hopcroft J.E., Motwani R. and Ullman J.D , "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education, New Delhi, 2008.

REFERENCES:

1. Harry R Lewis and Christos H Papadimitriou , "Elements of the Theory of Computation", 2nd Edition, Prentice Hall of India, New Delhi, 2015.
2. Peter Linz , "An Introduction to Formal Language and Automata", 6th Edition, Narosa Publishers, New Delhi, 2016.
3. Ganesh Gopalakrishnan , "Automata and Computability", 1st Edition, Chapman and Hall/CRC, USA, 2019.
4. D Shanthi, N Uma Maheshwari, S Jeyanthi , "Theory of Computation", 1st Edition, Yesdee, India, 2017.

23Z405 SOFTWARE ENGINEERING**3 1 0 4**

PRELIMINARIES: Definition of Software – Software characteristics – Types of Software – Evolution of Software – Software Development Lifecycle – Waterfall Model – Incremental Model – Prototyping – Spiral Model – Unified Process – Agile Development Approach – Software Myths (8+2)

REQUIREMENTS ENGINEERING: Requirements elicitation – Functional and Non-functional Requirements – Prioritization – Use cases – Use case diagram — Data flow diagrams – UML – Object Model – Class diagram – State diagram – Sequence diagram – Activity diagram – CRC cards – Software Requirements Specification document (SRS) (12+4)

SOFTWARE DESIGN: Architectural Design: Views and Viewpoints – Styles and Patterns – Layered Architecture. Detailed Design: Functional Decomposition – Object Oriented Design – User Interface Design – Good Design Attributes – Design Specifications – Coding Standards (8+3)

SOFTWARE TESTING: Testing fundamentals: Black Box and White Box Testing – Test Cases – Equivalence Partitioning – Boundary Value Analysis – Basis Path Testing – Cyclomatic Complexity. Testing Strategies: Unit Testing – Integration Testing – System Testing – Acceptance Testing. Special Testing: Regression Testing – Smoke Testing – Stress Testing - User Interface Testing – Test Automation – Test Documenting and Reporting – Testing Object Oriented System (8+3)

SOFTWARE ENGINEERING MANAGEMENT: Software Quality: Views of Quality – Quality Attributes – Cost of Quality – Quality Control vs. Quality Assurance – Formal Technical Reviews – Guidelines for Reviews – Quality Metrics. Software Configuration Management: Software Baselines – Version Control – Change Control – Software Configuration Audit. Software Maintenance: Maintenance Phase – Activities – Reengineering – Metrics.
(9+3)

TOTAL L: 45 +T: 15 = 60

TEXT BOOKS:

1. Roger S Pressman and Bruce Maxim, "Software Engineering - A Practitioner's Approach", McGraw Hill International Edition, Singapore, 2020.
2. Pankaj Jalote, "A Concise Introduction to Software Engineering", Springer, New Delhi, 2011

REFERENCES:

1. Ian Sommerville, "Software Engineering", Pearson Addison Wesley, Boston, 2017
2. Shari Lawrence Pfleeger, "Software Engineering: Theory and Practices", Pearson Education, New Delhi, 2009
3. Orlando Karam, Frank Tsui, "Essentials of Software Engineering", SBS Publishers and Distributors (P) Ltd, 2007 New Delhi.

23Z410 DATABASE MANAGEMENT SYSTEMS LABORATORY

0 0 4 2

1. SQL Practice: DDL, DML, DCL, TCL commands.
2. Implement Views and stored procedures.
3. Implement functions, Cursors, Triggers and Embedded SQL
4. Study of performance monitoring and tuning Tools
5. Study of NoSQL databases
6. Mini project- Application development

TOTAL P: 60

REFERENCES:

1. Abraham Silberchatz, Henry F Korth and Sudarshan S, "Database System Concepts", 7th Edition, Tata McGraw-Hill, New Delhi, 2021.
2. RamezElmasri and Shamkant B Navathe, "Fundamentals of Database Systems", 7th Edition, Addison Wesley, USA, 2016.
3. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", 4th Edition, BPB Publications New Delhi, 2020.
4. Rosenzweig, "Oracle PL/SQL by Example 5/e, For Dummies", 5th Edition, Pearson Education India, 2015.
5. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", 4th edition, Tata McGraw-Hill, New Delhi, 2015.

