Department of Computer Science & Engineering

Curriculum Structure

1st Semester to 8th Semester

(Effective from 2021-22 Admission Batch)

Curriculum for B.Tech under Autonomy
Computer Science & Engineering

L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Crl

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

1ST Year 1st Semester: 1st Semester								
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
	THEORY			L	T	P	Total	
1	Basic Science course	PH101	Physics-I	3	0	0	3	3
2	Basic Science course	M101	Mathematics –I	4	0	0	4	4
3	Humanities and Social Sciences including Management courses	HSMC 101	Professional Communication	2	0	0	**2**	2
	PRACTICAL							
4	Basic Science course	PH191	Physics-I Lab	0	0	3	3	1.5
5	Engineering Science Courses	ME 191	Workshop & Manufacturing Practices Lab	0	0	3	3	1.5
6	PROJECT	PR191	Theme based Project I	0	0	1	1	0.5
7	PROJECT	PR192	Skill Development I: Soft Skill	0	0	1	1	0.5
	MANDATORY ACTIVITIES / COURSES							
8	Mandatory Course	MC181	Induction Program	0	0	0	0	2Units
	TOTAL CREDIT							13.0

1ST Year 2nd Semester: 2nd Semester								
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
	THEORY			L	T	P	Total	
1	Basic Science courses	CH 201	Chemistry-I	3	0	0	3	3
2	Basic Science courses	M 201	Mathematics –II	4	0	0	4	4
3	Engineering Science Courses	EE 201	Basic Electrical Engineering	3	0	0	3	3
4	Engineering Science Courses	CS 201	Programming for Problem Solving	3	0	0	3	3
	PRACTICAL							
5	Basic Science course	CH 291	Chemistry-I Lab	0	0	3	3	1.5
6	Humanities and Social Sciences including Management courses	HSMC 291	Professional Communication LAB	0	0	2	2	1.0
7	Engineering Science Courses	EE 291	Basic Electrical Engineering Lab	0	0	3	3	1.5
8	Engineering Science Courses	ME 292	Engineering Graphics & Design Lab	0	0	3	3	1.5
9	Engineering Science Courses	CS 291	Programming for Problem Solving Lab	0	0	3	3	1.5
10	PROJECT	PR291	Theme based Project II	0	0	1	1	0.5
11	PROJECT	PR292	Skill Development II: Life Skill	1	0	0	1	0.5
	MANDATORY ACTIVITIES / COURSES							
12	Mandatory Course	MC281	NSS/Physical Activities / Meditation & Yoga / Photography	0	0	3	3	3 Units
	TOTAL CREDIT							21

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s).

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

2nd Year 1st Semester: 3rd Semester								
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
				L	**T**	**P**	**Total**	
A. THEORY								
1	Basic Science course	M301	Discrete Mathematics	3	0	0	3	3
2	Engineering Science Courses	ESC301	Analog Electronics	3	0	0	3	3
3	Engineering Science Courses	ESC302	Digital Logic and Electronics	3	0	0	3	3
4	Program Core Course	PCC-CS301	ITWorkshop (SciLab/MATLAB/C++)	3	0	0	3	3
5	Program Core Course	PCC-CS302	Data Structures	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	HSMC 303	Universal Human Values 2: Understanding Harmony	3	0	0	3	3
B. PRACTICAL								
7	Engineering Science Courses	M (CS)391	Numerical Methods Lab	1	0	3	3	2.5
8	Engineering Science Courses	ESC391	Digital and Analog Electronics Lab	0	0	3	3	1.5
9	Program Core Course	PCC-CS391	ITWorkshop Lab (SciLab/MATLAB/C++)	0	0	3	3	1.5
10	Program Core Course	PCC-CS392	Data Structures Lab	0	0	3	3	1.5
11	PROJECT	PR391	Theme based Project III	0	0	1	1	0.5
12	PROJECT	PR392	Skill Development III: Technical Seminar Presentation	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 301	Environmental Science		0	3	3	3 Units
	TOTAL CREDIT WITHOUT MOOCS COURSES							26.0
D.MOOCS COURSES**								

14	MOOCS COURSES	HM301	MOOCS COURSE-I	3	1	4	4
TOTAL CREDIT WITH MOOCS COURSES							**30**

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/ internship coordinator(s).

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

2nd Year 2nd Semester: 4th Semester								
Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	**T**	**P**	**Total**	
A. THEORY								
1	Program Core Course	PCC-CS401	Computer Organization and Architecture	3	0	0	3	3
2	Program Core Course	PCC-CS402	Design and Analysis of Algorithms	3	0	0	3	3
3	Program Core Course	PCC-CS403	Operating Systems	3	0	0	3	3
4	Program Core Course	PCC-CS404	Formal Language and Automata Theory	3	0	0	3	3
5	Humanities and Social Sciences including Management courses	HSMC 402	Gender Culture and Development	2	0	0	2	2
6	Basic Science course	BSC401	Probability and Statistics	3	0	0	3	3
B. PRACTICAL								
7	Program Core Course	PCC-CS491	Computer Organization and Architecture Lab	0	0	3	3	1.5
8	Program Core Course	PCC-CS492	Design and Analysis of Algorithms Lab	0	0	3	3	1.5
9	Program Core Course	PCC-CS493	Operating Systems Lab	0	0	3	3	1.5
10	Engineering Science Courses	ESC491	Programming using Python	0	0	3	3	1.5
11	PROJECT	PR 491	Theme based Project IV	0	0	1	1	0.5
12	PROJECT	PR492	Skill Development IV: Soft Skill & Aptitude-I	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 481	Learning an Art Form [vocal or instrumental, dance, painting, clay modeling, etc.] OR Environmental Protection Initiatives	0	0	0	3	3Units
	TOTAL CREDIT WITHOUT MOOCS COURSES							24

D.MOOCS COURSES								
14	MOOCS COURSES	HM401	MOOCS COURSE-II	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**28**

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/ internship coordinator(s).

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

3rd Year 1st Semester: 5th Semester								
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
					T	**P**	**Total**	
A. THEORY								
1	Humanities and Social Sciences including Management courses	HSMC 505	Principles of Management	2	0	0	2	2
2	Program Core Course	PCC-CS501	Compiler Design	3	0	0	3	3
3	Program Core Course	PCC-CS502	Database Management Systems	3	0	0	3	3
4	Program Core Course	PCC-CS503	Object Oriented Programming using Java	3	0	0	3	3
5	Professional Elective courses	PEC-CS-T-501	Advanced Algorithms	3	0	0	3	3
		PEC-CS-S-501	Advanced Computer Architecture					
		PEC-CS-D-501	Neural Networks and Deep Learning					
		PEC-CS-A-501	Artificial Intelligence					
B. PRACTICAL								
6	Program Core Course	PCC-CS591	Compiler Design Lab	0	0	3	3	1.5
7	Program Core Course	PCC-CS592	Database Management Systems Lab	0	0	3	3	1.5
8	Program Core Course	PCC-CS593	Object Oriented Programming using Java Lab	0	0	3	3	1.5
9	Professional Elective courses	PEC-CS-T-591	Advanced Algorithms Lab	0	0	3	3	1.5
		PEC-CS-S-591	Advanced Computer Architecture Lab					

		PEC-CS-D-591	Neural Networks and Deep Learning Lab					
		PEC-CS-A-591	Artificial Intelligence Lab					
10	PROJECT	PR 591	Minor Project I	0	0	3	2	1
11	PROJECT	PR 592	Skill Development V: Soft Skill & Aptitude-II	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC 501	Constitution of India	3	0	0	3	3Units
	TOTAL CREDIT WITHOUT MOOCS COURSES							21.5
D. MOOCS COURSES**								
13	MOOCS COURSES	HM501	MOOCS COURSE-III	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**25.5**

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/ internship coordinator(s).

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

3rd Year 2nd Semester: 6th Semester								
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
				L	**T**	**P**	**Total**	
A. THEORY								
1	Humanities and Social Sciences including Management courses	HSMC 604	Economics for Engineers	2	0	0	2	2
2	Program Core Course	PCC-CS601	Computer Neteworks	3	0	0	3	3
3	Program Core Course	PCC-CS602	Software Engineering	3	0	0	3	3
4	Professional Elective courses	PEC-CS-T-601	Microprocessor and Microcontroller	3	0	0	3	3
		PEC-CS-S-601	Advanced Operating Systems					
		PEC-CS-D-601	Machine Learning					
		PEC-CS-A-601	Web and Internet Technology					
5	Professional Elective courses	PEC-CS-T-602	Parallel and Distributed Algorithms	3	0	0	3	3
		PEC-CS-S-602	Embedded Systems					
		PEC-CS-D-602	Soft Computing					
		PEC-CS-A-602	Human Computer Interaction					
6	Open Elective courses	OEC-CS-601A	Introduction to Internet of Things	3	0	0	3	3
		OEC-CS-601B	Bio-informatics					
		OEC-CS-601C	Robotics					
B. PRACTICAL								

7	Program Core Course	PCC-CS691	Computer Networks Lab	0	0	3	3	1.5
8	Program Core Course	PCC-CS692	Software Engineering Lab	0	0	3	3	1.5
9	Professional Elective courses	PEC-CS-T-691	Microprocessor and Microcontroller Lab	0	0	3	3	1.5
		PEC-CS-S-691	Advanced Operating Systems Lab					
		PEC-CS-D-691	Machine Learning Lab					
		PEC-CS-A-691	Web and Internet Technology Lab					
10	PROJECT	PR 691	Minor Project II	0	0	3	2	1
11	PROJECT	PR 692	Skill Development VI: Soft Skill & Aptitude-III	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC 601	Intellectual Property Right	3	0	0	3	3Units
	TOTAL CREDIT WITHOUT MOOCS COURSES							23.0
D.MOOCS COURSES**								
13	MOOCS COURSES	HM601	MOOCS COURSE-IV	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**27**

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/ internship coordinator(s).

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

4th Year 1st Semester: 7th Semester								
Sl No	**Course Code**	**Paper Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	Professional Elective courses	PEC-CS-T-701	Information Theory and Coding	3	0	0	3	3
		PEC-CS-S-701	Ad-Hoc and Sensor Networks					
		PEC-CS-D-701	Data Mining and Data Warehouse					
		PEC-CS-A-701	Cloud Computing					
2	Professional Elective courses	PEC-CS-T-702	Quantum Computing	3	0	0	3	3
		PEC-CS-S-702	Mobile Computing					
		PEC-CS-D-702	Natural Language Processing					
		PEC-CS-A-702	Cryptography and Network Security					
3	Open Elective courses	OEC-CS-701A	High Performance Computing	3	0	0	3	3
		OEC-CS-701B	Image Processing					
		OEC-CS-701C	Optimization Techniques					
4	Open Elective courses	OEC-CS-702A	Cyber Law and Ethics	3	0	0	3	3
		OEC-CS-702B	Soft Skills and Interpersonal Communication					
		OEC-CS-702C	Foreign Language					
B. PRACTICAL								
5	Professional Elective courses	PEC-CS-T-791	Information Theory and Coding Lab	0	0	0	3	1.5
		PEC-CS-S-791	Ad-Hoc and Sensor Networks Lab					
		PEC-CS-D-791	Data Mining and Data Warehousing Lab					
		PEC-CS-A-791	Cloud Computing Lab					

6	Open Elective courses	OEC-CS-791A	High Performance Computing Lab	0	0	3	3	1.5
		OEC-CS-791B	Image Processing Lab					
		OEC-CS-791C	Optimization Techniques Lab					
7	PROJECT	PR 791	Major Project-I	0	0	0	4	2
8	PROJECT	PR 792*	Industrial Training / Internship	0	0	0	0	1
9	PROJECT	PR 793	Skill Development VII: Seminar & Group Discussion	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 781	Entrepreneurship & Innovation Skill	3	0	0	3	3 Units
TOTAL CREDIT WITHOUT MOOCS COURSES								18.5
D.MOOCS COURSES**								
11	MOOCS COURSES	HM701	MOOCS COURSE-V	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**22.5**

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/ internship coordinator(s).

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

4th Year 2nd Semester: 8th Semester								
Sl No	**Course Code**	**Paper Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	Professional Elective courses	PEC-CS-T-801	Advance Graph Algorithms	3	0	0	3	3
		PEC-CS-S-801	Real Time System					
		PEC-CS-D-801	Data Analytics					
		PEC-CS-A-801	Computer Graphics					
2	Open Elective courses	OEC-CS-801A	Human Resource Development and Organizational Behavior	3	0	0	3	3
		OEC-CS-801B	VLSI					
		OEC-CS-801C	Simulation and Modeling					
3	Open Elective courses	OEC-CS-802A	Values and Ethics in Profession	3	0	0	3	3
		OEC-CS-802B	History of Science					
		OEC-CS-802C	Economic Policies in India					
B. PRACTICAL								
4	PROJECT	PR 891	Major Project-II	0	0	0	12	6
5	PROJECT	PR 892	Grand Viva	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
6	MC	MC 801	Essence of Indian Knowledge Tradition	0	0	3	3	3 Units
TOTAL CREDIT								16

Department of Computer Science & Engineering

Curriculum Structure & Syllabus

1st Semester to 8th Semester

(Effective from 2021-22 Admission Batch)

Curriculum for B.Tech under Autonomy
Computer Science & Engineering

L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

1ST Year 1st Semester: 1st Semester								
Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	THEORY			L	T	P	Total	
1	Basic Science course	PH101	Physics-I	3	0	0	3	3
2	Basic Science course	M101	Mathematics –I	4	0	0	4	4
3	Humanities and Social Sciences including Management courses	HSMC 101	Professional Communication	2	0	0	**2**	2
	PRACTICAL							
4	Basic Science course	PH191	Physics-I Lab	0	0	3	3	1.5
5	Engineering Science Courses	ME 191	Workshop & Manufacturing Practices Lab	0	0	3	3	1.5
6	PROJECT	PR191	Theme based Project I	0	0	1	1	0.5
7	PROJECT	PR192	Skill Development I: Soft Skill	0	0	1	1	0.5
	MANDATORY ACTIVITIES / COURSES							
8	Mandatory Course	MC181	Induction Program	0	0	0	0	2Units
	TOTAL CREDIT							13.0

COURSE NAME: PHYSICS –I
Course Code: Ph 101
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Knowledge of Physics up to 12th standard.

Course Outcomes (COs):

After completion of the course students would be able to

PH101.1	Describe various types of mechanical resonance and its electrical equivalence
PH101.2	Explain basic principles of Laser, Optical fibers and Polarization of light
PH101.3	Apply superposition principle to explain interference and diffraction
PH101.4	Analyze different crystallographic structures according to their co-ordination number and packing factors
PH101.5	Determine and justify the need of a quantum mechanics as remedy to overcome limitations imposed by classical physics

Course Content:

Module 1 (5L):-
Waves &Oscillations:-
Simple Harmonic Motion (Recap), superposition of waves, damped harmonic motion-over damped, critically damped and under damped motion, energy decay, logarithmic decrement, force vibration and resonance (amplitude, velocity resonance), sharpness of resonance, quality factor, related numerical problems. 5L

Module 2 (12L):-
Classical Optics:
2.01- Interference of light: Huygens's principle, conditions of sustained interference, classification of interference, Newton's ring (qualitative descriptions of working principles and procedures-no deduction required). Engineering applications, related numerical problems. 4L

2.02-Diffraction of light: Fresnel and Fraunhofer class, Fraunhoffer diffraction of a single slit, double slit, multiple slits, intensity distributions, missing order, Rayleigh criterion (no deduction) and resolving power of grating and microscope (no deduction), related numerical problems. 4L
2.03-Polarization: Definition, Plane of polarization, Plane of vibration, Malus Law, Fundamental concepts of plane, circular & elliptical polarizations (only qualitative idea) with examples, Brewster's law, Double refraction: Ordinary & Extra ordinary rays, positive and negative crystal, Nicol's prism, Numerical problems 4L

Module 3 (8L):-
Quantum Mechanics-I
3.01 Quantum Theory: Inadequacy of classical physics-concept of quantization of energy, particle concept of electromagnetic wave (example: photoelectric and Compton Effect; no derivation required, origin of modified and unmodified lines), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment. 4L

3.02 Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions; uncertainty principle, relevant numerical problems. Introduction of Schrödinger wave equation (only statement). 4L

Module 4 (3L):-
Solid State Physics-I:
4.01 Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation, applications, numerical problems. 3L

Module 5 (8L):
Modern Optics-I:
5.01- Laser: Concepts of various emission and absorption processes, Einstein A and B coefficients and equations, working principle of laser, metastable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser, related numerical problems. 5L

5.02-Fibre optics-Principle and propagation of light in optical fibers (Step index, Graded index, single and multiple modes) - Numerical aperture and Acceptance angle, Basic concept of losses in optical fiber, related numerical problems. 3L

Recommended Text Books for Physics I (PH 101):

Waves & Oscillations:

1. Sound-N. K. Bajaj (TMH)
2. Advanced Acoustics-D. P. Roy Chowdhury (Chayan Publisher)
3. Principles of Acoustics-B.Ghosh (Sridhar Publisher)
4. A text book of sound-M. Ghosh (S. Chand publishers)
5. A text book of Light- K.G. Mazumder &B.Ghoshs, (Book & Allied Publisher)
6. Physics of Oscillations and Waves- R.P. Singh
7. College Physics Vol. II - A.B. Gupta
8. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

Classical & Modern Optics:

1. A text book of Light- K.G. Mazumder &B.Ghoshs (Book & Allied Publisher)
2. A text book of Light-Brijlal&Subhramanium, (S. Chand publishers)
3. Modern Optics-A. B. Gupta (Book& Allied Publisher)
4. Optics-Ajay Ghatak (TMH)
5. Optics-Hecht
6. Optics-R. Kar, Books Applied Publishers
7. PhysicalOptics Möler
8. Optics -F.A. Jenkins and H.E White

Quantum Mechanics-I

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
2. Quantum Mechanics-Bagde and Singh (S. Chand Publishers)
3. Perspective of Quantum Mechanics-S. P. Kuilla (New Central Book Agency)
4. Quantum Mechanics-Binayak Datta Roy (S. Chand Publishers)
5. Quantum Mechanics-Bransden (Pearson Education Ltd.)
6. Perspective of Modern Physics-A. Beiser (TMH)
7. Quantum mechanics -A.K. Ghatak and S Lokenathan
8. Modern Physics -E.E. Anderson

9. Physics Volume 2 -Haliday, Resnick & Krane, Published by Wiley India

Solid State Physics-I:

1. Solid state physics-Puri & Babbar (S. Chand publishers)
2. Materials Science & Engineering-Kakani Kakani
3. Solid state physics- S. O. Pillai
4. Introduction to solid state physics-Kittel (TMH)
5. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)
6. Problem in Solid state physics -S.O. Pillai (a. b.)

Text Books:

1. Refresher courses in physics (Vol. 1, Vol. 2 & Vol. 3)-C. L. Arora (S. Chand Publishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt. Ltd.)
3. Perspective & Concept of Modern Physics -Arthur Baiser
4. Principles of engineering physics – Md. N Khan and S Panigrahi.
5. Basic Engineering Physics-Sujoy Bhattacharya, Saumen Pal (MG)
6. Engineering Physics (Vol. 1, Vol. 2)-S.P. Kuila(S. Chand Publishers)
7. Engineering Physics-A. S. Vasudeva

**Total marks of the questions set from each module should be in proportion to the number of lectures allotted.

Project Domains

1. Study of Superposition of waves: Lissajous figures.

2. Electrical analogue of mechanical vibrations: application to electrical circuit (LC and LCR circuits), Electrical and mechanical impedance, quality factor, complex representation and phasor diagram.

3. Study of N-slit diffractions

4. Optical Fiber & its applications: Study of losses, estimation of numerical aperture in practical problems.

5. Photonic nature of electromagnetic waves

6. Optical Rotation

Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PH101.1	3	3	2	2								
PH101.2	3	3	2	2								
PH101.3	3	3	2	2								
PH101.4	3	3	2	2								
PH101.5	3	3	2	2								

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PH101.1	2	2	2
PH101.2	2	2	2
PH101.3	2	2	2
PH101.4	2	2	2
PH101.5	2	2	2

Course Name: Mathematics-I
Course Code: M 101
Contact: 3:1:0
Total Contact Hours: 48
Credits: 4

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) standard matrix algebra, calculus, and vector algebra.

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Understand and recall the properties and formula related to matrix algebra, differential calculus,
CO2	Determine the solutions of the problems related to matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series.
CO3	Apply the appropriate mathematical tools of matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series for the solutions of the problems.
CO4	Analyze different engineering problems linked with matrix algebra, differential calculus, multivariable calculus, vector calculus
CO5	Apply different engineering problems linked with matrix algebra, differential calculus, multivariable calculus, vector calculus

Course Content:

Module I: Matrix Algebra **11L**

Echelon form and Normal (Canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton theorem.

Module II: Differential Calculus and Infinite Series **10L**

Rolle‘s Theorem, Mean value theorems, Taylor‘s and Maclaurin theorems with remainders; Concept of sequence and series, Tests for convergence of infinite series: Comparison test, D‘Alembert‘s ratio test, Raabe‘s test, Cauchy‘s root test, Leibnitz‘s Test, Power series; Taylor's series, Series for exponential, trigonometric and logarithm functions.

Module III: Multivariable Calculus (Differentiation) **13L**

Function of several variables, Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; Chain rules, Derivatives of implicit functions Euler‘s theorem on homogeneous function, Jacobian. Maxima and minima of functions of two variables, Method of Lagrange multipliers.

Module IV: Multivariable Calculus (Integration) **6L**

Line Integral, Double Integral, Triple Integral,Change of order in multiple integrals, Change of variables in multiple integrals.

Module V: Vector Calculus **8L**

Gradient, Directional derivatives, Divergence, Curl, vector line integrals, vector surface integrals, vector volume integrals, Green‘s theorem, Gauss divergence theorem and Stokes‘ theorem.

Project Domain:

1. Study on eigenvalues and eigenvectors.
2. Study on convergence of infinite series.

3. Application of partial derivatives.
4. Application of vector calculus
5. Application of integral calculus.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
6. Samanta Guruprasad, A text book of Engineering Mathematics-I, New age International Publishers

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
3. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
4. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
5. Bronson, R., Schaum's Outline of Matrix Operations. 1988.
6. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
M101.1	3	2	3	2								2
M101.2	3	3	3	3								2
M101.3	3	3	3	3								2
M101.4	3	3	3	3								2
M101.5	3	3	3	3								2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
M101.1	2	2	2
M101.2	2	2	2
M101.3	2	2	2
M101.4	2	2	2
M101.5	2	2	2

Course Name: Professional Communication
Course Code: HSMC 101
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

Pre-requisites: Basic (10+2) level of knowledge of English grammar, vocabulary reading and writing skills.

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Understand about and use the modalities and nuances of communication in a workplace context.
CO2	Understand about communicating across cultures and societies.
CO3	Understand and know about and apply the basic formats, templates of business and official communication.
CO4	Understand and know about and employ formal communication modes in meetings and reports.
CO5	Understand and know about and use objective and culturally neutral language in interpersonal and business communication.

Course Content:

Module- 1:Verbal and Non-verbal communication **4L**

1.1: Definition, Relevance and Effective Usage
1.2: Components of Verbal Communication: Written and Oral Communication
1.3: Components of Non-verbal Communication: Kinesics, Proxemics, Chronemics, Haptics Paralanguage
1.4: Barriers to Effective Communication

Module- 2: Social Communication Essentials and Cross-Cultural Communication **6L**

2.1: Communication in Society and the Workplace
2.2: Greetings, Courtesies and Socially Useful Language
2.3: Cultural Contexts: High Context and Low Context Cultures
2.4: Understanding Cultural Nuances and Stereotyping
2.5: Achieving Culturally Neutral Communication in Speech and Writing

Module- 3: Meetings **4L**

3.1: Meetings: Nature and Types
3.2: Conducting Meetings: Organization and Procedures
3.3: Meeting Coordination: Roles of Chairpersons and Members
3.4: Notice and Agenda for a Meeting
3.5: Preparing the Minutes of a Meeting (MOM)

Module- 4: Report Writing **4L**

4.1: Nature and Function of Reports
4.2: Types of Reports
4.3: Researching for a Business Report
4.4: Format, Language and Style
4.5: Report Documentation

Module 5: Employment Communication **6L**

5.1: Writing Business Letters- (Enquiry, Order, Sales, Complaint, Adjustment, Job Application, Offer)
5.2: Preparing a CV or Rẽsumẽ
5.3: Creating a Digital/Online Profile – LinkedIn (Résumé/Video Profile)
5.4: Writing E-mails: types, convention, and etiquette
5.5: Memo, Notices and Circulars
5.6: Writing Technicalities—Paragraphing, Sentence Structure and Punctuation

Text Books & Reference Books:

1. Meenakshi Raman and Sangeetha Sharma. *Technical Communication*. 3rd edition. New Delhi: Oxford University Press, 2015.
2. Mark Ibbotson. *Cambridge English for Engineering*. Cambridge: Cambridge University Press, 2008.
3. Mark Ibbotson. *Professional English in Use: Engineering*. Cambridge: Cambridge UP, 2009.
4. Lesikar et al. *Business Communication: Connecting in a Digital World*. New Delhi: Tata McGraw-Hill, 2014.
5. John Seeley. *Writing Reports*. Oxford: Oxford University Press, 2002.

