Tripura University

(A Central University)

Curriculum

For

B. Tech. in Computer Science & Engineering

(CSE)

(1st to 8th Semester)

Detailed Syllabus

2021

Curriculum Structure (Total Credit: 162)

COMMON SYLLABUS- FIRST SEMESTER

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Basic Science - 1	BS 101	Mathematics - I	3	1	0	4	4	100
2.	Basic Science - 2	BS 102	Physics	3	1	0	4	4	100
3.	Engineering Science - 1	ES 103	Basic Electrical Engineering	3	1	0	4	4	100
4.	Engineering Science - 2	ES 104	Engineering Graphics and Design	1	0	0	1	1	100
5.	Basic Science - 3	BS 105	Physics Laboratory	0	0	3	3	1.5	100
6.	Engineering Science - 3	ES 106	Engineering Graphics Practice	0	0	4	4	2	100
7.	Engineering Science - 4	ES 107	Basic Electrical Engineering Laboratory	0	0	2	2	1	100
8.	Mandatory Course - 1	MC 108	Induction Program	3 weeks in the beginning of the semester				0	100
Total :				10	3	9	22	17.5	800

COMMON SYLLABUS- SECOND SEMESTER

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Humanities Science - 1	HS 201	English	2	0	0	2	2	100
2.	Basic Science - 4	BS 202	Mathematics-II	3	1	0	4	4	100
3.	Basic Science - 5	BS 203	Chemistry	3	1	0	4	4	100
4.	Engineering Science - 5	ES 204	Programming for Problem Solving	3	0	0	3	3	100
5.	Engineering Science - 6	ES 205	Manufacturing Practices	1	0	0	1	1	100
6.	Humanities Science - 2	HS 206	Language Laboratory	0	0	2	2	1	100
7.	Basic Science - 6	BS 207	Chemistry Laboratory	0	0	3	3	1.5	100
8.	Engineering Science - 7	ES 208	Programming for Problem Solving Lab	0	0	4	4	2	100
9.	Engineering Science - 8	ES 209	Workshop on Manufacturing Practices	0	0	4	4	2	100
10.	Mandatory Course - 2	MC 210	Environmental Engineering	3	0	0	3	0	100
Total :				15	2	13	30	20.5	1000

THIRD SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Humanities Science - 2	HU 301	Effective Technical Communication	3	0	0	3	3	100
2.	Basic Science - 7	BS 302	Mathematics-III	2	1	0	3	3	100
3.	Basic Science - 8	BS 303	Biology for Engineers	2	0	0	2	2	100
4.	Engineering Science - 5	ES 304	Engineering Mechanics	2	1	0	3	3	100
5.	Program Core - 1	PC CS 305	Digital Logic & Microprocessor.	3	1	0	4	4	100
6.	Program Core - 2	PC CS 306	Data Structure & Algorithm	3	0	0	3	3	100
7.	Program Core - 3	PC CS 307	Java Programming Lab	0	0	4	4	2	100
8.	Program Core - 4	PC CS 308	Data Structure Lab	0	0	2	2	1	100
9.	Program Core - 5	PC CS 309	Digital Electronics & Microprocessor Lab	0	0	2	2	1	100
10.	Mandatory Course -3	MC 310	Indian Constitution	2	0	0	2	0	100
Total :				17	3	8	28	22	1000

FOURTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Humanities Science - 3	HU 401	Engineering Economics and Accountancy	3	0	0	3	3	100
2.	Humanities Science - 4	HU 402	Universal Human Values-II: Understanding Harmony	2	1	0	3	3	100
3.	Program Core - 6	PC CS 403	Discrete Mathematics	3	1	0	4	4	100
4.	Program Core - 7	PC CS 404	Computer Organization & Architecture	3	1	0	4	4	100
5.	Program Core - 8	PC CS 405	Operating Systems	3	0	0	3	3	100
6.	Program Core - 9	PC CS 406	Object Oriented Programming	3	0	0	3	3	100
7.	Program Core - 10	PC CS 407	IT Workshop (Python/R)	0	0	2	2	1	100
8.	Program Core - 11	PC CS 408	Operating System Lab	0	0	2	2	1	100
9.	Program Core - 12	PC CS 409	Object Oriented Programming Lab	0	0	2	2	1	100
10.	Mandatory Course - 4	MC 410	Essence of Indian Knowledge Tradition	2	0	0	2	0	100
Total:				19	3	6	28	23	1000

FIFTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/week	Credit	Full Marks
1.	Humanities Science -5	HU 601	Professional Practice, Law and Ethics	2	0	0	2	2	100
2.	Program Core-13	PC CS 502	Design and Analysis of Algorithm	3	0	0	3	3	100
3.	Program Core-14	PC CS 503	Database Management Systems	3	0	0	3	3	100
4.	Program Core-15	PC CS 504	Formal Language & Automata Theory	3	0	0	3	3	100
5.	Program Core-16	PC CS 505	Artificial Intelligence	3	0	0	3	3	100
6.	Program Core-17	PC CS 506	Computer Networks	3	0	0	3	3	100
7.	Program Core-18	PC CS 507	Algorithm Lab	0	0	2	2	1	100
8.	Program Core-19	PC CS 508	Database Management System Lab	0	0	2	2	1	100
9.	Program Core-20	PC CS 509	Computer Hardware & Network Lab	0	0	4	4	2	100
10.	Summer Internship-1	SI CS 510	Industry Internship - I	0	0	0	0	1	100
Total :				17	0	8	25	22	1000

SIXTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Program Core-21	PC CS 601	Digital Image Processing	3	0	0	3	3	100
2.	Program Core-22	PC CS 602	Compiler Design	3	0	0	3	3	100
3.	Program Core-23	PC CS 603	Cryptography and Network Security	3	0	0	3	3	100
4.	Program Core-24	PC CS 604	Software Engineering	3	0	0	3	3	100
5.	Program Core-25	PC CS 605	Advanced Java Lab	0	0	2	2	1	100
6.	Program Core-26	PC CS 606	Web Technology Lab (PHP/ JavaScript)	0	0	2	2	1	100
7.	Program Core-27	PC CS 607	Image Processing Lab	0	0	2	2	1	100
8.	Program Elective-1	PE CS 608/1	Advanced Computer Architecture	3	0	0	3	3	100
		PE CS 608/2	Data Mining						
		PE CS 608/3	Web Technology						
9.	Project - 1	PR CS 609	Mini Project	0	0	6	6	3	100
Total :				15	0	12	27	21	900

SEVENTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Program Elective-2	PE CS 701/1	Internet of Things	3	0	0	3	3	100
		PE CS 701/2	Kotlin Programming						
		PE CS 701/3	Blockchain Technology						
2.	Program Elective-3	PE CS 702/1	Soft Computing	2	0	0	2	2	100
		PE CS 702/2	Machine Learning						
		PE CS 702/3	Cloud Computing						
3.	Open Elective-1	OE 703	Refer Annexure 1	3	0	0	3	3	100
4.	Open Elective-2	OE 704	Refer Annexure 2	2	0	0	2	2	100
5.	Project - 2	PR CS 705	Project Work Intermediate	0	0	12	12	6	200
6.	Summer Internship-2	SI CS-706	Internship - II	0	0	0	0	1	100
7.	Seminar - 1	SE CS 707	Seminar on Contemporary Engineering Topics - I	0	0	2	2	1	100
Total :				10	0	14	24	18	800

EIGHTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Program Elective-4	PE CS 801/1	Distributed Systems	3	0	0	3	3	100
		PE CS 801/2	Mobile Computing						
		PE CS 801/3	Big Data Analytics						
2.	Program Elective-5	PE CS 802/1	Pattern Recognition	2	0	0	2	2	100
		PE CS 802/2	Natural Language Processing						
		PE CS 802/3	Android Operating System						
3.	Open Elective-1	OE 803	Refer Annexure 3	3	0	0	3	3	100
4.	Open Elective-2	OE 804	Refer Annexure 4	2	0	0	2	2	100
5.	Project - 3	PR CS 805	Project Work Final	0	0	12	12	6	200
6.	Seminar - 2	SE CS 806	Seminar on Contemporary Engineering Topics - II	0	0	2	2	1	100
7.	Online Course	SW CS 807	SWAYAM Courses[#]	0	0	0	0	1	100
Total :				10	0	14	24	18	800

TRIPURA UNIVERSITY

(A CENTRAL UNIVERITY)

CURRICULUM STRUCTURE

OF

4 YEARS

BACHELOR OF TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (CSE)

THIRD SEMESTER

THIRD SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Humanities Science - 2	HU 301	Effective Technical Communication	3	0	0	3	3	100
2.	Basic Science - 7	BS 302	Mathematics-III	2	1	0	3	3	100
3.	Basic Science - 8	BS 303	Biology for Engineers	2	0	0	2	2	100
4.	Engineering Science - 5	ES 304	Engineering Mechanics	2	1	0	3	3	100
5.	Program Core - 1	PC CS305	Digital Logic & Microprocessor.	3	1	0	4	4	100
6.	Program Core - 2	PC CS 306	Data Structure & Algorithm	3	0	0	3	3	100
7.	Program Core - 3	PC CS 307	Java Programming Lab	0	0	4	4	2	100
8.	Program Core - 4	PC CS 308	Data Structure Lab	0	0	2	2	1	100
9.	Program Core - 5	PC CS 309	Digital Electronics & Microprocessor Lab	0	0	2	2	1	100
10.	Mandatory Course -3	MC 310	Indian Constitution	2	0	0	2	0	100
Total :				17	3	8	28	22	1000

Effective Technical Communication

Course Code	HS 301
Course Title	Effective Technical Communication
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	1st year B.Tech
Course Category	Humanities Science (HS)
Number of classes	36 hours

Course Outcomes:

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

CO Number	CO Description	K-level
CO-1	Illustrate the nature and objective of Technical Communication relevant for the work place as Engineers	K2
CO-2	Utilize the technical writing for the purposes of Technical Communication and its exposure in various dimensions.	K3
CO-3	Develop effective verbal and non-verbal communication skills.	K3
CO-4	Analyze ethical, legal, cultural, and global issues affecting Technical Communication and Develop appropriate life skills.	K4

Module 1: Essentials of Communication (09 hrs)

What is Communication, Process of Communication, Levels of communication, The flow of Communication: Downward, Upward, Lateral or Horizontal (Peer group) Communication Barriers to communication, Non-verbal Communication, , Technology Enabled communication, Impact of Technology, Selection of appropriate communication Technology, Importance of Technical Communication, Differences between general and technical communication.

Module 2: Technical Writing Skills (09 hrs)

Technical writing process – Choosing right words, phrases and sentence patterns, clarity of purpose, planning content, effective style of writing, formatting, proofreading.
Technical Reports & Proposals: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Writing of Reports & Proposals.
Business letters: Sales & Credit letters; Claim and Adjustment Letters; Letters of Enquiry, Order Placement letters

Email Writing: Reasons for popularity; guiding principles for composition; some common pitfalls; maintaining common etiquette.

Module: 3 Workplace Communication (09 hrs)

Applying for a job: Skimming advertisements; Writing job applications; Preparing CV, Resume.
Group Discussions: Group Discussion types; GD as a part of selection process; Key skills to succeed in group discussions; Dos and Don'ts of group discussions; Use of body language in GDs.
Job Interviews: Objectives; Types; Stages of Interview, Face to face Interviews; Telephonic Interviews.
Effective Business Presentations: Importance in workplace communication; Planning, Preparing, Organizing, Rehearsing, and Delivering Oral presentations, Handling Questions; Visual aids in presentations; Power Point Presentations
Ethics in Communication: Communication challenges in culturally diverse workforce; Bias-free communication

Module: 4 Developing soft skills/ Life Skills (09 hrs)

Introduction to soft skills: Soft skills as a competitive weapon in today's changing workplace.
Classification of soft skills: Time management, Attitude, Responsibility, Ethics & Values, self-confidence, Teamwork and Interpersonal skills, Problem solving skills.
Personality Development: Developing Right personality to enhance Life Skills, Personality types; Personality attributes; and Leadership Qualities.
Body Language : Emotions displayed by body language: Aggressive, Submissive, Attentive, Nervous, Upset, Bored, Relaxed, Defensive; Hand Shake; Eye Contact; Posture and Positioning.
Personality traits and soft skills in early stages of career advancement and for future career advancement.

Recommended Books:

1) Sanjay Kumar & PushpLata Communications Skills , 2nd Edition,Oxford University Press
2) Meenakshi Raman & Sangeeta Sharma Technical Communication: Principles & Practice Oxford University Press
3) Barun Kumar Mitra, Personality Development and Soft Skills Oxford University Press.
4) Personality Development, Harold R. Wallace & L. Ann Masters, Cengage Learning, NewDelhi.
5) Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
6) Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi.
7) Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, McGraw Hill & Co. Ltd., 2001, New Delhi.
8) A Text Book of Scientific and Technical Writing by S.D. Sharma; Vikas Publication, Delhi.
9) Skills for Effective Business Communication by Michael Murphy, Harward University, U.S

List of Software/Learning Websites

1. http://www.free-english-study.com/ 2. http://www.english-online.org.uk/course.htm
3. http://www.english-online.org.uk/ 4. http://www.talkenglish.com/

5. http://www.learnenglish.de/

Mathematics-III

Course Code	BS 302
Course Title	Mathematics-III
Number of Credits	3 (L: 2, T: 1, P: 0)
Prerequisites	B.Tech 1st Year Mathematics
Course Category	Basic Science (BS)
Number of classes	36 hours

Course Outcome:-

After completion of the course, students will be able to:

CO No	CO Description	K-level
CO-1	Solve problems in 1st and 2nd order linear Partial Differential Equations	K3
CO-2	Show fourier series expansion of a given function and solve PDEs by variables separable method	K3
CO-3	Identify mean and variance of a given probability distribution	K3
CO-4	Solve numerically algebraic/transcendental equation and ordinary differential equations	K3

Course Content:-

Module 1: Partial Differential Equations (10 hrs)

First order partial differential equations, solutions of first order linear and quasi-linear partial differential equation (Pp + Qq =R) by Lagrange method. Homogeneous and non-homogeneous type of second order linear differential equation with constant coefficients by complimentary function and particular integral method.

Module 2: Fourier series (08 hrs)

Expansion of a function in Fourier series for a given range - Half range sine and cosine expansions. One-dimensional wave equation and one-dimensional heat flow equation - method of separation of variables - Fourier series solution.

Module 3: Probability **(08 hrs)**

Classical and axiomatic definition of probability, conditional probability, Bayes' theorem, independent events, random variables, expectation and higher order moments, probability mass function and probability density function, distribution function, Sample space, Events, Random Variables; Definitions of probability, conditional Probability, examples of discrete and continuous distributions: Normal, Poisson, Binomial distributions.

Module 4: Numerical Analysis **(10 hrs)**

Numerical solution of algebraic and transcendental equations by Regula-Falsi method Newton-Raphson's method; Finite Differences - Newton's Forward, backward difference interpolation formulae - Lagrange interpolation; Numerical Integration with Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule; Solving first order differential equations –Taylor's series method, Euler's method, modified Euler's method, Runge-Kutta method of 4th order.

References / Suggested Learning Resources:-

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 1965.
2. RajnishVerma& H.K. Dass, Higher Engineering Mathematics, S Chand, 2014.
3. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993
4. Jain, Iyengar and Jain, Numerical methods for Scientific and Engineering Computation, New Age International Publications, 2008.
5. ErwynKreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 8th Edition, 2008.

Biology for Engineers

Course Code	BS 303
Course Title	Biology for Engineers
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	-
Course Category	Basic Science (BS)
Number of classes	26 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Demonstrate the understanding of biology and its branches, major classifications of life, Cells, Cellular systems their functions and biological molecules.	K2
CO-2	Illustrate the molecular basis of genetic information and the flow of genetic information from DNA to RNA to protein and the concept of mutations, re-combinations and its applications.	K2
CO-3	Classify microorganisms, growth, nutrition with their various methods used for the isolation, identification, control and maintenance of microbial cultures.	K4
CO-4	Explain the fundamental principles of energy transactions in physical and biological and physiological systems, basic metabolisms.	K2

Course Content:

Module 1: Introduction to Biology, Classification and Biomolecules (8 hours)

Detailed content of the module: Introduction to Biology and its branches. Molecular taxonomy-three major kingdoms of life. Prokaryotic and Eukaryotic cells. Energy and Carbon utilization. Cells: Animal and Plant cell structures and functions. Cell cycle and Cell division. Transport across cell membrane. Cell signaling.
Molecules of life. Monomeric units and polymeric structures. Sugars, starch and cellulose. Lipids, Amino acids and proteins. Nucleotides, DNA and RNA. Proteins- structure and function. Proteins as enzymes, transporters, receptors and structural elements. Enzyme classification. Mechanism of enzyme action. Enzyme kinetics.

Module 2: Fundamentals of genetics and flow of informations (6 hours)

Detailed content of the module: General principles of genetics, Concept of segregation and independent assortment. Molecular basis of information transfer, molecular basis of coding and decoding genetic information. DNA as genetic material. Concept of genetic code. Define gene in

terms of complementation and recombination. Mutation. Recombinant DNA technology. Gene mapping. Application of recombinant DNA technology, recombinant products available in the market and at laboratory scale.