23Z411 APPLICATION DEVELOPMENT LABORATORY

0 0 4 2

<Problem Formulation and Design>:

1. Problem Identification
2. Requirements Analysis and Design

<Implementation>:

1. Development of required packages
2. Implementation of the application using coding standards and the packages developed.

<Testing and Documentation>:

1. Application Testing
2. Documentation of the development process

NOTE: The students can develop Web based Application or Mobile Application of their choice. The Language for development can be chosen based on their application requirement.

Total P: 60

REFERENCES:

1. Love, Chris. Progressive Web Application Development by Example: Develop Fast, Reliable, and Engaging User Experiences for the Web. United Kingdom, Packt Publishing, 2018.
2. Robbins, Jennifer. Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics. United States, O'Reilly Media, 2018.
3. User Interface Design: Bridging the Gap from User Requirements to Design. United States, CRC Press, 2018.
4. Carlson Ph D, John R, and Carlson, John. Cross-Platform Mobile Application Development: A Beginner's Guide Using the Corona SDK. N.p., Amazon Digital Services LLC - KDP Print US, 2019.
5. Mobile Apps Engineering: Design, Development, Security, and Testing. United Kingdom, CRC Press, 2018.

23Q413 PROBLEM SOLVING**0 0 21**

1. Algorithmic Thinking, Branching & Repetition Problems
2. Logical Reasoning - Data Arrangements & Relations
3. Solving problems based on Coding & decoding, Series, Analogy, Odd man out and Visual reasoning
4. Problems based on Ages, Logical Connectives, Syllogisms, Data Interpretation & Data Sufficiency
5. Solving problems on Clocks Calendars, Direction Sense & Cubes
6. Problems based on Number system, Percentages, Simple & Compound Interest
7. Resume Update

TOTAL P: 30**REFERENCES:**

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examination", S Chand Publishing, New Delhi, 2017.

23O414 INDIAN CONSTITUTION**20 0 0**

INTRODUCTION: Evolution of Indian Constitution; Significance of Constitution; Composition; Preamble and its Philosophy. (4)

RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES: Fundamental Rights- Writs and Duties, Directive Principles of State Policy (5)

UNION GOVERNMENT: Union Government, President and Vice President, Houses of the Parliament and their functions; Types of Bills, Stages of passing of Bill into an Act, Veto Power, Constitution Amendment Procedure, Various Amendments made and their significance for India.(6)

STATE GOVERNMENT AND FEDERALISM: Composition of State Legislature; Powers, Functions and Position of Governor, Function of Chief Ministers, Council of Ministers; The Indian Federal System, Administrative Relationship between Union and States (8)

JUDICIARY: Supreme Court, High Court; District Court and Lower Courts - Functions and Powers – Judges – Qualifications and Powers - Judicial Review. (7)

Total L:30**TEXT BOOKS:**

1. Subash C. Kashyap, "Our Political System", National Book Trust, 2011.
2. PraveenkumarMellalli, E., "Constitution of India, Professional Ethics and Human Rights", Sage Publications India Pvt. Ltd., 2015.

REFERENCES:

1. Brij Kishore Sharma, "Introduction to the Constitution of India", Prentice Hall of India, 2010.
2. Basu D.D., "Introduction to the Constitution of India", Prentice Hall of India, 2016.
3. Jain. M. C., "The Constitution of India", Law House, New Delhi, 2001.
4. Shukla. V. N., "Constitution of India", Eastern Book Company Ltd., New Delhi, 2011.

SEMESTER – V**23Z501 OPERATING SYSTEMS****3 0 0 3**

INTRODUCTION: Functions - History - Operating System Concepts - System Calls - Services - User Operating System Interface - Design and Implementation - Introduction to Virtual Machines. (6)

PROCESS MANAGEMENT: Process Model - Creation – Termination - Hierarchies - States - Implementation - Scheduling Criteria - Scheduling Algorithms - Multithreading Models - Thread Libraries - Threading Issues - Thread and Multiprocessor Scheduling Algorithms - Interprocess Communication. (10)

PROCESS SYNCHRONIZATION AND DEADLOCKS: Race Conditions - Critical Section - Mutual Exclusion - Peterson's Solution – **Synchronization:** Hardware - Semaphores - Mutex - Monitor - Message Passing, Dining Philosophers Problem - Readers Writers Problem. **Deadlocks:** Conditions - Detection - Recovery - Prevention - Avoidance. (9)