6. Judith Leigh. *CVs and JobApplications*. Oxford: Oxford University Press, 2002.
7. Judith Leigh. *Organizing and Participating in Meetings*. Oxford: Oxford University Press, 2002.
8. Michael Swan. *Practical English Usage*. Oxford: OUP, 1980.
9. Pickett, Laster and Staples. *Technical English: Writing, Reading & Speaking*. 8th ed. London: Longman, 2001.
10. Diana Booher. *E-writing: 21st Century Tools for Effective Communication*.

Links:

1. Purdue University's Online Writing Lab (OWL)-https://owl.purdue.edu/
2. Business English Pod-https://www.businessenglishpod.com/

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
HSMC 101.1						2			3	3		3
HSMC 101.2						2			3	3		3
HSMC 101.3						2			3	3		3
HSMC 101.4						2			3	3		3
HSMC 101.5						2			3	3		3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
HSMC 101.1	2	2	2
HSMC 101.2	2	2	2
HSMC 101.3	2	2	2
HSMC 101.4	2	2	2
HSMC 101.5	2	2	2

Paper Name: Physics I Lab
Paper Code: Ph 191
Contact Hours: 0:0:3
Credit: 1.5

Prerequisites: Knowledge of Physics up to 12^{th} standard.

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Demonstrate experiments allied to their theoretical concepts
CO2	Conduct experiments using LASER, Optical fiber, Torsional pendulum, Spectrometer
CO3	Analyze and participate as an individual and as a member or leader in groups in laboratory sessions actively.
CO4	Analyze experimental data from graphical representations, and to communicate effectively them in Laboratory reports including innovative experiments.
CO5	Design solutions for real life challenges.

General idea about Measurements and Errors (One Mandatory):

i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.
ii) Proportional error calculation using Carrey Foster Bridge.

Any 6 to be performed from the following experiments

Experiments on Waves & Oscillations:
1. Study of Torsional oscillation of Torsional pendulum & determination of time using various load of the oscillator.
2. Determination of elastic moduli of different materials (Young‘s modulus /Rigidity modulus)
3. Determination of Q factor using LCR Circuit.
4. Calibration of an oscillator using Lissajous Figure.

Experiments on Classical Optics:
5. Determination of wavelength of light by Newton‘s ring method.
6. Determination of wavelength of light by Laser diffraction method.
7. To determine the angle of optical rotation of a polar solution using polarimeter

Experiments on Quantum Physics-I:
8. Determination of Planck‘s constant using photoelectric cell.
9. Verification of Bohr‘s atomic orbital theory through Frank-Hertz experiment.
10. Determination of Stefan‘s Constant

In addition it is **recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment

Probable experiments beyond the syllabus:
1. Determination of wavelength of light by Fresnel‘s bi-prism method (beyond the syllabus).
3. Study of dispersive power of material of a prism.
4. Study of viscosity using Poiseuille‘s capillary flow method/using Stoke‘s law.
5. Measurement of nodal and antipodal points along transmission wire and measurement of wavelength.

6. Any other experiment related to the theory**.**

Recommended Text Books for Physics I Lab (PH 291):

Waves & Oscillations:
1. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

Classical & Modern Optics:
1. A text book of Light- K.G. Mazumder &B.Ghoshs (Book & Allied Publisher)

Quantum Mechanics-I
1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)

Solid State Physics-I:
1. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)

Text Books:
1. Practical Physics by Chatterjee & Rakshit (Book & Allied Publisher)
2. Practical Physics by K.G. Mazumder (New Central Publishing)
3. Practical Physics by R. K. Kar (Book & Allied Publisher)

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PH191.1	2	3	2	3	3							
PH191.2	2	3	2	3	3							
PH191.3	2	3	2	3	3							
PH191.4	2	3	2	3	3							
PH191.5	2	3	2	3	3							

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PH191.1	2	2	2
PH191.2	2	2	2
PH191.3	2	2	2
PH191.4	2	2	2
PH191.5	2	2	2

Course Name: Workshop/Manufacturing Practices
Course Code: Me191
Contact: 0:0:3
Credits: 1.5

Prerequisite: Higher Secondary with Mathematics, Physics and Chemistry.

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Understand Engineering Graphics and visual aspects of design.
CO2	Understand and apply common drafting tools with the knowledge of drafting standards.
CO3	Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.
CO4	Create part models; carry out assembly operation and show working procedure of a designed project work using animation.
CO5	Apply common drafting tools with the knowledge of drafting standards and create project work using animation.

Course Content:

(i) Theoretical discussion & videos: 3P

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry
4. Welding (arc welding & gas welding), brazing
5. Electrical & Electronics
6. Metal casting
7. CNC machining, Additive manufacturing
8. Plastic moulding& Glass Cutting

(ii) Workshop Practice:

Module 1 - Machine shop 6P
Typical jobs that may be made in this practice module:
i. To make a pin from a mild steel rod in a lathe.
ii. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.

Module 2 - Fitting shop 6P
Typical jobs that may be made in this practice module:
i. To make a Gauge from MS plate.

Module 3 - Carpentry 6P
Typical jobs that may be made in this practice module:
i. To make wooden joints and/or a pattern or like.

Module 4 - Welding shop (Arc welding 3P + gas welding 3P) 3P
Typical jobs that may be made in this practice module:

i. ARC WELDING (3P): To join two thick (approx 5mm) MS plates by manual metalarcwelding. ii. GAS WELDING (3P): To join two thin mild steel plates or sheets by gas welding.

Module 5 - Electrical & Electronics **3P**
House wiring, soft Soldering

Module 6 – Smithy **3P**

Typical jobs that may be made in this practice module:

i. A simple job of making a square rod from a round bar or similar.

For further study (Optional)

Module 7 - Casting **3P**
Typical jobs that may be made in this practice module:
i. One/ two green sand moulds to prepare, and a casting be demonstrated.

Module 8 - Plastic moulding& Glass Cutting **3P**
Typical jobs that may be made in this practice module:
i. For plastic moulding, making at least one simple plastic component should be made. ii. At least one sample shape on glass should be made using laser cutting machine.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., –Elements of Workshop Technology‖, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Rao P.N., –Manufacturing Technology‖, Vol. I and Vol. II, Tata McGrawHill House, 2017.

Reference Books:

1. Gowri P., Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Roy A. Lindberg, –Processes and Materials of Manufacture‖, 4th edition, Prentice Hall India, 1998.
3. Kalpakjian S. and Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
4. Manufacturing Science by A. Ghosh and A.K. Mallick, Wiley Eastern.
5. Principles of Metal Cutting/Principles of Machine Tools by G.C. Sen and A. Bhattacharya, New Central Book Agency, Kolkata.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ME191.1	3	3	3	3	3	3						
ME191.1	3	3	3	3	3	3						
ME191.1	3	3	3	3	3	3						
ME191.1	3	3	3	3	3	3						
ME191.1	3	3	3	3	3	3						

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
ME191.1	2	2	2
ME191.1	2	2	2
ME191.1	2	2	2
ME191.1	2	2	2
ME191.1	2	2	2

1ST Year 2nd Semester: 2nd Semester								
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
	THEORY			L	T	P	Total	
1	Basic Science courses	CH 201	Chemistry-I	3	0	0	3	3
2	Basic Science courses	M 201	Mathematics –II	4	0	0	4	4
3	Engineering Science Courses	EE 201	Basic Electrical Engineering	3	0	0	3	3
4	Engineering Science Courses	CS 201	Programming for Problem Solving	3	0	0	3	3
	PRACTICAL							
5	Basic Science course	CH 291	Chemistry-I Lab	0	0	3	3	1.5
6	Humanities and Social Sciences including Management courses	HSMC 291	Professional Communication LAB	0	0	2	2	1.0
7	Engineering Science Courses	EE 291	Basic Electrical Engineering Lab	0	0	3	3	1.5
8	Engineering Science Courses	ME 292	Engineering Graphics & Design Lab	0	0	3	3	1.5
9	Engineering Science Courses	CS 291	Programming for Problem Solving Lab	0	0	3	3	1.5
10	PROJECT	PR291	Theme based Project II	0	0	1	1	0.5
11	PROJECT	PR292	Skill Development II: Life Skill	1	0	0	1	0.5
	MANDATORY ACTIVITIES / COURSES							
12	Mandatory Course	MC281	NSS/Physical Activities / Meditation & Yoga / Photography	0	0	3	3	3 Units
	TOTAL CREDIT							21

Course Name: Chemistry
Course Code: Ch 201
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisites: A basic knowledge in 10+2 science with chemistry

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Able to apply fundamental concepts of thermodynamics in different engineering applications.
CO2	Able to analyze & design simple and technologically advanced electrical and energy storagedevices.
CO3	Able to synthesize nanomaterials, composites, polymers.
CO4	Able to apply the basic concept of Organic Chemistry and knowledge of chemical reactions to industries , and technical fields.
CO5	Able to apply the knowledge of different fuels and corrosion to different industries

Course Content

Module- I: Inorganic Chemistry 9L

(i) Atomic structure 5L

Bohr's theory to hydrogen-like atoms and ions; spectrum of hydrogen atom. Quantum numbers, Introduction to the concept of atomic orbitals, diagrams of s, p and d orbitals, Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle and its limitation, introduction to Schrodinger equation.

(ii) *Periodic properties* *4L*

Modern Periodic table, group trends and periodic trends in physical properties: ***electron affinity, electronegativity, polarizability, oxidation states****, effective nuclear charges,* ***penetration of orbitals, variations of s, p and d orbital energies of atoms.***

Module II: Physical Chemistry 8L

(i) Use of free energy in chemical equilibria *6L*

Thermodynamic functions: internal energy, enthalpy, entropy and free energy. 2nd Law of Thermodynamics, Estimations of entropy and free energies, Free energy and emf, Cell potentials, the Nernst equation and applications.

(ii) Real Gases 2L

Reason for deviation of real gases from ideal behavior, Equations of state of real gases,Vander Waals' equation, pressure & volume correction, validity, critical state of gas.

Module III: Organic Chemistry 8L

(i) Stereochemistry *4L*

Representations of 3 dimensional structures, Chirality, optical activity, isomerism, structural isomerism, stereoisomers, enantiomers, diastereomers, configurations (D,L& cis trans), racemisation.

(ii) Organic reactions *4L*

Concepts of inductive effect, resonance, hyperconjugation, introduction to reactions involving

substitution, addition, elimination, oxidation (Baeyer villiger oxidation), reduction (Clemmensen reduction, Wolff- Kishner reduction).

Module IV: Industrial Chemistry **8L**

(i) Water *2L*

Hardness, alkalinity, numerical

(ii) Corrosion. *2L*

Types of corrosion: wet & dry, preventive measures

(iii) Polymers *3L*

Classification of polymers, conducting polymers, biodegradable polymers

(iv) Synthesis of a commonly used drug molecule. *1L*

Paracetamol, Aspirin

Module V: Spectroscopic techniques in Chemistry **3L**

Electromagnetic radiation, Principles of spectroscopy, spectrophotometer, infrared spectroscopy, fingerprint region, functional group region, UV-VIS spectroscopy, ^{1}H Nuclear magnetic resonance spectroscopy, chemical shift.

Textbooks

1. A Text Book of Organic Chemistry, Arun Bahl & Arun Bahl
2. General & Inorganic Chemistry, P.K. Dutt
3. General & Inorganic Chemistry, Vol I, R.P. Sarkar
4. Physical Chemistry, P.C. Rakshit

Reference Books

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2. Fundamentals of Molecular Spectroscopy, by C. N.Banwell
3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
4. Physical Chemistry, by P. W.Atkins
5. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Editionhttp://bcs.whfreeman.com/vollhardtschore5e/default.asp

Project Domain

1. Application of Thermodynamics
2. Application of polymers in daily life
3. Nanomaterials and its applications
4. Determination of water quality parameters
5. Electronic storage devices
6. Managing E –wastes
7. Application of chemistry in core engineering
8. Application of spectroscopy in medical field
9. Applications of green chemistry
10. Merits of commercial organic products
11. Bioplastics
12. Any other related topics

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CH201.1	3	2	3	2			3					
CH201.2	3	2	3	2			3					
CH201.3	3	2	3	2			3					
CH201.4	3	2	3	2			3					
CH201.5	3	2	3	2			3					

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CH201.1	2	2	2
CH201.2	2	2	2
CH201.3	2	2	2
CH201.4	2	2	2
CH201.5	2	2	2

Course Name: Mathematics-II
Course Code: M 201
Contact: 3:1:0
Total Contact Hours: 48
Credit: 4

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) calculus.

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Determine and recall the properties and formula related to ordinary differential equations, improper integral, Laplace transform and numerical techniques.
CO2	Determine the solutions of the problems related to ordinary differential equations, improper integral, Laplace transform and numerical techniques.
CO3	Apply appropriate mathematical tools of ordinary differential equations, improper integral, Laplace transform and numerical techniques for the solutions of the problems.
CO4	Analyze engineering problems by using differential equation, Laplace Transform and Numerical Methods.
CO5	Apply engineering solutions by using differential equation, Laplace Transform and Numerical Methods.

Course Content:

Module I: First Order Ordinary Differential Equations (ODE): 10L

Solution of first order and first degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation, Solution of first order and higher degree ODE: solvable for p, solvable for solvable for and Clairaut's equation.

Module II: Second Order Ordinary Differential Equations (ODE): 10L

Solution of second order ODE with constant coefficients: C.F. & P.I., Method of variation of parameters, Cauchy-Euler equations, Solution of simultaneous linear ODEs.

Module III: Laplace Transform (LT): 14L

Improper integrals; Beta and Gamma functions and their properties.

Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of $t\,f(t)$, LT of $\frac{f(t)}{t}$, LT of derivatives of $f(t)$, LT of integral of $f(t)$, Evaluation of

improper integrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties, Convolution theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODE with constant coefficients (initial value problem) using LT.

Module IV: Numerical Methods 14L

Introduction to error analysis, Calculus of finite difference. **Interpolation:** Newton forward and backward interpolation, Lagrange's interpolation, Newton's divided difference interpolation formula. Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule. Numerical solution of ordinary differential equation: Euler method, Modified Euler method, Fourth order Runge-Kutta method.

Project Domains:

1. Mathematical modeling using ODE.
2. Application of ODE.
3. Application of Laplace Transform in different engineering branches.
4. Application of Numerical Methods in different engineering branches.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
6. Samanta Guruprasad, A text book of Engineering Mathematics-II, New age International Publishers
7. Mollah, S. A, Numerical Analysis and Computational Procedures, Books and Allied (P) Ltd.

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Boyce, W. E. and DiPrima, R. C., Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
3. Ross, S. L., Differential Equations, 3rd Ed., Wiley India, 1984.
4. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers,

1969.
5. Coddington, E. A., An Introduction to Ordinary Differential Equations, Prentice Hall, India, 1995.
6. Dey, Sukhendu, Gupta Sisir, Numerical Methods, MsGraw Hill Education(India) Private Limited.
7. Jain, M. K., Iyengar, S. R. K., Jain, R. K., Numerical Methods, New age International Publishers

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
M201.1	3	3	3	3								2
M201.2	3	3	3	3								2
M201.3	3	3	3	3								2
M201.4	3	3	3	3								2
M201.5	3	3	3	3								2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
M201.1	2	2	2
M201.2	2	2	2
M201.3	2	2	2
M201.4	2	2	2
M201.5	2	2	2

Course Name: Basic Electrical Engineering
Course Code: Ee201
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre-requisite: Basic 12th standard Physics and Mathematics, Concept of components of electric circuit.

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Understand and analyze basic electric circuits
CO2	Determine and study the working principles of electrical machines.
CO3	Understand the components of low voltage electrical installations
CO4	Design the fundamentals of electrical Power systems and Control Systems
CO5	Analyze and study the fundamentals of electrical Power systems and Control Systems

Course Content

Module- I: DC Circuits **8L**

Definition of electric circuit, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, Dependent source, node, branch, active and passive elements, Kirchhoff _s laws, Source equivalence and conversion, Network Theorems - Superposition Theorem, Thevenin_s Theorem, Norton Theorem, Maximum Power Transfer Theorem, Star-Delta Conversions.

Module- II: AC Fundamentals **8L**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module- III: Electrical Machines **10L**

Transformer: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation, and efficiency. Auto-transformer and three-phase transformer connections.

Rotating Machines - DC Machines: Brief idea on constructional features, classifications, working principle of both motor and generator. Simple problems on Voltage equation. Three-Phase Induction Motor: Basic concept of three phase circuit and production of rotating magnetic field. Working principle of three-phase induction motor and torque-speed characteristics (concept only).

Module- IV: Electrical Installations **3L**

Earthing of Electrical Equipment, ideas of basic components- MCB, MCCB, ELCB, SFU, Megger. Types of Wires and Cables, Earthing.

Module- V: Fundamentals of Power Systems **5L**

Generation of power: Block schematic representation of Thermal and nuclear power plants. Renewable energy sources: solar, wind, tidal and geothermal (Block diagram and working only- No Problems). Power transmission: Typical electrical power transmission scheme-need for high voltage transmission-(Derivation is not needed, No Problems). Power Distribution: substation equipments, primary and secondary transmission and

distribution systems- feeder, service mains.

Module- VI: Introduction to Control Systems **2L**

Concept control systems, Objectives of control system, Types of control systems, Real examples of control systems.

Text books:

1. P. Kothari & I. J. Nagrath, Basic Electrical Engineering, TMH.
2. V. Mittle& Arvind Mittal, Basic Electrical Engineering, TMH.
3. Ashfaq Hussain, Basic Electrical Engineering, S. Chand Publication.
4. Chakrabarti, Nath& Chanda, Basic Electrical Engineering, TMH.
5. C.L. Wadhwa, Basic Electrical Engineering, Pearson Education.

Reference books:

1. E. Hughes, ―Electrical and Electronics Technology‖, Pearson, 2010.
2. V. D. Toro, ―Electrical Engineering Fundamentals‖, Prentice Hall India, 1989.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EE201.1	3	3	3	3								
EE201.2	3	3	3	3								
EE201.3	3	3	3	3								
EE201.4	3	3	3	3								
EE201.5	3	3	3	3								

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
EE201.1	2	2	2
EE201.2	2	2	2
EE201.3	2	2	2
EE201.4	2	2	2
EE201.5	2	2	2

Course Name: Programming For Problem Solving
Course Code: Cs 201
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Number system, Boolean Algebra

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Understand the fundamental concept of Computer and mathematical knowledge and apply them in designing and analyzing solution to engineering problem.
CO2	Understand the basic concept of C programming and use of data types/operators/input/output function for developing and implementing complete program leading to solution of mathematical and engineering problem.
CO3	Use conditional branching, iteration, recursion and formulate algorithms and programs in solving
CO4	Understand the concept of arrays, pointers, file and dynamic memory allocation and apply it for problem solving and also create new data types using structure, union and enum.
CO5	Understand how to decompose a problem into functions and assemble into a complete program by means of modular programming possibly as a team.

Course Content:

Module-1: Fundamentals of Computer **9L**

History of Computer, Generation of Computer, Classification of Computers, Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices.

Number System: basic of Binary, Octal, Decimal and Hexadecimal number systems; Representation and interchanging of number in different number systems. Introduction to complements system, Representation of signed and unsigned numbers in singed magnitude singed 1‘s complement system and signed 2‘s complement system.

Arithmetic– Addition and Subtraction (using1‘scomplementand2‘scomplement).
Representation of Characters-ASCII Code
Basics of Compiler, Interpreter and Assembler
Problem solving – Basic concept of Algorithm. Representation of algorithm using flow chart and pseudo code. Some basic examples.

Module-2: Introduction to C Programming **5L**

Overview of Procedural vs Structural language; History of C Programming Language.
Variable and Data Types: The C characterse identifiers
And keywords, data type & sizes, variable names, declaration, statements.
Operators & Expressions: Arithmetic operators, relational operators, logical operators, increment anddecrementoperators,bitwiseoperators,assignmentoperators,conditionaloperators,specialoperators-typeconversion, C expressions, precedence and associativity.
Input and Output: Standard input and output, formatted output–print f,formatted input scan f.

Module-3: Branch and Loop **5L**

Branching: Concept of Statement and Blocks in C, Simple if, if -else, nested if-else and if-else ladder.
Switch Case: break and continue; switch-case, concept of goto and labels
Loops - while, for, do while

Module-4: Program Structures **4L**

Function: Basics of Functions, function types, function prototypes, formal and actual parameter, function calling, functions returning values, functions not returning values. Recursion and Recursive Function.
Storage Class in C: Storage Class-auto, external, static and register storage class, scope rules and life time of variables
C pre-processor: Pre-processing directive and macro, parameterized macro.

Module-5: Array and Pointer **7L**

Arrays: One dimensional arrays, Two-dimensional arrays, Passing an array to a function
Pointers: Pointers, Pointer and Array, Pointer and functions.
Strings: Character array and string, array of strings, Passing a string to a function, String related functions, Pointer and String.
Dynamic memory allocation: Malloc, calloc, realloc and free with example.

Module-6: Structures, Unions and Enum **3L**

Basic of structures, arrays of structures, structures and pointers, bit fields. Basics of union and enum, difference between structure and union.

Module-7: File in C **3L**

Files handling- opening and closing a file in different mode, formatted and unformatted files, Command line arguments, f open, f close, f get c, f put c, f print f, f scan f function.

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. KanetkarY.-LetusC,BPBPublication,15th Edition

ReferenceBooks:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS201.1	3	3	3	2	2							
CS201.2	3	2	2	2	2							
CS201.3	3	3	3	2	2							
CS201.4	3	3	3	2	2							
CS201.5	3	3	3	2	2							

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CS201.1	3	3	3
CS201.2	3	3	3
CS201.3	3	3	3
CS201.4	3	3	3
CS201.5	3	3	3

Course Name: Chemistry Lab
Course Code: Ch 291
Contact: 0:0:3
Credits: 1.5

Pre-requisite: A basic knowledge in 10+2 science with chemistry.

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Understand different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.
CO2	Analyze and determine the composition of liquid and solid samples working as an individual and also as a team member.
CO3	Analyze different parameters of water considering environmental issues.
CO4	Synthesize drug and polymer materials.
CO5	Design innovative experiments applying the fundamentals of chemistry.

Course Content:

Choice of 10-12 experiments from the following:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Determination of hardness of water
4. Determination of chloride content of water
5. Determination of the rate constant of a reaction
6. Determination of cell constant and conductometric tritration
7. pH metric titrations
8. Synthesis of a polymer/drug
9. Saponification/acid value of an oil
10. Chemical analysis of a salt

Chemical oscillations- Iodine clock reaction

11. Determination of the partition coefficient of a substance between two immiscible liquids
12. Adsorption of acetic acid by charcoal
13. Estimation of iron in Mohr‘s salt solution by permanganometry (Redox Titration)
14. Innovative experiments (any one)

- Synthesis of silver nano-particles
- Green synthesis

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CH291.1	2	3	3	3	3	2	3					
CH291.2	2	3	3	3	3	2	3					
CH291.3	2	3	3	3	3	2	3					
CH291.4	2	3	3	3	3	2	3					
CH291.5	2	3	3	3	3	2	3					

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CH291.1	2	2	2
CH291.2	2	2	2
CH291.3	2	2	2
CH291.4	2	2	2
CH291.5	2	2	2

Course Name: Professional Communication Lab
Course Code: Hsmc291
Contact: 0:0:2
Credit: 1

Pre requisites: Basic knowledge of LSRW skills.