Module 3: Microbiology and applications (6 hours)

Detailed content of the module: Microorganisms and environment: Identification and classification of microorganisms. Ecological aspects of single celled organisms. Microbial integrations. Growth, nutrition and reproduction. Growth kinetics. Isolation and identification of microorganisms. Pure cultures and their characteristics. Maintenance of cultures. Sterilization. Physical and chemical methods of control of microorganisms. Management of toxic industrial wastes.

Module 4:Fundamentals of energy transaction and metabolism (6 hours)

Detailed content of the module: Thermodynamics –laws and its application in biological systems. Energy yielding and energy consuming biochemical processes.
Metabolism- Glycolysis & Krebs cycle, Role of ATP and concept of energy change. Equilibrium constant. Physiological steady-state, Living body as a thermodynamic system.
Fundamental aspects of analysis of living systems; quantitative aspects of physiology and engineering applications to clinical medicine based on body fluid balance, solute transport, basic endocrinology, reproduction physiology, neurophysiology, skeletal and smooth muscle physiology.

References / Suggested Learning Resources:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd. 12th Edition, 2020
2. Guyton and Hall, Medical Physiology, 14th Edition, Elsevier Saunders, 2020
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company.
4. Principles of Genetics, D. Peter Snustad and Michael J. Simmons. 7th Edition, Wiley Publisher, 2015
5. Prescott's Microbiology, Joanne Willey and Kathleen Sandman and Dorothy Wood, 2020. 11th Edition McGraw Hill

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Engineering Mechanics

Course Code	ES 304
Course Title	Engineering Mechanics
Number of Credits	3 (L: 2, T: 1, P: 0)
Prerequisites	---
Course Category	Engineering Science (ES)
Number of classes	36 hours

Course Outcome:-

After completion of the course, students will be able to:

CO No	CO Description	K-level
CO-1	Differentiate coplanar, concurrent & non-concurrent forces and their resultants and confidently tackle equilibrium equations and its applications.	K3
CO-2	Explain centroid of simple figures, centre of gravity, moment of inertia of composite sections & mass moment of inertia of circular plates, cylinder, cone, sphere & hook.	K2
CO-3	Analyze simple truss, compound truss, frame & virtual work.	K4
CO-4	Understand and be able to apply other basic dynamics concepts - the Work-Energy principle, analyze D'Alembert's principle and differentiate longitudinal, transverse, torsional and damped vibrations.	K2

Course Content:-

Module 1: Fundamentals of Engineering Mechanics: (9 Periods)

-Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy

-Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Module 2: Centre of Gravity & Moment of Inertia: (9 Periods)

Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications;

-Area moment of inertia-Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Module 3: Trusses, Frames & Virtual Work: (9 Periods)

-Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;

-Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

Module 4: Dynamics & Mechanical Vibrations: (9 Periods)

-Dynamics - Basic terms & General principles of dynamics, Types of motion, Instantaneous centre of rotation in plane motion, D'Alembert's principle and its application, Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.

-Vibration - Basic concepts of Longitudinal, Transverse and Torsional vibrations, Free & Forced vibration, Resonance and its effects, Damped vibration.

Text Books / References:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and RudraPratap (2011), Introduction to Statics and Dynamics, Oxford UniversityPress
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications
11. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education.
12. Irving, H.Shames, Engineering Mechanics-Statics and Dynamics, by Prentice-Hall of India.
13. Khurmi R. S. (2010), Engineering Mechanics, S. Chand & Co.
14. NPTEL web or video courses on Engineering Mechanics.
15. Timoshenko & D.H.Young, EngineerringMechanics,Tata McGraw-Hill publishing Co. Ltd.

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Digital Logic and Microprocessor

Course Code	PC CS 305
Course Title	Digital Logic and Microprocessor
Prerequisites	Basic knowledge of Electronics
Course Category	Program core
Number of classes	40 hours
Number of credits	04 (L: 3, T: 1 , P: 0)

Course Outcome:

After completion of the course, students will be able to:

Course Outcomes(COs): At the end of the course, the student will be able to		
CO Number	CO Description	K-level
CO-1	Explain the Combinational Circuits using Logic Gates.	K2
CO-2	Explain the Sequential Logic Circuits using Flip-Flop.	K2
CO-3	Build Sequential Circuits such as Register, Counter and Sequence Generator.	K4
CO-4	Explain the Basic Fundamentals of 8085 Microprocessor.	K2

Module 1: (10 lectures)

Binary Systems & Code conversion, Boolean Algebra & Logic Gates – Truth Tables – Universal Gates – Simplification of Boolean functions: SOP, POS methods – K-map, – Combinational Logic: Adders & Subtractors – Multiplexer – Demultiplexer - Encoder – Decoder.

Module 2: (08 lectures)

Sequential Logic: RS, Clocked RS, D, JK, Master Slave JK, T Flip-Flops – Shift Registers – Types of Shift Registers – Counters: Ripple Counter – Synchronous Counters – Up-Down Counter.

Module 3: (10 lectures)

Introduction to Microprocessors, Microcomputers, and Assembly Language – Microprocessor Architecture and Its Operations – Memory – I/O Devices – 8085 MPU – Introduction to 8085 Instructions – Data Transfer Operations – Addressing Modes - Arithmetic, Logic and Branch Operations – Writing Assembly Language Programs .

Module 4: (12 lectures)

Time Delay Programs: Time Delay Using One Register – Using a Register Pair – Using a Loop within Loop Technique – Counter Design with Time Delay – Stack and Subroutines – BCD to Binary Conversion and Viceversa – BCD to HEX Conversion and Vice-versa – Binary to ASCII Conversion and Vice-versa – BCD Addition and Subtraction **.**

8085 Interrupt – Vectored Interrupts – Interfacing I/O Devices: Basic Interfacing Concepts – Interfacing Input Devices- Memory-Mapped I/O.

References / Suggested Learning Resources:

1. M. Morris Mano,2005, Digital Logic and Computer Design, Prentice-Hall of India Pvt. Ltd.
2. Ramesh S. Gaonkar,1999,Microprocessor Architecture, Programming, and Applications with the 8085, 5thEdition,Penram International Publishing (India) Pvt. Ltd.
3. D. P. Leach and A. P. Malvino,2002,Digital Principles and Applications,5th Edition, Tata McGraw, Hill Publishing Co. Ltd.
4. V. Vijayendran,2004,Digital Fundamentals,S. Viswanathan (Printers & Publishers) Pvt. Ltd.
5. V. Vijayendran ,2004, Fundamentals of Microprocessor – 8085, S. Viswanathan (Printers & Publishers) Pvt. Ltd.
6. N. K. Srinath,2005, 8085 Microprocessor Programming and Interfacing, Prentice-Hall of India Pvt. Ltd.

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Data Structure and Algorithm

Course Code	PC CS 306
Course Title	Data Structure and Algorithm
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	ES204
Course Category	Program Core(PC)
Number of classes	38 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Explain and apply the basic concepts of data structures and algorithms	K3
CO-2	Explain and apply concepts about searching and sorting techniques	K3
CO-3	Explain and apply basic concepts about stacks, queues, lists, trees and graphs	K3
CO-4	Develop algorithms for solving problems with the help of fundamental data structures	K3

Course Content:

Module 1: Introduction (5 Hours)

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off Searching: Linear Search and Binary Search Techniques and their complexity analysis

Module 2: Stacks and Queues (9 Hours)

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Module 3: Linked List and Trees (12 Hours)

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue,

Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis

Module 4: Sorting Hashing and Graph (12 Hours)

Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis**.**

Suggested books:

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
2. “Data Structures using C/C++ “ Tannenbaum”

Suggested reference books:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education.

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Java Programming Lab

Course Code	PC CS 307
Course Title	Java Programming Lab
Number of Credits	2 (L: 0, T: 0, P: 4)
Prerequisites	ES 208 (Programming for Problem Solving Lab)
Course Category	Program Core(PC)
Number of classes	40 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Apply Object oriented features and Java concepts.	K3
CO-2	Apply the concept of multithreading and implement exception handling.	K3
CO-3	Compare the development of JAVA applets vs. JAVA applications.	K4
CO-4	Develop program to access data from a Database with java program.	K6

List of Experiments (*Minimum 10 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Write a program to swap two values using method.
2. Write a program to demonstrate method overloading by defining two different parameters in the same method.
3. Write a program to demonstrate Java Package.
4. Write a program to perform calculation based on numbers and operator entered.
5. Write a program to sum the elements of an array and determine the max element.
6. Write a program to add two matrices of the same size
7. Write three different programs to show usage of default and parameterized constructor.
8. Write a program to find area and volume of a rectangle using constructor.
9. Write a program to determine the volume of a room using inheritance.
10. Write a program to demonstrate the use of super keyword with a variable.
11. Write a program to calculate the area of circle and sphere using interface.
12. Write a program to demonstrate the usage of Runtime Polymorphism in java.

13. Write a programto demonstrate applet using appletviewer in java.
14. Write a program to demonstrate Digital clock in Applet.
15. Write a program to demonstrate JTextarea using java swing.
16. Write a program to demonstrate JCombo using java swing.
17. Write a program to demonstrate JTable using java swing.
18. Write a program to creating Edit menu for Notepad using java swing.
19. Write a program to Connect Java Application with mysql database.
20. Write a program to demonstrate transaction management in jdbc using Prepared Statement.

References / Suggested Learning Resources:

1. Introducing Java 8 Author: by Raoul-Gabriel Urma.
2. Object-Oriented vs. Functional Programming Author: by Richard Warburton
3. Data Structures and Algorithm Analysis in Java (3rd Edition) by Mark Allen Weiss, Addison Wesley,(2011).
4. Deitel & Deitel, JAVA : How to Program, Pearson education , 7e (2008)
5. Ivan BayRoss, Web Enabled Commercial Application using Java 2, bpb publication (1998)

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Data Structure Lab

Course Code	PC CS 308
Course Title	Data Structure and Algorithm Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	ES208
Course Category	Program Core (PC)
Number of classes	24 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	analyze the algorithms to determine the time and computation complexity.	K3
CO-2	Solve Search problem (Linear Search and Binary Search)	K3
CO-3	Solve problem of Stacks, Queues and linked list and analyze the same to determine the time and computation complexity	K4
CO-4	Construct an algorithm using Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity	K4
CO-5	Apply Graph search and traversal algorithms and determine the time and computation complexity	K4

List of Experiments (*Minimum 6 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Implementation of array operations
2. Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements
3. Problems to solve using stacks and queues as per the theory subject Data Structure and Algorithm
4. Implement different operations (insertion, deletion, searching, sorting, reversals) on Single linked list, double linked list, circular linked list.
5. Implement different sorting algorithms as listed in Data Structure and Algorithm subject
6. Implement Graph.
7. Perform Graph search operations

References / Suggested Learning Resources:

1. "Data Structures and Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung
2. "Data Structure & Algorithms Using C", 5th Ed., Khanna Publishing House
3. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Andersonfreed.
4. "Data Structures in C" by Aaron M. Tenenbaum.
5. "Data Structures" by S. Lipschutz.
6. "Data Structures Using C" by Reema Thareja.
7. "Data Structure Using C", 2/e by A.K. Rath, A. K. Jagadev.
8. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein
9. "Data Structures through C" by Yashwant Kanetkar, BPB Publications.

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Digital Electronics & Microprocessor Lab

Course Code	PC CS 309
Course Title	Digital Electronics & Microprocessor Lab
Prerequisites	Theoretical knowledge of Digital Logic and Microprocessor
Course Category	Program Core
Number of classes	24 hours
Number of credits	01 (L: 0, T: 0, P: 2)

Course Outcome:

After completion of the course, students will be able to:

Course Outcomes(COs): At the end of the course, the student will be able to		
CO Number	CO Description	K-level
CO-1	Analyze and realize different logic gates	K4
CO-2	Apply different combinational and sequential logic circuits.	K3
CO-3	Apply basic arithmetic operations in 8085	K4
CO-4	Apply searching and sorting in 8085.	K3

List of Experiments (*Minimum 6 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

DIGITAL ELECTRONICS: (also can be performed using VHDL)

1. Verification of Truth Table for AND, OR, NOT, NAND, NOR and EX-OR gates.
2. Realisation of NOT, AND, OR, EX-OR gates with only NAND and only NOR gates.
3. Karnaugh Map Reduction and Logic Circuit Implementation.
4. Verification of De-Morgan's Law.
5. Implementation of Half-Adder and Half-Subtractor.
6. Implementation of Full-Adder and Full-Subtractor.
7. Four Bit Binary Adder
8. Four Bit Binary Subtractor using 1's and 2's Complement.
9. Design a 4 X 1 Multiplexer using gates.

10. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type).

11. Design a counter using D/T/JK Flip-Flop.

12. Clocked D FF, T FF and JK FF (with Reset inputs).

MICROPROCESSOR:

1. 8 Bit Addition and Subtraction.

2. 16 Bit Addition.

3. BCD Addition .

4. BCD Subtraction.

5. 8 Bit Multiplication.

6. BCD Multiplication.

7. 8 Bit Division.

8. Searching for an Element in an Array.

9. Sorting in Ascending and Descending Orders.

10. Finding Largest and Smallest Elements from an Array.

11. Reversing Array Elements.

12. Block Move.

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Indian Constitution

Course Code	MC 310
Course Title	Indian Constitution
Number of Credits	0 (L: 2, T: 0, P: 0)
Prerequisites	Nil
Course Category	Mandatory Course (MC)
Number of classes	25 hours

Course Outcome:-

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Explain about framing and nature of Indian Constitution.	K2
CO-2	Identify the fundamental rights and duties of individual and demonstrate the knowledge on Directive Principles of State Policy.	K3
CO-3	Outline the Federal Structure, Centre- State relation, Union Executive and Amendment Procedure	K2
CO-4	Demonstrate the meaning of local self govt., types of local self govt. in rural and urban areas.	K2

Course Content:

Module 1: Constitutional Framework (05 hours)

1. Meaning of Constitutional Law and Constitutionalism.
2. Historical perspective of the Constitution of India.
3. Salient features of the Constitution of India.

Module 2: Fundamental Rights, Duties and Directive Principles of State Policy (06 hours)

1. Fundamental Rights- Articles 14, 19 and 21.
2. Fundamental Duties.
3. Directive Principles of State Policy; Its Legal Status and Significance

Module 3: Nature of India's Political system (07 hours)

1. Federal structure, Distribution of Legislative and Financial Powers between the Union and States.
2. Parliamentary Form of Government- Powers and Position of President of India.
3. Emergency Provisions.
4. Amendment Procedures of the Constitution of India.

Module 4: Rural and Urban Local Self Govt. (07 hours)

1. 73rd Amendment of the Constitution and Panchayati Raj Institutions.
2. 74th Amendment of the Constitution and Urban Local Self Govt. (Municipal Corporation, Municipal Council and Nagar Panchayat).
3. TTAADC

References / Suggested Learning Resources:

1. Fadia, B.L- "Indian Govt. and Politics"Sahitya Bhawan, Agra.

2. D.D.Basu- "An introduction to the Constitution of India"Lexis Nexis publichers.

3. M.V.Pylee- "Constitutional Govt. in India"S.Chand and Company Ltd.

4. S.C.Kashyap(ed)- "Perspectives on the constitution"Shipra Publication.

5. B.K. Sharma- "Introduction to the Constitution of India"Prentice Hall India Private Ltd.

6. Bhattacharya, D.C. and Banerjee, Malay- "Indian Govt. and Politics"Vijaya Publishing House

7. J.C. Johari- "Indian Govt. and Politics" (2 vols)

8. Das Nityananda- "Grassroot Democracy and Panchayati Raj in Tripura" Progressive Publichers

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TRIPURA UNIVERSITY

(A CENTRAL UNIVERITY)

CURRICULUM STRUCTURE

OF

4 YEARS

BACHELOR OF TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (CSE)

FOURTH SEMESTER

FOURTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Humanities Science - 3	HU 401	Engineering Economics and Accountancy	3	0	0	3	3	100
2.	Humanities Science - 4	HU 402	Universal Human Values-II: Understanding Harmony	2	1	0	3	3	100
3.	Program Core - 6	PCCS403	Discrete Mathematics	3	1	0	4	4	100
4.	Program Core - 7	PCCS404	Computer Organization & Architecture	3	1	0	4	4	100
5.	Program Core - 8	PCCS405	Operating Systems	3	0	0	3	3	100
6.	Program Core - 9	PCCS406	Object Oriented Programming	3	0	0	3	3	100
7.	Program Core - 10	PCCS407	IT Workshop (Python/R)	0	0	2	2	1	100
8.	Program Core - 11	PCCS408	Operating System Lab	0	0	2	2	1	100
9.	Program Core - 12	PCCS409	Object Oriented Programming Lab	0	0	2	2	1	100
10.	Mandatory Course - 4	MC 410	Essence of Indian Knowledge Tradition	2	0	0	2	0	100
Total:				19	3	6	28	23	1000

Engineering Economics and Accountancy

Course Code	HS 401
Course Title	Engineering Economics and Accountancy
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	-
Course Category	Humanities Science (HS)
Number of classes	38 hours

Course Outcomes:

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

CO Number	CO Description	K-level
CO-1	Explain the importance of engineering economics in business.	K2
CO-2	Demonstrate the necessary knowledge and skills for running a business organisation.	K2
CO-3	Interpret the financial statement and position of an organisation.	K2
CO-4	Analyze the accounting information for decision making.	K4
CO-5	Develop the knowledge & skill on business and management.	K3

Course Content:

Module 1: Engineering economics (9 hrs)

- Engineering economy and its importance;
- Demand& supply: Wants, satisfaction of wants, demand, supply, elasticity of demand, estimation of demand, supply chain economy;
- Production-Factors of production (land, labor, capital, and entrepreneurship), Laws of return.
- Money – Value of money, quantity theory; inflation and deflection.