MEMORY MANAGEMENT: Main Memory: Swapping - Contiguous Memory Allocation - Paging - Structure of Page Table - Segmentation - Examples. **Virtual Memory:** Demand Paging - Copy on Write - Page Replacement - Allocation of Frames - Thrashing - Memory Mapped Files - Allocating Kernel Memory - Memory Management Utilities. (10)

STORAGE MANAGEMENT: Files: Naming - Structure - Types - Access - Attributes - Operations - Implementation. Directories: Operations - Path Names - Hierarchical Directory System - Implementation - Allocation Methods - Free Space Management - NFS - Efficiency and Performance - Recovery. Mass Storage: Disk Structure - Disk Scheduling Algorithms - Swap Space Management - Streams. (10)

TOTAL L: 45

TEXT BOOKS:

1. Silberschatz A, Galvin P, Gagne G, "Operating Systems Concepts", John Wiley and Sons, Singapore, 2018.
2. William Stallings, "Operating Systems: Internals and Design Principles", Pearson Education, New Delhi, 2018.

REFERENCES:

1. Andrew S. Tanenbaum, "Modern Operating System", 4th Edition, PHI Learning, New Delhi, 2018.
2. Dhamdhare, "Operating Systems: A Concept Based approach", 3rd Edition, Tata McGraw Hill, New Delhi, 2015.
3. Harvey M Deitel, Paul J Deitel, David R Choffnes, "Operating Systems", 3rd Edition, Pearson Education, New Delhi, 2013.
4. Remzi Arpaci-Dusseau, Andrea Arpaci-Dusseau, "Operating Systems: Three Easy Pieces", 1st edition, Arpaci-Dusseau Books, 2015, Achyut S Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.

23Z502 ARTIFICIAL INTELLIGENCE

3 1 0 4

INTRODUCTION: Artificial Intelligence - The state of art - Intelligent Agents - Rationality - Nature of Environments – Structure of Agents - Examples. (9+3)

PROBLEM SOLVING AGENTS: Searching for solutions: Uninformed search - BFS, DFS, Uniform cost search, Iterative deepening search - Informed search - Greedy Best First search, A* search, AO* search - Adversarial search – Games - Optimal decisions in Games, alpha - beta pruning (9+3)

KNOWLEDGE AND REASONING: Representations and mappings – Approaches to knowledge representation – Property inheritance algorithm - First Order Predicate logic- Instance and ISA relationships – Computable functions and predicates - Unification-Resolution – Question Answering. (9+3)

ACTING UNDER UNCERTAINTY: Quantifying uncertainty – Efficient representation of conditional distributions – Probability and Bayes Theorem - Bayesian Networks - Exact and approximate inferences - Making simple decisions – Utility theory - Decision networks – Value of information – Decisions with multiple agents (9+3)

PLANNING: Classical Planning- Algorithms for Planning as state space search - Planning Graphs – Classic planning as Boolean Satisfiability - Analysis of planning approaches – Time, schedules and resources – Hierarchical planning (9+3)

TOTAL L: 45+T: 15 = 60

TEXT BOOKS:

1. Stuart J Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", 3rd Edition, Prentice Hall of India, Pearson Education, New Delhi, 2021.
2. Elaine Rich, Kevin Knight and Shivashankar B Nair, "Artificial Intelligence", 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2019.

REFERENCES:

1. George F Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", 6th Edition, Pearson Education, New Delhi, 2021.
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education, New Delhi, 2017.
3. John Paul Mueller, "Artificial Intelligence For Dummies", Wiley, 2018
4. Lavika Goel, "Artificial Intelligence: Concepts and Applications", Wiley, 2021
5. Pradeepta Mishra, "Practical Explainable AI Using Python: Artificial Intelligence Model Explanations Using Python-based Libraries, Extensions, and Frameworks", Apress, 2022

23Z503 COMPILER DESIGN

3 1 0 4

INTRODUCTION TO COMPILERS: Translators - Compilation and Interpretation - The Phases of Compiler – Errors Encountered in Different Phases - The Grouping of Phases - Compiler Construction Tools - JIT. (7+2)

LEXICAL ANALYSIS: Need and Role of Lexical Analyzer - Input Buffering - Lexical Errors - Expressing Tokens by Regular Expression - Finite Automata: NFA- DFA - Converting NFA to DFA - Minimization of DFA- Converting Regular Expression to DFA. LEX Tool: Structure of LEX Program – Predefined Variables – Library routines – Design of Lexical Analyzer for a Sample Language. (9 + 3)