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand and make use of a wide taxonomy of listening skills & sub-skillsfor comprehending & interpreting data in English
CO2	Speak in English, using appropriate vocabulary and pronunciation incontextualized situations
CO3	Understand and put into effective practice the pragmatics of Group Discussion
CO4	Understand and write a detailed technical report as per organizational needs
CO5	Understand and interact in professional presentations and interviews

Course Content:

Module- 1: Introduction to the Language Lab

a. The Need for a Language Laboratory
b. Tasks in the Lab
c. Writing a Laboratory Note Book

Module- 2: Active Listening

a. What is Active Listening?
b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
c. Academic Listening vs Business Listening
d. Listening in Business Telephony
e. Study of Contextualized Examples based on Lab Recordings

Module- 3: Speaking

a. Speaking—Accuracy and Fluency Parameters
b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
c. Fluency-focussed activities—JAM, Conversational Role Plays, Speaking using Picture/Audio Visual inputs
d. Accuracy-focussed activities—Identifying Minimal Pairs, Sound Mazes, Open and Closed Pair Drilling, Student Recordings (using software)
e. Group Discussion: Principles and Practice
f. Business Meetings and Sales Talks

Module- 4: Lab Project Work

a. Making a brief Advertisement video (1-2 minutes)
b. Making a brief Business Documentary film (5-7 minutes)
c. Client interaction video (5-7 minutes)
d. Making a short video CV (1-2 minutes)

References:

1. IIT Mumbai, Preparatory Course in English syllabus

2. IIT Mumbai, Introduction to Linguistics syllabus
3. Sasikumar et al. A Course in Listening and Speaking. New Delhi: Foundation Books, 2005.
4. Tony Lynch, Study Listening. Cambridge: Cambridge UP, 2004.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
HSMC 291.1	2	2	2	2			3	3	3	3		3
HSMC 291.2	2	2	2	2			3	3	3	3		3
HSMC 291.3	2	2	2	2			3	3	3	3		3
HSMC 291.4	2	2	2	2			3	3	3	3		3
HSMC 291.5	2	2	2	2			3	3	3	3		3

CO-PSO Mapping

Cos	PSO1	PSO2	PSO3
HSMC 291.1	2	2	2
HSMC 291.2	2	2	2
HSMC 291.3	2	2	2
HSMC 291.4	2	2	2
HSMC 291.5	2	2	2

Course Name: Basic Electrical Engineering Laboratory
Course Code: Ee291
Contact: 0:0:3
Credits: 1.5

Prerequisite: Basic Physics and applied physics, Basic Mathematics, Basic concept of Electric Circuit.
Course Outcomes (COs):

After completion of the course students would be able to

CO1	Identify and use common electrical components
CO2	To develop electrical networks by physical connection of various components and analyze the circuit behaviour.
CO3	Apply and analyze the basic characteristics of transformers and electrical machines.
CO4	Illustrate the venin's, Norton's, superposition and maximum power transfer theorem.
CO5	Create resonance condition in R-L-C series and parallel circuit and learn how to draw phasor diagram for the circuit

List of Experiments

1. Basic safety precautions – earthing, introduction to measuring instruments – Voltmeter, Ammeter, Multimeter, Wattmeter, Real life Resistor, Capacitor, Inductor.
2. Verification of Thevenin's and Norton's Theorem.
3. Verification of Superposition and Maximum Power Transfer Theorem.
4. Characteristics of Fluorescent, Tungsten and Carbon filament lamps.
5. Study of R-L-C series circuit.
6. Three-phase Power measurement with two wattmeter methods.
7. Demonstration of cut-out sections of machines: DC Machine (commutator-brush arrangement), Induction Machine (squirrel cage rotor).
8. Measurement of primary and secondary voltage and current of single-phase transformer – Open Circuit and Short Circuit Test.
9. Starting, Reversing and speed control of DC shunt motor.
10. Torque-Speed characteristics of DC Machine.
11. Torque-Speed characteristics of Three-phase Induction Motor.
12. Test on single-phase Energy Meter.
13. Innovative experiments

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EE291.1	2	2	3	3	3							
EE291.2	3	2	2	3	3							
EE291.3	2	3	2	3	2							
EE291.4	2	2	2	3	2							
EE291.5	2	3	2	3	3							

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
EE291.1	3		2
EE291.2	3		
EE291.3	3	2	3
EE291.4	3	2	3
EE291.5	3		

Course Name: Engineering Graphics & Design
Course Code: Me292
Contact: 0:0:3
Credits: 1.5

Prerequisites: Basic knowledge of geometry

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Understand Engineering Graphics and visual aspects of design.
CO2	Understand and apply common drafting tools with the knowledge of drafting standards.
CO3	Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.
CO4	Create part models; carry out assembly operation and show working procedure of a designed project work using animation.
CO5	Apply common drafting tools with the knowledge of drafting standards and create project work using animation.

List of Drawing:

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Module 1: Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2: Orthographic & Isometric Projections

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes on inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Module 3: Sections and Sectional Views of Right Angular Solids

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only).

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling.

Module 4: Overview of Computer Graphics

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut

menus (Button Bars), Zooming methods, Select and erase objects].

Module 5: CAD Drawing, Customization, Annotations, layering

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerancing; Using various methods to draw straight lines, circles, applying dimensions and annotations to drawings; Setting up and use of Layers, changing line lengths (extend/lengthen); Drawing sectional views of solids; Drawing annotation,

CAD modeling of parts and assemblies with animation, Parametric and nonparametric solid, surface and wireframe modeling, Part editing and printing documents.

Module 6: Demonstration of a simple team design project

Illustrating Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed topologies for engineering analysis and tool-path generation for component manufacture, use of solid-modeling software for creating associative models at the component and assembly levels.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar Publishing House

2. K. Venugopal, Engineering Drawing + AutoCAD, New Age International publishers

Reference Books:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House

2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education

4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ME 292.1	3	3	3	3	3	3						
ME 292.1	3	3	3	3	3	3						
ME 292.1	3	3	3	3	3	3						
ME 292.1	3	3	3	3	3	3						
ME 292.1	3	3	3	3	3	3						

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
ME 292.1	2	2	2
ME 292.1	2	2	2
ME 292.1	2	2	2
ME 292.1	2	2	2
ME 292.1	2	2	2

Coursename: Programming For Problem Solving Lab
Course Code: Cs 291
Contact: 0:0:3
Credits: 1.5

Prerequisites: Number system, Boolean Algebra

Course Outcomes (COs):

After completion of the course students would be able to

CO1	Understand and propose appropriate command or function in running system or developing program for engineering and mathematical problems depending on the platform used even in changed environment leading to their lifelong learning.
CO2	Identify and propose appropriate data type, arithmetic operators, input/output functions and also conditional statements in designing effective programs to solve complex engineering problem using modern tools.
CO3	Design and develop effective programs for engineering and mathematical problems using iterative statements as well as recursive functions using modular programming approach possibly as a team maintaining proper ethics of collaboration.
CO4	Explain and organize data in arrays, strings and structures and manipulate them through programs and also define pointers of different types and use them in defining self-referential structures and also to construct and use files for reading and writing to and from leading to solution of engineering and mathematical problem.
CO5	Prepare laboratory reports on interpretation of experimental results and analyze it for validating the same maintaining proper ethics of collaboration.

Module-2: Problem based on

a) Basic data types
b) Different arithmetic operators.
c) Print f( ) and scan f( ) functions.

Module-3: Problem based on conditional statements using

a) if-else statements
b) different relational operators
c) different logical operators

Module-4: Problem based on

a) **for** loop
b) **while** loop
c) **do-while** loop

Module-5: Problem based on

a) How to write a menu driven program using **switch-case** statement
b) How to write a function and passing values to a function
c) How to write a **recursive function.**

Module-6: Problem based on

a) How to use **array (both I-Dand2-D).**
b) How to pass an **array** to a **function.**

Module-7: Problem based on manipulation of strings in different way.

Module-8: Problem based on

a) How to handle compound variables in C
b) How to handle file in C
c) How to use command line argument in C

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. KanetkarY.-LetusC,BPBPublication,15th Edition

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS291.1	3	3	3	3	3							
CS291.2	3	3	2	3	3							
CS291.3	3	3	3	3	3							
CS291.4	3	3	3	3	3							
CS291.5	3	3	3	3	3							

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CS291.1	3	3	3
CS291.2	3	3	3
CS291.3	3	3	3
CS291.4	3	3	3
CS291.5	3	3	3

2nd Year 1st Semester: 3rd Semester								
Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	**T**	**P**	**Total**	
A. THEORY								
1	Basic Science course	M301	Discrete Mathematics	3	0	0	3	3
2	Engineering Science Courses	ESC301	Analog Electronics	3	0	0	3	3
3	Engineering Science Courses	ESC302	Digital Logic and Electronics	3	0	0	3	3
4	Program Core Course	PCC-CS301	ITWorkshop (SciLab/MATLAB/C++)	3	0	0	3	3
5	Program Core Course	PCC-CS302	Data Structures	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	HSMC 303	Universal Human Values 2: Understanding Harmony	3	0	0	3	3
B. PRACTICAL								
7	Engineering Science Courses	M (CS)391	Numerical Methods Lab	1	0	3	3	2.5
8	Engineering Science Courses	ESC391	Digital and Analog Electronics Lab	0	0	3	3	1.5
9	Program Core Course	PCC-CS391	ITWorkshop Lab (SciLab/MATLAB/C++)	0	0	3	3	1.5
10	Program Core Course	PCC-CS392	Data Structures Lab	0	0	3	3	1.5
11	PROJECT	PR391	Theme based Project III	0	0	1	1	0.5
12	PROJECT	PR392	Skill Development III: Technical Seminar Presentation	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 301	Environmental Science	0	3	3		3 Units
	TOTAL CREDIT WITHOUT MOOCS COURSES							26.0
D.MOOCS COURSES**								

14	MOOCS COURSES	HM301	MOOCS COURSE-I	3	1	4	4
TOTAL CREDIT WITH MOOCS COURSES							**30**

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s).

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

Course Name: Discrete Mathematics
Course Code: M301
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Higher Secondary Level Mathematics

Course Outcome(s):
After completion of the course students will be able to

CO1	Understand the fundamental concepts of Set Theory to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
CO2	Understand the fundamental concepts of Mathematical Logic and Proof Techniques so that they can Prove theorems using Proof Techniques and Mathematical Logic Frameworks to justify a claim.
CO3	Explain or Illustrate the fundamental Theory of Numbers and Identify problems where students can Use the concept appropriately to Solve them.
CO4	Explain or Illustrate the fundamental principles of Algebraic Structures and Identify problems where students can Apply the concept appropriately to Solve them.
CO5	Develop ideas to Propose solutions to the problems of Graph Theory and Identify problems where students can Apply the concept appropriately and Analyze the effectiveness as well as limitations of solutions making the students aware of its utilitarian importance for further explorations leading towards lifelong learning.

Course Content:

Module -1: Set Theory [8L]

Set: Operations and Properties of set, Finite Set, Power Set, Cardinality of finite set, Cartesian Product, Relation: Types of Relations, Properties of BinaryRelation, Equivalence Relation, Partial Ordering Relation and Poset, Lattice.[4L]
Combinatorics and Counting: Sum and product rule, Permutation and Combination Principle of Inclusion Exclusion. Pigeon Hole Principle.[2L]
Generating Functions and Recurrence Relations: Recursively defined relation and functions, Discrete Numeric Function, Growth of Functions, Problems on Recurrence Relations and their solutions using different methods.[2L]

Module-2: Mathematical Logic and Proof Techniques [8L]
Propositional Logic:Basics of Boolean Logic, Idea of Propositional Logic, well-formed formula, Truth tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Inference theory of Propositional Logic.[3L]
Predicate Logic: Idea of First Order Predicate Logic and Quantifiers, well-formed formula of predicate, Inference theory of Predicate Logic.[3L]
Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.[2L]

Module-3: Theory of Numbers [4L]
Well-Ordering Principle, Divisibility theory and properties of Divisibility, Fundamental theorem of Arithmetic,

Prime and Composite Numbers. [2L]
Greatest Common Divisor and Euclidean Algorithm, Congruence, Residue Classes. [2L]

Module-4: Algebraic Structures [8L]
Concepts of Groups, Subgroups and Order, Cyclic Groups, Cosets, Normal Subgroups, Permutation and Symmetric groups, Group Homomorphisms.[5L] Elementary
properties of Rings and related problems[1L] Elementary
properties of Fields and related problems.[1L] Elementary
properties of Vector Space and related problems . [1L]

Module-5: Graph Theory [8L]
Graph Terminologies and their properties: Degree, Connectivity, Path, Cycle,Sub-Graph, Isomorphism, Eulerian and Hamiltonian Walks, Matrix representation of graphs, Shortest Path in Graph. [2L]
Graph Colouring and Matching: Colouring Vertices and Chromatic Number, Colouring Edges and Total Colouring, Independence and Chromatic Partitioning, Cliques, Perfect Graphs, Bounds on Chromatic Numbers, Chromatic Polynomials, Matching.[3L]
Tree: Rooted Trees,Binary Search Tree and Tree Sorting, Spanning Tree, Weighted Trees and prefix codes. [3L]

Textbook:
1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill.
2. Susanna S. Epp, Discrete Mathematics with Applications,4th edition, Wadsworth Publishing Co. Inc.

Reference Books:

1. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.
2. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It‘s Application toComputer Science‖, TMG Edition, TataMcgraw-Hill
3. Seymour Lipschutz, Marc Lipson, Discrete Mathematics (Schaum‘s Outlines Series), Tata McGraw - Hill.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
M301.1	3	3	2									
M301.2	3	3	2	2								
M301.3	3	3	2									
M301.4	3	3	2									
M301.5	3	3	2	3								

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
M301.1	2	2	2
M301.2	2	2	2
M301.3	2	2	2
M301.4	2	2	2
M301.5	2	2	2

Course Name: Analog Electronics
Course Code: ESC301
Contact : 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Concept of basic electronics devices, basic law of circuit analysis

Course Outcomes (COs):

After attending the course students should be able to

CO1	Knowledge of Electronic components such as Resistors, Capacitors, Diodes, Transistors measuring equipment like DC power supply, Multimeter, CRO, Signal generator, DC power supply.
CO2	Analyze the characteristics of Junction Diode, Zener Diode, BJT & FET anddifferent types of Rectifier Circuits.
CO3	Determination of input-offset voltage, input bias current and Slew rate, Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
CO4	Able to know the application of Diode, BJT &OPAMP.
CO5	Familiarization and basic knowledge of Integrated Circuits

Course Content:

Module 1:[4L]
Small signal amplifiers: Introduction to Analog Integrated Circuits, BJT Modeling-hybrid model of transistors; Emitter follower circuits, High frequency model of transistors. FET Small signal analysis - Source follower

Module 2:[9L]
Transistor Amplifiers: RC coupled amplifier, functions of all components, equivalent circuit, derivation of voltage gain, current gain, input impedance and output impedance, frequency response characteristics, lower and upper half frequencies, bandwidth, andconceptof wide bandamplifier.
Feedback Amplifiers & Oscillators: Feedback concept, Voltage series-shunt, current series-shunt feedback Configurations, Berkhausen criterion, Colpitts, Hartley's, Phase shift, Wien bridge and crystal oscillators.

Module3:[14L]
Operational Amplifier: Introduction to Integrated Circuits, Differential Amplifier, Constant current source (current mirror etc.), level shifter, CMRR, Open & Closed loop circuits, importance of feedback loop (positive & negative), Block Diagram of OPAMP, IdealOPAMP.
Applications of Operational Amplifiers: analog adder, subtractor, integrator, differentiator, comparator, Schmitt Trigger. Instrumentation Amplifier, Log & Anti-log amplifiers, Analog multiplier, Precision Rectifier, voltage to current and current to voltage converter, free running Multivibrator, zero crossing detector

Multivibrator – Monostable, Bistable, Astable multivibrators ; Monostable and astable operation using 555 timer.

Module 4:[9L]

Large signal Amplifiers: Introduction to power amplifiers (Class A, B, AB)

Power Supply: Analysis for DC voltage and ripple voltage with C, L-C and C-L-C filters in Rectifier Circuit - Regulated DC power supplies- Line regulation, output resistance and temperature coefficient, Series and Shunt Voltage Regulation – percentage regulation, Fixed output voltage IC regulator 78xx and 79xx series , Adjustable output voltage regulator, LM 337 series power supply ICs , Concept of **Switched** Mode Power Supply`

Text Books:

1. Millman Halkias – Integrated Electronics, McGraw Hill
2. Ramakant A. Gayakwad —Op- Amps and linear Integrated Circuits, Pub: PHI

Reference Books:

1. Rashid-Microelectronic Circuits- Analysis and Design- Thomson(Cenege Learning)
2. Linear Integrated Circuits – D. Roy Choudhury & Shail B. Jain

CO-PO Mapping

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ESC301.1	3	3	3	3	3							
ESC301.2	3	3	3	3	3							
ESC301.3	3	3	3	3	3							
ESC301.4	3	3	3	3	3							
ESC301.5	3	3	3	3	3							

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
ESC301.1	2	2	2
ESC301.2	2	2	2
ESC301.3	2		2
ESC301.4	2	2	2
ESC301.5	2	2	2

-

Course Name: Digital Logic and Electronics
Course Code: ESC302
Credit: 3
Total Contact Hours: 36

Pre-requisite:

Basic concepts of Logic gates, Truth Tables, Concept of basic components of a digital computer.

Course Outcome(s):

CO1: To realize basic gate operations and laws Boolean algebra.
CO2: To understand basic mechanism of digital computer and digital logic behind different arithmetic and control unit operations.
CO3: To design combinational circuits and combinational functions for larger more complex circuits.
CO4: To perform different operations with sequential circuits.
CO5: To understand fundamental concepts and techniques used in Logic families and PLDs.

Course Content:

Module – 1: [**8L**]

Binary Number System [1L]; BCD, ASCII, EBDIC, Gray codes and their conversions [1L], Introduction and laws of Boolean algebra [1L], Boolean functions, Minterm and maxterm, Prime implicants, Representation in SOP and POS forms[2L], Minimization of logic expressions by Karnaugh Map and algebraic method [3L]

Module – 2: [**8L**]
Combinational circuits:
Adder and Subtractor (half-full adder & subtractor) [2L], Serial & Parallel Adder, Carry look ahead adder and Parity Generator[2L], Encoder, Decoder, Multiplexer [2L], Demultiplexer, Comparator, Code Converters [2L]

Module – 3: [**12L**]
Sequential Circuits:
Flip-Flops, SR, JK, Master slave JK, D, T , characteristic Tables , Excitation tables [5L]
Basic concept of Synchronous and Asynchronous counters, Up/Down Counters, Ring counter, Johnson counter, Design of Modulo-N Counter, Counter applications [5L]
Registers (SISO, SIPO, PIPO, PISO) [2L]

Module – 4:[8L]
A/D and D/A conversion techniques – Basic concepts (D/A :R-2-R only [2L] , A/D: successive approximation [2L])
Logic families- TTL, ECL, MOS and CMOS - basic concepts [2L],
Programmable logic Array, programmable Array logic, Sequential Programmable Devices [2L]

Text Book:
1. Salivahanan S, Digital Circuits and Design, Oxford
2. Morries Mano- Digital Logic Design- PHI

Reference Book:
1. R.P.Jain—Modern Digital Electronics, 2/e , Mc Graw Hill
2. Digital Fundamentals – A Systems Approach – Thomas L. Floyd, Pearson,

CO-PO Mapping:

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

Course Name: IT Workshop
Course Code: PCC-CS301
Credits: 3
Total Contact Hours: 36

Prerequisite: Fundamentals and principles of computer programming

Course Outcomes (COs):

After attending the course students should be able to

CO1	Demonstrate a thorough understanding of modular programming by designing programs that requires the use of programmer-defined functions.
CO2	Demonstrate a thorough understanding of arrays by designing and implementing programs that search and sort arrays.
CO3	Demonstrate a thorough understanding of the object-oriented programming concepts of encapsulation, data abstraction and composition by designing and implementing classes including the use of overloaded functions and constructors.
CO4	Demonstrate a thorough understanding of the concept of pointers and dynamic memory allocation, the implementation of programmer-defined functions and classes by writing code, performing unit testing and debugging of multiple complex programs.
CO5	Demonstrate an understanding of the differences between C and C++ in the areas of strings, pass by reference/passing pointers, and structs by designing and implementing programs that use C strings, C++

Course Content:

Module 1: [6L]
Object-Oriented Programming Concepts: Introduction, comparison between procedural programming paradigm and object-oriented programming paradigm, basic concepts of object-oriented programming — concepts of an object and a class, interface and implementation of a class, operations on objects, relationship among objects, abstraction, encapsulation, data hiding, inheritance, overloading, polymorphism, messaging. [4]

Standard Input/ Output: Concept of streams, hierarchy of console stream classes, input/output using overloaded operators >> and << and member functions of i/o stream classes, formatting output, formatting using ios class functions and flags, formatting using manipulators. [2]

Module 2: [10L]
Classes and Objects: Specifying a class, creating class objects, accessing class members, access specifiers, static members, use of *const* keyword, friends of a class, empty classes, nested classes, local classes, abstract classes, container classes, bit fields and classes. [4]
Constructors and Destructors: Need for constructors and destructors, copy constructor, dynamic constructors, explicit constructors, destructors, constructors and destructors with static members, initializer lists. [2]
Operator Overloading and Type Conversion: Overloading operators, rules for overloading operators, overloading of various operators, type conversion - basic type to class type, class type to basic type, class type to another class type. [4]

Module 3:[2L]
Pointers and Dynamic Memory Management: Declaring and initializing pointers, accessing data through pointers, pointer arithmetic, memory allocation (static and dynamic), dynamic memory management using *new* and *delete* operators, pointer to an object, *this* pointer, pointer related problems - dangling/wild pointers, null pointer assignment, memory leak and allocation failures. [4]

Module 4: [6L]

Inheritance: Introduction, defining derived classes, forms of inheritance, ambiguity in multiple and multipath inheritance, virtual base class, object slicing, overriding member functions, object composition and delegation, order of execution of constructors and destructors. [5]

Virtual functions & Polymorphism: Concept of binding - early binding and late binding, virtual functions, pure virtual functions, abstract clasess, virtual destructors. [3]

Module 5: [6L]

Exception Handling: Review of traditional error handling, basics of exception handling, exception handling mechanism, throwing mechanism, catching mechanism, rethrowing an exception, specifying exceptions. [2]

Templates and Generic Programming: Template concepts, Function templates, class templates, illustrative examples. [2]

Files: File streams, hierarchy of file stream classes, error handling during file operations, reading/writing of files, accessing records randomly, updating files. [2]

Module 6: [6L]

MATLAB Overview:

Environment, variable , constant, operators, loop, function, MATLAB Toolbox, MATLAB Graphic function, Reading and Writing to file, Numerical simulation.

Suggested Readings/ Books:

1. Lafore R., Object Oriented Programming in C++, Waite Group.
2. E. Balagurusamy, Object Oriented Programming with C++, Tata McGraw Hill.
3. R. S. Salaria, Mastering Object-Oriented Programming with C++, Salaria Publishing House.
4. Bjarne Stroustrup, The C++ Programming Language, Addison Wesley.
5. Herbert Schildt, The Complete Reference to C++ Language, McGraw Hill-Osborne.
6. R. S. Salaria, Test Your Skills in Object-Oriented Programming With C++, Salaria Publishing House.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC-CS301.1	3	3	3	2	2				3			
PCC-CS301.2	3	2	2	2	2				3			
PCC-CS301.3	3	3	3	2	2				3			
PCC-CS301.4	3	3	3	2	2				3			
PCC-CS301.5	3	3	3	2	2				3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC-CS301.1	3	3	3
PCC-CS301.2	3	3	3
PCC-CS301.3	3	3	3
PCC-CS301.4	3	3	3
PCC-CS301.5	3	3	3

Paper Name: Data Structures
Paper Code: CS302
Contact Hours/Week: 3L
Credits: 3
Allotted Lectures: 36L

Prerequisite:

1. Familiarity with the fundamentals of C or other programming language
2. A solid background in mathematics, including probability, set theory.

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the concept of data structure and create new data structure to propose efficient solution by writing appropriate algorithm and program for engineering and mathematical problem after analyzing the efficiency of the same.
CO2	Identify and differentiate different types of data structures and implement the appropriate data structure after analyzing complex engineering problem leading to their lifelong
CO3	Understand and implement stack, queue and dequeue by selecting appropriate methods and use it for solving real life and engineering problem choosing appropriate modern
CO4	Understand and implement different non-linear data structures by selecting appropriate methods and apply it for solving complex engineering problem and also argue and judge maintaining the professional ethics to validate the same.
CO5	Understand different factors of sorting and searching algorithm and select the appropriate algorithm for solving complex engineering problem and also implement and analyze the algorithm.

Course Content:

Module 1: Introduction [4L]
Concepts of data and information; Concept of Abstract Data Type, Data Structure and Data Type.Classification of Data Structures- Primitive and Non-Primitive Data Structure, Linear and Non-Linear Data Structure.Need of Data Structures. (1L)
Concept of algorithms and programs, Different methods of representing algorithm; Algorithmanalysis, time and space analysis of algorithms – Asymptotic notations like Big Oh (O), Small Oh(o), Big Omega(Ω), Small Omega(ω) and Theta(Θ) notation (definition and significance). (3L)

Module 2: Non-Restricted Linear Data Structure[9L]
List or Linear List: Definition and Example, List as ADT. Representation of Linear List- Sequential Representation and Linked Representation.
Array: Introduction to sequential representation, Linearization of multidimensional array. Application of array-representation of polynomial using array, Representation of Sparse matrix using array.
Linked List: Introduction to linked representation, Implementation of different types of linked list- Singly linked list, Doubly linked list, Circular linked list, Circular Doubly Linked List.Application of Linked list-Representation of polynomial.

Module 3: Restricted Linear Data Structure [6L]

Stack: Definition of Stack, implementations of stack using array and linked list

Applications of stack- infix to postfix conversion, Postfix Evaluation

Recursion: Principles of recursion - use of stack, tail recursion. Tower of Hanoi using recursion.

Queue: Definition of Queue; Implementation of queue using array-physical, linear and circular model; Implementation of queue using linked list.

Dequeue - Definition and different types of dequeue.

Module 4: Nonlinear Data structures [9L]

Trees and Binary Tree:

Basic terminologies; Definition of tree and binary tree. Difference between tree and binary tree, Representation of binary tree (using array and linked list)

Binary tree traversal (pre-, in-, post- order); Threaded binary tree- definition, insertion and deletion algorithm; Binary search tree- Definition, insertion, deletion, searching algorithm;

Height balanced binary tree: AVL tree- definition, insertion and deletion with examples only.

m –Way Search Tree: B Tree – Definition, insertion and deletion with examples only; B+ Tree – Definition, insertion and deletion with examples only.

Heap: Definition (min heap and max heap), creation, insertion and deletion algorithm. Application of heap (priority queue and sorting).

Graphs: Definition and representation (adjacency matrix, incidence matrix and adjacency list).

Graph traversal– Depth-first search (DFS), Breadth-first search (BFS) - concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge).

Module 5: Sorting and Searching [8L]

Sorting Algorithms: Definition and need of sorting, different types of sorting algorithm (internal, external, stable, in-place, comparison based); Factors affecting sorting Methods, Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort, Radix sort – algorithm with analysis (time complexity)

Searching: Factors affecting searching Methods; Sequential search –algorithm with analysis (time complexity); improvement using sentinel.

Binary search and Interpolation Search algorithm with analysis (time complexity)

Hashing: Introduction and purpose of Hashing and Hash functions (division, folding and mid-square), Collision resolution techniques.