Module 2: Business Skills for Engineers (9 hrs)

- Business Structure: Proprietorship, Partnership and Joint Stock Company;
- Basic management for businesses: Basic functions of management,
- Risk Management: Type of risk, Risk management steps
- Entrepreneur and Leadership: Leadership styles, Qualities of a good leader for a business;
- Financing and the business: Objectives and sources of funds;
- Taxation: Basics of Income tax & Goods and Services Tax (GST)

Module 3: Financial Accounting for Business (10 hrs)

- Transactions: Financial event, Features of transactions; Recording of transactions;
- Basic accounting: Ledger, Trail balance, Cash book (double column only);
- Final account: Objectives, Preparation of final accounts (Trading A/C, Profit & Loss A/C and Balance Sheet).

Module 4: Managerial Accounting for Decision-making (10 hrs)

- Cost classifications – Material cost control, labor cost control and overhead cost control (only theory);
- Cost sheet: Objective and preparation of Cost sheet (Basic problem);
- Capital budgeting: Objectives Pay-back period and NPV method for feasibility testing of investment
- Working capital management: Factors and sources of WC
- Ratio analysis: Interpretation for industrial control, Basic ratios- Current Ratio, Debt-equity ratio, proft ratio

References / Suggested Learning Resources:

- Fundamentals of Engineering Economics, 4th Edition, by Chan S. Park, Pearson Publishing;
- Engineering Economics And Financial Accounting Paperback, by Arasu, Scitech publication
- Engineering Economics and Financial Accounting for Anna University Paperback by A. Bagad,Technical Publications;
- Financial Management- An analytical framework , Nayak& Manna, Parul Library;
- Principles of Management, Ghose and Basu,ABS Publishing House;

Universal Human Values-II: Understanding Harmony

Course Code	HU-402
Course Title	Universal Human Values-II: Understanding Harmony
Number of Credits	3(L: 2, T: 1, P: 0)
Prerequisites	Induction Programme and Universal Human Values -I
Course Category	Humanities Science (HS)
Number of classes	36 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Explain the term self-exploration and its application for self-evaluation and development.	K2
CO-2	Identify the holistic perception of harmony at level of self, family, society, nature and explain it by various examples.	K3
CO-3	Illustrate the role of a human being in ensuring harmony in society and nature.	K2
CO-4	Distinguish between ethical and unethical practices, and start identifying a strategy to actualize a harmonious environment wherever they work.	K4

Module 1: Introduction- Need, Basic Guidelines, Content and Process for Value Education (8 Hrs)

Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility-the basic requirement for fulfillment of aspirations of every human being with their correct priority.
Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Module2: Understanding Harmony in the Human Being (10 Hrs)

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body'-happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'.
Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

Module 3: Understanding Harmony in the Nature and Existence – Whole existence as Coexistence (8Hrs)

Understanding the harmony in the Nature Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

Module 4: Implications of the above Holistic Understanding of Harmony on Professional Ethics (10Hrs)

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
Competence in professional ethics:
a. Ability to utilize the professional competence for augmenting universal human order
b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems,
c.Ability to identify and develop appropriate technologies and management patterns for above production systems.

ReferenceBooks

1. Human Values and Professional Ethics by RR Gaur, RSangal, GP Bagaria, Excel Books, New Delhi,2010
2. Jeevan Vidya:Ek Parichaya, A Nagaraj, JeevanVidya Prakashan, Amarkantak, 1999.
3. HumanValues, A.N.Tripathi,NewAgeIntl.Publishers,NewDelhi,2004.
4. TheStoryofMyExperimentswithTruth byMohandasKaramchandGandhi.
5. BharatMeinAngrejiRaj-PanditSunderlal
6. RediscoveringIndia-byDharampal
7. HindSwarajor Indian HomeRule- by MohandasK.Gandhi
8. IndiaWinsFreedom-MaulanaAbdulKalamAzad
9. Vivekananda-RomainRolland(English)
10. Gandhi-RomainRolland(English)

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Discrete Mathematics

Course Code	PC CS 403
Course Title	Discrete Mathematics
Number of Credits	4 (L: 3, T: 1, P: 0)
Prerequisites	BS 101, BS 202
Course Category	Program Core(PC)
Number of classes	48 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Construct a logic sentence in terms of predicates, quantifiers, and logical connectives	K3
CO-2	Simplify and Derive the solution for a given problem using deductive logic and prove the solution based on logical inference.	K4
CO-3	Classify its algebraic structure for a given a mathematical problem.	K4
CO-4	Analyze and Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.	K4
CO-5	Develop the given problem as graph networks and solve with techniques of graph theory	K4

Course Content:

Module 1: (10 Hours)

Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Principles of Mathematical Induction: The Well Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

Module 2: (10Hours)

Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination. Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication,

Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

Module 3: (15 Hours)

Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form.

Module 4: (13 Hours)

Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.

Suggested books:

1. Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimisation
2. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI
3. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning
4. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH
5. J.K. Sharma, Discrete Mathematics, Macmillan
6. Winfried Karl Grassmann and Jean-Paul Tremblay, Logic and Discrete Mathematics, PEARSON.

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Computer Organization & Architecture

Course Code	PC CS 404
Course Title	Computer Organization & Architecture
Number of Credits	4 (L: 3, T: 1, P: 0)
Prerequisites	ES204
Course Category	Program Core(PC)
Number of classes	48 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Apply the basics of stored program concepts.	K3
CO-2	Utilize the functional block diagram of a single bus architecture of a computer and describe the function of the instruction execution cycle	K3
CO-3	Examine a memory module and analyze its operation by interfacing with the CPU.	K4
CO-4	Apply design techniques to enhance performance using pipelining, parallelism and RISC methodology	K4

Course Content:

Module 1 **(12 Hours)**

Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.

Data representation: signed number representation, fixed and floating-point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-andadd, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.

Module 2 **(12 Hours)**

Introduction to x86 architecture.

CPU control unit design: hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU.

Memory system design: semiconductor memory technologies, memory organization.

Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, USB

Module 3 **(12 Hours)**

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

Module 4: **(12 Hours)**

Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies.

Suggested books:

1. "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.
2. "Computer Organization and Embedded Systems", 6th Edition by CarlHamacher, McGraw Hill Higher Education

Suggested reference books:

1. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill
2. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
3. "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

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Operating Systems

Course Code	PC CS 405
Course Title	Operating Systems
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Computer Basics
Course Category	Program Core(PC)
Number of classes	38 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Create processes and threads.	K3
CO-2	Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.	K4
CO-3	Develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.	K4
CO-4	Design and implement file management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.	K4

Course Content:

Module 1 **(8 Hours)**

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

Module 2 **(10 Hours)**

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores,

Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Module 3 **(10 Hours)**

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction;

Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU)

Module 4: **(10 Hours)**

I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

Suggested books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.

2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

Suggested reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing

2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, AddisonWesley

3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India

Object Oriented Programming

Course Code	PC CS 406
Course Title	Object Oriented Programming
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	ES204,PCCS306
Course Category	Program Core(PC)
Number of classes	38 hours

Course Outcome:

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

CO Number	CO Description	K-level
CO-1	Classify simple abstract data types and design implementations, using abstraction functions to document them.	K4
CO-2	Classify features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.	K4
CO-3	~~A~~pply some common object-oriented design patterns and give examples of their use.	K4
CO-4	Design applications with an event-driven graphical user interface.	K4

Course Content:

Module 1: Abstract Data Types and Their specifications (5 Hours)

Abstract data types and their specification. How to implement an ADT. Concrete state space, concrete invariant, abstraction function. Implementing operations, illustrated by the Text example

Module 2: Features of Object Oriented Programming (10 Hours)

Features of object-oriented programming. Encapsulation, object identity, polymorphism – but not inheritance

Module 3: Inheritance in Object Oriented Design (10 Hours)

Inheritance in Object Oriented design. Design patterns. Introduction and classification. The iterator pattern. Model-view-controller pattern. Commands as methods and as objects. Implementing OO language features. Memory management.

Module 4: Generic Types and Collections (13 Hours)

Generic types and collections, GUIs. Graphical programming with Scale and Swing . The software development process

Suggested books:

1. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – PrenticeHall, India
2. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
4. R.K Das – "Core Java For Beginners" – VIKAS PUBLISHING
5. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
6. Ivor Horton's Beginning Java 2 SDK – Wrox 7. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

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IT Workshop

Course Code	PC CS407
Course Title	IT Workshop
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	ES 208(Programming for Problem Solving Lab)
Course Category	Program Core (PC)
Number of classes	24 hours

Course Outcome:-

After completion of the course, students will be able to:

CO No	CO Description	K-level
CO-1	Develop algorithmic solutions to simple computational problems.	K3
CO-2	Demonstrate programs using Python control flow and functions.	K3
CO-3	Utilize Python datatypes for accessing different data.	K3
CO-4	Analyse and use different machine learning libraries using python	K4

List of Experiments (*Minimum 6 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Download & Install Python and introduction to Python Language, Python Language Syntax, python Keywords and Identifiers, python Comments and python Variables.
2. Python Data Types, User Input, and Operators.
3. Python Modules.
4. Python Control Flow – Decision Making.
5. Python Control Flow – Looping and Branching.
6. Python Function.
7. Python Numbers and Lists
8. Python Tuples and Strings.
9. Python Sets and Dictionaries.
10. PythonArrays.
11. Python OOPs Concepts, Classes and Object and Constructors.
12. Python Inheritance and Polymorphism.
13. Python Regular Expressions.
14. Python Database Access.
15. Python-Numpy, SciPy, Matplotlib.

16. Python-Pandas.
17. Python Scikit-learn.
18. Python Scikit-image, PIL, Pillow etc.

References / Suggested Learning Resources:-

1. John V Guttag. “Introduction to Computation and Programming Using Python”, Prentice Hall of India.
2. R. Nageswara Rao, “Core Python Programming”, dreamtech.
3. Wesley J. Chun. “Core Python Programming - Second Edition”, Prentice Hall
4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structures and Algorithms in Pyhon”, Wiley.
5. Kenneth A. Lambert, “Fundamentals of Python – First Programs”, CENGAGE Publication.
6. MySQL for Python, by Albert Lukaszewski, Packt Publishing.

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Operating Systems Lab

Course Code	PC CS 408
Course Title	Operating Systems Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Computer Basics
Course Category	Program Core (PC)
Number of classes	24 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Implement deadlock avoidance, and Detection Algorithms	K3
CO-2	Compare the performance of various CPU scheduling Algorithm	K4
CO-3	Analyze the performance of the various page replacement algorithms	K4
CO-4	Create processes and implement IPC	K3
CO-5	Implement C programs using Unix system calls	K4

List of Experiments (*Minimum 6 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Basics of UNIX commands.

2. Shell Programming- creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands)
3. Password security, Shadow file, Groups and the group file, Shells, restricted shells, user-management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users &user groups.

4. Implement the following CPU scheduling algorithms a) Round Robin b) SJF c) FCFS d) Priority

5. Implement all file allocation strategies a) Sequential b) Indexed c) Linked
6. Implement Inter-process communication- pipes (use functions pipe, popen, pclose), named pipes(FIFOs, accessing FIFO), message passing & shared memory (IPC version V).
7. Implement Semaphores
8. Implement all File Organization Techniques:
   a) Single level directory b) Two level c) Hierarchical d) DAG
9. Implement Bankers Algorithm for Dead Lock Avoidance
10. Implement an Algorithm for Dead Lock Detection
11. Implement e all page replacement algorithms a) FIFO b) LRU c) LFU
12. Implement Shared memory and IPC

13. Implement Paging Technique of memory management.
14. Implement Threading & Synchronization Applications
15. Implement disk management algorithms-FCFS, SSTF, SCAN, C-SCAN

SUGGESTED TEXT BOOKS:

1. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley
2. Advanced programming in the Unix environment, W.R.Stevens, Pearson education.

REFERENCE BOOKS:

1. Operating Systems – Internals and Design Principles, William Stallings, Fifth Edition– 2005, Pearson Education/PHI
2. Operating System - A Design Approach-Crowley, TMH.
3. Modern Operating Systems, Andrew S Tanenbaum, 2nd edition, Pearson/PHI
4. UNIX Programming Environment, Kernighan and Pike, PHI/Pearson Education
5. UNIX Internals: The New Frontiers, U. Vahalia, Pearson Education

Object Oriented Programming Lab

Course Code	PCCS409
Course Title	Object Oriented Programming Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	ES208
Course Category	Program Core (PC)
Number of classes	24 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Inspect simple abstract data types and design implementations, using abstraction functions to document them.	K4
CO-2	Identify features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity	K4
CO-3	Apply some common object-oriented design patterns and give examples of their use	K4
CO-4	Design applications with an event-driven graphical user interface	K4

List of Experiments (*Minimum 10 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Assignments on class, constructor, overloading, inheritance, overriding
2. Assignments on wrapper class, arrays
3. Assignments on developing interfaces- multiple inheritances, extending interfaces
4. Assignments on creating and accessing packages
5. Assignment on using third party libraries
6. Assignment on multithreaded programming.

Essence of Indian Knowledge Tradition

Course Code	MC-410
Course Title	Essence of Indian Knowledge Tradition
Number of Credits	0 (L: 2, T: 0, P: 0)
Prerequisites	Nil
Course Category	Mandatory Course (MC)
Number of classes	26

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Outline Vedic literature, Puranic Literature and other ancient knowledge tradition of India.	K2
CO-2	Explain about scientific heritage of ancient India along with comprehending its relevance and application in various modern scientific disciplines.	K2
CO-3	Demonstrate Indian Philosophical systems with a conscious emphasis on their relevance and application in modern scientific enquiry.	K2
CO-4	Illustrate Indian Linguistic tradition along with its branches.	K2
CO-5	Critically analyse the worth of Indian intellectual heritage, traditional practices and Indian lifestyle from scientific lenses.	K4

Course Content:

Module 1: Introduction to Vedic Literature, Dharmaśāstra and Purāṇas (08 hrs)

- General structure of Vedic Literature,
- Different theories on the age of the Vedas,
- Educational system in the Vedic times
- Subject-matter of Ṛgveda-samhitā, Sāmaveda -Saṁhitā, Yajurveda-Saṁhitā, Atharvaveda-Saṁhitā, Brāhmaṇa and Āraṇyaka literature, Upaveda
- Vedāṅga Literature
- History of Dharmaśāstra
- Basic concepts of Purānas

Module 2: Indian Knowledge System, Yoga and Health care (06 hrs)

- Origin and Development of Indian Knowledge System
- Concept of Dharma in Indian knowledge tradition
- General ideas about Yoga,
- Origin and Development of Pātañjala Yoga
- Origin and Development of Āyurveda and its relevance

Module 3: Introduction to Indian Philosophy (06 hrs)

- General introduction to Indian Philosophical systems, i.e. Orthodox and Heterodox
- Concept of Puruṣārthas in Indian Philosophy
- General introduction of Upaniṣadic literature
- Indian Philosophy and Modern Science
- Principles in different philosophical systems
- Relevance of Indian Philosophy in Modern time

Module 4: Indian Linguistic and Artistic Tradition (06 hrs)

- Origin and Definition of Language
- Branches and aspects of Science of language
- Vedic and Classical Sanskrit
- Indo-European family of Language
- Role of Sanskrit in comparative Philology
- Sanskrit Phonology and Phonetic laws
- History of Sanskrit Grammar
- Introduction to Śikṣā literature
- Origin and Development of Artistic tradition

References / Suggested Learning Resources :

1) Capra, Fritjof. The Tao of Phisics. New York: Harpercollins, 2007.
2) Capra, Fritjof. The Web of Life. London: Harpar Collins Publishers, 1996.
3) Chaitanya, Krishna. Arts of India, Abhinav Publications, 1987.
4) Chatterjee, S.C & Datta, D.M. An Introduction to Indian Philosophy, Calcutta: University of Calcutta, 1984.
5) Cowell, E.B and Gough. A.E (Ed.), Sarvadarśanasaṅgraha. Sadguru Publications, 2008.
6) Dasgupta, Surendranath & De, Sushil Kumar. A History of Sanskrit Literature.Delhi: Motilal Banarsidass, 2017.
7) Dasgupta, Surendranath. A History of Indian Philosophy. Delhi: Motilal Banarsidass, 1991.
8) GN Jha (Eng. Trans.), Ed. RN Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakashan, Delhi 2016.