SYNTAX ANALYSIS: Need and Role of the Parser - Context Free Grammars - Top Down Parsing: Recursive Descent Parser - Predictive Parser. Bottom Up Parsers: Shift Reduce Parser - LR Parser - LR (0) Item - Construction Of SLR Parsing Table - CLR Parser - LALR Parser. Error Handling and Recovery in Syntax Analyzer – YACC Tool: Structure of YACC Program – Communication between LEX and YACC - Design of a Syntax Analyzer for a Sample Language. (10 + 5)

INTERMEDIATE CODE GENERATION: Benefits- Intermediate Languages - Generation of Three Address Code - Declarations - Assignment Statements - Arrays - Boolean Expressions - Backpatching - Flow of Control Statements – Procedure calls. (9+3)

RUN-TIME ENVIRONMENT, CODE OPTIMIZATION AND GENERATION: Source Language Issues - Storage Organization - Storage Allocation - Symbol Tables. Principal Sources of Optimization - Optimization of Basic Blocks - Global Optimization - Global Data Flow Analysis - Issues in Design of A Code Generator - A Simple Code Generator Algorithm. (10 + 2)

TOTAL L: 45+T: 15 = 60

TEXT BOOKS:

1. Alfred V Aho, Monica Lam, Ravi Sethi , Jeffrey D Ullman , "Compilers - Principles, Techniques and Tools", Essex Pearson, Harlow, 2014.
2. Sudha Sadasivam G , "Compiler Design", Scitech Publications (India) Private Limited, Chennai, 2010.

REFERENCES:

1. Dick Grone, Henri E Bal, Cerial J H Jacobs , Koen G Langendoen , "Modern Compiler Design", John Wiley & Sons, USA, 2000.
2. Dhamdhare D M , "Compiler Construction Principles & Practice", Macmillan India Limited, New Delhi, 1997.
3. O.G. Kakde , "Compiler Design", 5th Edition, An Imprint of Laxmi Publications Pvt. Ltd., 2015.
4. V Raghavan, "Principles Of Compiler Design", Tata Mcgraw Hill Publishing Co Ltd, 2016.

23Z504COMPUTER NETWORKS

3 0 0 3

INTRODUCTION AND MEDIUM: Building a Network - Network Edge and Core - Layering and Protocols - TCP/IP Protocol suite - OSI Reference Model - Network Topologies - Internet Architecture–Physical Layer: Signal Characteristics – Transmission media – Signal Encoding Techniques – Performance Metrics. (10)

LINK LAYER SERVICES: Link Layer Services - Framing - Flow Control - Error Control - Media Access Control - Ethernet - Wireless LAN – Introduction about Bluetooth, Zigbee. (8)

SWITCHING AND ROUTING: Switching: Circuit Switching - Packet Switching - IPV4 - Global Address - Datagram Forwarding - Subnetting - CIDR - ARP- ICMP - Routing Algorithms: Distance Vector Routing and Link State Routing - IPV6 Addressing – IPV6 Protocol. (9)

CONNECTION-ORIENTED AND CONNECTIONLESS SERVICES: Overview of Transport Layer - UDP - TCP – Reliable Byte Stream - Connection Management - Flow Control - Congestion Control - SCTP. (9)

APPLICATION LAYER SERVICES: Needs/Principles of Application Layer Protocols – Role of proxy, Web and HTTP - FTP - Electronic Mail (SMTP - POP3 - IMAP - MIME) - DHCP - DNS - DASH - QUIC. (9)

TOTAL L: 45

TEXTBOOKS:

1. Larry L Peterson and Bruce S Davie, " Computer Networks: A systems approach", Morgan Kaufmann Publishers, USA, 6th Edition 2021.
2. James F Kurose, Keith W Ross, " Computer Networking - A Top-Down Approach Featuring the Internet", Pearson Education, New Delhi, Sixth Edition, 2012.