Text book:

1. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications
2. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2nd Edition, Universities Press

Reference Books:

1. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1 Edition, Pearson.
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited
3. Data Structures and Program Design in C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson
4. Data Structures in C by Aaron M. Tenenbaum, 1St Edition, Pearson

CO-PO Mapping

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS302.1	3	3	3	3	2							
CS302.2	3	3	3	3								3
CS302.3	3	3	3	3								
CS302.4	3	3	3	3	2			2				
CS302.5	3	3	3	3	2							

CO-PSO Mapping

Cos	PSO1	PSO2	PSO3
CS302.1	3	3	3
CS302.2	3	3	3
CS302.3	3	3	2
CS302.4	3	3	3
CS302.5	3	2	3

Course Name: Universal Human Values2: Understanding Harmony
Course Code: HSMC 303
Contacts: 3:0:0
Total Contact Hours: 36
Credit: 3
Prerequisite: None

Course Outcomes (COs):

After attending the course students should be able to

CO1	Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field
CO2	Identify the multiple ethical interests at stake in a real-world situation or practice
CO3	Articulate what makes a particular course of action ethically defensible
CO4	Assess their own ethical values and the social context of problems
CO5	Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work integrate, synthesize, and apply knowledge of ethical dilemmas and resolutions in academic settings, including focused and interdisciplinary research

Course Content:

Module1: Course Introduction-Need, Basic Guidelines, Content and Processfor Value Education[8L]

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 requirements for fulfillment of aspirations of every human being with the incorrect 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. Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Module2: Understanding Harmony in the Human Being – Harmony in Myself! [6L]

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 the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health. Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Ensuring health vs dealing with disease discussion.

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship [7L]

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment 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 meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society – Undivided Society, Universal Order-from family to world family. Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Elicit examples from

students‘ lives.

Module4: Understanding Harmony in the Nature and Existence-Whole existence as Coexistence[8L]
Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment 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. Practice sessions to discuss human being as cause of imbalance in nature (film ‒Home‖ can be used), pollution, depletion of resources and role of Technology etc.

Module5: Implications of the above Holistic Understanding of Harmony on Professional Ethics [7L]
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.
d. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order:
e. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
f. At the level of society: as mutually enriching institutions and organizations.
g. Practice Exercises and Case Studies in Practice (tutorial) Sessions to discuss the conduct as an engineer or scientist etc.

Text Books:

1. HumanValuesandProfessionalEthicsbyRRGaur,RSangal,GPBagaria,ExcelBooks,NewDelhi,2010

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, NewDelhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautifu l- E.F Schumacher.
6. Slow is Beautiful- Cecile Andrews
7. Economy of Permanence-JC Kumarappa
8. Bharat Mein Angreji Raj-Pandit Sunderlal
9. Rediscovering India-by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K.Gandhi
11. India Wins Freedom-Maulana Abdul KalamAzad
12. Vivekananda-Romain Rolland(English)
13. Gandhi-Romain Rolland(English)

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
HSMC 303.1		2				2	3	3				3
HSMC 303.2		2				2	3	3				3
HSMC 303.3		2				2	3	3				3
HSMC 303.4		2				2	3	3				3
HSMC 303.5		2				2	3	3				3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
HSMC 303.1	2	2	2
HSMC 303.2	2	2	2
HSMC 303.3	2	2	2
HSMC 303.4	2	2	2
HSMC 303.5	2	2	2

Course Name: Numerical Methods Lab
Course Code: M(CS)391
Contact: 3
Total Contact Hours: 30
Credits: 2.5

Prerequisite: Any introductory course on programming language (example. C/ Matlab).

Course Outcomes (COs):

After attending the course students should be able to

CO1	Describe and explain the theoretical workings of numerical techniques with the help of C
CO2	Compute basic command and scripts in a mathematical programming language
CO3	Apply the programming skills to solve the problems using multiple numerical approaches.
CO4	Analyze if the results are reasonable, and then interpret and clearly communicate the
CO5	Apply the distinctive principles of numerical analysis and the associated error measures.

Course Content:

1. Assignments on Newton forward /backward, Lagrange‘s interpolation.

2. Assignments on numerical integration using Trapezoidal rule, Simpson‘s 1/3 rule, Weddle‘s rule.

3. Assignments on numerical solution of a system of linear equations using Gauss elimination, Tridiagonal matrix algorithm, Gauss-Seidel iterations. LU Factorization method.

4. Assignments on numerical solution of Algebraic Equation by Bisection method, Regula-Falsi method, Secant Method, Newton-Raphson method

5. Assignments on ordinary differential equation: Euler‘s method, Euler‘s modified method, Runge-Kutta methods, Taylor series method and Predictor-Corrector method.

   Implementation of numerical methods on computer through C/C++ and commercial Software Packages: Matlab / Scilab / Labview / Mathematica/NAG (Numerical Algorithms Group)/Python.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS392.1	3	3	2	2	3	2			3			
CS392.2	3	3	2	2	3	2			3			
CS392.3	3	3	2	2	3	2			3			
CS392.4	3	3	2	2	3	2			3			
CS392.5	3	3	2	2	3	2			3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CS392.1	2	2	2
CS392.2	2	2	2
CS392.3	2	2	2
CS392.4	2	2	2
CS392.5	2	2	2

Course Name: Digital Logic and Electronics Lab
Course Code: ESC392
Credit: 1.5

Pre-requisite:
Basic concepts of Logicgates, Truth Tables, function realization –minimization of Logic expressions by K-map, Concept of basic components of a digital computer, Binary Arithmetic

Course Outcomes (COs):

After attending the course students should be able to

CO1	Knowledge of Electronic components such as Resistors, Capacitors, Diodes, Transistors measuring equipment like DC power supply, Multimeter, CRO, Signal generator, DC power supply.
CO2	Analyze the characteristics of Junction Diode, Zener Diode, BJT & FET anddifferent types of Rectifier Circuits.
CO3	Determination of input-offset voltage, input bias current and Slew rate, Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
CO4	Able to know the application of Diode, BJT &OPAMP.
CO5	Familiarization and basic knowledge of Integrated Circuits

Course Content:

1. A) Realization of basic gates and universal gates.
   B) Realization of basic gates using universal gates.
2. Design a Half adder and Full Adder circuit using basic gates and verify its output.
3. Design a Half subtractor and Full Subtractor circuit using basic gates and verify its output
4. Design an Adder/Subtractor composite unit.
5. Design of a ‗Carry-Look-Ahead' Adder circuit.
6. Realization of a)Encoder, b)Decoder c) Multiplexer , d) De-MUX , e)Comparator and their Truth Table verification.
7. Realization of RS / JK / D flipflops using logic gates.
8. Design of Shift Register using J-K / D Flip Flop.
9. Realization of Synchronous Up/Down counters.
10. Design of MOD- N Counter
11. Study of DAC
12. Study of logic families and PLDs

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ESC392.1	3	3	3	3	3							
ESC392.2	3	3	3	3	3							
ESC392.3	3	3	3	3	3							
ESC392.4	3	3	3	3	3							
ESC392.5	3	3	3	3	3							

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
ESC392.1	2	2	2
ESC392.2	2	2	2
ESC392.3	2		2
ESC392.4	2	2	2
ESC392.5	2	2	2

Course Name: IT Workshop Lab
Course Code: PCC-CS391
Credits: 3

Prerequisite

1. Computer Fundamentals and principles of computer programming

Course Outcomes (COs):

After attending the course students should be able to

CO1	Demonstrate a thorough understanding of modular programming by designing programs that requires the use of programmer-defined functions.
CO2	Demonstrate a thorough understanding of arrays by designing and implementing programs that search and sort arrays.
CO3	Demonstrate a thorough understanding of the object-oriented programming concepts of encapsulation, data abstraction and composition by designing and implementing classes including the use of overloaded functions and constructors.
CO4	Demonstrate a thorough understanding of the concept of pointers and dynamic memory allocation, the implementation of programmer-defined functions and classes by writing code, performing unit testing and debugging of multiple complex programs.
CO5	Demonstrate an understanding of the differences between C and C++ in the areas of strings, pass by reference/passing pointers, and structs by designing and implementing programs that use C strings, C++

Course Content:

1. Introduction of UNIX/Linux Operating System which includes preliminary commands, start-up & shutdown methodology, file .
2. Handling as well as introduction to editors like Vi editor, introduction to GNU C & C++ compiler, as well as introduction to GNU & GDB script.
3. Introduction to C++, basic loop control, executing programs.
4. Writing functions, selection statements, review of functions and parameters, command line arguments, recursion, I/O streams, arrays and string manipulation, pointers, structures & unions.
5. Object-Oriented Programming in C++, fundamentals of classes, constructors-destructors.
6. Dealing with member functions, operator overloading and polymorphism (both static & dynamic).
7. Dealing with inheritance, derived class handling.
8. Abstract class, virtual class, overriding, template class, name-space & exception handling.
9. Dynamic memory allocation, implementation of Linked Lists, using C++.
10. MATLAB Environment, variable , constant, operators, loop, function.
11. MATLAB Toolbox, MATLAB Graphic function.
12. Reading and Writing to file, Numerical simulation.
13. Innovative experiments/Projects

Text Books

1. The C++ Programming Language by Bjarne Stroustrup Addison-Wesley publisher
2. Object-Oriented Programming in C++ b by Robert Lafore Publisher: Sams

Reference Books

1. Object Oriented Programming with C++ by Balagurusamy McGraw Hill Education; Sixth edition Addison-Wesley publisher
2. Object-Oriented Programming in C++ b by Robert Lafore Publisher: Sams
3. MATLAB Getting Started Guidehttps://www.mathworks.com/help/pdf_doc/matlab/getstart.pdf

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC-CS391.1	3	3	3	2	2				3			
PCC-CS391.2	3	2	2	2	2				3			
PCC-CS391.3	3	3	3	2	2				3			
PCC-CS391.4	3	3	3	2	2				3			
PCC-CS391.5	3	3	3	2	2				3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC-CS391.1	3	3	3
PCC-CS391.2	3	3	3
PCC-CS391.3	3	3	3
PCC-CS391.4	3	3	3
PCC-CS391.5	3	3	3

Course Name: Data Structures Lab
Course Code: CS392
Contact: 0:0:3
Credits: 1.5

Prerequisites:
1. Computer Fundamentals and principal of computer programming Lab

Course Outcomes (COs):

After attending the course students should be able to

CO1	Identify and propose appropriate data structures and data types to implement list using array and linked list and design effective programs to solve complex engineering problem using list and modern tools.
CO2	Design and develop effective programs for engineering and mathematical problems using stack, queue and recursive functions after implementing stack and queue using modular programming approach possibly as a team maintaining proper ethics of
CO3	Implement different data structures like binary tree, heap and use them to explain and organize data and manipulate them through programs leading to solution of complex engineering problem.
CO4	Implement different sorting and searching algorithm selecting appropriate data structures and analyze the efficiency of the resulting program using modern engineering tools and methods leading to lifelong learning.
CO5	Prepare laboratory reports on interpretation of experimental results and analyze it for validating the same maintaining proper ethics of collaboration.

Course Content:

Module 1: Implementing Non-Restricted Linear Data Structure [2 Lab]
Problem based on Implementation of Non-Restricted Linear Data Structure like-
Implementation of list as data structure using array.
Implementation of list as data structure using linked list of different types.
Implementation of polynomial as data structure using array and linked list.
Implementation of sparse matrix as data stricture using array.

Module 2: Implementing Restricted Linear Data Structure [3 Lab]
Problem based on Implementation of Restricted Linear Data Structure like-
Implementation of stack as data structure using array.
Implementation of stack as data structure using linked list.
Implementation of queue as data structure using array (physical, linear and circular model).
Implementation of queue as data structure using linked list.
Converting infix to post-fix and evaluating post-fix expression using stack.
Implementing Tower-of-Hanoi problem.

Module 3: Implementing Non-Linear Data Structure [2 Lab] Problem based on Implementation of Non-Linear Data Structure like
Implementation of Binary Tree as data structure using array and linked list.

Implementation of Binary Search Tree (BST) as data structure using linked list.
Implementation of Heap as data structure using array.
Implementation of Priority Queue as data structure using Heap.

Module 4: Implementing Sorting and Searching algorithm [5 Lab]
Problem based on Implementation of Sorting and Searching algorithm like
Implementation of Bubble sort using appropriate data structure.
Implementation of Selection sort using appropriate data structure.
Implementation of Insertion sort using appropriate data structure.
Implementation of Quick sort using appropriate data structure.
Implementation of Merge sort using appropriate data structure.
Implementation of Heap sort using appropriate data structure.
Implementation of Radix sort using appropriate data structure.
Implementation of Sequential Search using appropriate data structure.
Implementation of Binary Search using appropriate data structure.
Implementation of hashing with collision resolution using linear and quadratic probing.

Text books:

1. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications
2. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2nd Edition, Universities Press

Reference books:

1. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1 Edition, Pearson.
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited
3. Data Structures and Program Design In C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson
4. Data Structures in C by Aaron M. Tenenbaum, 1St Edition, Pearson

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS392.1	3	3	3	2	3							2
CS392.2	3	3	3	2	3							2
CS392.3	3	3	3	2	3							2
CS392.4	3	3	3	2	3							2
CS392.5	3	3	3	2	3							2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CS392.1	3	3	3
CS392.2	3	3	3
CS392.3	3	3	3
CS392.4	3	3	3
CS392.5	3	3	3

Course Name: Environmental Science
Course Code: MC 301
Credits: 0
Total Lectures: 36

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the natural environment and its relationships with human activities.
CO2	Apply the fundamental knowledge of science and engineering to assess environmental and health risk.
CO3	Understand guidelines and procedures for health and safety issues obeying the environmental laws and regulations.
CO4	Develop guidelines and procedures for health and safety issues obeying the environmental laws and regulations. Acquire skills for scientific problem-solving related to air, water, noise& land pollution.
CO5	Develop skills for scientific problem-solving related to air, water, noise & land pollution.

Course Contents:

Module 1: General [11L]
Natural Resources: Forest Resource, water resource, mineral resource, energy resources: alternative source of energy
Population Growth: Exponential Growth, logistic growth, Maximum sustainable yield, demography
Disaster Management: Types of disasters (Natural & Man-made), Floods, Earthquake, Tsunamis, Cyclones, landslides (cause, effect & control)
Ecology & Ecosystem: Elements of ecology, definition of ecosystem- components types and function, Food chain & Food web, Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems
Environmental Management: Environmental impact assessment, Environmental laws and protection act of India(The Environment protection Act, Air pollution Act, Water Act, Wildlife Protection Act) , Hazardous waste(management and Handling) Rules.

Module 2: Air pollution and control [10L]
Sources of Pollutants: point sources, nonpoint sources and manmade sources primary & secondary pollutant
Types of air pollutants: primary & secondary pollutant ; Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN, Smog (Photochemical smog and London smog),
Effects on human health & climate: Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion
Air pollution and meteorology: Ambient Lapse Rate, Adiabatic Lapse Rate, Atmospheric stability & Temperature inversion control of air pollution (ESP, cyclone separator, bag house, catalytic converter, scrubber (century).

Module 3: Water Pollution [9L]
Classification of water (Ground & surface water)

Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, heavy metals, pesticides, volatile organic compounds.

Surface water quality parameters: pH, DO, 5 day BOD test, BOD reaction rate constants, COD. Numerical related to BOD

Lake: Eutrophication [Definition, source and effect].

Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only),ground water pollution (Arsenic & Fluoride; sources, effects, control)

Quality of Boiler fed water: DO, hardness, alkalinity, TDS and Chloride

Layout of waste water treatment plant (scheme only).

Module 4: Land Pollution [3L]

Types of Solid Waste: Municipal, industrial, commercial, agricultural, domestic, hazardous solid wastes (bio-medical), E-waste

Solid waste disposal method: Open dumping, Land filling, incineration, composting,
recycling (Advantages and disadvantages).

Waste management: waste classification, waste segregation, treatment & disposal

Module 5: Noise Pollution [3L]

Definition of noise, effect of noise pollution on human health, Average Noise level of some common noise sources

Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, $L10$ (18 hr Index) .Noise pollution control.

Textbook:

1. A Textbook of Environmental Studies, Shashi Chawla. Tata McGraw Hill Education Private Limited

References Books:

1. Environmental Studies, Dr. J P Sharma, University Science Press
2. Environmental Engineering, J K Das Mohapatra, Vikas Publication

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MC301.1			2			3	3					
MC301.2			2			3	3					
MC301.3			2			3	3					
MC301.4			2			3	3					
MC301.5			2			3	3					

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
MC301.1	2	2	2
MC301.2	2	2	2
MC301.3	2	2	2
MC301.4	2	2	2
MC301.5	2	2	2

2nd Year 2nd Semester: 4th Semester								
Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	**T**	**P**	**Total**	
A. THEORY								
1	Program Core Course	PCC-CS401	Computer Organization and Architecture	3	0	0	3	3
2	Program Core Course	PCC-CS402	Design and Analysis of Algorithms	3	0	0	3	3
3	Program Core Course	PCC-CS403	Operating Systems	3	0	0	3	3
4	Program Core Course	PCC-CS404	Formal Language and Automata Theory	3	0	0	3	3
5	Humanities and Social Sciences including Management courses	HSMC 402	Gender Culture and Development	2	0	0	2	2
6	Basic Science course	BSC401	Probability and Statistics	3	0	0	3	3
B. PRACTICAL								
7	Program Core Course	PCC-CS491	Computer Organization and Architecture Lab	0	0	3	3	1.5
8	Program Core Course	PCC-CS492	Design and Analysis of Algorithms Lab	0	0	3	3	1.5
9	Program Core Course	PCC-CS493	Operating Systems Lab	0	0	3	3	1.5
10	Engineering Science Courses	ESC491	Programming using Python	0	0	3	3	1.5
11	PROJECT	PR 491	Theme based Project IV	0	0	1	1	0.5
12	PROJECT	PR492	Skill Development IV: Soft Skill & Aptitude-I	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 481	Learning an Art Form [vocal or instrumental, dance, painting, clay modeling, etc.] OR Environmental Protection Initiatives	0	0	0	3	3Units
	TOTAL CREDIT WITHOUT MOOCS COURSES							24

D.MOOCS COURSES								
14	MOOCS COURSES	HM401	MOOCS COURSE-II	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**28**

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semes-ter Break & Internship should be done after 5th Semester or 6th Semester). All re-lated certificates to be collected by the training/internship coordinator(s).

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

Course Name: Computer Organization and Architecture
Course Code: PCC-CS401
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Digital Electronics

Course Outcomes (COs):

After attending the course students should be able to

CO1	Illustrate the basic concept of computer architecture and its performance measurement, parallel processing, Flynn's classification and Amdahl's law and apply this knowledge in designing solution for real life engineering problem.
CO2	Summarize the basic concept of pipeline, instruction pipeline, arithmetic pipeline hazards detection and prevention and use this knowledge for designing and implementing mathematical and engineering problem leading to lifelong learning.
CO3	Identify the concept of Instruction-Level Parallelism to solve engineering problem.
CO4	Illustrate and Compare concept of Multiprocessor architecture and parallel architecture and apply this knowledge for developing an approach by means of existing and new methods as a team work.
CO5	Understand the concept of message passing architecture and interconnection network and design an optimized model for building a new solution as a professional engineering practice as a team.

Course Contents:

Module 1[8L]:
IntroductiontoCPUandconceptsofALU[2L],InstructionformatandInstructionCycle[1L],AddressingModes [1L] Fixed-point multiplication -Booth's algorithm. [2L], Fixed-point division - Restoring and non-restoring algorithms[1L], Floating-point number representation-IEEE754 format and Floating-point arithmetic operation[1L]

Module 2 [7L]:
Introduction to basic computer architecture [1L], Stored Program Concepts: Von Neumann & Harvard Architecture [1L], RISC VS CISC [1L], Amdahl's law [1L], Performance measurement parameters – MIPS, MFLOPS, SPEC ratings, CPI etc. [2L] Micro programmed and hardwired control unit [1L]

Module 3[8L]:
Pipelining: Basic concepts, instruction and arithmetic pipeline[2L], data hazards, control hazards and structural hazards, techniques for handling hazards[2L]
Pipeline vs. Parallelism, Levels of parallelism [1L], Instruction-Level Parallelism: Basic Concepts, Techniques for Increasing ILP, Superscalar, Super Pipelined and VLIW Processor Architectures [2L], Array and Vector Processors [1L]

Module 4[9L]:
Introduction to memory-RAM and ROM [1L], Register transfer, memory transfer, Tri-state bus buffer, Memory Hierarchy: Secondary memory [1L], Main Memory [1L], Cache Memory [1L], Mapping Technique in cache

memory: Direct, Full Associative and Set Associative [2L], Performance Implementation in Cache Memory [1L], Virtual memory Concepts [1L], page replacement policies [1L].

Module 5[4L]:
Multiprocessor architecture: taxonomy of parallel architectures; Flynn's Classification [1L], Centralized and Shared- memory architecture: synchronization [1L], Interconnection Network (Omega, Baseline, Butterfly, Crossbar) [2L]

Text Books:
1. _Advanced Computer Architecture Parallelism Scalability Programmability', Tata McGraw-Hill Education Private Limited ISBN-13: 978-0-07-053070-6 ISBN-10: 0-07-053070-X
2. Hwang & Briggs—Computer Architecture & Parallel Processing, TMH

Reference Books:
1. Patterson D.A. and Hennessy, J.L. –Computer architecture a quantitative approach‖, 2nd ed., Morgan Kaufman, 1996
2. Hayes J. P., –Computer Architecture & Organisation‖, McGraw Hill
3. Siegel, H.J., –Interconnection Network for Large Scale parallel Processing‖, 2nd Ed., McGraw Hill, 1990
4. Design and Analysis of Parallel Algorithm-Schim G. Akl

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC- CS 401.1	3	3	3	2								
PCC- CS 401.2	3	3	3	3								3
PCC- CS 401.3	2	2	2	3								
PCC- CS 401.4	3	3	3	3								
PCC- CS 401.5	3	3	3	3								

CO-PSO Mapping

Cos	PSO1	PSO2	PSO3
PCC- CS 401.1	3	3	3
PCC- CS 401.2	3	3	3
PCC- CS 401.3	3	3	3
PCC- CS 401.4	3	3	3
PCC- CS 401.5	3	3	3

Course Name: Design & Analysis of Algorithm
Course Code: PCC-CS402
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: To know data-structure and basic programming ability

Course Outcomes (COs):

After attending the course students should be able to

CO1	To understand and illustrate the concepts of time and space complexity, worst case, average case and best-case complexities and the asymptotic notation.
CO2	To analyze and apply the design principles and concepts to various basic algorithm design viz. dynamic programming, greedy method etc.
CO3	To understand and analyze various string matching and graph algorithms.
CO4	To understand, illustrate and analyze the different complexity classes
CO5	To discuss, implement and analyze, verify the efficiency of the randomized and approximation algorithms.

Course Content:

Module-1 [4L]
Algorithm Development & Complexity Analysis: [4L]
Stages of algorithm development for solving a problem: Describing the problem, identifying a suitable technique, Design of an algorithm, Proof of Correctness of the algorithm. Time and Space Complexity, Different Asymptotic notations – their mathematical significance.Solving Recurrences: Substitution Method, Recurrence Tree Method, Master Theorem (Statement Only).

Module-2 [14L]
Algorithm Design Techniques :
Brute force techniques – Travelling Sales man Problem, Divide and Conquer - Matrix multiplication: Strassen‘s algorithm, Greedy techniques - Fractional Knapsack problem, Job Sequencing with Deadline, Graph Coloring, Finding Minimum Cost Spanning Tree, Dynamic programming - O/1 Knapsack problem, Matrix chain multiplication, Travelling Salesman Problem, Backtracking-N-Queens Problem, Knights Tour on Chess Board.

Module-3 [3L]
String matching problem:
Different techniques – Naive algorithm, string matching using finite automata, and Knuth, Morris, Pratt (KMP) algorithm with their complexities.

Module-4 [5L]
Graph Algorithms
Single Source Shortest Path – Dijkstra‘s Algorithm, All pair shortest path – Floyd-Warshall Algorithm. Network Flows, Maximum Flows – Ford-Fulkerson Algorithm, Push Re-label Algorithm, Minimum Cost Flows – Cycle Cancelling Algorithm.

Module-5 [5L]
Complexity Classes:
The Class P, The Class NP, Reducibility and NP-completeness – SAT (without proof), 3-SAT, Vertex Cover,

Independent Set, Maximum Clique.

Module-6 [5L]

Approximation and Randomized Algorithms [3L]

Approximation Algorithms - The set-covering problem – Vertex cover, K-center clustering. Randomized Algorithms - The hiring problem, Finding the global Minimum.

Recent Trends [2L]

Text book:

1."Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.

2."The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman. 3. "Algorithm Design" by Kleinberg and Tardos**.**

3. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi Reference Books:

4. –Design Analysis and Algorithms‖ by Hari Mohan Pandey.

CO-PO Mapping

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC- CS 402.1	2	2	2	2								2
PCC- CS 402.2	3	3	3	3								2
PCC- CS 402.3	3	3	3	3								2
PCC- CS 402.4	3	3	3	3								2
PCC- CS 402.5	3	3	3	3								2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC- CS 402.1	3	3	3
PCC- CS 402.2	3	3	3
PCC- CS 402.3	3	3	3
PCC- CS 402.4	3	3	3
PCC- CS 402.5	3	3	3

Paper Name: Operating System
Paper Code: PCC-CS403
Contact Hours/Week: 3
Credit: 3
Total Contact Hours: 36L

Prerequisites:
1. Computer organization
2. Computer Architecture
3. Data Structures
4. Algorithms & Programming Concept

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the fundamental concepts of Operating System, Protection & Security and differentiate different types of Operating System.
CO2	Understand and implement process & thread; understand, apply, compare different process synchronization algorithm and inter process communication to solve engineering problems.
CO3	Understand/explain/analyze different synchronization techniques, critical section problems and deadlock and apply them to solve engineering problems.
CO4	Understand/explain different memory management techniques including virtual memory management; also able to apply, compare, and implement different page replacement algorithms to solve engineering problems.
CO5	Understand/explain different I/O mechanisms, File structures and disk management techniques and solving engineering problem applying different disk scheduling algorithm.