9) Gonda, Jan. A History of Vedic Literature. Delhi: Monohar Publishers and Distributors, 2020.
10) Jha, R.N. Science and Consciousness Psychotherapy and Yoga Practices. Delhi: Vidyanidhi Prakashan, 2016.
11) Jha, V.N. Language, Thought and Reality.
12) Kane. P.V. History of Dharmasastra, Poona: Bhandarkar Oriental Research Institute, 1930.
13) Knowledge traditions and practices of India, CBSE Publications.
14) Max Muller. Ancient Sanskrit Literature, London: Spottiswoode and Co., 1859.
15) Nagaswamy, R. Foundations of Indian Art, Tamil Arts Academy, 2002.
16) Pride of India,New Delhi: Samskrita Bharati, 2006.
17) Shastri, Gourinath. A History of Vedic Literature, Kolkata: Sanskrit Pustak Bhandar, 2006.
18) Sinha, Jadunath. Indian Philosophy. Delhi: Motilal Banarsidass,1938.
19) Subrahmanialyer,K.S. Vakyapadia of Bhrarthrihari. Pune: Deccan College, 1965.
20) V. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material. Mumbai: Bharatiya Vidya Bhavan, 5th Edition, 2014.
21) Wujastiyk, Dominik. The Roots of Ayurveda. India: Penguin India, 2000.

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TRIPURA UNIVERSITY

(A CENTRAL UNIVERITY)

CURRICULUM STRUCTURE

OF

4 YEARS

BACHELOR OF TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (CSE)

FIFTH SEMESTER

FIFTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/week	Credit	Full Marks
1.	Humanities Science -5	HU 601	Professional Practice, Law and Ethics	2	0	0	2	2	100
2.	Program Core-13	PC CS 502	Design and Analysis of Algorithm	3	0	0	3	3	100
3.	Program Core-14	PC CS 503	Database Management Systems	3	0	0	3	3	100
4.	Program Core-15	PC CS 504	Formal Language & Automata Theory	3	0	0	3	3	100
5.	Program Core-16	PC CS 505	Artificial Intelligence	3	0	0	3	3	100
6.	Program Core-17	PC CS 506	Computer Networks	3	0	0	3	3	100
7.	Program Core-18	PC CS 507	Algorithm Lab	0	0	2	2	1	100
8.	Program Core-19	PC CS 508	Database Management System Lab	0	0	2	2	1	100
9.	Program Core-20	PC CS 509	Computer Hardware & Network Lab	0	0	4	4	2	100
10.	Summer Internship-1	SI CS 510	Industry Internship - I	0	0	0	0	1	100
Total :				17	0	8	25	22	1000

Professional Practice, Law and Ethics

Course Code	HS 501
Course Title	Professional Practice, Law & Ethics
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	-
Course Category	Humanities Science (HS)
Number of classes	26 hours

Course Outcome:-

After completion of the course, students will be able to:

CO Number	CO Description	K Level
CO 1	Develop ideas of the professionalism, values and ethics in a profession	K3
CO 2	Develop a good insight into contracts and contracts management in engineering, arbitration and dispute resolution mechanisms	K3
CO 3	Interpret laws governing engagement of labour in construction related works and other related areas	K2
CO 4	Demonstrate an understanding of Intellectual Property Rights and Patents	K2

Module1: Professionalism, Values and Ethics in Profession (6hrs)

Professionalism: Professional characteristics, professional education, professional development in Industry.
Values and Ethics in Profession- Value system- goodness, means and ends; Ethics-ethical premises, expectation, conflicts and practices; Moral and ego, Ethics and morality
Right, virtue ethics and justice, utility and justice, privacy, challenges to privacy, privacy on the Internet.

Professional Ethics–Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers(India); Profession, Professionalism, Professional Responsibility, ProfessionalEthics;ConflictofInterest,GiftVsBribery,Environmentalbreaches,Negligence, Deficiencies in state-of-the-art;VigilMechanism,Whistleblowing,protecteddisclosures.

Module2: General Principles of Contracts Management and Arbitration (10hrs)

Indian Contract Act, 1972 and amendments covering General principles of contracting; Valid & Voidable Contracts; Prime and Subcontracts Tenders, Request For Proposals, Bids & Proposals; Bid Evaluation; Cost escalation; Delays, Suspensions & Terminations; Time

extensions & Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation.

Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system*:* Arbitration–meaning, scope and types–distinction between laws of 1940 and 1996; Arbitration agreements–essential and kinds, validity, reference and interim measures by court; Arbitration tribunal–appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision.

Module 3: Engagement of Labour & other construction-related Laws (5hrs)

Role of Labour in Civil Engineering; Methods of engaging labour-on rolls, labour sub-contract, piece rate work; Industrial Disputes Act,1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act,1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act(1996) and Rules (1998); RERA Act2017, NBC 2017

Module 4: Law relating to Intellectual property (5 hrs)

Introduction–meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Copy Rights Act, 1957, Meaning of copyright–computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet–Remedies and procedures in India; LawrelatingtoPatentsunderPatentsAct,1970 including Concept and historical perspective of patents law in India. Process of obtaining patent–application, examination, opposition and sealing of patents. Duration of patents–law and policy considerations, Infringement and related remedies;

Text/Reference Books:

1. B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
2.TheNationalBuildingCode,BIS,2017
3.MeenaRao(2006), Fundamental conceptsinLawof Contract, 3rdEdn. ProfessionalOffset
4.NeelimaChandiramani(2000),TheLawofContract:AnOutline,2ndEdn. AvinashPublications Mumbai
5.Avtarsingh(2002),Lawof Contract,EasternBookCo. 7.Dutt(1994), IndianContractAct,Eastern LawHouse
6.T. Ramappa(2010),Intellectual PropertyRightsLawinIndia,AsiaLawHouse
9.Baretext(2005),RighttoInformationAct
7.O.P.Malhotra,Lawof Industrial Disputes,N.M. TripathiPublishers
8.Ethics inEngineering- M.W.Martin&R.Schinzinger, McGraw-Hill
9.EngineeringEthics,National InstituteforEngineeringEthics,USA.
10.Ethics&Mgmt andEthos , Ghosh, VIKASH
11.Business Ethics; Concept and Cases, Velasqez, Pearson

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Design and Analysis of Algorithm

Course Code	PC CS502
Course Title	Design and Analysis of Algorithm
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	ES204,PCCS306
Course Category	Program Core(PC)
Number of classes	38 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.	K4
CO-2	Synthesize divide-and-conquer algorithms and Derive and solve recurrence relation.	K4
CO-3	Develop the dynamic programming algorithms, and analyze it to determine its computational complexity	K5
CO-4	Develop the greedy algorithms for a given problem.	K5
CO-5	Develop an understanding of Tractable and Intractable problems	K3

Course Content:

Module 1: Introduction (5 Hours)

Characteristics of algorithms. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem

Module 2: Divide and Conquer (9Hours)

Structure of divide-and-conquer algorithms; examples: binary search, quick sort, Strassen Matrix Multiplication; merge sort, heap sort and Analysis of divide and conquer run time recurrence relations.

Module 3: Dynamic Programming and Backtracking (10 Hours)

Principles of dynamic programming. Applications: Factorial calculation, Rod cutting problem, Floyd-Warshall algorithm for all pair shortest paths. Matrix multiplication, Travelling salesman Problem, Longest Common sequence, **Back tracking**: Overview, Find all subsequences of a string, 8-queen problem, and Knapsack problem, Traveling Salesman problem.

Module 4: Greedy Algorithms (14 Hours)

Overview of the greedy paradigm examples of exact optimization solution: minimum cost spanning tree, approximate solutions: Knapsack problem, Kruskal's algorithm and Prim's algorithm for finding Minimum cost Spanning Trees, Dijkstra's and Bellman Ford Algorithm for finding Single source shortest paths, Huffman coding, Activity Selection Problem. Tractable and Intractable Problems: Computability of Algorithms, Computability classes - P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques

Suggested books:

1. T .H . Cormen, C . E . Leiserson, R .L . Rivest "Introduction to Algorithms", 3rd Ed., PHI, 2011

2. E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms,"

Suggested reference books:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company

2. Algorithm Design, Jon Kleinberg and ÉvaTardos, Pearson.

3. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.

4. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA

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Database Management Systems

Course Code	PC CS 503
Course Title	Database Management Systems
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Operating System
Course Category	PC
Number of classes	36 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Illustrate relational algebra expressions for a given query and optimize the developed expressions.	K2
CO-2	Design the databases using E-R method for a given specification of the requirement and normalize them.	K3
CO-3	Construct the SQL queries in Open source and commercial DBMS -MYSQL, ORACLE for a given specification and optimize its execution using Query optimization algorithms	K3
CO-4	Implement the isolation property, including locking, time stamping based on concurrency control and serializability of scheduling	K4
CO-5	Develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.	K2

Course Content:

Module 1: Introduction (8 Hours)

Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).
Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

Module 2: Relational Model (12 Hours)

Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server.

Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design.
Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms

Module 3: Transaction Processing (8 Hours)

Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic, Concurrency Control schemes,
Database recovery: Failure Classification, Atomicity, Log–Based Recovery, Recovery with Concurrent Transactions, Advance Recovery systems, Remote Backup.

Module 4: Database Security (8 Hours)

Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.
Advanced Topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and Data mining.

References / Suggested Learning Resources:

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.
2. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.
3. "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education
4. "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley

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Formal Language & Automata Theory

Course Code	PC CS 504
Course Title	Formal Language & Automata Theory
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	NIL
Course Category	Program Core(PC)
Number of classes	38 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Construct a formal notation for strings, languages and machines and design finite automata to accept a set of strings of a language	K3
CO-2	Identify whether the given language is regular or not	K4
CO-3	Analyze context free grammars to generate strings of context free language and determine equivalence of languages accepted by Push Down Automata and languages generated by context free grammars	K4
CO-4	Classify computability and non-computability and Decidability and undecidability.	K4

Course Content:

Module 1: Regular Language and Finite Automata (10 Hours)

Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages. Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata)

Module 2: Context Free Language and Pushdown Automata (10Hours)

Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic push down automata, closure properties of CFLs.

Module 3: Context Sensitive language and Turing Machines (10 Hours)

Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG. Turing machines: The basic model for Turing machines (TM), Turing recognizable(recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators

Module 4: Undecidability (8 Hours)

Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rices theorem, undecidable problems about languages.

Suggested books:

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.
2. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
3. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
4. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
5. John Martin, Introduction to Languages and The Theory of Computation, TataMcGraw Hill., PEARSON.
6.Dr. R.B.Patel, Theory of Computation, Khanna Publishing House

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Artificial Intelligence

Course Code	PC CS 505
Course Title	Artificial Intelligence
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Data Structure & Algorithm, Mathematics, Basic Programming
Course Category	Program Core
Number of classes	38 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Explain the biological foundations to intelligent systems and searching.	K2
CO-2	Apply knowledge representation and implement logic programming.	K3
CO-3	Explain the fundamentals of experts systems.	K2
CO-4	Formulate reasoning under uncertainty.	K6

COURSE CONTENT

Module 1: Introduction (10 lectures)

Concept of AI, history, current status, Defining the Problem as a State Space Search, Search: BFS, DFS; Heuristic Search Techniques: Hill Climbing, Best-First Search, A* Algorithm, Problem Reduction, AO*Algorithm, stochastic annealing, Minimax Search, Alpha-Beta Pruning.

Biological foundations to intelligent systems: Overview of different forms of learning, Learning Decision Trees, Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks. Fuzzy logic, Genetic algorithm, and fuzzy neural networks.

Module 2: (10 lectures)

Knowledge representation and logical inference Issues in knowledge representation, Knowledge-based systems structures, and its components. Propositional Logic, First Order Predicate Logic: Representing Instance and is-a Relationships, Computable Functions and Predicates, Syntax and Semantics of FOPL, Normal Forms, Unification and Resolution, Representation Using Rules, Natural Deduction; Structured Representations of Knowledge: Semantic Nets, Frames, Conceptual Dependency, Scripts.

Module 3: (08 lectures)

Overview of an Expert System, Structure of an Expert Systems, Different Types of Expert Systems- Rule Based, Model Based, Case Based and Hybrid Expert Systems, Knowledge Acquisition and Validation Techniques, Black Board Architecture, Knowledge Building System Tools, Expert System Shells, Fuzzy Expert systems.

Module 4: (10 lectures)

Uncertain Knowledge and Reasoning, Probabilities, Reasoning under uncertainty: Probabilistic reasoning, belief networks, hidden Markov model.

Truth Maintenance Systems, Logics for Non-Monotonic Reasoning, Statistical Reasoning: Bayes Theorem, Certainty Factors and Rule-Based Systems, Bayesian Probabilistic Inference, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic: Crisp Sets, Fuzzy Sets, Fuzzy Logic Control, Fuzzy Inferences and Fuzzy Systems.

BOOKS AND REFERENCES

1. Artificial Intelligence, George F Luger, Pearson Education Publications
2. Artificial Intelligence, Elaine Rich and Knight, Mcgraw-Hill Publications
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
4. Multi Agent systems- a modern approach to Distributed Artificial intelligence, Weiss. G, MIT Press.
5. Artificial Intelligence : A modern Approach, Russell and Norvig, Printice Hall

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Computer Networks

Course Code	PC CS 506
Course Title	Computer Networks
Number of Credits	03 (L: 3, T: 0, P: 0)
Prerequisites	Nil
Course Category	Program Core-17
Number of classes	38 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Interpret the different building blocks of communication network and its architecture.	K2
CO-2	Identify and analyze error and flow control mechanisms in data link layer.	K4
CO-3	Design subnetting and analyze the performance of network layer	K3
CO-4	Construct and examine various routing protocols	K4
CO-5	Illustrate the suitable Application layer protocols for specific applications and its respective security mechanisms	K2

Course Content:

Module 1: Networking Principles and layered architecture (9)

Data Communications and Networking: A Communications Model – Data Communications - Evolution of network, Requirements, Applications, Network Topology (Line configuration, Data Flow), Protocols and Standards, Network Models (OSI, TCP/IP)

Switched Communications Networks – Circuit Switching – Packet Switching – Comparison of Circuit Switching and Packet Switching – Implementing Network Software, Networking Parameters (Transmission Impairment, Data Rate and Performance)

Module 2: Data link layer (10)

Error Detection and Correction – Hamming Code , CRC, Checksum- Flow control mechanism – Sliding Window Protocol - GoBack - N - Selective Repeat - Multiple access Aloha - Slotted Aloha - CSMA, CSMA/CD – Multiple Access Networks (IEEE 802.3), Token Ring (IEEE 802.5) and Wireless Networks (IEEE 802.11, 802.15)

Module 3: Network layer (10)

IPV4 Address Space – Notations – Classful Addressing – Classless Addressing – Network Address Translation – IPv6 Address Structure – IPv4 and IPv6 header format.

Routing-Link State and Distance Vector Routing Protocols- Implementation-Performance Analysis- Packet Tracer.

Module 4: Transport layer & Application layer (9)

TCP and UDP-Congestion Control-Effects of Congestion-Traffic Management-TCP Congestion Control-Congestion Avoidance Mechanisms-Queuing Mechanisms-QoS Parameters
Application layer-Domain Name System-Case Study : FTP-HTTP-SMTP-SNMP.
Recent Trends in Computer Networks.