REFERENCES:

1. Behrouz A.Forouzan , " Data Communications and Networking with TCP/IP Protocol Suite", 6th Edition, McGraw Hill, 2021.
2. Andrew S Tanenbaum and David J Wetherall, "Computer Networks", Prentice Hall of India/ Pearson Education, New Delhi, 6th Edition, 2021
3. Prakash C Gupta, " Data Communication and Computer Networks", Prentice Hall of India, New Delhi, 2014.
4. Prakash C Gupta, " Data Communication and Computer Networks", 2nd Edition, Prentice Hall of India, New Delhi, 2013
5. Ajit Pal, "Data Communication And Computer Networks", 1st Edition, PHI Learning, 2013

23Z510 COMPUTER NETWORKS LABORATORY

0 0 4 2

LIST OF EXPERIMENTS:

1. Study of Network Components, Basic Network Commands and Network Configuration Commands 2. Chat Program using TCP Sockets using C language
2. Sliding Window Protocol using TCP Sockets using C language

3. DNS using UDP Sockets using C language
4. Study of Wireshark Tool
5. Capturing of packet header at each layer using Wireshark
6. Tracing of TCP and UDP Connection using Wireshark
7. Study of any Simulator Tool
8. Performance comparison of TCP and UDP protocols using Simulation tool
9. Set up a typical network in a lab
10. Set up a typical network in a lab

TOTAL P: 60**23Z511 SYSTEM SOFTWARE LABORATORY****0 0 4 2**

1. Linux commands
2. Shell Programming
3. Programs on system calls
4. Process management: creation, synchronization and inter-process communication
5. Introduction and exploration of xv6
6. Study of lex and yacc tool
7. Scanner implementation
8. Parser implementation
9. Syntax directed translation engine implementation
10. Code generation implementation with generalized assembly code

TOTAL P: 60**23Q513 APTITUDE SKILLS****0 0 2 1**

1. Algorithmic Thinking, Branching & Repetition Problems
2. Logical Reasoning - Data Arrangements & Relations
3. Solving problems based on Coding & decoding, Series, Analogy, Odd man out and Visual reasoning
4. Problems based on Ages, Logical Connectives, Syllogisms, Data Interpretation & Data Sufficiency
5. Solving problems on Clocks Calendars, Direction Sense & Cubes
6. Problems based on Number system, Percentages, Simple & Compound Interest
7. Resume Update

TOTAL P: 30**REFERENCES:**

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examination", S Chand Publishing, New Delhi, 2017.

SEMESTER – VI**23Z601 MACHINE LEARNING****3 0 0 3**

INTRODUCTION: Designing a learning system - concept learning - Find-s Algorithm - Candidate Elimination – Polynomial Curve Fitting – Bayesian Probabilities – The Gaussian Distribution – Curve Fitting with Probabilistic Perspective – Bayesian Curve Fitting. (9)

LINEAR MODELS: Linear Regression Models - Maximum Likelihood Estimation - Least Squares – Bias Variance Decomposition - Linear Models for Classification - Linear Discriminant Analysis - Probabilistic Generative Models - Probabilistic Discriminative Models (9)

NEURAL NETWORKS AND DECISION TREES: Feed-forward Networks - Network Training - Delta Rule- Gradient Descent - Error Backpropagation - Regularization in Neural Networks - Decision Tree Learning- Representation - Inductive Bias- Issues (9)

KERNEL AND GRAPHICAL METHODS: Constructing Kernels - Radial Basis Function Networks - Maximum Margin Classifiers - SVM- Bayes Theorem - Naive Bayes - Bayesian Networks (9)

UNSUPERVISED AND REINFORCEMENT LEARNING: Measures of Similarity and Dissimilarity - Clustering - Partitioning methods - KMeans - Hierarchical Methods - Reinforcement Learning - Reinforcement Learning Tasks - Q-learning (9)

TOTAL L: 45

TEXT BOOKS

1. Tom Mitchell , "Machine Learning", McGraw Hill, 2017.
2. Christopher M Bishop , "Pattern Recognition and Machine Learning", Springer, 2011.

REFERENCES

1. EthemAlpaydin , "Introduction to Machine Learning", 3rd Edition, PHI Learning, 2015.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman , "The Elements of Statistical learning", 2nd Edition, Springer, 2017
3. Kevin Murphy , "Machine Learning - A Probabilistic Perspective", MIT Press, 2012.
4. Yaser S. Abu-Mostafa , "Learning from Data", AML, 2017.