Course Content

Module – 1:
[3L]
Functionalities of Operating System, Evolution of Operating System.
Types of Operating System: batch, multi-programmed, time-sharing, real-time, distributed, parallel, Structural overview, Protection & Security. [3L]

Module – 2:
[11L]
Processes: Concept of processes, process states, PCB, process scheduling, co-operating processes, independent process, suspended process, Interaction between processes and OS, Inter-process communication: Message passing. [3L]
Threads: overview, benefits of threads, user and kernel level threads, Thread models. [2L]
CPU scheduling: Scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, SRTF, RR, priority, multilevel queue, multilevel feedback queue scheduling). [6L]

Module – 3:[11L]
Process Synchronization: background, critical section problem, synchronization hardware, classical problems of synchronization (producer-consumer, readers-writer, dining philosophers, etc), semaphores, monitors. [6L]
Deadlocks: deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock

avoidance, deadlock detection, recovery from deadlock.[5L]

Module 4:[6L]
Background, logical vs. physical address space, swapping, contiguous memory allocation, paging, Segmentation, TLB. [3L]
Virtual Memory: background, demand paging, page replacement algorithms (FCFS, LRU, Optimal), thrashing, Working set model. [3L]

Module 5:[5L]
Disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK etc), disk reliability, disk formatting, boot block, bad blocks. [2L]

File: File concept, access methods, directory structure, file system structure, UNIX file structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector). [2L]

I/O: I/O hardware, polling, interrupts, DMA, caching, buffering, blocking-non blocking I/O. [1L]

Text Book:
1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts.
2. Operating Systems& Systems Programming by P Balakrishna Prasad

Reference Book:
1. Dietel H. N., –An Introduction to Operating Systems‖, Addison Wesley.
2. Andrew Tanenbaum, Modern Operating Systems, Prentice Hall.
3. William Stallings, Operating Systems, Prentice Hall.

CO-PO Mapping

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC-CS403.1	3	3	3	3								3
PCC-CS403.2	3	3	3	3								3
PCC-CS403.3	3	3	3	3								3
PCC-CS403.4	3	3	3	3								3
PCC-CS403.5	3	3	3	3								3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC-CS403.1	3	3	3
PCC-CS403.2	3	3	3
PCC-CS403.3	3	3	3
PCC-CS403.4	3	3	3
PCC-CS403.5	3	3	3

Course Name: Formal Language and Automata Theory
Course Code: PCC-CS404
Contacts: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:

1. Digital Logic
2. Computer organization
3. Computer Fundamentals

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the fundamental concepts of Finite State Automata to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
CO2	Understand the fundamental concepts of Regular Expressions and its relation with DFA so that they can Develop regular expression for a specified language and Validate it.
CO3	Understand the fundamental concepts of Context Free Grammar so that they can Design grammar for a specified language and Validate it.
CO4	Explain or Illustrate the fundamental operating principles of Push Down Automata and Use it appropriately to Solve problems.
CO5	Understand the operating principles of Turing Machine and Design Turing Machines to Propose solutions to the related problems appropriately and validate the effectiveness as well as limitations of computations making the students aware of its utilitarian importance for further explorations leading towards lifelong learning.

Course Contents:
Module-1:[9L]

Fundamentals: Basic definition of sequential circuit, block diagram, mathematical representation, concept of transition table and transition diagram,**[1L]**
Introduction to Finite State Model (FSM), Design of sequence detector, Finite State Machine, Finite Automata, Deterministic Finite Automation (DFA) and Non-deterministic Finite Automation (NFA), Transition diagrams, Transition tables and Language recognizers.**[3L]**
NFA with empty transitions, Equivalence between NFA with and without empty transitions. NFA to DFA conversion.**[2L]**
Minimization of FSM: Minimization Algorithm for DFA, Introduction to Myhill-NerodeTheorem **[2L]**

Limitations of FSM, Application of Finite Automata**[1L]**

Module-2:[7L]
Finite Automata with output − Moore & Mealy machine. Representation of Moore & Mealy Machine, Processing of the String through Moore & Mealy Machine, Equivalence of Moore & Mealy Machine – Inter- conversion.**[2L]**
Equivalent states and Distinguishable States, Equivalence and k-equivalence, Minimization of Mealy
Machine**[1L]**
Minimization of incompletely specified machine−Merger Graph, Merger Table, Compatibility Graph **[2L]**

Lossless and Lossy Machine – Testing Table, Testing Graph **[2L]**

Module-3:[5L]
Regular Languages, Regular Sets, Regular Expressions, Algebraic Rules for Regular Expressions, Arden‘s
Theorem statement and proof**[1L]**
Constructing Finite Automata (FA) for given regular expressions, Regular string accepted by FA**[2L]**
Constructing Regular Expression for a given Finite Automata**[1L]**
Pumping Lemma of Regular Sets. Closure properties of regular sets**[1L]**

Module-4:[9L]
Grammar Formalism-Context Free Grammars, Derivation trees, sentential forms. Rightmost and leftmost derivation of strings, Parse Tree, Ambiguity in context free grammars.**[1L]**
Minimization of Context Free Grammars. **[1L],**Removal of null and unit production**[1L]**
Chomsky normal form and Greibach normal form.**[1L]**
Pumping Lemma for Context Free Languages.**[1L]**

Enumeration of properties of CFL, Closure property of CFL, Ogden‘s lemma & its applications **[1L],** Regular grammars−right linear and left linear grammars**[1L]**
Pushdown Automata: Pushdown automata, definition. Introduction to DCFL, DPDA, NCFL, NPDA**[1L]** Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence.**[1L]** Equivalence of CFL and PDA, inter-conversion.**1L]**

Module-5:[5L]
Turing Machine: Turing Machine, definition, model**[1L]**
Design of TM, Computable functions **[1L],** Church‘s hypothesis, counter machine **[1L]** Types of Turing machines **[1L]**
Universal Turing Machine, Halting problem**[1L]**

Textbook:
1.―Introduction to Automata Theory Languages and Computation‖, Hopcroft.E. and Ullman J.D., Pearson
Educ
ation.

Reference Books:

1. ―Formal Languages and Automata Theory‖,C. K. Nagpal, Oxford
2. ―Switching and Finite Automata Theory‖, Zvi Kohavi, 2nd Edition, Tata McGraw Hill

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC- CS 404.1	3	3	3	3								3
PCC- CS 404.2	2	2	2	2								3
PCC- CS 404.3	3	3	3	3								3
PCC- CS 404.4	3	3	3	3								3
PCC- CS 404.5	3	3	3	3					2	2		3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC- CS 404.1	3	3	3
PCC- CS 404.2	3	3	3
PCC- CS 404.3	3	3	3
PCC- CS 404.4	3	3	3
PCC- CS 404.5	3	3	3

Course Name: Gender, Culture and Development
Course Code: HSMC 402
Contacts: 2:0:0
Total Contact Hours: 24
Credit: 2

Prerequisite: None

Course Outcome(s):

On successful completion of the learning sessions of the course, the learner will be able to:
CO1: Provide an analysis of the location of women in the processes of economic development; to understand what economic development is, the scales or levels at which it occurs, and the centrality of gender at every level.
CO2: Examine theoretical and conceptual frameworks for that analysis.
CO3: Reflect upon linkages between the global economy and the gendered macro and micro process of development and transitions from _government' to _governance.'
CO4: Explain the usefulness of a rights based approach to gender justice.
CO5: Provide basis for research, practical action and policy formulation and or evaluating for evaluating directions and strategies for social change from a gender perspective.

Course Content:

Module1:
Introduction to Gender, Definition of Gender, Basic Gender Concepts and Terminology, Exploring Attitudes towards Gender, Social Construction of Gender .[4L]

Module 2:
Gender Roles and Relations, Types of Gender Roles, Gender Roles and Relationships Matrix, Gender-based Division and Valuation of Labour .[6L]

Module 3:
Gender Development Issues , Identifying Gender Issues, Gender Sensitive Language, Gender, Governance and Sustainable Development, Gender and Human Rights, Gender and Mainstreaming. [5L]

Module 4:
Gender-based Violence, The concept of violence, Types of Gender-based violence, The relationship between gender, development and violence, Gender-based violence from a human rights perspective. [5L]

Module5:
Gender and Culture Gender and Film, Gender and Electronic Media, Gender and Advertisement, Gender and Popular Literature. [4L]

Text Books:

1. Beneria, Lourdes. (2004). Gender, Development, and Globalization: Economics as if All People Mattered. Roultedge Press. (GDGE)

2. Molyneux and Razavi. (2002). Gender Justice, Development and Rights. Oxford University Press (GJDR or WGD)
3. Visvanathan, Duggan,Wiegersma and Nisonoff. (2011). The Women, Gender and Development Reader. 2nd Edition. Zed Press (WGD)

CO-PO Mapping:

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

Course Name: Probability and Statistics
Course Code: BSC 401
Total Contact Hours: 36
Credit: 3

Prerequisite:

The students to whom this course will be offered must have the concept of (10+2) standard algebra and calculus.

Course Outcome(s):

After completion of the course students will be able to
CO1: Recall the distinctive principles of probability and statistics.
CO2: Understand the theoretical workings of theory of probability and tests of hypotheses.
CO3: Apply statistical methods to compute and explain point estimators and interval estimators for mean, variance and proportion.
CO4: Analyze statistical data from engineering experiments.

Course Content

Module 1 (Probability and Random Variables) (15 Hours)
The axioms of probability , Conditional probability, Baye_s theorem, Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, Moments, Moment generating functions, Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

Module 2 (Two dimensional random variables) (5 Hours)
Joint distributions, Marginal and conditional distributions, Covariance , Correlation and linear regression , Transformation of random variables , Central limit theorem (for independent and identically distributed random variables).

Module 3 (Sampling Distribution) (3 Hours)
Distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions, problems

Module 4 (Estimation) (4 Hours)
Unbiasedness, consistency, the method of moments and the method of maximum likelihood estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions, problems

Module 5 (Testing of Hypotheses) (9 Hours)
Null and alternative hypotheses, the critical and acceptance regions, two types of error, power of the test, the most powerful test and Neyman-Pearson Fundamental Lemma, tests for one sample and two sample problems for normal populations, tests for proportions, Chi square goodness of fit test and its applications, problems.

Project Domains:

1. Construction of Univariate and Bivariate frequency tables
2. Diagrammatic and Graphical representation of data.
3. Fitting of discrete and Continuous distributions
4. Regression Analysis
5. Curve Fitting
6. Tests of significance with regard to Single Mean, Two Means
7. Construction of Confidence intervals for Mean, Variance and Proportion

Text and Reference Books:

1. Sheldon M. Ross, ―Introduction to Probability and Statistics for Engineers and Scientists‖, Academic Press, (2009).
2. D. C. Montgomery and G.C. Runger, ―Applied Statistics and Probability for Engineers‖, 5th edition, John Wiley & Sons, (2009)..
3. Robert H. Shumway and David S. Stoffer, ―Time Series Analysis and Its Applications with R Examples‖, Third edition, Springer Texts in Statistics, (2006).
4. N. G. Das: Statistical Methods, TMH.
5. Sancheti , *D. S. &*Kapoor ,*V.K. : Statistics Theory , Method & Application*, Sultan chand & sons , New Delhi
6. N.K.Dutta (2004). Fundamentals of Biostatistics, Kanishka Publishers.

CO-PO Mapping:

PO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1	3	1	1	-	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	2
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	3	2	3	-	-	-	-	-	-	-	2

Course Name: Computer Organization and Architecture Lab
Course Code: PCC-CS491
Contact: 0:0:3
Credits: 1.5

Prerequisites:
Knowledge of designing different circuits in Computer Organization Lab

Course Outcomes (COs):

After attending the course students should be able to

CO1	Illustrate and use proper syntax in appropriate platform for developing program to solve problems related to Mathematics and Engineering field leading to lifelong learning.
CO2	Apply the knowledge of algorithms in the computational area to efficient programming codes to design the problem using modern tools for solving complex engineering problems.
CO3	Outline different types of digital electronic circuits such as adder, subtract or, encoder, decoder, multiplexer, de-multiplexer, flip-flops, register, counter using various mapping and modern tools to prepare the most simplified circuit and optimize using various mapping and mathematical methods for solving the problem as a professional engineering practice as a team.
CO4	Apply the knowledge of digital electronic circuits to design memory and ALU and analyse the same to solve engineering-related computational problems as a team.
CO5	Interpret the result of the experiments, prepare laboratory reports based on observed output and analyse it to validate professional ethics and responsibilities and norms of the engineering practice.

List of Experiment:

1. Implement different types of Basic gates and simulate for truth table verification.
2. Implement half adder circuit and simulate for truth table verification.
3. Implement full adder circuit and simulate for truth table verification.
4. Implement half subtractor circuit and simulate for truth table verification.
5. Implement full subtractor circuit and simulate for truth table verification.
6. Implement Multiplexer, DeMultiplexer circuit and simulate for truth table verification.
7. Implement Encoder, Decoder circuit and simulate for truth table verification.
8. Implement different types of flip flop and simulate for truth table verification.
9. Implement different types of parallel circuits (SISO, SIPO, PISO, PIPO) and simulate the result.
10. Implement ALU and simulate the result.
11. Implement RAM chip and simulate the result.
12. Innovative Experiments.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC-CS491.1	3	3	3	2	3				3			
PCC-CS491.2	3	3	3	3	3				3			
PCC-CS491.3	3	3	3	3	3				3			
PCC-CS491.4	3	3	3	3	3				3			
PCC-CS491.5	3	3	3	3	3				3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC-CS491.1	3	3	3
PCC-CS491.2	3	3	3
PCC-CS491.3	3	3	3
PCC-CS491.4	3	3	3
PCC-CS491.5	3	3	3

Course Name: Design & Analysis of Algorithm Lab
Course Code: PCC-CS492
Contact: 0:0:2
Credit: 1.5

Prerequisite:
Programming knowledge

Course Outcomes (COs):

After attending the course students should be able to

CO1	To identify and prove the correctness and analyze the running time of the basic algorithms for those classic problems in various domains.
CO2	To understand and illustrate methods for analyzing the efficiency and correctness of algorithms (such as exchange arguments, recurrence, induction, and average case analysis)
CO3	To analyze and design algorithms using the dynamic programming, greedy method, Backtracking, Branch and Bound strategy, and recite algorithms that employ this strategy.
CO4	To understand, compare, contrast, and choose appropriate implementation of the algorithmic design techniques to present an algorithm that solves a given problem.
CO5	To Identify and analyze criteria and specifications appropriate to new problems.

Course Content:

A. Implementation of various Divide & Conquer Methods; viz. Matrix Multiplication.
B. Implementations of various Dynamic Programming Methods, viz. Matrix Chain Multiplication Method, Travelling Salesman Problem etc.
C. Implementations of various Brunch & Bound Techniques, viz.
D. Implementations of various Backtracking Methods, viz. n-Queen Problem.
E. Implementations of Greedy Method, viz. Fractional Knapsack Problem, Job Sequencing Problem etc.
F. Implementations of String Matching Algorithm viz. Naïve Algorithm, String Matching with Finite Automata etc.
G. Implementations of Various Graph Algorithm, viz. Dijkstra‘s Algorithm, Floyd Algorithm etc.
H. Implementation of some Real Life Trendy Problems.

CO-PO Mapping

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC-CS492.1	3	3	2	2	3				3			3
PCC-CS492.2	3	3	3	2	3				3			3
PCC-CS492.3	3	3	2	3	3				3			3
PCC-CS492.4	3	3	2	2	3				3			3
PCC-CS492.5	3	3	3	2	3				3			3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC-CS492.1	3	3	3
PCC-CS492.2	3	3	3
PCC-CS492.3	3	3	3
PCC-CS492.4	3	3	3
PCC-CS492.5	3	3	3

Paper Name: Operating Systems Lab
Code: PCC-CS493
Allotted hours: 36L

Prerequisites:

1. Computer organization
2. Computer Architecture
3. Data Structures
4. Algorithms & Programming Concept

Course Outcomes (COs):

After attending the course students should be able to

CO1	Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.
CO2	Understand the concepts of deadlock in operating systems.
CO3	Implement them in Multiprogramming system.
CO4	Create process creation and implement inter process communication
CO5	Analyze the performance of the various page replacement schemes

Course Contents:

1. **Essential Linux Commands[9P]:** Commands for files and directories cd, cp, mv, rm, mkdir, more, less, creating and viewing files, using cat, file comparisons, View files, kill, ps, who, sleep, grep, fgrep, find, sort, cal, banner, touch, file related commands – ws, sat, cut, grep etc. Mathematical commands –expr, factor, units, Pipes(use functions pipe, popen, pclose), named Pipes (FIFOs, accessing FIFO)

2. **Shell Programming [6P]:** Creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, and commands).
3. **Process [3P]**: Starting new process, replacing a process image, duplicating a process image.

4. **Semaphore [3P]:** Programming with semaphores (use functions semget, semop, semaphore_p, semaphore_v).
5. **POSIX Threads[6P]:** Programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel) .
6. **Shared Memory [9P]:**Create the shared memory , Attach the shared memory segment to the address space of the calling process , Read information from the standard input and write to the shared memory, Read the content of the shared memory and write on to the standard output , Delete the shared memory

Books:

1. Yashavant P. Kanetkar, UNIX Shell Programming, 1st edition, BPB Publications
2. Beej's Guide to Unix IPC
3. W. Richard Stevens, UNIX Network Programming, 2nd edition, Prentice Hall

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC-CS493.1	3	3	3	3	3				3			
PCC-CS493.2	3	3	3	3	3				3			
PCC-CS493.3	3	3	3	3	3				3			
PCC-CS493.4	3	3	3	3	3				3			
PCC-CS493.5	3	3	3	3	3				3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC-CS493.1	3	3	3
PCC-CS493.2	3	3	3
PCC-CS493.3	3	3	3
PCC-CS493.4	3	3	3
PCC-CS493.5	3	3	3

Course Name: Programming using Python
Course Code: ESC491
Contact: 0:0:3
Credits: 1.5

Prerequisites:
Knowledge of Mathematics and basic concepts of Programming

Course Outcome(s):

After completion of the course students will be able to CO1:
Understand basic of Python Programming Language CO2:
Understand the use of Conditional statement and Loops
CO3: Learn functions in python and represent collection type data using List and Dictionary
CO4: Read and write data from & to files in Python
CO5: Understand Numpy array and numerical operations on Numpy array.

Course Contents:

1. **Basics of Python:** Python Installation, python variables, data types and Operator.
2. **Loops:** While and For loops, Python Syntax, Colon & Indentation, Conditional Statements: if, elif and else.
3. **Functions:** Defining Functions in python; passing arguments.
4. **String:** Python Programming to explore string functions
5. **Lists**: Python programs using Lists; understand the use of List methods, Slicing on List.
6. **Sets**: Working with Sets; Write programs to show different set operations.
7. **Dictionary**: Demonstrate the use of Dictionaries
8. **File handling:** Reading & Writing data from a file, Redirecting output streams to files.
9. **Numpy**: Numerical operations using Numpy array; slicing numpy array; stacking numpy arrays; Write programs to show different numerical operations on numpy array;.

CO-PO Mapping:

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

3rd Year 1st Semester: 5th Semester								
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
				L	**T**	**P**	**Total**	
A. THEORY								
1	Humanities and Social Sciences including Management courses	HSMC 505	Principles of Management	2	0	0	2	2
2	Program Core Course	PCC-CS501	Compiler Design	3	0	0	3	3
3	Program Core Course	PCC-CS502	Database Management Systems	3	0	0	3	3
4	Program Core Course	PCC-CS503	Object Oriented Programming using Java	3	0	0	3	3
5	Professional Elective courses	PEC-CS-T-501	Advanced Algorithms	3	0	0	3	3
		PEC-CS-S-501	Advanced Computer Architecture					
		PEC-CS-D-501	Neural Networks and Deep Learning					
		PEC-CS-A-501	Artificial Intelligence					
B. PRACTICAL								
6	Program Core Course	PCC-CS591	Compiler Design Lab	0	0	3	3	1.5
7	Program Core Course	PCC-CS592	Database Management Systems Lab	0	0	3	3	1.5
8	Program Core Course	PCC-CS593	Object Oriented Programming using Java Lab	0	0	3	3	1.5
9	Professional Elective courses	PEC-CS-T-591	Advanced Algorithms Lab	0	0	3	3	1.

		PEC-CS-S-591	Advanced Computer Architecture Lab							5
		PEC-CS-D-591	Neural Networks and Deep Learning Lab							
		PEC-CS-A-591	Artificial Intelligence Lab							
10	PROJECT	PR 591	Minor Project I		0	0	3	2	1	
PROJECT		PR 592	Skill Development V: Soft Skill & Aptitude-II	1	0	0	1	0.5		
C. MANDATORY ACTIVITIES / COURSES										
12	MC	MC 501	Constitution of India	3	0	0	3		3Units	
TOTAL CREDIT WITHOUT MOOCS COURSES									21.5	

D. MOOCS COURSES**

13	MOOCS COURSES	HM501	MOOCS COURSE-III	3	1	0	4	4

TOTAL CREDIT WITH MOOCS COURSES **25.5**

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semes-ter Break & Internship should be done after 5th Semester or 6th Semester). All re-lated certificates to be collected by the training/internship coordinator(s).

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from**
MOOCS
BASKET

Paper name: Principles of Management
Paper Code: HSMC505
Credits: 2
No. of lectures: 24

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the basic concepts and technologies used in the field of management information Systems
CO2	Have the knowledge of the different types of management information systems
CO3	Understand the processes of developing and implementing information systems.
CO4	Be aware of the ethical, social, and security issues of information systems.
CO5	An ability to effectively integrate IT-based solutions into the user environment

Course Content:

Module-1: Management Concepts: Definition, roles, functions and importance of Management, Evolution of Management thought-contribution made by Taylor,Fayol,Gilbreth,Elton Mayo,McGregor,Maslow**(4L)**

Module - 2: Planning and Control: Planning: Nature and importance of planning, -types of planning, Levels of planning - The Planning Process. –MBO, SWOTanalysis, McKinsey‘s7S Approach.
Organising for decision making: Nature of organizing, span ofcontrol, Organisational structure –line andstaff authority.
Basic control process -control as a feedback system – Feed Forward Control –Requirements for effective control – control (**4L)**

Module - 3:Group dynamics: Types of groups, characteristics, objectives of Group Dynamics.
Leadership: Definition, styles & functions of leadership, qualities for good leadership, Theories of leadership (**4L)**

Module – 4: Work Study and work measurement: Definition of work study**,** Method Study Steps, Tools and Techniques used in the Method Study and Work Measurement Time Study: Aim & Objectives, Use of stopwatch procedure in making Time Study. Performance rating, allowances and its types.Calculation of Standard Time. Work sampling**(4L)**

Module - 5:Marketing Management: Functions of Marketing, Product Planning and development, PromotionalStrategy (**2L)**

Module - 6: Quality management: Quality definition, Statistical quality control,acceptance sampling ,Control

Charts –Mean chart, range chart,c chart,p chart,np chart, Zero Defects, Quality circles,, Kaizen & Six Sigma ,ISO -9000 Implementation steps, Total quality management **(6L)**

Text Books:

1. Essentials of Management, by Harold Koontz & Heinz Weihrich Tata McGraw
2. Production and Operations Management-K.Aswathapa,K .Shridhara Bhat,Himalayan Publishing House

References:

1. Organizational Behavior, by Stephen Robbins Pearson Education, New Delhi
2. New era Management, Daft, 11th Edition, Cengage Learning
3. Principles of Marketing, Kotlar Philip and Armstrong Gary, Pearson publication

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
HSMC 505.1	3	2	2	2							3	
HSMC 505.2	3	2	2	2							3	
HSMC 505.3	3	3	2	2							3	
HSMC 505.4	3	2	2	2							3	
HSMC 505.5	3	2	2	2							3	

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
HSMC 505.1	2	2	2
HSMC 505.2	2	2	2
HSMC 505.3	2	2	2
HSMC 505.4	2	2	2
HSMC 505.5	2	2	2

Course Name: Compiler Design
Course Code: PCC-CS501
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites:

1. Mathematics
2. Concept of programming languages
3. Data structures
4. Computer architecture
5. Formal languages and automata theory
6. Some advanced math might be required if you Adventure in code optimization

Course Outcomes (COs):

After attending the course students should be able to

CO1	Illustrate the basic concept of compilers and discuss on the components as well as the strengths and weaknesses of various phases of designing a compiler.
CO2	Design and analyze algorithms for syntactic or parsing techniques and semantic analysis of the process of designing compilers.
CO3	Develop the parsers and experiment the knowledge of activation tree, activation record and dynamic storage allocation techniques
CO4	Construct the intermediate code representations and generation.
CO5	Apply for various optimization techniques for dataflow analysis.

Course Contents:

Module-1[7L]

Compilers, Cousins of the Compiler, Analysis-synthesis model, Phases of the compiler, Role of the lexical analyser, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of tokens, Finite automata, From a regular expression to an NFA, From regular expression to DFA, Design of a lexical analyser generator(Lex).