References / Suggested Learning Resources:

1. D., Voet, Voet, J.G. & Pratt, C. W., "Fundamentals of Biochemistry", John Wiley & Sons, 2nd ed, 2006
2. Pavel Pevzner, "Computational Molecular Biology: An Algorithmic Approach", MIT Press, 2000
3. Neil C. Jones, "An Introduction to Bioinformatics Algorithms", The MIT Press 2004
4. Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison, "Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids", Cambridge University Press 1998
5. David W. Mount, "Bioinformatics: Sequence and Genome Analysis", Cold Spring Harbor Laboratory Press 2001
6. Ewens, W. J. & Grant, G. R., "Statistical methods in bioinformatics: an introduction", New York. Springer, 2001

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Algorithm Lab

Course Code	PC CS 507
Course Title	Design and Analysis of Algorithm
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	ES208, PC CS306
Course Category	Program Core (PC)
Number of classes	24 hours

Course Outcome:

After completion of the course, students will be able to:

CO	CO Description	K-level
CO-1	Implement sorting algorithms	K3
CO-2	Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.	K4
CO-3	Develop the dynamic programming algorithms, and analyze it to determine its computational complexity.	K5
CO-4	Develop the greedy algorithms for a given problem	K5

List of Experiments (*Minimum 6 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Implement Binary Search using Divide and Conquer approach Implement Merge Sort , quick sort using Divide and Conquer approach.
2. Search and replace character in a string using divide and conquer approach.
3. Find subsequences of a string using divide and conquer approach.
4. Find Maximum and Minimum element from a array of integer using Divide and Conquer approach
5. Find the minimum number of scalar multiplication needed for chain of matrix
6. Implement n Queen problem
7. Implement Travelling sales man problem
8. Implement knapsack problem
9. Solve factorial calculation dynamic programming way.
10. Problems on graph search
11. Problems on Dynamic programming

References / Suggested Learning Resources:

1. “Algorithm Design Manual “ By Steve Skiena

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Database Management System Laboratory

Course Code	PC CS 508
Course Title	Database Management System Laboratory
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	OS
Course Category	PC
Number of classes	30 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Execute DDL,DML and TCL commands	K3
CO-2	Create views, partitions and locks for a particular database	K4
CO-3	Create and execute procedure for an application using exception handling and cursors	K4
CO-4	Create and execute procedure for an application using triggers	K4

List of Experiments (*Minimum 6 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

Structured Query Language

1. Creating Database
    - Creating a Database
    - Creating a Table
    - Specifying Relational Data Types
    - Specifying Constraints
    - Creating Indexes
2. Table and Record Handling
    - INSERT statement
    - Using SELECT and INSERT together
    - DELETE, UPDATE, TRUNCATE statements
    - DROP, ALTER statements
3. Retrieving Data from a Database
    1. The SELECT statement
    2. Using the WHERE clause
    3. Using Logical Operators in the WHERE clause
    4. Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause
    5. Using Aggregate Functions
    6. Combining Tables Using JOINS

7. Subqueries

4. Database Management
   - Creating Views
   - Creating Column Aliases
   - Creating Database Users
   - Using GRANT and REVOKE
5. Cursors in Oracle PL / SQL
6. Creating database triggers and functions PL/SQL
7. Writing Oracle PL / SQL Stored Procedures

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Computer Hardware & Network Lab

Course Code	PC CS 509
Course Title	Computer Hardware & Network Lab
Number of Credits	02 (L: 0, T: 0, P: 4)
Prerequisites	Nil
Course Category	Program Core-20
Number of classes	44 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Identify and describe the functions of common networking devices.	K3
CO-2	Construct a local area network (LAN) using a switches/hubs and configure TCP/IP for the LAN.	K3
CO-3	Construct and implement wide area network (WAN) using routers	K3
CO-4	Relate / understand the need of PC Hardware, internet & world wide web and office suites	K2
CO-5	Apply the knowledge of installation for different system & application software	K3

List of Experiments (*Minimum 6 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Study of different types of cross-wired cable and straight through cable.
2. Study of different types of Network cables and Practically implement the
1. Cross-wired cable and straight through cable using clamping tool.
2. Study of Basic network commands and network configuration commands.
3. Study of network IP.
4. Study of Network Devices in Detail.
5. Socket programming using Java or C programming language.
6. Connect the computers in Local Area Network.
7. Study of basic network command and Network configuration commands.
8. Configure a Network topology using packet tracer software.
9. Configure a Network using Distance Vector Routing protocol.
10. Configure Network using Link State Vector Routing protocol.
11. Network topology configuration of static routing using using packet tracer software
12. Routing Protocol Configuration of a network using any using packet tracer software
13. (Eg. Static routing, RIP, RIP Version 2 etc)
14. Firewall Configuration using IP tables and IP chains and solve different general problems in Linux OS.
15. Practical on Server Configuration Example, Web Server, Mail Server, FTP Server, DHCP, NFS etc.

List of Experiments related to PC Hardware

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1. To be familiar with and to be able to troubleshoot motherboard.
2. Identifying external ports and interfacing
3. Identifying PC cards and interfacing.
4. Identifying PC cards and interfacing.
5. Preventive maintenance of a PC
6. Understanding CMOS set up
7. Partitioning and formatting Hard disks.
8. Installing Different Operating System, Device Drivers and application software.
9. Understanding control panel settings.
10. To be familiar with SMPS.
11. To install video card, sound card, etc.
12. To install DMP, inkjet and laser printing; to undertake preventive maintenance and to troubleshoot DMP.
13. To disassemble and reassemble a total PC system.
14. Working with antivirus software
15. To practice anti-virus software installation and virus removal.
16. Working with Backups and Archival utilities

References / Suggested Learning Resources:

1. Hands on networking essentials with projects / M.J. Palmer
2. Internet working with TCP-IP / D.E. Comer and D. Stevens / Prentice Hall of India
3. CISCO Internetworking / Charles Riley / SPD Pvt. Ltd.
4. Networking Cabling handbook / Chris Clark / Tata McGraw Hill
5. Designing and implementing local and WANs / M.J. Palmer and R.B. Sinclair / Vikas Publishing House.

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Industry Internship – I

Course Code	SI CS 510
Course Title	Industry Internship – I
Number of Credits	1 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Summer Internship (SI)
Number of classes	20 hrs

Course Outcome:-

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Solve real life challenges in the workplace by analysing work environment and conditions, and selecting appropriate skill sets acquired from the course of study	K3
CO-2	Develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting	K3
CO-3	Demonstrate the skill to communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means	K2
CO-4	Show professional ethics by displaying positive disposition during internship.	K2
CO-5	Decide career options by considering opportunities in company, sector, industry, professional, educational advancement and entrepreneurship;	K5

Course Content:-

The industry internship aims to provide the student with:

1. A practice-oriented and 'hands-on' working experience in the real world or industry, and to enhance the student's learning experience.

2. An opportunity to develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting.

3. An opportunity to further develop and enhance operational, customer service and other life-long knowledge and skills in a real world work environment.

4. Pre-employment training opportunities and an opportunity for the company or organisation to assess the performance of the student and to offer the student an employment opportunity after his/her graduation, if it deems fit.

Each student shall

1) Identify an internship program of relevance in his/her branch of engineering to undergo during summer break between 4^{th} and 5^{th} semester,
2) Get approval of the concerned HOD,
3) Undergo the industry internship program for minimum 4 weeks duration
4) Prepare their own report
5) Present in the class among fellow students and faculty members / deliver viva voce.
6) Submit the report and participation/course completion certificate.

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TRIPURA UNIVERSITY

(A CENTRAL UNIVERITY)

CURRICULUM STRUCTURE

OF

4 YEARS

BACHELOR OF TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (CSE)

SIXTH SEMESTER

SIXTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Program Core-21	PC CS 601	Digital Image Processing	3	0	0	3	3	100
2.	Program Core-22	PC CS 602	Compiler Design	3	0	0	3	3	100
3.	Program Core-23	PC CS 603	Cryptography and Network Security	3	0	0	3	3	100
4.	Program Core-24	PC CS 604	Software Engineering	3	0	0	3	3	100
5.	Program Core-25	PC CS 605	Advanced Java Lab	0	0	2	2	1	100
6.	Program Core-26	PC CS 606	Web Technology Lab (PHP/ JavaScript)	0	0	2	2	1	100
7.	Program Core-27	PC CS 607	Image Processing Lab	0	0	2	2	1	100
8.	Program Elective-1	PE CS 608/1	Advanced Computer Architecture	3	0	0	3	3	100
		PE CS 608/2	Data Mining						
		PE CS 608/3	Web Technology						
9.	Project - 1	PR CS 609	Mini Project	0	0	6	6	3	100
Total :				15	0	12	27	21	900

Digital Image Processing

Course Code	PC CS 601
Course Title	Digital Image Processing
Prerequisites	Basic Knowledge of Mathematics and Signals
Course Category	Program Core-21
Number of classes	36 hours
Number of credits	03 (L: 3, T: 0, P: 0)

Course Outcome:

After completion of the course, students will be able to:

Course Outcomes(COs): At the end of the course, the student will be able to		
CO Number	CO Description	K-level
CO-1	Mathematically represent images and analyze different relationships and operations on them.	K2
CO-2	Utilize different techniques employed for the enhancement of images	K3
CO-3	Analyze various colour image models and restoration approaches.	K4
CO-4	Develop algorithms for image compression and coding.	K4

COURSE CONTENT

Module 1: Digital Image Fundamentals (8 lectures)

Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures. Simple Operations- Arithmetic, Logical, Geometric Operations. Mathematical Preliminaries - 2D Linear Space Invariant Systems - 2D Convolution - Correlation 2D Random Sequence - 2D Spectrum

Module 2: Image Transforms and Enhancement (10 lectures)

Image Transforms: 2D Orthogonal and Unitary Transforms-Properties and Examples. 2D DFT-FFT – DCT - Hadamard Transform - Haar Transform - Slant Transform - KL Transform - Properties And Examples. Image Enhancement:- Histogram Equalization Technique- Point Processing-Spatial Filtering-In Space And Frequency - Nonlinear Filtering-Use Of Different Masks.

Module 3: Color Models and Image Restoration (8 lectures)

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

Image Observation And Degradation Model, Circulant And Block Circulant Matrices and Its Application In Degradation Model - Algebraic Approach to Restoration- Inverse By Wiener Filtering - Generalized Inverse-SVD and Interactive Methods - Blind Deconvolution-Image Reconstruction From Projections.

Module 4: Image compression and Segmentation (10 lectures)

Redundancy and Compression Models -Loss Less And Lossy. Loss Less- Variable-Length, Huffman, Arithmetic Coding - Bit-Plane Coding, Loss Less Predictive Coding, Lossy Transform (DCT) Based Coding, JPEG Standard - Sub Band Coding, Image Segmentation: Edge Detection - Line Detection - Curve Detection - Edge Linking And Boundary Extraction, Boundary Representation, Region Representation and Segmentation, Morphology-Dilation, Erosion, Opening and Closing. Hit And Miss Algorithms Feature Analysis.

References / Suggested Learning Resources:

(i) R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008

(ii) Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004

(iii) Digital Image Processing, Kenneth R Castleman, Pearson Education,1995.

(iv) Digital Image Procesing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill Education ,2009. Pvt Ltd, NewDelhi

(v) www.nptel.ac.in

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Compiler Design

Course Code	PE CS 602
Course Title	Compiler Design
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	PC CS 04
Course Category	Program Elective-4
Number of classes	36 hours

Course Outcome:

After completing this course, the student should be able to-

CO Number	CO Description	K-level
CO-1	Infer the different stages in the process of compilation and identify different methods of lexical analysis	K2
CO-2	Identify synthesized and inherited attributes	K3
CO-3	Design top-down and bottom-up parsers and develop syntax directed translation schemes	K3
CO-4	Develop algorithms to generate code for a target machine	K4

Course Content:

Module 1: **(8 hours)**

Introduction to Compiling: Compilers, Analysis of the source program, The phases of the compiler, Cousins of the compiler.
Lexical Analysis: The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of a tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyzer generator (Lex).

Module 2: **(12 hours)**

Syntax Analysis: The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non-recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.
Syntax directed translation: Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.
Type checking: Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions

Module 3: **(8 hours)**

Run time environments
Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.

Module 4: **(8 hours)**

Intermediate code generation: Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).
Code optimization: Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimization.
Code generations: Issues in the design of code generator, a simple code generator, Register allocation & assignment.

References / Suggested Learning Resources:

1. Aho, Sethi, Ullman - "Compiler Principles, Techniques and Tools" - Pearson Education.
2. Holub - "Compiler Design in C" - PHI.

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Cryptography and Network Security

Course Code	PC CS 603
Course Title	Cryptography and Network Security
Number of Credits	03 (L: 3, T: 0, P: 0)
Prerequisites	Computer Network
Course Category	Program Core
Number of classes	36 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Demonstrate security of the data over the network.	K2
CO-2	Utilize the concept of cipher	K3
CO-3	Implement various networking protocols on authentication	K2
CO-4	Apply the methods to protect any network from the threats in the world.	K4

Course Content:

Module 1: Introduction (8)

Attacks on Computers and Computer Security: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security.

Cryptography: Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, stenography, key range and key size, possible types of attacks.

Module 2: Ciphers (10)

Symmetric key Ciphers: Block Cipher principles & Algorithms (DES, AES, Blowfish), Differential and Linear Crypt analysis, Block cipher modes of operation, Stream ciphers, RC4, Location and placement of encryption function, Key distribution.

Asymmetric key Ciphers: Principles of public key crypto systems, Algorithms (RSA, Diffie-Hellman, ECC), Key Distribution.

Module 3: Authentication (10)

Message Authentication Algorithms and Hash Functions: Authentication requirements, Functions, Message authentication codes, Hash Functions, Secure hash algorithm, Whirlpool, HMAC, CMAC, Digital signatures, knapsack algorithm.

Authentication Applications: Kerberos, X.509 Authentication Service, Public – Key Infrastructure, Biometric Authentication.

Module 4: Applications (8)

E-Mail Security: Pretty Good Privacy, S/MIME

IP Security: IP security overview, IP Security architecture, Authentication Header, Encapsulating security payload, combining security associations, key management.
Web Security: Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction Intruders, virus and Firewalls: Intruders, Intrusion detection, password management, virus and related threats, Countermeasures, Firewall design principles, types of firewalls
Case Studies on Cryptography and security: Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability, Virtual E lections

References / Suggested Learning Resources:

7. William Stallings, “Cryptography and Network Security,” 3rd ed, Pearson Education (Asia) Pte. Ltd./ Prentice Hall of India, 2003.
8. C. Kaufman, R. Perlman, and M. Speciner, "Network Security: Private Communication in a Public World,” 2nd ed, Pearson Education (Asia) Pte. Ltd., 2002.
9. B. Forouzan, “Cryptography & Network Security”, Tata McGraw-Hill.
10. Atul Kahate, “Cryptography and Network Security,” Tata McGraw-Hill, 2003.
11. Eric Maiwald, “Fundamentals of Network Security,” McGraw-Hill, 2003.

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Software Engineering

Course Code	PE CS 604
Course Title	Software Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Nil
Course Category	Program Elective-4
Number of classes	36 hours

Course Outcome:

After completing this course, the student should be able to-

CO Number	CO Description	K-level
CO-1	Identify the scope and necessity of software engineering and apply appropriate principles and techniques	K2
CO-2	Develop, maintain and evaluate large-scale software systems.	K3
CO-3	Plan to work as an effective member or leader of software engineering teams.	K3
CO-4	Discover efficient, reliable, robust and cost-effective software solutions.	K4

Course Content:

Module 1: (8hours)

Overview of System Analysis & Design , Business System Concept, System Development Life Cycle, Waterfall Model , Spiral Model, Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model.

Module 2: (10 hours)

System Design – Context diagram and DFD, Problem Partitioning, Top-Down And Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach.
Coding & Documentation – Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation.
Testing – Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment, Validation & Verification. Metrics, Monitoring & Control.

Module 3: (8 hours)

Software Project Management – Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring.

Module 4: (10 hours)

Software Cost Estimation – underlying factors of critical concern, Risk Management, Metrics for estimating costs of software products – Function Points, software cost estimation – Expert judgment, Delphi cost estimation, Work break-down structure and Process breakdown structure, COCOMO and COCOMO-II.
Static and dynamic models, why modeling, UML diagrams: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, implementation diagram.

References / Suggested Learning Resources:

1. Pressman, Software Engineering : A practitioner's approach– (TMH)
2. Pankaj Jalote, Software Engineering- (Wiley-India)
3. N.S. Gill, Software Engineering – (Khanna Publishing House)
4. Rajib Mall, Software Engineering- (PHI)
5. Agarwal and Agarwal, Software Engineering – (PHI)
6. Sommerville, Software Engineering – Pearson
7. Martin L. Shooman, Software Engineering – TMH

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Advanced Java Lab

Course Code	PC CS 605
Course Title	Advanced Java Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	PC CS 307 and PC CS406
Course Category	Program Core(PC)
Number of classes	24 hours

Course Outcome:-

Upon the successful completion of the course, students will be able to:

CO No	CO Description	K-level
CO1	Design and Develop Swing-based GUI components.	K3
CO2	Examine client/server applications using socket programming	K4
CO3	Develop distributed applications using RMI and component-based Java software using JavaBeans	K3
CO4	Explain server-side programs in the form of Servlets and enterprise applications.	K2/K4

List of Experiments (*Minimum 6 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Implementation of multithread application using Java.
2. Create a full set of UI widgets and other components, including windows, menus, buttons, checkboxes, text fields, scrollbars and scrolling lists, using Abstract Windowing Toolkit (AWT) & Swings.
3. Apply Event Handling on AWT and Swing components.
4. Implementation of Socket program for chat application.
5. Invoke the remote methods in an application using Remote Method Invocation(RMI)
6. Develop java Applet program to accept two numbers from user and output the sum, difference in the respective text boxes.
7. Servlet program to implement and demonstrate get () and post() methods (using HTTP Servlet class).
8. Session tracking for a hit count using Java Servlet.
9. Establishing Communication between Applet and Servlet.
10. Create three tier application using Servlet by incorporating Java Database Connectivity inside Servlet to save data in a table.
11. Creating Jakarta (formerly Java) Server Pages (JSP) program to implement attributes of directive tags.
12. Cookies and session management using Jakarta (formerly Java) Server Pages (JSP).
13. Create Model-View-Controller (MVC) application with Struts framework: using Servlet/JSP

14. Creating Stateless and Stateful Session Beans.
15. Enterprise JavaBeans (EJB) Application that demonstrates Entity Bean.
16. Enterprise JavaBeans (EJB) Application that demonstrates Session Bean.