23Z602 GRAPH THEORY**3 1 0 4**

INTRODUCTION: Review on Definition and Basic Terminologies of Graphs – Representations of Graphs – Walks in Graphs and Digraphs- Subgraphs-Vertex Degrees - Path and Cycles - Regular and Bipartite Graphs- Representations of graphs – adjacency and incidence lists – adjacency and incidence matrices -Graph Traversals-Applications: Four Cubes Problem- Social Networks. (9+3)

EULERIAN AND HAMILTONIAN GRAPHS: Exploring and Travelling – Eulerian Graphs – Konigsberg bridge problem - Hamiltonian Graphs – Applications: Dominoes – Chinese Postman Problem - Travelling salesman problem (8+3)

PATHS AND CONNECTIVITY: Connected Graphs and Digraphs-Menger's Theorem for Graphs-Applications: Reliable Telecommunication Networks. Network flows and applications- Flows and cuts in Networks, Maximum-flow problem, flows and connectivity– applications (10+3)

VERTEX-COLORING: Vertex-coloring - chromatic number of a graph, vertex coloring algorithms – sequential vertex coloring, largest degree first algorithm, applications - scheduling problem, fast register allocation for computer programming. (10+3)

MATCHING AND FACTORS: Matching, Perfect matching, Tutte's 1-factor theorem, weighted Bipartite matching, Hall's theorem (8+3)

TOTAL L: 45+T: 15 = 60**TEXTBOOKS:**

1. Jonathan L. Gross and Jay Yellen, Graph Theory and its Applications, CRC Press, New York, 2016.
2. Douglas B West, Graph Theory, Prentice Hall, New Delhi, 2017.

REFERENCES:

1. Bondy J.A. and Murty U.S.R., Graph Theory, Springer, London, 2016.
2. Narsingh Deo, Graph Theory with Applications to Engineering And Computer Science, Prentice Hall ,New Delhi 2017.
3. Joan M Aldous and Robin J Wilson, "Graphs and Applications- An Introductory Approach, Springer-Verlag", New York, 2014.
4. Reinhard Diestel, "Graph Theory", Springer-Verlag, Berlin Heidelberg, 2012.

23Z603 EMBEDDED SYSTEMS**2 2 0 4**

INTRODUCTION: Fundamental Components of Embedded Systems - Architecture of Embedded Systems - Embedded Design Life Cycle - Development Environment (5+5)

MEMORY AND INTERRUPTS: Types of Memory - Memory Access Procedure - Memory Management techniques - Memory Testing - Common Memory problems - Interrupts - Interrupt Service Routines (6+6)

COMMUNICATION INTERFACES AND PROTOCOLS: Interfacing Buses - Serial Interfaces - RS232/UART - UART Programming - RS422/RS485 - I2C Interface - SPI Interface - I2C/SPI Programming - USB (7+7)

REAL TIME OPERATING SYSTEMS: Real-Time Concepts - Task Management - Task Scheduling - Classification of Scheduling Algorithms - Clock Driven Scheduling - Event Driven Scheduling - Resource Sharing - Priority Inheritance Protocol - Priority Ceiling Protocol - Commercial RTOS (7+7)

HOST and TARGET TESTING: Validation - Host and Target Testing - Debugging tool - **CASE STUDY** - Development of Automatic Vending Machine - Protocol converter - Development of a navigation (5+5)

TOTAL L: 30 +T: 30 = 60**TEXT BOOKS:**

1. Arnold S Berger, "Embedded Systems Design - An Introduction to Processes, Tools and Techniques", Elsevier, New Delhi, 2011

2. Prasad K V K K, "Embedded/Real-Time Systems: Concepts, Design and Programming - The Ultimate Reference", Himal Impressions, New Delhi, 2003

REFERENCES:

1. Raj Kamal, "Embedded Systems - Architecture, Programming and Design", 3rd Edition, Tata McGraw Hill, 2017
2. Rajib Mall, "Real-Time Systems: Theory and Practice", First Edition, Pearson, 2009
3. Sriram V Iyer and Pankaj Gupta, "Embedded Real-time Systems Programming", TataMcGraw-Hill Publishing Company Limited, New Delhi, 2006.