Module-2[10L]

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, Canonical LR), Parser generators (YACC), Error Recovery strategies for different parsing techniques, Syntax directed translation: Syntax directeddefinitions,Constructionofsyntaxtrees,Bottom-upevaluationofS-attributeddefinitions,L-attributeddefinitions,Bottom-upevaluationof inherited attributes.

Module-3[7L]

Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions, Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Symbol tables, dynamic storage allocation techniques.

Module-4[4L]

Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirecttriples).

Module-V[8L]

Consideration for Optimization, scope of optimization, local optimization, loop optimization, folding, DAG representation, Flow Graph, Dataflow equation, global optimization, redundant sub expression elimination, induction variable elimination, copy propagation, basic blocks & flow graphs ,transformation of basic blocks, DAG representation of basic blocks, peephole optimization, Object code forms, machine dependent code optimization, register allocation and assignment, generic code generation algorithms, DAG for register allocation.

Text Books

1. Aho, A.V.,Sethi,R.,&Ullman,J.D.Addison-Wesley,2007.Compilers-Principles,Techniques,andTools.
2. Holub, A. I.(1990).CompilerdesigninC(Vol.5).EnglewoodCliffs,NJ:PrenticeHall.

ReferenceBooks

1. Chattopadhyay, S.(2005). Compiler Design. PHI Learning Pvt. Ltd.
2. Tremblay, J.P., &Sorenson, P.G.(1985).Theory and Practice of Compiler Writing. McGraw-Hill, Inc.
3. Appel, A.W.(2004). Modern compiler implementation in C. Cambridge university press.
4. Barrett, W.A.,Bates, R.M.,Gustafson, D.A.,& Couch,J.D.(1986). Compiler construction: theory and practice. SRA School Group.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC-CS501.1	3	3	2	3								3
PCC-CS501.2	3	3	3	3								3
PCC-CS501.3	3	2	2	3								3
PCC-CS501.4	2	2	3	3								3
PCC-CS501.5	3	2	3	3								3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC-CS501.1	3	3	3
PCC-CS501.2	3	3	3
PCC-CS501.3	3	3	3
PCC-CS501.4	3	3	3
PCC-CS501.5	3	3	3

Course Name: Database Management System
Course Code: PCC-CS502
Contact (Periods/Week): 3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisite:
1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Outcomes (COs):

After attending the course students should be able to

CO1	To Understand and Describe the basic concepts and utility of Database management system, different data models of Database management system.
CO2	To Design an Entity Relationship (E-R) Diagram and relational model for any kind of real-life application and able to Apply relational algebra operations, SQL, Neo4j for solving
CO3	To Analyze and Create the relational database for any real-life applications based on normalization.
CO4	To Apply the query optimization techniques, different file organization techniques and Determine whether the transaction satisfies the ACID properties.
CO5	To Implement and organize the database of an organization as a team.

Module 1:
Introduction [3L]
Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

Module 2:
Entity-Relationship and Relational Database Model [11L]

Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database.

Module 3:
SQL and Integrity Constraints [6L]
Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain
Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.

Module 4:
Relational Database Design [8L]
Functional Dependency, Different anomalies in designing a Database., Normalization using functional
dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-

valued dependencies, 4NF, 5NF, Case Study

Module 5: Internals of RDBMS [9L]

Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols; two phase locking, Dead Lock handling.

Module 6: File Organization & Index Structures [6L]

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes

Text Books:

1. Henry F. Korth and Silberschatz Abraham, –Database System Concepts‖, Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, –Fundamentals of Database Systems‖, Benjamin Cummings Publishing.Company.

Reference Books:

1. –Fundamentals of Database Systems‖, Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing.
2. Ramakrishnan: Database Management System, McGraw-Hill

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC-CS502.1	3	3	2	2								3
PCC-CS502.2	3	3	2	2								3
PCC-CS502.3	3	3	2	2								3
PCC-CS502.4	3	3	2	2								3
PCC-CS502.5	3	3	2	2								3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC-CS502.1	3	3	3
PCC-CS502.2	3	3	3
PCC-CS502.3	3	3	3
PCC-CS502.4	3	3	3
PCC-CS502.5	3	3	3

Course Name: Object Oriented Programming using Java
Course Code:
CS504A Contact:
3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Partial Object Oriented Programming using C++

Course Outcomes (COs):

After attending the course students should be able to

CO1	Design the process of interaction between Objects, classes & methods w.r.t. Object Oriented Programming.
CO2	Acquire a basic knowledge of Object Orientation with different properties as well as different features of Java.
CO3	Analyze various activities of different string handling functions with various I/O
CO4	Discuss basic code reusability feature w.r.t. Inheritance, Package and Interface.
CO5	Implement Exception handling, Multithreading and Applet (Web program in java) programming concept in Java.

Course Contents:

Module 1: [2L]
Introduction:
Object Oriented Analysis (OOA) & Object Oriented Design (OOD) - Concepts of object oriented programming language, Relationships among objects and classes-Generalization, Specialization, Aggregation, Association, Composition, links, Meta-class. **[1L];** Object Oriented Programming concepts - Difference between Java and C++; Different features of Java **[1L];**

Module 2: [10L]
Java Basics:
Basic concepts of java programming - Advantages of java, Byte-code & JVM, Data types, Different types of Variables.**[1L] ;**Java Operators & Control statements **[1L];** Java loops. **[1L];** Array.**[1L] ;**Creation of class, object, method. **[1L];** Constructor- Definition, Usage of Constructor, Different types of Constructor.**[1L];** finalize method and garbage collection, Method & Constructor overloading. **[1L];** this keyword, use of objects as parameter & methods returning objects.**[1L];** Call by value & call by reference. **[1L];** Static variables & methods.Nested & inner classes.**[1L].**

Module 3: [5L]
Basic String handling & I/O:
Basic string handling concepts- Concept of mutable and immutable string, Methods of String class- charAt(), compareTo(), equals(), equalsIgnoreCase(), indexOf(), length() , substring(). **[1L];** toCharArray(), toLowerCase(), toString(), toUpperCase() , trim() , valueOf() methods, Methods of String buffer class- append(), capacity(), charAt(), delete(), deleteCharAt(). **[1L];**ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString(). **[1L] ;**Command line arguments, basics of I/O operations – keyboard input using BufferedReader **[1L] ;** Scanner class in Java I/O operation **[1L];**

Module 4: [8L]
Inheritance and Java Packages:

Inheritance - Definition, Advantages, Different types of inheritance and their implementation. **[1L] ;**Super and final keywords, super() method. **[1L];** Method overriding, Dynamic method dispatch.**[1L];** Abstract classes & methods.**[1L];** Interface - Definition, Use of Interface.**[1L];** Multiple inheritance by using Interface.**[1L] ;**Java Packages -Definition, Creation of packages. **[1L];** Java Access Modifiers - public, private, default and protected, Importing packages, member access for packages. **[1L]**

Module 5: [11L]

Exception handling, Multithreading and Applet Programming :

Exception handling - Basics, different types of exception classes.Difference between Checked & Unchecked Exception.**[1L];** Try & catch related case studies.**[1L];** Throw, throws & finally. **[1L];** Creation of user defined exception. **[1L];** Multithreading - Basics, main thread **[1L];** Thread life cycle.**[1L];** Creation of multiple threads-yield(), suspend(), sleep(n), resume(), wait(), notify(), join(), isAlive().**[1L] ;**Thread priorities, thread synchronization.**[1L];**Interthread communication, deadlocks for threads**[1L];** Applet Programming - Basics, applet life cycle, difference between application & applet programming**[1L];** Parameter passing in applets. **[1L]**

Textbooks:

1. Herbert Schildt – "Java: The Complete Reference " – 9th Ed. – TMH
2. E. Balagurusamy – " Programming With Java: A Primer " – 3rd Ed. – TMH.

Reference Books:

1. R.K Das – " Core Java for Beginners " – VIKAS PUBLISHING.
2. Rambaugh, James Michael, Blaha – " Object Oriented Modelling and Design " – Prentice Hall, India.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS504A .1	3	3	2	3	2							
CS504A.2	3	3	3	3	2							
CS504A.3	3	3	3	3	2							
CS504A.4	3	3	3	3	2							
CS504A.5	3	3	3	3	2							

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CS504A.1	3	3	3
CS504A.2	3	3	3
CS504A 3	3	3	3
CS504A.4	3	3	3
CS504A.5	3	3	3

Course Name: Advanced Algorithms
Course Code: PEC-CS-T-501
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Design & Analysis of Algorithm (PCC-CS402)

Course Outcomes (COs):

After attending the course students should be able to

CO1	To understand and illustrate the concepts of time and space complexity, worst case, average case and best-case complexities and the asymptotic notation.
CO2	To analyze and apply the design principles and concepts to various basic algorithm design viz. dynamic programming, greedy method etc.
CO3	To understand and analyze various string matching and graph algorithms.
CO4	To understand, illustrate and analyze the different complexity classes
CO5	To discuss, implement and analyze, verify the efficiency of the randomized and approximation algorithms.

Course Content:

Module-1 [4L]
Sorting:
Review of various sorting algorithms, topological sorting
Graph:
Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), DFS and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

Module-2
[6L] Matroids:
Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching:
Algorithm to compute maximum matching.Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Module-3 [16L]
Flow-
Networks:
Maxflow-Mincut Theorem, Ford Fulkerson Method to compute Maximum Flow, Edmond-Karp maximum-flow algorithm.
Matrix Computations:
Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition
Shortest Path in Graphs:
Floyd-Warshall algorithm and introduction to dynamic programming paradigm.More examples of dynamic programming.
Modulo Representation of integers/ polynomials:
Chinese Remainder Theorem, Conversion between base-representation and modulo-representation.Extension to

polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT):

In complex field, DFT in modulo ring.Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

Amortized Analysis:

Aggregate, Accounting, and Potential Method

Module-4[10L]

Linear Programming:

Geometry of the feasibility region and Simplex algorithm

NP-completeness:

Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm

Problem Solving Application

Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Textbook:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman. 3. "Algorithm Design" by Kleinberg and Tardos. 4. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi

Reference Books:

1. "Algorithm Design" by Kleinberg and Tardos.
2. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-T-501.1	2	2	2	2								2
PEC-CS-T-501.2	3	3	3	3								2
PEC-CS-T-501.3	3	3	3	3								2
PEC-CS-T-501.4	3	3	3	3								2
PEC-CS-T-501.5	3	3	3	3								2

CO-PSO Mapping

Cos	PSO1	PSO2	PSO3
PEC-CS-T-501.1	3	3	3
PEC-CS-T-501.2	3	3	3
PEC-CS-T-501.3	3	3	3
PEC-CS-T-501.4	3	3	3
PEC-CS-T-501.5	3	3	3

Name of the Paper: Advanced Computer Architecture
Paper Code: PEC-CS-S-501
Contact (Periods/Week):3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisite:
1. Familiarity with the functionalities of basic digital computer system.
2. Fundamentals of Computer Architecture.

Course Outcomes (COs):

After attending the course students should be able to

CO1	Illustrate the basic concept of computer architecture and its performance measurement, parallel processing, Flynn's classification and Amdahl's law and apply this knowledge in designing solution for real life engineering problem.
CO2	Summarize the basic concept of pipeline, instruction pipeline, arithmetic pipeline hazards detection and prevention and use this knowledge for designing and implementing mathematical and engineering problem leading to lifelong learning.
CO3	Identify the concept of Instruction-Level Parallelism to solve engineering problem.
CO4	Illustrate and Compare concept of Multiprocessor architecture and parallel architecture and apply this knowledge for developing an approach by means of existing and new methods as a team work.
CO5	Understand the concept of message passing architecture and interconnection network and design an optimized model for building a new solution as a professional engineering practice as a team.

Module 1: Introduction to Advanced Computer Architectures [5L]
Different types of architectural classifications – instruction vs. data (SISD, SIMD, MISD, MIMD), serial vs. parallel, pipelining vs. parallelism; Pipelining: Definition, different types of pipelining, hazards in pipelining. Concept of reservation tables, issue of multiple instructions with minimum average latency (MAL).

Module 2: Parallel Processing & ILP [8L]
RISC architecture, characteristics of RISC instruction set & RISC pipeline, its comparisons with CISC, necessity of using optimizing compilers with RISC architecture, Review of instruction-level parallelism- Super pipelining, Superscalar architecture, Diversified pipelines and out of order execution, VLIW architecture, Dataflow and Control Flow Architectures, Loop Parallelization

Module 3: Interconnection Networks [13L]
Desirable properties of interconnection networks, static interconnection networks – path, cycle, double-loop, star, wheel, 2D mesh and its variants, multi-mesh, tree, shuffle-exchange, cube, cubeconnected cycles.
Dynamic interconnection networks: concepts of blocking, rearrangeable and blocking but rearrangeable networks, various types of multistage interconnection networks (MIN)- crossbar, clos,baseline, omega, Benes.

Module 4: Shared Memory Architecture [5L]
Fundamentals of UMA, NUMA, NORMA,COMA architectures, Performance measurement for parallel architectures –Amadahl‘s law, Gustafson's law.

Module 5: Embedded System Architecture [5L]
Definition, Example, Classification of Embedded system, Embedded System Design Issues:
Hardware issues (Processor, Memory, Peripherals) ,Software issues (Programming Languages, Time Criticality, RTOS).

Text Books:
1. J. L. Hennessey and D. A. Patterson: Computer Architecture: A Quantitative Approach, 5th edition, Morgan Kaufmann, 2012.
2. K. Hwang and F. A. Briggs: Computer Architecture and Parallel Processing, Tata McGraw Hill, New Delhi.

Reference Books:
1. Tse-yun Feng, A Survey of Interconnection Networks, IEEE, 1981.
2. Selim G. Akl, The Design and Analysis of Parallel Algorithms, Prentice-Hall, 1989.
3. Raj Kamal, Embedded Systems Architectures Programming and Design, Second Edition The MacGraw-Hill(for Embedded System).

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-S-501.1	3	3	3	2								
PEC-CS-S-501.2	3	3	3	3					2	2	2	3
PEC-CS-S-501.3	2	2	2	3								
PEC-CS-S-501.2	3	3	3	3								
PEC-CS-S-501.4	3	3	3	3								

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-S-501.1	3	3	3
PEC-CS-S-501.2	3	3	3
PEC-CS-S-501.3	3	3	3
PEC-CS-S-501.4	3	3	3
PEC-CS-S-501.5	3	3	3

Paper Name: Neural Networks and Deep Learning
Paper Code: PEC-CS-D-501
Contact (Periods/Week): 3:0:0
Credit Point: 3
No. of Lectures: 35

Prerequisite:

1. A solid background in Statistics, Calculus, Linear Algebra and Probability.
2. Good Exposure of Python packages like, Numpy, Pandas, Matplotlib, Scikit-learn

Course Outcome(s):

On completion of the course students will be able to

CO1: Understand the basic concepts in Neural Networks and Deep Learning and applications.
CO2: Understand the Shallow & Deep Neural Networks.
CO3: Understand the Convolutional Neural Network models for Images.
CO4: Understand the Recurrent Neural Network models for Sequence data.

Course Content

Module 1: Introduction to Neural Networks and Deep Learning [8L]

What is a Neural Network? Supervised Learning with Neural Networks, why is Deep Learning taking off? Binary Classification, Logistic Regression, Logistic Regression Cost Function, Gradient Descent, Derivatives, Computation Graph, Derivatives with a Computation Graph, Logistic Regression Gradient Descent, Vectorization, Vectorizing Logistic Regression, Vectorizing Logistic Regression's Gradient Output.

Module 2: Shallow Neural Network & Deep Neural Network [9L]

Neural Networks Overview, Neural Network Representation, computing a Neural Network's Output, Vectorizing Across Multiple Examples, Activation Functions, why do you need Non-Linear Activation Functions? Derivatives of Activation Functions, Gradient Descent for Neural Networks, Backpropagation Intuition, Random Initialization, Deep L-layer Neural Network, Forward Propagation in a Deep Network, getting your Matrix Dimensions Right, Building Blocks of Deep Neural Networks, Forward and Backward Propagation, Parameters vs Hyperparameters.

Module 3: Foundations of Convolutional Neural Networks [9L]

Computer Vision, Edge Detection Example, Padding, Strided Convolutions, Convolutions Over Volume, One Layer of a Convolutional Network, Simple Convolutional Network Example, Pooling Layers, Why Convolutions? Classic Networks, ResNets, Why ResNets Work? Networks in Networks and 1X1 Convolutions, Inception Network, MobileNet Architecture, EfficientNet, Using Open-Source Implementation, Transfer Learning, Data Augmentation; Object Localization, Landmark Detection, Object Detection, Convolutional Implementation of Sliding Windows, Bounding Box Predictions, Non-max Suppression, Anchor Boxes, YOLO Algorithm, Semantic Segmentation with U-Net, Transpose Convolutions, U-Net Architecture.

Module 4: Sequence Models [9L]

Why Sequence Models? Notation, Recurrent Neural Network Model, Backpropagation Through Time, Different Types of RNNs, Language Model and Sequence Generation, Sampling Novel Sequences, Vanishing Gradients with RNNs, Gated Recurrent Unit (GRU),Long Short Term Memory (LSTM),Bidirectional RNN, Deep RNNs, Word Representation, Using Word Embeddings, Properties of Word Embeddings, Embedding Matrix, Learning Word Embeddings,Word2Vec,GloVe Word Vectors, Sentiment Classification, Debiasing Word Embeddings, Basic Sequence Models, Picking the Most Likely Sentence, Beam Search, Refinements to Beam Search, Error Analysis in Beam Search, Attention Model, Speech Recognition, Trigger Word Detection,

Transformer Network Intuition, Self-Attention, Multi-Head Attention.

Text Books:

1. Charu C. Aggarwal,"Neural Networks and Deep Learning: A Textbook‖, Springer; 1st ed. 2018 edition
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, " Deep Learning‖, published by MIT Press

Reference Books:

1. Francois Chollet, ―Deep Learning with Python‖, Manning Publications; 1st edition
2. Simon Haykin, "Neural Networks and Learning Machines", Pearson Prentice Hall, 3rd Edition
3. Martin T. Hagan, Howard B. Demuth, Mark H. Beale, Orlando De Jess, "Neural Network Design (2nd Edition)".

CO-PO Mapping

CO	PO1	PO2	POP3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	2	3	3	3	-	-	-	-	-	1	2
2	-	2	2	2	1	-	-	-	-	-	-	1
3	-	2	3	3	3	3	-	-	-	-	2	-
4	3	2	2	2	1	3	2	-	-	-	3	2

Course Name: Artificial Intelligence
Course Code: PEC-CS-A-501
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

Data Structure, Design and Analysis of Algorithms, Statistics

Course Objective(s):

- The objective of the course is to enable students to
- Comprehendthe fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context
- Formulate aproblem as State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
- Use the strategies of AI-Heuristics to find acceptable solutionsavoiding brute-force techniques.
- DesignAI-Frameworks for Inferencing based on knowledge base.
- Analyzethe effectiveness of anAI-Inferencing Modelin offeringsolutions to the respective problem.

Course Outcomes(s):

CO1 To **Understand and explain** the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context for further exploration leading towards lifelong learning.

CO2 To **Identify** and **formulate** an engineering problem primarily to fita State-Space Exploration Framework or an Inferencing Agent Design Frameworkwithin the scope of Artificial Intelligence paradigm.

CO3 To **Explore**relevant literature and **apply** the concept of Heuristic Techniques or Inferencing Models of Artificial Intelligence to **solve** problems.

CO4 To**Develop** Inferencing Models for **proposing** solutions to the problems of Artificial Intelligence.

CO5 To **Implement** Inferencing Models of Artificial Intelligence through **developing** feasible algorithms and **investigate** their effectiveness by **analyzing** their performances in solving the relevant problems.

Course Content:

Module-1: Introduction to Artificial Intelligence [2L]
Basic Concepts, History of Artificial Intelligence, Architecture of an Artificial Intelligent Agent, Applications of Artificial Intelligence

Module-2: Artificial Intelligence Problem Formulation as State-Space Exploration Problem for Goal Searching [8L]

Basic Concepts, State-Space Exploration Formulation for Water Jug Problem, Missionaries and Cannibals Problems, Farmer-Wolf-Goat-Cabbage Problem, 8-Puzzle Problem, Constraint Satisfaction Problem and Production System for Goal Searching.

Blind Search Techniques for Goal Searching: Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, Bi-directional Search.

Module-3: Heuristic Techniques for Goal Searching [8L]

Basic Concepts of Heuristic Techniques and Properties of Heuristic Functions, Hill Climbing Search.Best First Search, A* Search, AO* Search

Genetic Algorithm Based Evolutionary Search, Ant Colony Optimization, Particle Swarm Optimization.

Module-4: Adversarial Search for Game Playing [3L]

Basic Concepts, Minimax Search, Alpha-Beta Pruning.

Module-5: Knowledge Representation and Inference using Propositional Logic and Predicate Logic [5L]

Propositional Logic: Knowledge Representation and Inference using Propositional Logic

Predicate Logic: Knowledge Representation, Inference and Answer Extraction using First Order Predicate Logic

Module-7: Reasoning under Uncertainty [5L]

Bayesian Inferencing and Bayesian Belief Network, Dempster-Shafer Theory, Overview of Fuzzy Logic and Inferencing,

Introduction to Natural Language Processing [2L]

Basic Concepts, Steps of Natural Language Processing, Morphological, Syntactic and Semantic Analysis, Discourse Integration and Pragmatic Analysis, Applications of Natural Language Processing.

Module-8: Introduction to Machine Learning [3L]

Basic concepts of Machine Learning Model, Supervised Learning, Unsupervised Learning, and Reinforced Learning, Overview of Artificial Neural Network

Textbook:

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
2. Rich, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGrawHill.

Reference Books:

1. Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.
2. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill.

CO PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										3			
CO2	2	3													
CO3	2	2	3	2											
CO4	2	2	2	3								2			
CO5	2	2	3	3								2			

Course Name: Compiler Design Lab
Course Code: PCC-CS591
Contact: 0:0:3
Credits: 1.5

After attending the course students should be able to

CO1	Ability to design, develop, and implement a compiler for any language
CO2	Able to use lex and yacc tools for developing a scanner and a parser
CO3	Able to design and implement LL and LR parsers
CO4	To understand syntax directed translation schemes
CO5	To provide hands-on experience on web technologies

List Of Experiments (Includes But Not Limited To)

1. NFA Construction from a regular expression.
2. Conversion between NFA and DFA.
3. Use LEX tool to implement a lexical analyser.
4. Use YACC tool to implement a syntax analyser or parser.
5. Implementation of a recursive descent parser for an expression grammar that generates arithmetic expressions with digits, + and *.
6. Checking whether a string belongs to a grammar or not.
7. Calculation of leading& trailing for all then on-terminals of the given grammar.
8. Calculation of FIRST, FOLLOW of the given grammar.
9. Identifying whether a given string is a identifier or not.
10. Identifying whether a string is a keyword or not.
11. Identifying whether a string is a constant or not.

Recommended Books

1. Das, V.V.(2007).Compiler Designusing FLEX and YACC. PHI Learning Pvt. Ltd.
2. Mason, T.,& Brown, D.(1990). Lex & yacc. O'Reilly & Associates, Inc.
3. Johnson, S.C.(1975).Yacc: Yet another compiler-compiler (Vol.32). Murray Hill, NJ: Bell Laboratories.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC-CS591.1	3	3	3	3	3							
PCC-CS591.2	3	3	3	3	3							
PCC-CS591.3	3	3	3	3	3							
PCC-CS591.4	3	3	3	3	3							
PCC-CS591.5	3	3	3	3	3							

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC-CS591.1	3	3	3
PCC-CS591.2	3	3	3
PCC-CS591.3	3	3	3
PCC-CS591.4	3	3	3
PCC-CS591.5	3	3	3

Course Name: Database Management System Lab
Course Code: PCC-CS592
Contact: 3P/Week
Credits: 1.5

Prerequisite:
1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Outcomes (COs):

After attending the course students should be able to

CO1	To Understand and Describe the basic concepts and utility of Database management system, different data models of Database management system.
CO2	To Design an Entity Relationship (E-R) Diagram and relational model for any kind of real-life application and able to Apply relational algebra operations, SQL, Neo4j for solving query.
CO3	To Analyze and Create the relational database for any real-life applications based on normalization.
CO4	To Apply the query optimization techniques, different file organization techniques and Determine whether the transaction satisfies the ACID properties.
CO5	To Implement and organize the database of an organization as a team.

Course Content:

Module 1
Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.)

Module 2
Converting ER Model to Relational Model (Represent entities and relationships in Tabular form, Represent attributes as columns, identifying keys) and apply the normalization techniques.

Module 3
Creation of Tables using SQL- Overview of using SQL tool, Data types in SQL, Creating Tables (along with Primary and Foreign keys), Altering Tables and Dropping Tables

Module 4
Practicing DML commands- Insert, Select, Update, Delete

Module 5
Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, CONSTRAINTS etc., Practicing Sub queries (Nested, Correlated) and Joins (Inner, Outer and Equi).