Learning Resources

i. Text Books:

1. ElliotteRustyHarold,"JavaNetworkProgramming",O'Reillypublishers,2004
2. EdRoman, "MasteringEnterprise JavaBeans", JohnWiley&SonsInc.,2004.

ii. Reference Books:

1. Hortsmann& Cornell, "CORE JAVA 2 ADVANCED FEATURES, VOL II", PearsonEducation, 2002.
2. Patrick Naughton, "COMPLETE REFERENCE: JAVA2", Tata McGraw-Hill,2003.
3. Michael Morrison, The Complete IDIOT's, Guide to JAVA 2", Prentice Hall of India.

iii. Online resources

1. www.cs.rit.edu/~jmk/java707/lecnotes/lecnotes.html
2. http://www.inf.ed.ac.uk/teaching/courses/cs2/LectureNotes/CS2Bh/APJ/apj5.pdf
3. http://ebookmaterials.blogspot.in/2011/07/advanced-programming-in-java-lecturer.html
4. http://java.sun.com.

Web Technology Lab

Course Code	PC CS 606
Course Title	Web Technology Lab (LTP: 0:0:2, Credit: 1)
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	ES 208(Programming for Problem Solving Lab)
Course Category	Program Core(PC)
Number of classes	24 hours

Course Outcome:

After completion of the course, students will be able to:

CO No	CO Description	K-level
CO-1	Analyze and apply the HTML, CSS, XML, JavaScript and protocols to build websites.	K4
CO-2	Utilize JavaScript to create functional forms	K3
CO-3	Utilize XML to access information methodically	K3
CO-4	Utilize php and database connectivity to create dynamic website.	K3

List of Experiments (*Minimum 6 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. To create a simple html file to demonstrate the use of different tags.
2. To create an html file to link to different html page which contains images, tables, and also link within a page.
3. To create a registration form as mentioned below.
4. To create an html file by applying the different styles using inline, external & internal style sheets.
5. To write a JavaScript program to define a user defined function for sorting the values in an array.
6. To create an html page to explain the use of various predefined functions in a string and math object in java script.
7. To create an html page to explain the use of various predefined functions in a array & Date object in JavaScript.
8. To create an html page to demonstrate exception handling in JavaScript.

9. To create a html registration form and to validate the form using JavaScript code.
10. To create a CD catalog using XML file.
11. To create external style sheet and using the style sheet in xml file.
12. To create a xml style sheet to display the data in the xml using html table.
13. To create a php program to demonstrate the different file handling methods.
14. To create a php program to demonstrate the different predefined function in array, Math, Data & Regular Expression.
15. Write a program to introduce file.
16. Write a program to show database connectivity.
17. Install WordPress.
18. Working with the plugins in WordPress.

References / Suggested Learning Resources:

1. Deitel&Deitel, Internet and World Wide Web How to Program, Pearson education, 3e ,(2005)
2. HTML & XHTML: The Complete Reference, Thomas A. Powell, McGraw Hill
3. Learning Perl, by R.L. Schwartz, B.D Foy, T. Phoenix, O'Reilly
4. Perl Black Book, by Steven Holzner, DreamTech
5. Learning PHP, MySQL & JavaScript with j Query, CSS & HTML5, by Robin Nixon, O'Reilly
6. JavaScript: The Good Parts, O'Reilly

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Digital Image Processing Lab

Course Code	PC CS 607
Course Title	Digital Image Processing Lab
Prerequisites	Theoretical knowledge of Digital Image Processing
Course Category	Program Core-27
Number of classes	24 hours
Number of credits	01 (L: 0, T: 0, P: 4)

Course Outcome:

After completion of the course, students will be able to:

Course Outcomes(COs): At the end of the course, the student will be able to		
CO Number	CO Description	K-level
CO-1	Illustrate and execute basic commands in working environment/tool.	K3
CO-2	Explain discrete transform works including concepts of basic images.	K2
CO-3	Apply de-noising and restoration techniques.	K3
CO-4	Apply binary image processing operations	K3

List of Experiments (*Minimum 6 experiments are to be performed. Use of virtual laboratory to perform few experiments may be explored, if available****):***

1. Familiarize the working environment/tool.

2. Digital Signal Processing Basics

3. Image Enhancement

4. Image Segmentation

5. Image Restoration and Denoising

6. Binary Image Processing

Laboratory softwares / programming languages which may be used

MATLAB/ GNU Octave 3.8 or higher/ Scilab 5.5 or higher/ Choice of any open-source tool with the prior permission obtained from the department./ Python

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Advanced Computer Architecture

Course Code	PE CS 608/1
Course Title	Advanced Computer Architecture
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	PC CS404
Course Category	Program Core (PC)
Number of classes	38 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Demonstrate concepts of parallelism in hardware/software	K3
CO-2	Identify memory organization and mapping techniques	K3
CO-3	Classify architectural features of advanced processors and Interpret performance of different pipelined processors	K4
CO-4	Explain data flow in arithmetic algorithms	K4

Course Content:

Module 1 **(8 Hours)**

PARALLEL COMPUTER MODELS: Evolution of Computer architecture, system attributes to performance, Multi processors and multi computers, Multi-vector and SIMD computers, PRAM and VLSI models-Parallelism in Programming, conditions for Parallelism-Program Partitioning and Scheduling-program flow Mechanisms-Speed up performance laws-Amdahl‘s law, Gustafson‘s law-Memory bounded speedup Model.

Module 2 **(10 Hours)**

MEMORY SYSTEMS AND BUSES: Memory hierarchy-cache and shared memory concepts-Cache memory organization-cache addressing models, Aliasing problem in cache, cache memory mapping techniques-Shared memory organization-Interleaved memory organization, Lower order interleaving, Higher order interleaving. Back-plane bus systems-Bus addressing, arbitration and transaction.

ADVANCED PROCESSORS: Instruction set architectures-CISC and RISC scalar processors-Super scalar processors-VLIW architecture- Multivector and SIMD computers-Vector processing principles-Cray Y-MP 816 system-Inter processor communication

Module 3 **(10 Hours)**

MULTI PROCESSOR AND MULTI COMPUTERS: Multiprocessor system interconnects-Cross bar switch, Multiport Memory-Hot spot problem, Message passing mechanisms-Pipelined processors-Linear pipeline, on linear pipeline Instruction pipeline design-Arithmetic pipeline design.

Module 4: **(10 Hours)**

DATA FLOW COMPUTERS AND VLSI COMPUTATIONS: Data flow computer architectures-Static, Dynamic-VLSI Computing Structures-Systolic array architecture, mapping algorithms into systolic arrays, Reconfigurable processor array-VLSI matrix arithmetic processors-VLSI arithmetic models, partitioned matrix algorithms, matrix arithmetic pipelines.

Suggested books:

1. Computer Architecture and Parallel Processing- Kai Hwang and A. Brigggs International Edition, McGraw Hill.

2. Advanced Computer Architecture: D. Sima, T. fountain, P. Kacsuk, Pearson

3. Parallel Computer Architecture: D. Culler, J.P. Singh, A. Gupta, Elsevier

Suggested reference books:

1. Computer Organization and Architecture, William Stallings,8th edition,PHI

2. Computer Organization, Carl Hamachar, Vranesic, Zaky, 5th edition, McGraw Hill.

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Data Mining

Course Code	PC CS 608/2
Course Title	Physics
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	DBMS
Course Category	Elective
Number of classes	36 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Illustrate stages in building a Data Warehouse.	K2
CO-2	Design and develop business intelligence application.	K3
CO-3	Analyze and evaluate performance of algorithms for classification and prediction	K4
CO-4	Analyze clustering algorithms	K4

Course Content:

Module 1: Data Warehouse and OLAP Technology (10)

Data Warehouse and OLAP Technology for Data Mining: Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Further Development of Data Cube Technology, From Data Warehousing to Data Mining Data Cube Computation and Data Generalization: Efficient Methods for Data Cube Computation, Further Development of Data Cube and OLAP Technology, Attribute-Oriented Induction.

Module 2: Data Mining (10)

Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Major issues in Data Mining. Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation

Module 3: Classification and Prediction (8)

Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Backpropagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction, Accuracy and Error measures, Evaluating the accuracy of a Classifier or a Predictor, Ensemble Methods.

Module 4: Cluster Analysis (8)

Introduction: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data, Constraint-Based Cluster Analysis, Outlier Analysis.

References / Suggested Learning Resources:

1. Data Mining – Concepts and Techniques - Jiawei Han & Micheline Kamber, Morgan Kaufmann Publishers, Elsevier,2nd Edition, 2006.

2. Introduction to Data Mining – Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Pearson education.

3. Data Mining Techniques – Arun K Pujari, 2nd edition, Universities Press.

4. Data Warehousing in the Real World – Sam Aanhory & Dennis Murray Pearson Edn Asia.

5. Insight into Data Mining, K.P.Soman, S.Diwakar, V.Ajay, PHI, 2008.

Web Technology

Course Code	PC CS 608/3
Course Title	Web Technology
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	ES 204 (Programming for Problem Solving)
Course Category	Program Core(PC)
Number of classes	36 hours

Course Outcome:-

After completion of the course, students will be able to:

CO No	CO Description	K-level
CO-1	Apply different HTML tags and CSS to build a website.	K3
CO-2	Utilize JavaScript to ensure validation and use XML to access information.	K3
CO-3	Explain the working of PHP along with form handling.	K4
CO-4	Explain the file handling and database accessibility using PHP.	K4

Course Content:-

Module- 1: HTML and CSS(8)

Web Programming Introduction, **HTML:** HTML-Introduction, Basic Formatting Tags, Grouping Using Div Span, Lists, Images, Hyperlink, Table, frames, **HTML-Headers:** Title, Base, Link, Styles, Script, Meta, **CSS:**CSS-Introduction, CSS Syntax, CSS Selectors, CSS Color Background Cursor, CSS Text Fonts, CSS Lists Tables, CSS Box Model, CSS Display Positioning.

Module- 2: JavaScript and XML(8)

JavaScript: Introduction to JavaScript, JavaScript language – declaring variables, scope of variables functions, event handlers (on click, on submit etc.), Document Object Model, Form validations. Simple AJAX applications. **XML:** Introduction to XML, Defining XML tags, their attributes and values, Document type definition, XML Schemas, Document Object model, XHTML, Parsing XML Data - DOM and SAX parsers in java.

Module- 3: Introduction to PHP and handling Forms (10)

PHP programming: Introduction to PHP: Evaluation of Php, Basic Syntax, defining variable and constant, Php Data type, Operator and Expression, Doing Repetitive task with looping, Mixing

Decisions and looping with Html. Define a function, call by value and Call by reference, Recursive function, String Creating and accessing, String Searching & Replacing String, Formatting String, String Related Library function. Looping with Index based array, looping with associative array using each () and for each(), Some useful Library function. **Handling Html Form with Php:** Capturing Form, Data Dealing with Multi-value filed, and Generating File uploaded form, redirecting a form after submission.

Module- 4: PHP files, database and Content Management System (CMS)(10)

Working with file and Directories: Understanding file& directory, Opening and closing, a file, Coping, renaming and deleting a file, working with directories, Creating and deleting folder, File Uploading & Downloading. **Session and Cookie:** Setting Cookies with PHP. Using Cookies with Sessions, Deleting Cookies, Registering Session variables, Destroying the variables and Session. **Database Connectivity with MySQL**: Introduction to RDBMS, Connection with MySQL Database, performing basic database operation(DML) (Insert, Delete, Update, Select), Setting query parameter, Executing query- Join (Cross joins, Inner joins, Outer Joins, Self joins. **Exception Handling:**Understanding Exception and error, Try, catch, throw, **CMS:**Introduction to CMS, Introduction to WordPress.

References/ Suggested Learning Resources: -

1. Learning PHP, MySQL, books by ' O' riley Press.
2. Java Script, D.Flanagan, O'Reilly, SPD.
3. Web Programming, building internet applications, Chris Bates 2nd edition, Wiley Dremtech
4. XML: The Complete Reference, Heather Williamson, TATA McGraw-HILL.
5. XML: The Complete Reference, Thomas A. Powell, McGraw-HILL.
6. Head First Python, By Paul barry, O'Reilly.
7. Head First Ajax, By Rebecca M. Riordan, O'Reilly.
8. Head First WordPress, Jeff Siarto, O'Reilly.

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Mini Project

Course Code	PR CS 609
Course Title	Mini Project
Number of Credits	3 (L: 0, T: 0, P: 6)
Prerequisites	Nil
Course Category	Project(PR)
Number of classes	70 hours

Course Outcome:-

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Demonstrate a through and systematic understanding of project contents	K2
CO-2	Identify the methodologies and professional way of documentation and communication	K3
CO-3	Illustrate the key stages in development of the project	K2
CO-4	Develop the skill of working in a Team	K3
CO-5	Apply the idea of mini project for developing systematic work plan in major project	K3

Course Content:-

The miniproject topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Perform detailed study about various components of a project.
2) Study about methodologies and professional way of documentation and communication related to project work.
3) Develop idea about problem formulation.
4) Knowledge of how to organize, scope, plan, do and act within a project thesis.
5) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
6) Demonstrate the implementation of a mini project work.

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TRIPURA UNIVERSITY

(A CENTRAL UNIVERITY)

CURRICULUM STRUCTURE

OF

4 YEARS

BACHELOR OF TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (CSE)

SEVENTH SEMESTER

SEVENTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Program Elective-2	PE CS 701/1	Internet of Things	3	0	0	3	3	100
		PE CS 701/2	Kotlin Programming						
		PE CS 701/3	Blockchain Technology						
2.	Program Elective-3	PE CS 702/1	Soft Computing	2	0	0	2	2	100
		PE CS 702/2	Machine Learning						
		PE CS 702/3	Cloud Computing						
3.	Open Elective-1	OE 703	Refer Annexure 1	3	0	0	3	3	100
4.	Open Elective-2	OE 704	Refer Annexure 2	2	0	0	2	2	100
5.	Project - 2	PR CS 705	Project Work Intermediate	0	0	12	12	6	200
6.	Summer Internship-2	SI CS-706	Internship - II	0	0	0	0	1	100
7.	Seminar - 1	SE CS 707	Seminar on Contemporary Engineering Topics - I	0	0	2	2	1	100
Total :				10	0	14	24	18	800

Internet of Things

Course Code	PE CS 701/1
Course Title	Internet of Things
Prerequisites	Computer Networks, Sensors, System Integration
Course Category	Program Elective
Number of classes	36 hours
Number of credits	03 (L: 3, T: 0, P: 0)

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Understand internet of Things and its hardware and software components	K2
CO-2	Interface idea of I/O devices, sensors and communication modules	K3
CO-3	Understand about the monitoring of data and control devices	K2
CO-4	Develop IoT based problem solving concepts for real world problems.	K6

COURSE CONTENT

Module 1 (**8** lectures)

Introduction to IoT Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.

Module 2 (8 Hours)

Elements of IoT Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

Module 3 (10 lectures)

IoT Application Development Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.

Module 4 (10 lectures)

IoT Case Studies IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation

References / Suggested Learning Resources:

1. Vijay Madisetti, Arshdeep Bahga, Ïnternet of Things, "A Hands on Approach", University Press
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
4. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
5. Adrian McEwen, "Designing the Internet of Things", Wiley
6. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill
7. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media
8. www.nptel.ac.in

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Kotlin Programming

Course Code	PE CS 701/2
Course Title	Kotlin Programming
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	ES 204 and PC CS 307
Course Category	Program Elective(PE)
Number of classes	38 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Use the basic concepts of App Development with Kotlin Programming Language	K3
CO-2	Apply operators and arrays in Kotlin Programming Language.	K3
CO-3	Apply Inheritance, Interface and Extensions in kotlin	K4
CO-4	Explain the working of Android Studio on PC and run using emulator	K4

Course Content:

Module 1: Fundamental concepts of Kotlin Programming Language(10)

Kotlin Programming: Advantages and Disadvantages, Architecture; **Kotlin Hello World** - Your First Kotlin Program; How to declare a variable in Kotlin; Difference Between var and val**;Kotlin Basic Types**: Number Type, Short, Int, Long, Double, Float, Char, Boolean; **Kotlin Strings;** IDE, Kotlin syntax, Main Parameter, **Kotlin comments**: Single Line, Multi Line; **Kotlin Operators**: Arithmetic Operators; **Strings; Kotlin Boolean**: Ranges, Functions

Module 2: Kotlin Type Conversion, Basic Input/ Output and Arrays(10)

Kotlin Type Conversion; Conversion from Larger to Smaller Type; **Kotlin Comments**: Traditional comment, End of Line Comment; **Kotlin Basic Input/Output**; Difference Between println() and print(); Print Variables and Literals; **Kotlin Input**: Print String Entered By the User, Getting Integer Input from the User; **Arrays:** Access the elements, Change an element, Length Size, Loop through Array; **Kotlin Class & Object**: Nested Class, Inner Class, Anonymous Inner Class, Type Aliases; **Kotlin Constructors**: Primary Constructor, Initializer Blocks, Secondary Constructor;

Module 3: Kotlin Inheritance, Interface, Visibility Control and Extension (8)

Kotlin Inheritance: Overriding Methods, Overriding Properties, derived Class Initialization Order, Calling the superclass Implementation, overridingrules; **Kotlin Interface**: Implementing Interfaces, Properties in Interface, Interface Inheritance, Resolving Overriding Conflicts, **Kotlin Visibility Control**: Private, Protected, Internal, Public; **Kotlin Extension**: Extension Functions, Nullable Receiver, Extension Properties, Companion Object Extensions, Scope of extensions. **Kotlin Data Classes.**

Module 4: Introduction to Android and Android Architecture (10)

Introduction to Android - What is Android; Popular Android Application Categories; **Features of Android**; Popular Android Apps; **Android Architecture**: Android Platform Architecture Division; **Kotlin Project using Android Studio**: Creating First Project in Android Studio using Kotlin; Step to install Kotlin Plugin for Windows Users; **Running the Emulator on your Android Device.**

References / Suggested Learning Resources:

1. Programming Kotlin by Venkat Subramaniam.
2. Kotlin Programming Cookbook by Anand Shekhar Roy and Rashi Kanupuria
3. Kotlin for Android Developers by Antonio Leiva.
4. Kotlin Blueprints by Ashish Belagali, Hardik Trivedi, Akshay Chordia.
5. Mastering High Performance with Kotlin by Igor Kucherenko.