23Z610 MACHINE LEARNING LABORATORY**0 0 4 2****LIST OF EXPERIMENTS:**

1. Data Preparation for Machine Learning
2. Candidate elimination Algorithm
3. Implement Linear regression for data fitting
4. Implement Perceptron for binary Classification
5. Implement Kmeans algorithm
6. Comparing Regression Models(OLS, ridge, lasso) for a real world dataset
7. Comparing Classification Algorithms(decision tree, SVM, Naïve Bayes etc) for a real world dataset
8. Comparing Hierarchical Clustering Methods for a real world dataset
9. Reinforcement Learning

TOTAL P: 60**REFERENCES**

1. 1EthemAlpaydin , "Introduction to Machine Learning", 4thEdition, PHI Learning, 2020.
2. Willi Richert, Luis Pedro Coelho, Building Machine Learning Systems with Python, Packt Publishing, 2018.
3. AurelienGeron, Hands-On Machine Learning with Scikit-Learn, Keras and Tensor Flow: Concepts, Tools and Techniques to Build Intelligent Systems, O'Reilly, 2019.
4. Tom Mitchell, "Machine Learning", McGraw Hill, 2017
5. Richard O. Duda, Peter E. Hard, David G. Stork, "Pattern Recognition", 2nd Edition, Wiley, 2020

23Z611INNOVATION PRACTICES**0 0 2 1**

This course involves preparing students to think innovatively and present possible solutions to identified industry/academic problem or issue

TOTAL P: 30**23Q614 ENHANCING ARITHMETIC PROBLEM SOLVING****0 0 2 1****ENHANCING ARITHMETIC PROBLEM SOLVING:**

1. Logarithms, Progressions, Geometry and Quadratic equations
2. Attention to detail&Image Interpretation
3. Voices and Speech
4. Algebraic Expressions
5. Surds, Indices and Simplification
6. Set Theory & Functions
7. Cryptarithmic & Trigonometry
8. Advance Quantitative
9. Advance Verbal
10. Advance Logical
11. Preparing for Business roles, Case studies, &Guesstimation techniques
12. Handling Stress
13. Handling Peer pressure
14. Resume progress check

Total P: 30**REFERENCES:**

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examination", S Chand Publishing, New Delhi, 2017.
2. P.C.Wren and H.Martin, "High school English grammar & composition ", S Chand Publishing, New Delhi, 2017.

3. Norman Lewis, "Word Power Made Easy", Goyal Publisher, New Delhi, 2011.
4. Arun Sharma, "How to Prepare for Quantitative Aptitude for the CAT", 8th edition, McGraw Hill Education, 2018.

SEMESTER – VII

23Z701 PARALLEL AND DISTRIBUTED SYSTEMS

3 0 0 3

INTRODUCTION TO PARALLEL COMPUTING : Flynn's Taxonomy-Types of Parallel Computers-Characteristics of Parallel Systems-Parallel Computing Models: Shared Memory Models-Interconnection Network Models-Dataflow Model-Parallel Algorithms: Classes of Problems Solvable through Parallelization-Types of Parallelization-Assigning Computational Tasks to Processors- Map Reduce -Spark. (9)

PARALLEL COMPUTING ARCHITECTURE : Introduction-Shared Memory Architecture: Shared Memory Paradigm - Message-Passing Architecture: Message-Passing Paradigm-Routing- Switching-Stream Processing Architecture: Dataflow Paradigm-Parallel Accelerators- Stream Processors – Kafka (9)

PARALLEL PROGRAMMING WITH OpenMP and MPI :OpenMP:Overview of Features-Additional Feature Details:OpenMP Directives-Synchronization-Runtime Library Routines-MPI:Introduction to MPI-Basic Point-to-point Communication Routines-Basic MPI Collective Communication Routines-Environment Management Routines-Point-to-point Communication Routines-Collective Communication Routines (9)

DISTRIBUTED COMPUTING : Definition, motivation, Coordination – clocks- mutual exclusion - Deadlock– leader election, Replication management – Consistency protocols. (9)

GPU COMPUTING : CPU vs GPU, Architecture of CUDA capable GPU – GPU computing – Data parallelism – CUDA program structure – Vector addition – CUDA thread Organisation – Matrix-matrix multiplication – Blocks – OpenCL data parallel model, device architecture (9)

Total L: 45

TEXT BOOKS:

1. Vivek Kale, Parallel Computing Architectures and APIs: IoT, big data stream processing", CRC Press, 2020.
2. Andrew S.Tanenbaum and Maarten van Steen, "Distributed Systems, Principles and Paradigm" Prentice Hall,2013

REFERENCES:

1. AnanthGrama, Anshul Gupta, George Karypis and VipinKumar,"Introduction to Parallel ComputingII", Second Edition, Pearson Education, 2009
2. David Kirk, Wen Mei W Hwu, "Programming Massively Parallel Processors", Third Edition: A Hands-on Approach", Morgan Kaufmann Publishers Inc, 3rd edition, 2016
3. Michael J Quinn, "Parallel Computing: Theory and Practice", Tata Mcgraw-Hill, 2004
4. Shane Cook,"CUDA Programming: A Developer's Guide to Parallel Computing with GPU's (Applications of GPU Computing)
5. Wan Fokkink, " Distributed Algorithms: An Intuitive Approach", MIT Press, 2013

23Z702 CRYPTOGRAPHY AND NETWORK SECURITY

3 1 0 4

COMPUTER SECURITY CONCEPTS: The OSI Security Architecture - Security Attacks - Security Services - Security Mechanisms - A Model for Network Security - Number Theory Concepts: Fermat's and Euler's Theorems, Euclidean Algorithm - Classical Encryption Techniques (9 + 2)

SYMMETRIC CIPHERS: Block Ciphers and Stream Ciphers - Random Bit Generation and Stream Ciphers: Principles of Pseudorandom Number Generation - Pseudorandom Number Generators:Linear Congruential Generators - Block Cipher Modes - Data Encryption Standard (9 + 3)

PUBLIC-KEY CRYPTOGRAPHY: Principles of Public Key Cryptosystems - The RSA Algorithm - Diffie-Hellman Key Exchange - Elliptic Curve Cryptography (9 + 3)

CRYPTOGRAPHIC HASH FUNCTIONS: Secure Hash Algorithm (SHA) - Message Authentication Codes - Message Authentication Requirements - Message Authentication Functions - Digital Signatures - Digital Signature Standard (DSS) - Blockchain: The growth of blockchain technology - Types, Consensus, and Mining Task - Platforms. (9 + 4)

ROLE OF CRYPTOGRAPHY IN SECURITY PROTOCOLS: Network and Internet Security Protocols: Transport-Level Security -Secure Sockets Layer (SSL) - Email Security: Pretty Good Privacy (PGP) - Firewalls: Characteristics and Types(9 + 3)

TOTAL L: 45+T: 15 = 60

TEXT BOOKS

1. Hans, Knebl, Helmut, Delfs , "Introduction To Cryptography Principles And Applications", 3rd Edition, Springer- Verlag, Berlin Heidelberg, 2015.
2. William Stallings , "Cryptography and Network Security: Principles and Practice", 7th Edition, Prentice Hall of India, Pearson Education, New Delhi, 2017.

REFERENCES

1. Behrouz A Forouzan , "Cryptography and Network Security", 3rd Edition, Tata McGraw Hill Ltd, New Delhi, 2015.
2. AtulKahate , " , Cryptography and Network Security", 3rd Edition, Tata McGraw Hill Ltd, New Delhi, 2013.
3. Imran Bashir , "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", 7th Edition, Packt Publishing Ltd, 2018.
4. Douglas Robert Stinson, Maura Paterson , "Cryptography: Theory and Practice", 4th Edition, Chapman and Hall/CRC, 2018.

23Z710 PARALLEL AND DISTRIBUTED SYSTEMS LABORATORY**0 0 4 2****LIST OF EXPERIMENTS:**

1. Program using Multithreading
2. Map-Reduce program with Spark
3. Stream Processing using Kafka
4. Simple application using MPI brsocialanpythonoacasting (Matrix Multiplication, Pi calculation)
5. Point - to – Point application in MPI (Matrix Multiplication, Pi calculation)
6. Matrix operations / PI Calculation using OpenMP
7. Implementation of Election algorithms
8. Implementation of Distributed deadlock detection algorithms
9. Study of CUDA
10. Matrix operations using CUDA

TOTAL P: 60**23Z711 PROJECT WORK – 1****0 0 4 2**

The project I involves the following:

- Identification of Real-World Problem
- System Requirement Analysis and Specification
- Developing a Model and Solution for the Identified Problem
- Consolidated Report Preparation and Presentation

TOTAL P: 60

SEMESTER – VIII
23Z810 PROJECT WORK – 2

0 0 8 4

The Project work II involves

- Preparing a project - brief proposal including
- Problem Identification
- A statement of system / process specifications proposed to be developed
- List of possible solutions including alternatives and constraints
- Cost benefit analysis
- Time Line of activities
- Presentation highlighting the
- Design based on functional requirements
- Implementation
- Testing and Validation
- Results and future work
- Consolidated report based on standards

TOTAL P: 120