Module 6
Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS Creation and Dropping, Practicing on Triggers - creation of trigger, Insertion using trigger, Deletion using trigger, Updating using trigger

Module 7

Procedures- Creation of Stored Procedures, Execution of Procedure, and Modification of Procedure, PL/SQL, Cursors- Declaring Cursor, Opening Cursor, Fetching the data, closing the cursor.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC-CS592.1	3	2	2	2	2				3			3
PCC-CS592.2	3	2	2	2	2				3			3
PCC-CS592.3	3	3	2	2	2				3			3
PCC-CS592.4	3	2	2	2	2				3			3
PCC-CS592.5	3	2	2	2	2				3			3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC-CS592.1	3	3	3
PCC-CS592.2	3	3	3
PCC-CS592.3	3	3	3
PCC-CS592.4	3	3	3
PCC-CS592.5	3	3	3

Course Name: Object Oriented Programming using Java Lab
Course Code: PCC-CS593
Contact: 0:0:3
Credits: 1.5

Prerequisites:

1. Computer Fundamentals
2. Basic understanding of Computer Programming and related Programming Paradigms
3. Problem Solving Techniques with proper logic Implementation.

Course Outcomes (COs):

After attending the course students should be able to

CO1	Create the procedure of communication between Objects, classes & methods.
CO2	Understand the elementary facts of Object Orientation with various characteristics as well as several aspects of Java.
CO3	Analyze distinct features of different string handling functions with various I/O
CO4	Discuss simple Code Reusability notion w.r.t. Inheritance, Package and Interface.
CO5	Apply Exception handling, Multithreading and Applet (Web program in java) programming concept in Java.

Course Contents:

Module 1:Java Basics:

1. Simple Java programming using operators, control statements & loops, array.
2. Programming on class, object, and method, access specifier.
3. Programming on constructor, method/constructor overloading.
4. Programming on this keyword, call by value & call by reference, static variables & methods, inner classes.

Module 2: Basic String handling & I/O:

1. Programming to show the use of String class methods - charAt(), compareTo(), equals(), equalsIgnoreCase(), indexOf(), length() , substring(), toCharArray(), toLowerCase(), toString(), toUpperCase(), trim(), valueOf() methods.
2. Programming to show the use of StringBuffer class methods - append(), capacity(), charAt(), delete(), deleteCharAt(),ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods.
3. Programming on Command line arguments.
4. Programming using keyboard input by implementing BufferedReader& Scanner classes.

Module 3: Inheritance, Interface and Java Packages:

1. Programming on Simple Inheritance, super and final keywords, super() method.
2. Programming on method overriding, dynamic method dispatch,abstract classes & methods, multiple inheritance by using interface.
3. Programming on importing system package, creating user-defined package, importing user-defined

package, using protected access specifier, subclassing an imported class of a package, using same names for classes of different packages, adding multiple public classes to a package.

Module 4: Exception handling, Multithreading and Applet Programming:

1. Programming on exception handling using try-catch block, implementing throw and throws keywords, using finally block, creating user-defined exception.
2. Programming on creating child threads i) by extending thread class ii) by implementing runnable interface, creating child threads by assigning thread priorities.
3. Programming on creating simple applet to display some message, creating applet two add 2 integers, creating applet to do GUI based programming.

Textbooks:

1. Herbert Schildt – "Java: The Complete Reference " – 9th Ed. – TMH

2. E. Balagurusamy – " Programming With Java: A Primer " – 3rd Ed. – TMH.

Reference Books:

1. R.K Das – " Core Java for Beginners " – VIKAS PUBLISHING.
2. Rambaugh, James Michael, Blaha – " Object Oriented Modelling and Design " – Prentice Hall, India

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC-CS593.1	3	3	2	3	2				3			2
PCC-CS593.2	3	3	3	3	2				3			2
PCC-CS593.3	3	3	3	3	2				3			2
PCC-CS593.4	3	3	3	3	3				3			2
PCC-CS593.5	3	3	3	3	3				3			2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC-CS593.1	3	2	2
PCC-CS593.2	3	2	2
PCC-CS593.3	3	2	3
PCC-CS593.4	3	2	3
PCC-CS593.5	3	3	3

Course Name: Advanced Algorithms Lab
Course Code: PEC-CS-T-591
Contact: 0:0:3
Credits: 1.5

Prerequisites:

1. Programming knowledge
2. Knowledge of Design and Analysis of Algorithm

Course Outcomes (COs):

After attending the course students should be able to

CO1	Illustrate and use proper syntax in appropriate platform for developing program to solve problems related to Mathematics and Engineering field leading to lifelong learning.
CO2	Apply the knowledge of algorithms in the computational area to efficient programming codes to design the problem using modern tools for solving complex engineering problems.
CO3	Outline different types of digital electronic circuits such as adder, subtract or, encoder, decoder, multiplexer, de-multiplexer, flip-flops, register, counter using various mapping and modern tools to prepare the most simplified circuit and optimize using various mapping and mathematical methods for solving the problem as a professional engineering practice as a team.
CO4	Apply the knowledge of digital electronic circuits to design memory and ALU and analyse the same to solve engineering-related computational problems as a team.
CO5	Interpret the result of the experiments, prepare laboratory reports based on observed output and analyse it to validate professional ethics and responsibilities and norms of the engineering practice.

Course Content:

Write the following problems in any programming language. Programming Language used: C

1. **Divide and Conquer:** Implementation of finding Maximum and Minimum element from an array of integer, Quick Sort, Check the running time for different positions of pivot elements. Randomized version of quick sort using Divide and Conquer Method.
2. **Dynamic Programming:** Calculation of the minimum number of scalar multiplication needed for chain of Matrices Multiplication Technique, Implementation of Single Source shortest Path for a graph (Dijkstra and Bellman Ford Algorithm), Implement all pair Shortest path for a graph (FloydWarshall Algorithm)

3. **Greedy method:** Implementation of fractional Knapsack Problem, MST by Prim‘s algorithm, Implement MST by Kruskal‘s algorithm
4. **Graph Traversal Algorithm:** Implement Depth First Search (DFS), application of DFS (do topological sorting, identify strongly connected components)
5. **String Matching:** Implement KMP algorithm
6. **Network Flow:** Implement Ford-Fulkerson algorithm to get maximum flow of a given flow network.
7. **Modulo Representation of integers/ polynomials:** Chinese Remainder Theorem
8. **Linear Programming:** Simplex Algorithm

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-T-591.1	3	3	3	2	3				3			
PEC-CS-T-591.2	3	3	3	3	3				3			
PEC-CS-T-591.3	3	3	3	3	3				3			
PEC-CS-T-591.4	3	3	3	3	3				3			
PEC-CS-T-591.5	3	3	3	3	3				3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-T-591.1	3	3	3
PEC-CS-T-591.2	3	3	3
PEC-CS-T-591.3	3	3	3
PEC-CS-T-591.4	3	3	3
PEC-CS-T-591.5	3	3	3

Course Name: Advanced Computer Architecture Lab
Course Code: PEC-CS-S-591
Contact: 0:0:3
Credits: 1.5

Prerequisites:
Knowledge of designing different circuits in Computer Organization and Architecture Lab

Course Outcomes (COs):

After attending the course students should be able to

CO1	Illustrate and use proper syntax in appropriate platform for developing program to solve problems related to Mathematics and Engineering field leading to lifelong learning.
CO2	Apply the knowledge of algorithms in the computational area to efficient programming codes to design the problem using modern tools for solving complex engineering problems.
CO3	Outline different types of digital electronic circuits such as adder, subtract or, encoder, decoder, multiplexer, de-multiplexer, flip-flops, register, counter using various mapping and modern tools to prepare the most simplified circuit and optimize using various mapping and mathematical methods for solving the problem as a professional engineering practice as a team.
CO4	Apply the knowledge of digital electronic circuits to design memory and ALU and analyse the same to solve engineering-related computational problems as a team.
CO5	Interpret the result of the experiments, prepare laboratory reports based on observed output and analyse it to validate professional ethics and responsibilities and norms of the engineering practice.

List of Experiment:

1. HDL introduction
2. Basic digital logic base programming with HDL
3. 8-bit Addition, Multiplication, Division
4. 8-bit Register design
5. Memory unit design and perform memory operators.
6. Implement Encoder, Decoder circuit and simulate for truth table verification.
7. Implement different types of flip flop and simulate for truth table verification.
8. Implement different types of parallel circuits (SISO, SIPO, PISO, PIPO) and simulate the result.
9. Implement ALU and simulate the result.
10. Implement RAM chip and simulate the result.
11. 8-bit simple CPU design
12. 8. Interfacing of CPU and Memory
13. Innovative Experiments.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-S-591.1	3	3	3	2	3				3			
PEC-CS-S-591.2	3	3	3	3	3				3			
PEC-CS-S-591.3	3	3	3	3	3				3			
PEC-CS-S-591.2	3	3	3	3	3				3			
PEC-CS-S-591.4	3	3	3	3	3				3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-S-591.1	3	3	3
PEC-CS-S-591.2	3	3	3
PEC-CS-S-591.3	3	3	3
PEC-CS-S-591.4	3	3	3
PEC-CS-S-591.5	3	3	3

Paper Name: Neural Networks and Deep Learning Lab
Paper Code: PEC-CS-D-591
Contact (Periods/Week): 0:0:3
Credit Point: 1.5

Prerequisite:

1. A solid background in Statistics, Calculus, Linear Algebra and Probability.
2. Good Exposure of Python packages like, Numpy, Pandas, Matplotlib, Scikit-learn

Course Outcome(s):

On completion of the course students will be able to

CO1: Understand the Keras/Tensorflow API in details using Python.
CO2: Implement the Convolutional Neural Network models using Keras/Tensorflow API
CO3: Implement the Recurrent Neural Network models using Keras/Tensorflow API

The following list of Experiments

1. Getting Started with DL in Keras
2. Deep Neural Networks for Supervised Learning: Regression
3. Deep Neural Networks for Supervised Learning: Classification
4. Tuning and Deploying Deep Neural Networks
5. Deep learning for computer vision
6. Deep learning for text and sequences
7. Going beyond the Sequential model: The Keras functional API
8. Inspecting and monitoring deep-learning models using Keras callbacks and TensorBoard
9. Text generation with LSTM
10. Generating images with variational autoencoders and Generative adversarial networks
11. Introduction to TensorFlow 2.0
12. Images and Tests with TensorFlow 2.0

Text Books:

1. Jojo Moolayil, "Learn Keras for Deep Neural Networks",Apress,ISBN-13 (pbk): 978-1-4842-4239-1
2. Francois Chollet,"Deep Learning with Python",Manning Publications; 1st edition

CO-PO Mapping

CO	PO1	PO2	POP3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2	3	3	3	-	-	-	-	-	1	2
2	3	2	2	2	1	-	-	-	-	-	-	1
3	3	2	3	3	3	3	-	-	-	-	2	-

Course Name: Artificial Intelligence Lab
Course Code: PEC-CS-A-591
Contact: 0:0:3
Total Contact Hours: 36
Credits: 1.5

Prerequisite:

Data Structure, Design and Analysis of Algorithms, Statistics

Course Outcomes (COs):

After attending the course students should be able to

CO1	Acquire foundational knowledge of PROLOG to implement an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing and understand the working principle of the agent and assess its utilitarian importance in current technological context leading towards lifelong learning.
CO2	Identify and formulate an engineering problem by analyzing its characteristics to fit a State-Space Exploration Framework or an Inferencing Agent Formulation Framework of Artificial Intelligence.
CO3	Explore relevant literature and apply the concepts of Artificial Intelligence to solve a problem by implementing well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.
CO4	Develop ideas and propose expert systems offering solutions to the challenging problems of Artificial Intelligence.
CO5	Plan and Implement Artificial Intelligence based ideas as executable PROLOG programs through developing intelligent heuristic strategies or expert systems with adequate documentation in collaborative environment for successfully carrying out projects on Artificial Intelligence Problems and investigate their effectiveness by analyzing the performances using proper techniques and tools.

Course Content:

WEEK-1: Introduction to PROLOG Programming along with the IDE and its Basic Components
Assignments for understanding the Basic Components of Knowledge Representation and Inferencing in Artificial Intelligence using PROLOG Programming and its working strategy.

WEEK -2: Arithmetic, Boolean Expression, Decision Making Strategies
Assignments for understanding implementation of Arithmetic Expression, Boolean Expression, and Decision-Making Strategies.

WEEK -3: Recursion and Looping through Recursion
Assignments for understanding implementation of Recursion and Looping through Recursion.

WEEK -4: List of Data Items in PROLOG
Assignments for understanding the utility of List in solving various problems.

WEEK -5: Blind Search Techniques – BFS, DFS
Implementation of BFS and DFS Algorithms for Goal Searching to solve Puzzles (8-Puzzle, Water Jug Puzzle)

WEEK -6: Heuristic Search Techniques – A* Search
Implementation of A* Search Algorithm for Goal Searching to solve Puzzles (8-Puzzle, Route Finding Puzzle)

WEEK-7: Constraint Satisfaction Problem Solving

Implementation of Backtracking Strategies to solve Constraint Satisfaction Problems (Graph Coloring Problem, 8-Queens Problem)

WEEK -8: Game Playing

Implementation of Adversarial Search Algorithm with alpha-beta pruning strategy for Game Playing (Tic-Tac-Toe)

WEEK -9: Discussion on Project Problems and Allocation (Problem Description Report Submission)

WEEK -10: Designing Solution Model and Proposal Report Submission

WEEK -11: Project Implementation, Verification and Documentation

WEEK -12: Project Demonstration and Project Report Review

Textbook:

1. Ivan Bratko, Prolog Programming for Artificial Intelligence, 4th Edition, Addison-Wesley
2. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
3. Rich, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGrawHill.

Reference Books:

1. Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.
2. Deepak Khemani, –A First Course in Artificial Intelligence‖, McGraw Hill.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-A-591.1	3	3	2	2	3				3			3
PEC-CS-A-591.2	3	2	2	3	3				3			3
PEC-CS-A-591.3	3	3	2	2	3				3			3
PEC-CS-A-591.2	3	3	3	3	3				3			3
PEC-CS-A-591.4	3	3	3	3	3				3			3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-A-591.1	3	2	2
PEC-CS-A-591.2	3	3	3
PEC-CS-A-591.3	3	3	3
PEC-CS-A-591.4	3	2	3
PEC-CS-A-591.5	3	3	3

Course Name: Constitution of India
Course Code: MC 501
Contacts: 2:0:0
Total Contact Hours: 24
Credit: 0

Prerequisite: None

Course Outcomes:
On completion of the course students will be able to
CO1: Identify and explore the basic features and modalities of Indian constitution.
CO2: Differentiate and relate the functioning of Indian parliamentary system at the centre and state level.
CO3: Differentiate the various aspects of Indian Legal System and its related bodies.

Course Content

Module 1: Introduction: 4L

–Constitution‖- Historical Background of the Constituent Assembly, Indian Constitution and its Salient Features, the Preamble of the Constitution.

Module 2: Fundamental Rights, Fundamental Duties,

Directive Principles of State Policy: 8L

The Right to Equality
The Right to Freedom: I (Article 19)
The Right to Freedom: II (Articles 20, 21 and 22)
The Right against Exploitation
The Right to freedom of Religion
Cultural and Educational rights
The Right to Property
The Right to Constitutional Remedies
The Directive Principles
Fundamental Duties

Module 3: Union Government and its Administration 6L

Structure of the Indian Union, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

Module 4: The Machinery of Government in the State 6L

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges

State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

Text / Reference Books:

1) Indian Constitution by D.D.Basu, The Publisher, LexisNexis
2) Constitution of India by Subhas C Kasyap, Vitasta Publishing
3) The Constitution of India, P.M Bakshi, Universal Law Publishing Co.Ltd, New Delhi, 2003.
4) Indian Constitution Text Book - Avasthi, Avasthi,Publisher: LAKSHMI NARAIN AGARWAL

CO-PO Mapping:

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

3rd Year 2ndSemester: 6thSemester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Humanities and Social Sciences including Management courses	HSMC 604	Economics for Engineers	2	0	0	2	2
2	Program Core Course	PCC-CS601	Computer Networks	3	0	0	3	3
3	Program Core Course	PCC-CS602	Software Engineering	3	0	0	3	3
4	Professional Elective courses	PEC-CS-T-601	Microprocessor and Microcontroller	3	0	0	3	3
		PEC-CS-S-601	Advanced Operating Systems					
		PEC-CS-D-601	Machine Learning					
		PEC-CS-A-601	Web and Internet Technology					
5	Professional Elective courses	PEC-CS-T-602	Parallel and Distributed Algorithms	3	0	0	3	3
		PEC-CS-S-602	Embedded Systems					
		PEC-CS-D-602	Soft Computing					
		PEC-CS-A-602	Human Computer Interaction					
6	Open Elective courses	OEC-CS-601A	Introduction to Internet of Things	3	0	0	3	3
		OEC-CS-601B	Bio-informatics					
		OEC-CS-601C	Robotics					
B. PRACTICAL								
7	Program Core Course	PCC-CS691	Computer Networks Lab	0	0	3	3	1.5

8	Program Core Course	PCC-CS692	Software Engineering Lab	0	0	3	3	1.5
9	Professional Elective courses	PEC-CS-T-691	Microprocessor and Microcontroller Lab	0	0	3	3	1.5

		PEC-CS-S-691	Advanced Operating Systems Lab					
		PEC-CS-D-691	Machine Learning Lab					
		PEC-CS-A-691	Web and Internet Technology Lab					
10	PROJECT	PR 691	Minor Project II	0	0	3	2	1
11	PROJECT	PR 692	Skill Development VI: Soft Skill & Aptitude-III	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC 601	Intellectual Property Right	3	0	0	3	3Units
	TOTAL CREDIT WITHOUT MOOCS COURSES							23.0
D.MOOCS COURSES**								
13	MOOCS COURSES	HM601	MOOCS COURSE-IV	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**27**

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s).

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from**
MOOCS
BASKET

Course Name: Economics for Engineers
Course Code: HSMC 604
Contact: 2:0:0
Total Contact Hours: 24
Credits:2

Pre-requisites:
MATH – College Algebra, Pre-Calculus Algebra and Trigonometry.

Course Outcomes (COs):

After attending the course students should be able to

CO1	Apply the appropriate engineering economics analysis method(s) for problem solving present worth, annual cost, rate-of-return, payback, break-even, benefit-cost ratio.
CO2	Evaluate the cost effectiveness of individual engineering projects using the methods learned and draw inferences for the investment decisions.
CO3	Compare the life cycle cost of multiple projects using the methods learned, and make a quantitative decision between alternate facilities and/or systems.
CO4	Evaluate the profit of a firm, carry out the break even analysis and employ this tool to make production decision.
CO5	Discuss and solve advanced economic engineering analysis problems including taxation and inflation.

Course Contents:

MODULE I Introduction[3L]
Managerial Economics-Relationship with other disciplines-Firms: Types, Objectives and goals-Managerial Decisions-Decision Analysis.

MODULE II Demand and Supply Analysis[5 L]
Demand-Types of demand-determinants of demand-Demand function-Demand Elasticity-Demand forecasting-Supply-Determinants of supply-Supply function-Supply Elasticity.

MODULE III Cost Analysis[5 L]
Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis – PV ratio.

MODULE IV Elementary economic Analysis [4 L]
Inflation-Meaning of inflation, types, causes, measures to control inflation. National Income-Definition, Concepts of national income, Method of measuring national income.

MODULE V: Financial Accounting [5 L]
Concepts and Definition of Accounting, Journal, Ledger, Trial Balance. Trading A/C, Profit & Loss A/C

and Balance Sheet.

MODULE VI: Investment Decision[2L]

Time value of money- Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence. Evaluation of engineering projects-Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects.

Textbooks:

1. Riggs, Bedworth and Randhwa, –Engineering Economics‖, McGraw Hill Education India
2. Principles of Economics, Deviga Vengedasalam; Karunagaran Madhavan, Oxford University Press.

Reference Books:

1. Engineering Economy by William G.Sullivan, Elin M.Wicks, C. Patric Koelling, Pearson
2. R.Paneer Seelvan, – Engineering Economics‖, PHI
3. Ahuja,H.L., –Principles of Micro Economics‖ , S.Chand & Company Ltd
4. Jhingan,M.L., –Macro Economic Theory‖
5. Macro Economics by S.P.Gupta, TMH
6. Haniff and Mukherjee,Modern Accounting,Vol-1,TMG
7. Modern Economic Theory – K.K. Dewett (S.Chand)

Reference Books:

1. Engineering Economy by William G.Sullivan, Elin M.Wicks, C. Patric Koelling, Pearson
2. R.Paneer Seelvan, – Engineering Economics‖, PHI
3. Ahuja,H.L., –Principles of Micro Economics‖ , S.Chand & Company Ltd
4. Jhingan,M.L., –Macro Economic Theory‖
5. Macro Economics by S.P.Gupta, TMH
6. Haniff and Mukherjee,Modern Accounting,Vol-1,TMG
7. Modern Economic Theory – K.K. Dewett (S. Chand)

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
HSMC604.1							2	3			3	3
HSMC604.2							2	3			3	3
HSMC604.3							2	3			3	3
HSMC604.4							2	3			3	3
HSMC604.5							2	3			3	3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
HSMC604.1	2	2	2
HSMC604.2	2	2	2
HSMC604.3	2	2	2
HSMC604.4	2	2	2
HSMC604.5	2	2	2

Course Name: Computer Networks
Course Code: PCC-CS601
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:
1. Familiarity and knowledge of Operating Systems and Computer Architecture
2. Also require little bit programming languages concepts like C, Java.

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand basics of computer network and different architecture and topologies of computer network and analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
CO2	Understand/analyze different protocol of data link layer and apply them to solve engineering problems.
CO3	Understand/analyze different protocol of Network and Transport Layer and apply them to solve engineering problems.
CO4	Understand/analyze different protocol of session and application layer and apply them to solve engineering problems.
CO5	Develop Analyze, specify and design the topological and routing strategies using socket programming.

Course Contents:
Module 1: Introduction [6L]
Introduction (3L):
Introduction: Computer Network, data communication, topology, OSI & TCP/IP Reference Models, layers and characteristics, Wireless Network, comparison to wired and wireless network.
Physical Layer: [3L]
Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus; Telephone Network;

Module 2: Data Link Layer [10L] Framing, Error Control, Error Detection and Correction, Flow Control, Data Link Protocols, Simple Stop-and-Wait Protocol, ARQ mechanism, Sliding Window Protocols, One-Bit Sliding Window Protocol, Go-Back-N and Selective Repeat, HDLC, PPP Medium Access Control Sub-layer, The Channel Allocation. **[5L]**
Multiple Access Protocols**:** ALOHA, Carrier Sense Multiple Access Protocols, IEEE 802.x Ethernet, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet, Wireless LANs - IEEE 802.xx, Bluetooth, RFID, Bridges, Virtual LANs, Switching**. [5L]**

Module 3: Network Layer [10L]
IP Addressing, IPv4and IPv6. Difference IPv4and IPv6, Conversion ofIPv4and IPv6, Subnetting, Supernetting, Design Issues, Store-and-Forward Packet Switching, Virtual-Circuit and Datagram Networks, ARP, IP, ICMP, IPV6, BOOTP and DHCP–Delivery protocols Other Protocols such as mobile IP in wireless Network**. [5L]** Routing: Shortest Path Algorithms, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Anycast Routing: RIP, OSPF, BGP; Routing for Mobile Hosts**. [5L]**

Module 4: Transport layer: [6L]
Process to Process delivery; UDP; TCP, SCTP, TCP RENO, TCP/IP in Wireless environment, Congestion control in TCP: Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm. **[5L]**
Advanced topic such as Remote Procedure Call, Delay Tolerant Networks.**[1L]**

Module 5: Application Layer [3L]
Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW: Cryptography (Public, Private Key based), Digital Signature, Firewalls

Module 6: Socket Programming [1L]
Introduction to Socket Programming, UDP socket and TCP Socket

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

Reference books:
1. Kurose and Rose – ―Computer Networking -A top-down approach featuring the internet‖ – Pearson Education
2. Leon, Garica,Widjaja – ―Communication Networks‖ – TMH
3. Walrand – ―Communication Networks‖ – TMH.
4. Comer – ―Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)‖ – Pearson Education/PHI

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC-CS601.1	3	3	2	2	2				2	2		3
PCC-CS601.2	3	3	3	3	3				2	2		3
PCC-CS601.3	3	3	3	3	3				2	2		3
PCC-CS601.4	3	3	3	3	3				2	2		3
PCC-CS601.5	2	3	3	3	3				2	2		3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC-CS601.1	3	3	3
PCC-CS601.2	3	3	3
PCC-CS601.3	3	3	3
PCC-CS601.4	3	3	3
PCC-CS601.5	3	3	3

Course Name: Software Engineering
Course Code: CS 602
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Programming for Problem Solving

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the basic concept of Software Engineering and mathematical knowledge and apply them in designing solution to engineering problem including the specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements
CO2	Analyze, elicit and specify software requirements through a productive working relationship with various stakeholders of the project
CO3	Design applicable solutions in one or more application domains using software engineering approaches that integrates ethical, social, legal and economic concerns.
CO4	Develop the code from the design and effectively apply relevant standards and perform testing, and quality management and practice team work.
CO5	Identify and Use modern engineering tools necessary for software project management time management and software reuse, and an ability to engage in life-long learning.

Course Content:
Module-1:[6L]
Introduction: Software Engineering, Characteristics, Components, Application, Definitions. Software Project Planning-Feasibility Analysis, Technical Feasibility, Cost-Benefit Analysis, Basics of estimation : COCOMO(Basic, intermediate, Complete) model.

Module- 2: [6L]
Evolution and impact of Software engineering, software life cycle models: Waterfall, prototyping, Evolutionary, and Spiral models. Feasibility study, Functional and Non-functional requirements, Requirements gathering, Requirements analysis and specification.