Blockchain Technology

Course Code	PE CS 701/3
Course Title	Blockchain Technology
Number of Credits	3 (L: 3, T: 1, P: 0)
Prerequisites	Database Management System
Course Category	Block Chain Technology (PE)
Number of classes	36 hours

Course Outcome:-

After completion of the course, students will be able to:

CO No	CO Description	K-level
CO-1	Explain the blockchain technology and its underlying mechanism	K2
CO-2	Explain the work flow behind bitcoin and various consensus mechanism	K2
CO-3	Identify major research challenges and technical gaps between theory and practice in crypto currency domain.	K4
CO-4	Design own cryptocurrency and decentralized network.	K4

Course Content:-

Module- 1: Introduction (8)

Basic of Blockchain Architecture – Challenges – Applications – Block chain Design Principles - The Blockchain Ecosystem - The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS).

Module- 2: Cryptographic Fundamentals (8)

Cryptographic basics for crypto currency - a short overview of Hashing, cryptographic algorithm – SHA 256,signature schemes, encryption schemes and elliptic curve cryptography- Introduction to Hyperledger- Hyperledger framework - Public and Private Ledgers.

Module- 3: Bitcoin (8)

Bitcoin - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bit coin. Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their uses.

Module- 4: Ethereum (12)

Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts. Ethereum and Smart Contracts- The Turing Completeness of Smart Contract Languages and verification challenges- comparing Bitcoin scripting vs. Ethereum Smart Contracts

Blockchain - Recent Trends- Implementation Challenges- Zero Knowledge proofs and protocols in Block chain - Succinct non interactive argument for Knowledge (SNARK) - pairing on Elliptic curves – Zcash - attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks - - advent of algorand, and Sharding based consensus algorithms

References/ Suggested Learning Resources:-

1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O‟Reilly, first edition – 2015.

2. Daniel Drescher, “Block Chain Basics”, Apress; 1stedition, 2017

3. Antonopoulos A.M., Mastering Bitcoin. 2nd ed. O’Reilly Media, 2017.

4. Raj K., Foundation of Blockchain: The pathway to cryptocurrency and decentralized blockchain application.1st ed. Packt Publishing Ltd, 2019

5. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing, first edition – 2012

6. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Block Chain”, Packt Publishing

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Soft Computing

Course Code	PE CS 702/1
Course Title	Soft Computing
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Mathematics, Artificial Intelligence
Course Category	Program Elective
Number of classes	26 hours

Course Outcome:

After completing this course, the student should be able to-

CO Number	CO Description	K-level
CO-1	Explain soft computing techniques and their applications	K2
CO-2	Apply various neural network model to solve real-life problems	K3
CO-3	Explain fuzzy logic and its applications	K2
CO-4	Solve various optimization problems using genetic algorithm	K3

Course Content:

Module 1: Introduction (4 hours)

Introduction to soft computing, soft computing vs. hard computing, various types of soft computing techniques, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

Module 2: Neural Networks (8 hours)

Biological neurons and its working, Simulation of biological neurons to problem solving, artificial neuron, characteristic and applications of ANN, various activation functions, McCulloch–Pitt neural network, Perceptron training algorithm, Linear separability, Hebb's learning rule/Delta rule, Backpropagation Learning and Architecture, Introduction to Associative Memory, Self Organizing Map, Adaptive Resonance Theory, Applications of ANNs to solve some real-life problems.

Module 3: Fuzzy Systems (7hours)

Introduction to Fuzzy logic. Fuzzy versus Crisp set, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications, and inferences, Defuzzification techniques, Fuzzy logic controller design, Some applications of Fuzzy logic.

Module 4: Genetic Algorithm **(7 hours)**

History of Genetic Algorithms (GA),Concept of "Genetics" and "Evolution", Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc., Solving single-objective optimization problems using Gas, Concept of multi-objective optimization problems (MOOPs) and issues of solving them.

References / Suggested Learning Resources:

1. S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing,Wiley Publications, 2nd Edition, 2011.
2. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks,Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHIPublication, 1st Edition, 2009.
3. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications,S.Rajasekaran, G. A. Vijayalakshami, PHI.
4. Genetic Algorithms: Search and Optimization, E. Goldberg.
5. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
6. S.N. Shivanandam, Principle of soft computing, WileyISBN13: 9788126527410 (2011).
7. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India, 2003.
8. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall, 1995
9. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Edition, 2003.
10. Mitchell Melanie, "An Introduction to Genetic Algorithm", Prentice Hall, 1998.
11. David E. Goldberg, Genetic Algorithms in Search, Optimization & Machine Learning, Addison Wesley, 1997.

Machine Learning

Course Code	PE CS 702/2
Course Title	Machine Learning
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Data Mining, AI
Course Category	Machine Learning (PE)
Number of classes	26 hours

Course Outcome:

After completing this course, the student should be able to-

CO Number	CO Description	K-level
CO-1	Explain the concepts of computational intelligence like machine learning	K2
CO-2	Apply machine learning techniques to address the real time problems in different areas.	K3
CO-3	Illustrate the Ensemble methods and its usage in machine learning application	K3
CO-4	Apply Reinforcement learning techniques to respective problems.	K4

Course Content:

Module 1: Introduction (6)

Introduction: Machine learning, Terminologies in machine learning, Types of machine learning: supervised, unsupervised, semi-supervised learning. Review of probability. **Decision Trees,** Clustering - K-means/Kernel K-means, Dimensionality Reduction - PCA and kernel PCA, Matrix Factorization and Matrix Completion

Module 2: Discriminative Models (6)

Least Square Regression, Gradient Descent Algorithm, Univariate and Multivariate Linear Regression, Prediction Model, probabilistic interpretation, Regularization, Logistic regression, multi class classification, Support Vector Machines- Large margin classifiers, Nonlinear SVM, kernel functions, SMO algorithm.

Module 3: Generative models (6)

k-Nearest Neighbour Classification, Bayesian concept learning, Likelihood, Posterior predictive distribution, beta-binomial model, Naive Bayes classifiers, classifying documents using bag of

words. Bayesian Statistics and Frequentist statistics. Directed graphical models (Bayes nets), Conditional independence, Inference.

Module 4: Advanced ML Models (8)

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference.

Recent trends in various learning techniques of machine learning and classification methods.

References / Suggested Learning Resources:

1. E. Alpaydin, "Introduction to Machine Learning", PHI, 2005.
2. Tom Mitchell, "Machine Learning", McGraw Hill, 1997
3. Kevin P. Murphy, "Machine Learning, a probabilistic perspective", The MIT Press Cambridge, Massachusetts, 2012.
4. Alex Smola and SVN. Viswanathan, "Introduction to Machine Learning", Cambridge University Press, 2008.
5. Introduction to Machine Learning(link is external) | Nils J. Nilsson, Stanford University

Cloud Computing

Course Code	PE CS 702/3
Course Title	Cloud Computing
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Computer Networks
Course Category	Program Elective
Number of classes	26 hours

Course Outcome:

After completing this course, the student should be able to-

CO Number	CO Description	K-level
CO-1	Explain the concept of Cloud Computing	K2
CO-2	Illustrate the various Cloud Architecture, Model and Service Management	K2
CO-3	Apply Virtualization for Cloud Computing	K3
CO-4	Explain Cloud Security	K2

Course Content:

Module 1: Introduction (8hours)

Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture, Evolution of Cloud Computing, usage scenarios and Applications, Business models around Cloud – Major Players in Cloud Computing - Issues in Cloud - Eucalyptus, CloudSim,Research trend in Cloud Computing, Fog Computing.

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Module 2: Cloud Architecture, Model and Service Management (8 hours)

Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges, and risks in cloud adoption.

Cloud deployment model: Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing.

Service Management in Cloud Computing, Data Management in Cloud Computing, Resource Management in Cloud.

Module 3: Virtualization for Cloud (4 hours)

Need for Virtualization – Pros and cons of Virtualization – Types of Virtualizations – Basics of VMWare, advantages of VMware virtualization, using VMware workstation, creating virtual machines-understanding virtual machines, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.

Module 4: Cloud Security (6 hours)

Infrastructure Security: Network level security, Host level security, Application-level security. Data security and Storage: Data privacy and security Issues, Jurisdictional issues raised by Data location. Identity & Access Management, Access Control, Trust, Reputation, RiskAuthentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations. Case Study on Open Source & Commercial Clouds

References / Suggested Learning Resources:

1. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011
2. Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
3. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010
5. Gautam Shroff, "Enterprise Cloud Computing Technology Architecture Applications", Cambridge University Press.
6. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach" McGraw-Hill Osborne Media.
7. Dimitris N. Chorafas, "Cloud Computing Strategies" CRC Press.

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Project Work Intermediate

Course Code	PR CS 705
Course Title	Project Work Intermediate
Number of Credits	6 (L: 0, T: 0, P: 12)
Prerequisites	Nil
Course Category	Project (PR)
Number of classes	130 hours

Course Outcome:-

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Demonstrate a sound technical knowledge of their selected project topic	K2
CO-2	Develop the skill of working in a Team	K3
CO-3	Design engineering solutions to complex problems utilizing a systematic approach	K6
CO-4	Design the solution of an engineering project involving latest tools and techniques	K6
CO-5	Develop the skill of effective communication with engineers and the community at large in written an oral forms	K3
CO-6	Demonstrate the knowledge, skills and attitudes of a professional engineer	K2

Course Content:-

The project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Develop sound knowledge about the domain of the project work.
2) Perform detailed study about various components of a project.
3) Learn to be an important member of a team for successful execution of a project work.
4) Study about methodologies and professional way of documentation and communication related to project work.
5) Develop idea about problem formulation, finding the solution of a complex engineering problem.
6) Develop project report as per the suggested format to communicate the findings of the project work.
7) Acquire the skill of effective oral communication to the fellow engineers and people in the society at large.
8) Develop knowledge of how to organize, scope, plan, do and act within a project thesis.
9) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.

10) Demonstrate the implementation of a project work.

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Industry Internship – II

Course Code	SI CS 706
Course Title	Industry Internship – II
Number of Credits	1 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Summer Internship (SI)
Number of classes	-

Course Outcome:-

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Solve real life challenges in the workplace by analysing work environment and conditions, and selecting appropriate skill sets acquired from the course of study	K3
CO-2	Develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting	K3
CO-3	Demonstrate the skill to communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means	K2
CO-4	Show professional ethics by displaying positive disposition during internship	K2
CO-5	Decide career options by considering opportunities in company, sector, industry, professional and educational advancement	K5

Course Content:-

The industry internship aims to provide the student with:

1. A practice-oriented and 'hands-on' working experience in the real world or industry, and to enhance the student's learning experience.

2. An opportunity to develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting.

3. An opportunity to further develop and enhance operational, customer service and other life-long knowledge and skills in a real world work environment.

4. Pre-employment training opportunities and an opportunity for the company or organisation to assess the performance of the student and to offer the student an employment opportunity after his/her graduation, if it deems fit.

Each student shall

1) Identify aninternship program of relevance in his/her branch of engineering to undergo during summer break between 6^{th} and 7^{th} semester,
2) Get approval of the concerned HOD,
3) Undergo the industry internship program for minimum 4 weeks duration
4) Prepare their own report
5) Present in the class among fellow students and faculty members / deliver viva voce.
6) Submit the report and participation/course completion certificate.

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Seminar on Contemporary Engineering Topics – I

Course Code	SE CS 707
Course Title	Seminar on Contemporary Engineering Topics – I
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Nil
Course Category	Seminar (SE)
Number of classes	24 hours

Course Outcome:-

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Identify contemporary topics in respective branch of engineering	K3
CO-2	Survey literature to understand insight of the selected topic	K4
CO-3	Develop report writing and presentation making skill	K3
CO-4	Presentthe topic so prepared among audience using suitable aid	K3

Course Content:-

Each student shall

1) Identify a topic of current relevance in his/her branch of engineering,
2) Get approval of the faculty concerned/HOD,
3) Collect sufficient literature on the selected topic, study it thoroughly (literature survey),
4) Prepare their own report and presentation slides and
5) Present in the class among fellow students and faculty members.

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TRIPURA UNIVERSITY

(A CENTRAL UNIVERITY)

CURRICULUM STRUCTURE

OF

4 YEARS

BACHELOR OF TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING (CSE)

EIGHTH SEMESTER

EIGHTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/ week	Credit	Full Marks
1.	Program Elective-4	PECS 801/1	Distributed Systems	3	0	0	3	3	100
		PECS 801/2	Mobile Computing						
		PECS 801/3	Big Data Analytics						
2.	Program Elective-5	PECS 802/1	Pattern Recognition	2	0	0	2	2	100
		PECS 802/2	Natural Language Processing						
		PECS 802/3	Android Operating System						
3.	Open Elective-1	OE 803	Refer Annexure 3	3	0	0	3	3	100
4.	Open Elective-2	OE 804	Refer Annexure 4	2	0	0	2	2	100
5.	Project - 3	PRCS 805	Project Work Final	0	0	12	12	6	200
6.	Seminar - 2	SECS 806	Seminar on Contemporary Engineering Topics - II	0	0	2	2	1	100
7.	Online Course	SWCS 807	SWAYAM Courses[#]	0	0	0	0	1	100
Total :				10	0	14	24	18	800

Distributed Systems

Course Code	PE CS 801/1
Course Title	Distributed Systems
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Database Management Systems
Course Category	Program Elective-4
Number of classes	36 hours

Course Outcome:

After completing this course, the student should be able to-

CO Number	CO Description	K-level
CO-1	Explain the trends in distributed systems	K2
CO-2	Design distributed systems.	K4
CO-3	Apply remote method invocation and objects.	K3
CO-4	Illustrate the reliability issues of distributed systems.	K2

Course Content:

Module 1: Introduction (8hours)

Distributed data processing; what is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts
DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE
Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues .

Module 2: Design (10 hours)

DISTRIBUTED DATABASE DESIGN
Alternative design strategies; Distributed design issues; Fragmentation; Data allocation **SEMANTICS DATA CONTROL**
View management; Data security; Semantic Integrity Control QUERY
PROCESSING ISSUES
Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data .

Module 3: **(10hours)**

DISTRIBUTED QUERY OPTIMIZATION
Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms
TRANSACTION MANAGEMENT
The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models
CONCURRENCY CONTROL
Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management

Module 4: **(8 hours)**

Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols Algorithm.
PARALLEL DATABASE SYSTEMS
Parallel architectures; parallel query processing.
ADVANCED TOPICS
Mobile Databases, Distributed Object Management, Multi-databases

References / Suggested Learning Resources:

1. Principles of Distributed Database Systems, M.T. Ozsu and PValduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison- Wesley, 1992.

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Mobile Computing

Course Code	PE CS 801/2
Course Title	Mobile Computing
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	--
Course Category	Program Core (PC)
Number of classes	36 hours

Course Outcome:

CO Number	CO Description	K-level
CO-1	Explain Mobile Communication and next generation mobile computing system	K2
CO-2	Analyze IP and TCP layers of Mobile Communication.	K3
CO-3	Explain network and transport layers of Mobile Communication.	K2
CO-4	Analyze various protocols of all layers for mobile and ad hoc wireless communication networks.	K3

Course Content:

Module 1 **(8 Hours)**

Basic history of Mobile Computing Architecture for mobile computing, Three tier architecture, design considerations for mobile computing, mobile computing through internet, Wireless network architecture, Applications, Security, Concerns and Standards, Benefits, Future. Evolution of mobile computing.

Module 2 **(12 Hours)**

Overview of Wireless n/w. and Technologies: Introduction, Different generations. Introduction to 1G, 2G, 3G and 4G, Bluetooth, Radio frequency identification(Rfid),Wireless Broadband, Mobile IP: Introduction, Advertisement, Registration, TCP connections, two level addressing, abstract mobility management model, performance issue, routing in mobile host, Adhoc networks, Mobile transport layer: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, transaction oriented TCP,IPv6 Wireless network topologies, Cell fundamentals and topologies, Global system for mobile communication, Global system for mobile communication, GSM architecture, GSM entities, call routing in GSM,PLMN interface, GSM addresses and identifiers, network aspects in GSM,GSM frequency allocation, authentication and security, Short message services, Mobile computing over SMS,SMS, value added services through SMS,accessing the SMS bearer, Security in wireless networks.

Module 3 **(6 Hours)**

General packet radio service (GPRS): GPRS and packet data network, GPRS network architecture, GPRS network operation, data services in GPRS, Applications of GPRS, Billing and charging in GPRS.

Module 4: **(10 Hours)**

Wireless Application Protocol(WAP): WAP,MMS,GPRS application CDMA and 3G Spread-spectrum Technology, CDMA versus GSM, Wireless data, third generation networks, applications in 3G Wireless LAN, Wireless LAN advantages,IEEE802.11 standards ,Wireless LAN architecture, Mobility in Wireless LAN, Deploying Wireless LAN, Deploying Wireless LAN, Mobile ad hoc networks and sensor networks, wireless LAN security, WiFi v/s 3G Voice over Internet protocol and convergence, Voice over IP,H.323 framework for voice over IP,SIP, comparison between H.323 ad SIP, Real time protocols, convergence technologies, call routing, call routing, voice over IP applications, IMS, Mobile VoIP, 13 30 Security issues in mobile Information security, security techniques and algorithms, security framework for mobile environment.

Suggested books:

1. Mobile Computing,Raj Kamal by Oxford
2. Wireless Communications & Networks, Second Edition,William Stallings by Pearson
3. Mobile Computing Theory and Practice-Kumkum Garg-Pearson
4. TCP/IP Protocol Suite by Behrouz A Forouzan, Third Edition,TMH

Suggested reference books:

1. Mobile Computing Technology, Applications and service creation, Asoke K Telukder, Roopa R Yavagal by TMH.
2. V.K.Garg, J.E.Wilkes, “Principle and Application of GSM”, Pearson Education, 5th edition, 2008.
3. V.K.Garg, “IS-95 CDMA & CDMA 2000”, Pearson Education, 4th edition, 2009.
4. T.S.Rappaport, “Wireless Communications Principles and Practice”, 2nd edition, PHI,2002.
5. William C.Y.Lee, “Mobile Cellular Telecommunications Analog and Digital Systems”, 2nd edition, TMH, 1995.
6. Asha Mehrotra, “A GSM system Engineering” Artech House Publishers Bosten, London,1997

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Big Data Analytics

Course Code	PE CS 801/3
Course Title	Big Data Analytics
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Data Mining
Course Category	Program Elective (PE)
Number of classes	36 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Explain big data and use cases from selected business domains.	K2
CO-2	Explain NoSQL big data management.	K3
CO-3	Configure, and run Hadoop and HDFS and perform map-reduce analytics using Hadoop	K3
CO-4	Utilize Hadoop related tools such as Cassandra, Pig, and Hive for big data analytics	K2

Module 1: Introduction (8)

Types of Digital Data-Characteristics of Data – Evolution of Big Data - Definition of Big Data - Challenges with Big Data - 3Vs of Big Data - Non Definitional traits of Big Data - Business Intelligence vs. Big Data - Data warehouse and Hadoop environment - Coexistence. Introduction to Big Data tools like Hadoop, Spark, Impala etc., Data ETL process, Identify gaps in the data and follow-up for decision making.
Map Reduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression.

Module 2: Big Data Analytics (8)
Big Data Analytics: Classification of analytics - Data Science - Terminologies in Big Data - CAP Theorem - BASE Concept. Run descriptive to understand the nature of the available data, collate all the data sources to suffice business requirement, Run descriptive statistics for all the variables and observer the data ranges, Outlier detection and elimination. Hypothesis testing and determining the multiple analytical methodologies, Train Model on 2/3 sample data using various Statistical/Machine learning algorithms, Test model on 1/3 sample for prediction etc.

Module 3: No SQL databases (10)

NoSQL: Types of Databases – Advantages – NewSQL - SQL vs. NOSQL vs NewSQL.
Mongo DB: Introduction – Features - Data types - Mongo DB Query language - CRUD operations – Arrays - Functions: Count – Sort – Limit – Skip – Aggregate - Map Reduce. Cursors – Indexes - Mongo Import – Mongo Export.
Cassandra: Introduction – Features - Data types – CQLSH - Key spaces - CRUD operations – Collections – Counter – TTL - Alter commands - Import and Export - Querying System tables.

Module 4: Hadoop Ecosystems (10)
Hive – Architecture - data type - File format – HQL – SerDe - User defined functions
Pig: Features – Anatomy - Pig on Hadoop - Pig Philosophy - Pig Latin overview - Data types - Running pig - Execution modes of Pig - HDFS commands - Relational operators - Eval Functions - Complex data type - Piggy Bank - User defined Functions - Parameter substitution - Diagnostic operator.
Jasper Report: Introduction - Connecting to Mongo DB - Connecting to Cassandra.
Hadoop 2 (YARN): Architecture - Interacting with Hadoop Eco systems.

Data Visualization: Prepare the data for Visualization, Use tools like Tableau, Qlick View and D3, Draw insights out of Visualization tool

References / Suggested Learning Resources:

1. Seema Acharya, Subhashini Chellappan, “Big Data and Analytics”, Wiley Publication, 2015.
2. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, “Big Data for Dummies”, John Wiley & Sons, Inc., 2013.
3. Tom White, “Hadoop: The Definitive Guide”, O’Reilly Publications, 2011.
4. Kyle Banker, “Mongo DB in Action”, Manning Publications Company, 2012.
5. Russell Bradberry, Eric Blow, “Practical Cassandra A developers Approach“, Pearson Education, 2014.

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Pattern Recognition

Course Code	PE CS 802/1
Course Title	Pattern Recognition
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Soft Computing
Course Category	Program Elective-4
Number of classes	26 hours

Course Outcome:

After completing this course, the student should be able to-

CO Number	CO Description	K-level
CO-1	Explain supervised and unsupervised pattern classifiers	K2
CO-2	Classify the data and identify the patterns	K3
CO-3	Apply different feature extraction techniques.	K3
CO-4	Utilize Hidden Markov model and SVM in pattern recognition.	K3

Course Content:

Module 1: Pattern Classifier (6 hours)

Overview of Pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach– Pattern classification by distance functions – Minimum distance pattern classifier- Fisher Linear Discriminant.

Module 2: Classification and Clustering (8 hours)

Classification: Bayes decision rule, Error probability, Error rate, Minimum distance classifier, Mahala Nobis distance; K-NN Classifier, Linear discriminant functions and Non-linear decision boundaries.
Clustering for unsupervised learning and classification–Clustering concept – C Means algorithm – Hierarchical clustering – Graph theoretic approach to pattern Clustering – Validity of Clusters
Clustering: Different distance functions and similarity measures.

Module 3: Feature Extraction and Structural Pattern Recognition (6 hours)

Principle component analysis, independent component analysis, Linear discriminant analysis, Feature selection through functional approximation.

Feature selection: Problem statement and Uses, Probabilistic separability-based criterion functions, interclass distance-based criterion functions, Branch and bound algorithm, sequential forward/backward selection algorithms.

Module 4: Hidden Markov Models and Support Vector Machine (6 hours)

State Machines – Hidden Markov Models – Training – Classification – Support vector Machine – Feature Selection-obtaining the optimal hyperplane.

References / Suggested Learning Resources:

1. Andrew Webb, "Statistical Pattern Recognition", Arnold publishers, London,1999
2. C.M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
3. M. Narasimha Murthy and V. Susheela Devi, "Pattern Recognition", Springer 2011.
4. Menahem Friedman, Abraham Kandel, "Introduction to Pattern RecognitionStatistical, Structural, Neural and Fuzzy Logic Approaches", World Scientificpublishing Co. Ltd, 2000.
5. Robert J.Schalkoff, "Pattern Recognition Statistical, Structural and NeuralApproaches", John Wiley & Sons Inc., New York, 1992.
6. R.O. Duda, P.E.Hart and D.G.Stork, "Pattern Classification", John Wiley, 2001
7. S.Theodoridis and K.Koutroumbas, "Pattern Recognition", 4th Ed., Academic Press, 2009
8. R.O. Duda, P.E.Hart and D.G.Stork, Pattern Classification,John Wiley, 2002.
9. C.M. Bishop, Neural Networks and Pattern Recognition,Oxford University Press(Indian Edition), 2003.

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Natural Language Processing

Course Code	PE CS 802/2
Course Title	Natural Language Processing
Number of Credits	02 (L: 2, T: 0, P: 0)
Prerequisites	Nil
Course Category	Program Elective-5
Number of classes	26 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Explain the various challenges of NLP.	K2
CO-2	Implement a parser by providing suitable grammar and words	K3
CO-3	Perform syntax and semantic analysis using language analysis tools.	K4
CO-4	Design and evaluate the NLP applications.	K3

Course Content:

Module 1: Overview and Language Modeling (6)
Overview: Origins and challenges of NLP – Language and Grammar – Processing Indian Languages – NLP Applications: Machine Translation – Information Extraction. Language Modeling: Introduction – Various Grammar-Based Language Models – Statistical Language Model

Module 2: Part-of-Speech Tagging and Context-Free Grammars (7)
English Word classes – Tag sets for English – Part-of-Speech Tagging – Rule based Part-of-Speech Tagging – Stochastic Part-of-Speech Tagging – Transformation-Based Tagging. Stemming – Context-Free Grammars for English: Constituency – Context Free Rules and Trees – Sentence Level Constructions – The Noun Phrase - Coordination – Agreement – The Verb Phase and Sub categorization – Auxiliaries – Spoken Language Syntax – Grammars Equivalence and Normal Form–Finite-State and Context-Free Grammars – Grammars and Human Processing

Module 3: Parsing & Semantics (8)
Parsing and Advanced Features: Parsing as Search – A Basic Top-Down Parser – Problems with the Basic Top-Down Parser – The Early Algorithm – Finite-State Parsing Methods. Features and Unification: Feature Structures – Unification of Feature Structures – Features Structures in the Grammar – Implementing Unification – Parsing with Unification Constraints – Types and Inheritance.
Semantics Analysis and Lexical Semantics: Semantic Representing Meaning – Meaning Structure of Language – First Order Predicate Calculus – Semantic Analysis: Syntax-Driven Semantic

Analysis – Attachments for a Fragment of English – Integrating Semantic Analysis into the Early Parser – Idioms and Compositionality – Robust Semantic Analysis – Lexical Semantics: Relational among Lexemes and their Senses – Word Net: A database of Lexical Relations – The Internal Structure of Words.

Module 4: Evaluation Metrics & Applications of NLP (5)

Manual Evaluation – Fluency and Adequacy – Other Evaluation Criteria – Automatic Evaluation – Precision and Recall – F-Measure – Word Error Rate – Bilingual Evaluation Understudy – METEOR – Multiple Reference Translations – Pearson's Correlation Coefficient – Hypothesis Testing – Pair wise comparison – Task oriented Evaluation.

Applications of NLP: NL Interfaces, Text Summarization, Sentiment Analysis, Machine Translation, Question answering. Recent Trends in NLP

References / Suggested Learning Resources:

1. Jurafsky, Daniel, and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Speech Recognition, and Computational Linguistics", Prentice Hall, 2000.
2. Christopher D. Manning and Hinrich Schütze, "Foundations of Statistical Natural Language Processing". Cambridge, MIT Press, 1999.
3. James Allen, "Natural Language Understanding", Benjamin/Cummings, 2ed, 1995.
4. Eugene Charniak, "Statistical Language Learning", MIT Press, 1996.
5. Martin Atkinson, David Britain, Harald Clahsen, Andrew Redford, "Linguistics", Cambridge University Press, 1999.
6. P. Lieberman, "Toward an evolutionary biology of language", Harvard University Press, 2006.
7. Philipp Koehn, “Statistical Machine Translation”, 1st Edition, Cambridge University Press, January 2010.
8. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, 3rd Edition, Oxford University Press
9. Nitin Indurkhya, Fred J. Damerau, “Handbook of Natural Language Processing”, 2ed, CRC Press, 2010.

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Android Operating System

Course Code	PE CS 802/3
Course Title	Android Operating System
Number of Credits	02 (L: 2,T:0,P:0)
Prerequisites	ES 204 and PECS 701(Kotlin Programming)
Course Category	Program Elective(PE)
Number of classes	26 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Explain the development tools and major components of Android API.	K2
CO-2	Utilize the user interface properties to develop the structure.	K3
CO-3	Demonstrate the use of multimedia in Android.	K3
CO-4	Analyze the networking and touch event properties in Android.	K4

Course Content:

Module 1: Introduction to Android OS (6)

Android Software Stack, Activities and Applications, Android using Kotlin, Activity Life Cycles, Activity Stacks, Activity States, Resources, Android OS vs. IOS.

Module 2: User Interfaces (8)

Views, Layouts, Android Widgets, UI XML Specifications, Explicit Intents, Implicit Intents, Event Broadcasting with Intents, Event Reception with Broadcast Receivers, Adapters and Data Binding.

Module 3: Multimedia (7)

Audio, Video, Camera, Playing Audio and Video, Recording Audio and Video, Using the Camera to Take and Process Pictures

Module 4: Networking& Touchscreen (6)

Networking Internet Access, HTML and XML Parsing, Wi-Fi, Capturing Touch Events, Touchscreen Gesture Recognition.

References / Suggested Learning Resources:

1. Android Development with Kotlin, by Marcin Moskala and Igor Wojda, Packt Publishing Limited.
2. Rito Meier. "Professional Android Application Development." Wiley Publishing, Inc.
3. Sayed Hashimi, Satya Komatineni, Dave MacLean. "Pro Android 2." APRESS.
4. Mark Murphy. "Beginning Android 2." APRESS.
5. Carmen Delessio, Lauren Darcey ”Android Application Development” Pearson
6. J.F. DiMarzio “Android a programming guide” TMH

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Project Work Final

Course Code	PR CS 805
Course Title	Project Work Final
Number of Credits	6 (L: 0, T: 0, P: 12)
Prerequisites	Nil
Course Category	Project (PR)
Number of classes	130 hours

Course Outcome:-

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Demonstrate a sound technical knowledge of their selected project topic	K2
CO-2	Develop the skill of working in a Team	K3
CO-3	Design engineering solutions to complex problems utilizing a systematic approach	K6
CO-4	Design the solution of an engineering project involving latest tools and techniques	K6
CO-5	Develop the skill of effective communication with engineers and the community at large in written an oral forms	K3
CO-6	Demonstrate the knowledge, skills and attitudes of a professional engineer	K2

Course Content:-

The project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Develop sound knowledge about the domain of the project work.
2) Perform detailed study about various components of a project.
3) Learn to be an important member of a team for successful execution of a project work.
4) Study about methodologies and professional way of documentation and communication related to project work.
5) Develop idea about problem formulation, finding the solution of a complex engineering problem.
6) Develop project report as per the suggested format to communicate the findings of the project work.
7) Acquire the skill of effective oral communication to the fellow engineers and people in the society at large.
8) Develop knowledge of how to organize, scope, plan, do and act within a project thesis.
9) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.

10) Demonstrate the implementation of a project work.

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Seminar on Contemporary Engineering Topics – II

Course Code	SE CS 806
Course Title	Seminar on Contemporary Engineering Topics – II
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Nil
Course Category	Seminar (SE)
Number of classes	24 hours

Course Outcome:-

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Identify contemporary topics in respective branch of engineering	K3
CO-2	Survey literature to understand insight of the selected topic	K4
CO-3	Develop report writing and presentation making skill	K3
CO-4	Present the topic so prepared among audience using suitable aid	K3

Course Content:-

Each student shall

1) Identify a topic of current relevance in his/her branch of engineering,
2) Get approval of the faculty concerned/HOD,
3) Collect sufficient literature on the selected topic, study it thoroughly (literature survey),
4) Prepare their own report and presentation slides and
5) Present in the class among fellow students and faculty members.

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SWAYAM Courses

Course Code	SW CS 807
Course Title	SWAYAM Courses
Number of Credits	1 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Online Course (SW)
Number of classes	-

Courses Outcome:-

After completion of the courses, students will be able to:

CO Number	CO Description	K-level
CO-1	Make use of digital learning platform to enhance knowledge and skill beyond the prescribed curriculum structure	K3
CO-2	Take part in proctored examination system to prepare oneself for similar future challenges	K4
CO-3	Utilize the opportunity to learn from best faculty in the countryfor professional development	K3
CO-4	Develop the skill of lifelong self-learning and become future ready	K3

Courses Content:-

SWAYAM (Study Webs of Active-learning for Young Aspiring Minds); India Chapter of Massive Open Online Courses. SWAYAM is an indigenous developed IT platform, initiated by Government of India, which is instrumental for self-actualization providing opportunities for a life-long learning. Learner can choose from hundreds of courses, virtually every course that is taught at the university/college/school level and these shall be offered by best of the teachers in India and elsewhere. Student having registered a course, having submitting the Assignments as per requirements of the course, shall at the end of each course, be assessed through a proctored examination. A student having successfully completed the course shall get a Certificate.

Each student has to undergo and qualify at least two relevant SWAYAM or equivalent courses (to be certified by concerned HOD) with certification during the entire course of B. Tech. program. The Head of the departments will approve the relevancy of a SWAYAM or equivalent course for respective branch of engineering.

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PROGRAM OUTCOMES (POs) AS PER NATIONAL BOARD OF ACCREDITATION (NBA)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.