Module -3:[8L]
Basic issues in software design, modularity, cohesion, coupling and layering, function-oriented software design: DFD and Structure chart, object modeling using UML, Object-oriented software development, user interface design. Coding standards and Code review techniques.

Module -4:[7L]
Fundamentals of testing, White-box, and black-box testing, Test coverage analysis and test case design techniques, mutation testing, Static and dynamic analysis, Software reliability metrics, reliability growth modeling.

Module -5: [9L]
Software project management, Project planning and control, cost estimation, project scheduling using PERT and GANTT charts, cost-time relations: Rayleigh-Norden results, quality management, ISO and SEI CMMI, PSP and Six Sigma. Computer aided software engineering, software maintenance, software reuse, Component-based software development.

Text Books:
1. Fundamentals of Software Engineering by Rajib Mall, –PHI-3rd Edition, 2009.
2. Software Engineering- Pankaj Jalote(Wiley-India)

Reference Books:
1. Software Engineering – AgarwalandAgarwal(PHI)
2. Software Engineering, by Ian Sommerville, Pearson Education Inc., New Delhi, (2009).
3. Software Engineering: A Practitioner‟s Approach‖, by Roger S. Pressman, McGraw-Hill.(2005)

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS602.1	3	3	3	2								3
CS602.2	3	3	3	2								3
CS602.3	3	3	3	2								3
CS602.4	3	3	3	2								3
CS602.5	3	3	3	2								3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CS602.1	3	3	3
CS602.2	3	3	3
CS602.3	3	3	3
CS602.4	3	3	3
CS602.5	3	3	3

Course Name: Microprocessors & Microcontrollers
Course Code: PEC-CS-T 601
Contact: 2:1:0
Total Contact Hours: 36
Credits: 3

Prerequisite:
1. Familiarity with the number system
2. A solid background in digital logic.

Course Outcomes (COs):

After attending the course students should be able to

CO1	To understand and apply the fundamentals of assembly level programming of microprocessors and Microcontroller.
CO2	To work with standard microprocessor real time interfaces including GPIO, serial ports, digital-to-analog converters and analog-to-digital converters.
CO3	To troubleshoot interactions between software and hardware.
CO4	To analyze abstract problems and apply a combination of hardware and software to address the problem

Course Contents:

Module -1: [9L]

Introduction to Microcomputer based system. [1L]
History of evolution of Microprocessor and Microcontrollers and their advantages and disadvantages. [1L]
Architecture of 8085 Microprocessor, Pin description of 8085. [2L] Address/data bus De- multiplexing, Status Signals and the control signals. [1L]
Interrupts of 8085 processor (software and hardware) [2L]
I/O Device Interfacing - I/O Mapped I/O and Memory Mapped I/O, Memory interfacing with 8085 [2L]

Module -2: [9L]

Instruction set of 8085 microprocessor, Addressing modes. [3L]
Assembly language programming with examples, Counter and Time Delays, Stack and Subroutine. [4L]
Timing diagram of the instructions (a few examples) [2L]

Module 3: [7L]

The 8086 microprocessor- Architecture, Pin Details, Addressing modes, interrupts [3L] Instruction set, Examples of Simple Assembly Language [2L]
Memory interfacing with 8086 [2L]

Module -4: [6L]

Introduction to 8051 Microcontroller – Architecture, Pin Details. [3L]
Addressing modes, Instruction set, Examples of Simple Assembly Language. [3L]

Module -5: [5L]

Introduction, AVR Family architecture[1L],
Register File, The ALU[1L].

Memory access and Instruction execution.I/O memory.EEPROM. I/O ports[2].
Timers. UART. Interrupt Structure[1L]

Text Books:

1. MICROPROCESSOR architecture, programming and Application with 8085 - R. Gaonkar (Penram international Publishing LTD.) ***[For Module 1 and2]***
2. Fundamentals of Microprocessor and Microcontrollers - B. Ram (Paperback) ***[For Module3]***
3. 8051 Microcontroller – K. Ayala (Cengage learning) ***[For Module4]***

Reference Books:

1. 8086 Microprocessor – K Ayala (Cengagelearning)
2. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (PEARSON)

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-T-691.1	3	3	3	2	3				3			
PEC-CS-T-691.2	3	3	3	2	3				3			
PEC-CS-T-691.3	3	3	3	2	3				3			
PEC-CS-T-691.4	3	3	3	2	3				3			
PEC-CS-T-691.5	3	3	3	2	3				3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-T-691.1	3	3	3
PEC-CS-T-691.2	2	3	3
PEC-CS-T-691.3	3	3	2
PEC-CS-T-691.4	3	2	3
PEC-CS-T-691.5	3	3	3

Course Name: Advanced Operating Systems
Course Code: PEC-CS-S-601
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Operating Systems

Course Outcomes (COs):

After attending the course students should be able to

CO1	Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.
CO2	Understand the concepts of deadlock in operating systems.
CO3	Implement them in Multiprogramming system.
CO4	Create process creation and implement inter process communication
CO5	Analyze the performance of the various page replacement schemes

Course Content:

Module 1:

Architectures of Distributed Systems: System Architecture Types, 1L
Distributed Operating Systems, Issues in Distributed Operating Systems, Communication Primitives.2L
Theoretical Foundations: Inherent Limitations of a Distributed System, 1L
Lamports Logical Clocks, Vector Clocks, Causal Ordering of Messages, Termination Detection.2L

Module 2:

Distributed Mutual Exclusion: The classification of Mutual Exclusion Algorithms 2L
Non-Token-Based Algorithms: Lamports Algorithm1L
The Ricart-Agarwala Algorithm, Maekawas Algorithm, 1L
Token-Based Algorithms: Suzuki-Kasamis Broadcast Algorithm, 1L
Singhals Heuristics Algorithm, Raymonds Heuristric Algorithm. 2L

Module 3:

Distributed Deadlock Detection: Preliminaries, 1L
Deadlock Handling Strategies in Distributed Systems 1L
Issues in Deadlock Detection and Resolution, 1L
Control Organizations for Distributed Deadlock Detection, 1L
Centralized- Deadlock – Detection Algorithms, 1L
Distributed Deadlock Detection Algorithms, 1L
Hierarchical Deadlock Detection Algorithms1L

Module 4:

Multiprocessor System Architectures: Introduction, Motivation for multiprocessor Systems, 1L
Basic Multiprocessor System Architectures 1L
Multi Processor Operating Systems: Introduction, Structures of Multiprocessor Operating Systems 1L
Operating Design Issues, Threads, Process Synchronization. 2L
Processor Scheduling 1L
Distributed File Systems: Architecture, Mechanisms for Building Distributed File Systems, Design Issues 2L

Module 5:

Distributed Scheduling : Issues in Load Distributing, Components of a load Distributed Algorithm, 2L
Stability, Load Distributing Algorithm, Requirements for Load Distributing, Task Migration, Issues in task migration. 2L
Distributed Shared Memory: Architecture and Motivation, Algorithms for Implementing DSM, 2L
Memory Coherence, Coherence Protocols, Design Issues 2L

Text book:

1. Mukesh Singhal and Niranjan Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill.
2. Andrew S. Tanenbaum, Distributed Operating Systems, ACM Press.

Reference Books:

1.Nancy Lynch, Distributed Algorithms, Morgan Kaufmann.
2.Jie Wu, Distributed Systems, CRC Press.
3.Hagit Attiya, Jennifer Welch, Distributed Computing: Fundamentals, Simulations and Advanced Topics, McGraw-Hill.
4.Sape Mullender (ed.), Distributed Systems, Addison-Wesley

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-S-691.1	3	3	3	3	3				3			
PEC-CS-S-691.2	3	3	3	3	3				3			
PEC-CS-S-691.3	3	3	3	3	3				3			
PEC-CS-S-691.4	3	3	3	3	3				3			
PEC-CS-S-691.5	3	3	3	3	3				3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-S-691.1	3	3	3
PEC-CS-S-691.2	3	3	3
PEC-CS-S-691.3	3	3	3
PEC-CS-S-691.4	3	3	3
PEC-CS-S-691.5	3	3	3

Name of the Paper: Machine Learning
Paper Code: PEC-CS-D-601
Contact (Periods/Week): 3L/Week
Credit Point: 3
No. of Lectures: 36

Prerequisite:
1. Basic programming skills, Algorithm design.
2. Probability, Axioms of Probability, Conditional Probability, Bernoulli Distribution, Binomial Distribution, Multinomial Distribution, Uniform Distribution, Normal (Gaussian) Distribution, Chi-Square Distribution, t Distribution, F Distribution. Probability Distribution and Density Functions, Joint Distribution and Density Functions, Conditional Distributions, Bayes' Rule, Expectation, Variance, Weak Law of Large Numbers.
3. Linear Algebra; Convex Optimization ; Statistics; Calculus.

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the fundamental concepts of basics of machine learning to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
CO2	Understand the fundamental concepts of regression problems so that they can propose models for predicting values based on exemplary data and Analyze their performances.
CO3	Explain or Illustrate the fundamental strategies of unsupervised machine learning paradigm to solve clustering problems and Analyze their performances.
CO4	Explain or Illustrate the concepts of Mining Frequent Patterns, Associations and Data Streams and Apply them to solve the relevant problems and Analyse their performances.
CO5	Develop ideas to Propose solutions to the problems of supervised learning and Identify problems where students can Apply the concept appropriately and Analyze the effectiveness as well as limitations of solutions making the students aware of its utilitarian importance for further explorations leading towards lifelong learning.

Course Content

Module 1: [8L]

Supervised Learning (Regression/Classification) Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Module 2:[5L]

Unsupervised Learning Clustering: K-means/Kernel K-means Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models)

Module 3:[4L]
Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

Module 4: [7L]
Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Module 5: [7L]
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

Module6: [4L]
Recent trends in various learning techniques of machine learning and classification methods.

Text Books:
1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer

Reference Books:
1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
2. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-D-691.1	3	3	3	3	3							3
PEC-CS-D-691.2	3	3	3	3	3							3
PEC-CS-D-691.3	3	3	3	3	3							3
PEC-CS-D-691.4	3	3	3	3	3							3
PEC-CS-D-691.5	3	3	3	3	3							3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-D-691.1	3	3	3
PEC-CS-D-691.2	3	3	3
PEC-CS-D-691.3	3	3	3
PEC-CS-D-691.4	3	3	3
PEC-CS-D-691.5	3	3	3

Name of the Paper: Web and Internet Technology
Paper Code: PEC-CS-A-601
Contact (Periods/Week): 3L/Week
Credit Point: 3
No. of Lectures: 36

Course Outcomes (COs):

After attending the course students should be able to

CO1	To develop interactive web pages using HTML, DHTML, CSS and image map
CO2	To procure the knowledge of information interchange formats like XML
CO3	To validate fields of web pages using scripting languages like JavaScript
CO4	To develop web applications using PHP and ASP.net
CO5	To acquire the server side programming concepts using servlet, JSP

Course Contents:

Module 1: [6L]

Introduction (1L): Overview, Network of Networks, Intranet, Extranet, and Internet.
World Wide Web (1L): Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP.
Review of TCP/IP (1L): Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6.
IP Subnetting and addressing (1L): Classful and Classless Addressing, Subnetting. NAT, IP masquerading, IP tables.
Internet Routing Protocol (1L): Routing -Intra and Inter Domain Routing, Unicast and Multicast Routing, Broadcast.
Electronic Mail (1L): POP3, SMTP, Clients - Servers Communication.

Module -2: [9L]

HTML, DHTML &CSS : Introduction, Elements, Attributes, Heading, Paragraph. Formatting[1L]; Link, Table, List, Block, Layout, Html Forms, and input [1L]; Iframe, Colors[1L], Image Maps andattributes of image area [1L];
Introduction to CSS, basic syntax and structure of CSS, different typesinternal, external and inline CSS [1L];
Basic Introduction of DHTML, Difference between HTMLand DHTML, Documentary Object Model (DOM) [1L].
Extended Markup Language (XML) : Introduction, Difference between HTML & XML,XML-Tree [1L]; Syntax, Elements, Attributes, Validation and parsing, DTD [2L].

Module 3: [15L]

Java Scripts: Basic Introduction, Statements, comments, variable, operators, data types[1L];condition, switch, loop, break [1L]; Java script functions, objects, and events[1L].
CGI Scripts: Introduction, Environment Variable, GET and POST Methods[1L].
Java Servlet: Servlet environment and role, Servlet life cycle [1L]; Servlet methods- Request,Response, Get and post [1L]; Cookies and Session [1L].

Java Server Page (JSP):
JSP Architecture [1L]; JSP Servers, JSP Life Cycle [1L]; Understanding the layout of JSP, JSP Scriptlet Tag [1L]; JSP implicit object (request and response) [1L]; Variable declaration, methodsin JSP [1L]; JSP directive (Taglib and Include), JavaBean- inserting JavaBean in JSP [1L]; JSPAction tags (Forward & Include) [1L]; Creating ODBC data source name, Introduction to JDBC,prepared statement and callable statement [1L].

Module-4: [6L]
Threats [1L]: Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks.
Network security techniques: Password and Authentication; VPN, IP Security[1L], security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH)[1L].
Firewall (1L): Introduction, Packet filtering, Stateful, Application layer, Proxy.
Search Engine and Web Crawler: Definition, Meta data, Web Crawler[1L], Indexing, Page rank, overview of SEO[1L].

Textbooks:
1. –Web Technology: A Developer's Perspective‖, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013. (Topics covered: html, CSS, imagemap, xml)
2. –Learning PHP, MySQL & JavaScript‖, Robin Nixon, O'Reilly Publication. (Topics covered:Java Script)
3. –Head First Servlet's & JSP‖, Bryan Basham, Kathy Sterra, Bert Bates, O'Reilly Publication. (Topics covered: Servlet, JSP)
4.Cryptography and Network Security by William Stallings Publisher: Pearson Education India(Topics covered: Threats, Security techniques, Firewall)

Recommended books:
1. "Programming the World Wide Web", Robert. W. Sebesta, Fourth Edition, Pearson Education, 2007.
2. –Core Web Programming‖- Second Edition-Volume I and II, Marty Hall and Larry Brown, Pearson Education, 2001

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-A-691.1	3	3	3	3	3				2			3
PEC-CS-A-691.2	3	3	3	3	3				2			3
PEC-CS-A-691.3	3	3	3	3	3				2			3
PEC-CS-A-691C.4	3	3	3	3	3				2			3
PEC-CS-A-691.5	3	3	3	3	3				2			3

CO-PSO Mapping

Cos	PSO1	PSO2	PSO3
PEC-CS-A-691.1	3	3	3
PEC-CS-A-691.2	3	3	3
PEC-CS-A-691.3	3	3	3
PEC-CS-A-691.4	3	3	3
PEC-CS-A-691.5	3	3	3

Course Name: Parallel and Distributed Algorithms
Course Code: PEC-CS-T-602
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Familiarity with the fundamentals of Design and Analysis of Algorithms.

Course Outcome(s):
Course Outcomes (COs):

After attending the course students should be able to

CO1	Develop the fundamental knowledge of parallel and distributed models
CO2	Design, development, and performance analysis of parallel and distributed
CO3	Develop and implement parallel and distributed algorithms
CO4	Analyze the performance issues in parallel computing and trade-offs
CO5	Understand the different issues involved in distributed environment

Course Content:

Parallel Algorithms:
Module 1: Parallel Programming Models and Algorithm Design Techniques
Shared-memory model: PRAM, MIMD, SIMD, Network Model: line, ring, mesh, hypercube, Performance measurement of Parallel Algorithms
Design Techniques for PRAM Models Algorithms: Balancing, divide and conquer, parallel prefix computation, pointer jumping, symmetry breaking, pipelining, accelerated cascading

Module 2: Algorithms for Parallel models and complexity
Algorithms for PRAM Models: List ranking, sorting and searching, tree algorithms, graph algorithms, string algorithms
Algorithms for Network Models: Matrix algorithms, sorting, graph algorithms, routing, Relationship with PRAM models
Parallel Complexity: Lower bounds for PRAM models, the complexity class NC, P completeness

Distributed Algorithms:
Module 3: Distributed Models of computation
Models of computation: Shared memory and message passing systems, synchronous and asynchronous systems, Logical time and event ordering. Global state and snapshot algorithms, clock synchronization

Module 4: Distributed Operating Systems
Mutual exclusion, deadlock detection
Classical Algorithms: Leader election, termination detection, distributed graph algorithms

Module 5: Fault tolerance and recovery
Basic concepts, fault models, agreement problems and its applications, commit protocols, voting protocols, check pointing and recovery, reliable communication

Textbooks:

1. Joseph F Jájá, An Introduction to Parallel Algorithms, Addison-Wesley, 1992
2. Mukesh Singhal and Niranjan Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill

Reference Books:

1. Michael J Quinn, Parallel Computing: Theory and Practice, second edition, McGraw Hill
2. Nancy Lynch, Distributed Algorithms, Morgan Kaufmann
3. Andrew S. Tanenbaum, Distributed Operating Systems, ACM Press
4. Jie Wu, Distributed Systems, CRC Press

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-T-602.1	3	3	3	3								3
PEC-CS-T-602.2	3	3	2	2								3
PEC-CS-T-602.3	3	2	3	3								3
PEC-CS-T-602.4	3	2	3	3								3
PEC-CS-T-602.5	2	2	2	2								3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-T-602.1	3	3	3
PEC-CS-T-602.2	2	2	2
PEC-CS-T-602.3	3	3	2
PEC-CS-T-602.4	2	2	3
PEC-CS-T-602.5	3	3	3

Course Name: Embedded System
Course Code: PEC-CS-S-602
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36

Prerequisite: Knowledge of microprocessor and microcontroller.
Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the architecture and classifications of different embedded systems and the related programming knowledge.
CO2	Identify and understand the concepts of embedded systems like I/O, timers, interrupts, interaction with peripheral devices
CO3	Choose case-specific debugging technique for an embedded system.
CO4	Design various real time systems using embedded systems.
CO5	Understand the working principles of microcontroller and apply this knowledge for developing an approach by means of existing and new methods as a team work.

Course Content:

Module 1: **[5L]**
Introduction to the Embedded System: Embedded system Vs General computing systems, Purpose of Embedded systems, classifications of embedded systems, fundamentals of embedded processor and microcontrollers, CISC vs. RISC, ASIC.

Module 2: **[9L]**
Serial and parallel communication: devices and protocols, wireless communication: devices and protocols, parallel communication network using ISA, PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth.

Module 3: **[5L]**
Program Modeling Concepts ; Fundamental issues in Hardware software co-design, Unified Modeling Language(UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system.

Module 4: **[5L]**
Real Time Operating Systems: Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS.

Module 5: **[12L]**
PIC microcontroller: introduction, architecture, comparison of PIC with other CISC and RISC based systems and microprocessors, assembly language programming, addressing modes, instruction set, Interfacing with various sensors and actuators using PIC microcontroller. Programming concepts and embedded programming, embedded architecture.

Text Books:
1. Introduction to Embedded Systems : Shibu K. V. (TMH)
2. Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley)

Reference Books:

1. Embedded Systems : Rajkamal (TMH)
2. Embedded Systems : L. B. Das (Pearson)

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-S-602.1	3	3	3	3	2							3
PEC-CS-S-602.2	3	3	3	3	2							3
PEC-CS-S-602.3	3	3	3	3	2							3
PEC-CS-S-602.4	3	3	3	3	2							3
PEC-CS-S-602.5	3	3	3	3	2							3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-S-602.1	3	3	3
PEC-CS-S-602.2	3	3	3
PEC-CS-S-602.3	3	3	3
PEC-CS-S-602.4	3	3	3
PEC-CS-S-602.	3	3	3

Course Name: Soft computing
Course Code: PEC-CS-D-602
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Discrete Mathematics, Probability and Statistics

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand and explain the basic concept of soft computing and hard computing and apply them in designing solution to engineering problem.
CO2	Identify and formulate learning rules for each of the architectures and learn several neural network paradigms and its applications to solving engineering and other problems.
CO3	Explore relevant literature and apply fuzzy logic and reasoning to handle uncertainty and solving interdisciplinary engineering problems
CO4	Use genetic algorithms to combinatorial optimization problems and recognize the feasibility of applying a soft computing methodology for a particular problem.
CO5	Implement the concept and techniques of designing of soft computing methods in real world problem.

Course Content:

Module-1: Introduction to Soft Computing: 8L
An Overview of Artificial Intelligence, Evolution of Computing - Soft Computing Constituents – From Conventional Artificial Intelligence to Computational Intelligence - Machine Learning Basics.
Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing

Module-2: Fuzzy sets and Fuzzy logic 7L
Introduction, Fuzzy sets versus crisp sets, operations on fuzzy sets, Extension principle, Fuzzy relations and relation equations, Fuzzy numbers, Linguistic variables,
Fuzzy logic, Linguistic hedges, Applications, fuzzy controllers, fuzzy pattern recognition, fuzzy image processing, fuzzy database.

Module -3: Artificial Neural Networks 9L
Artificial Neural Network: Introduction, basic models, Hebb's learning, Adeline, Perception, Multilayer feed forward network.
Back propagation, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications.

Module -4: Genetic Algorithms 7L
Evolutionary and Stochastic techniques: Genetic Algorithm (GA), different operators of Genetic Algorithm, Analysis of selection operations, Hypothesis of building Blocks, Schema theorem and convergence of Genetic Algorithm, Simulated annealing and Stochastic models, Boltzmann Machine, Applications.
Rough Set: Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge,

Decision Tables, and Applications.

Module -5: Hybrid Systems 5L

Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic controlled Genetic Algorithm. Fuzzy Logic and Genetic Algorithm for Optimization, Applications.

Text book:

1.–Neural Networks, Fuzzy logic, and Genetic Algorithms‖, S. Rajasekaran & G. A. V. Pai , PHI.
2.–Principles of Soft Computing‖, S.N.Sivanandam, S.N Deepa, wiley publications.
3.–Neural Networks‖, S. Haykin, Pearson Education, 2ed, 2001.
4.–An Introduction to Genetic Algorithm‖, Mitchell Melanie, Prentice Hall, 1998.

Reference Books:

1. –Genetic Algorithms in Search, Optimization and Machine Learning‖, David E. Goldberg, Addison Wesley, 1997.
2.–Intelligent Hybrid Systems‖, D. Ruan, Kluwer Academic Publisher, 1997.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-D-602.1	3	3	3	3	3	2	2		2			3
PEC-CS-D-602.2	3	3	3	3	3	2	2		2			3
PEC-CS-D-602.3	3	3	3	3	3	2	2		2			3
PEC-CS-D-602.4	3	3	3	3	3	2	2		2			3
PEC-CS-D-602.5	3	3	3	3	3	2	2		2			3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-D-602.1	3	3	3
PEC-CS-D-602.2	3	3	3
PEC-CS-D-602.3	3	3	3
PEC-CS-D-602.4	3	3	3
PEC-CS-D-602.5	3	3	3

Name of the Paper: Human computer Interaction
Paper Code: PEC-CS-A-602
Contact (Periods/Week): 3L/Week
Credit Point: 3
No. of Lectures: 36

Prerequisite:
Basic understanding of relevant psychological theories and approaches

Course Outcome(s):
Upon Completion of the Course, The Student Should Be Able to:
CO1: Design Effective Dialog for HCI.
CO2: Design Effective HCI for Individuals and Persons with Disabilities.
CO3: Assess The Importance of User Feedback.
CO4: Explain The HCI Implications for Designing Web Sites.
CO5: Develop Meaningful User Interface.

Course Content:

Module 1: FOUNDATIONS OF HCI [7L]
The Human: I/O Channels – Memory – Reasoning And Problem Solving; The Computer: Devices – Memory – Processing And Networks; Interaction: Models – Frameworks – Ergonomics – Styles – Elements – Interactivity- Paradigms.

Module 2: DESIGN & SOFTWARE PROCESS [7L]
Interactive Design Basics – Process – Scenarios – Navigation – Screen Design – Iteration And Prototyping.

HCI in Software Process – Software Life Cycle – Usability Engineering – Prototyping in Practice – Design
Rationale. Design Rules – Principles, Standards, Guidelines, Rules. Evaluation Techniques – Universal Design.

Module 3: MODELS AND THEORIES
[7L] Cognitive Models –Socio-Organizational Issues And Stake Holder Requirements –Communication And Collaboration Models-Hypertext, Multimedia And WWW.

Module 4: MOBILE HCI
[7L] Mobile Ecosystem: Platforms, Application Frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

Module 5: WEB INTERFACE DESIGN
[8L] Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays And Virtual Pages, Process Flow. Case Studies.

Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, –Human Computer Interaction‖, 3rd Edition,
Pearson Education, 2004 (Module I, II & III)
2. Brian Fling, –Mobile Design and Development‖, First Edition, O'Reilly Media Inc., 2009 (Module – IV)

3. Bill Scott and Theresa Neil, –Designing Web Interfaces‖, First Edition, O'Reilly, 2009. (Module-V)

Recommended books:

1. Preece J, Rogers Y, Sharp H, Baniyon D., Holland S. and Carey T. Human Computer Interaction, Addison-Wesley, 1994.

2. B. Shneiderman; Designing the User Interface, Addison Wesley 2000 (Indian Reprint).

CO-PO Mapping:

CO	PO1	PO2	POP3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	-	-	-	-	-	-	-	-	2
CO2	1	3	3	-	-	-	-	-	-	-	-	2
CO3	2	3	-	2	-	-	-	-	-	-	-	2
CO4	-	3	-	3	2	-	-	-	-	-	-	2
CO5	1	-	3	-	-	-	-	-	-	-	-	2

Name of the Paper: Introduction to Internet of Things
Paper Code: OEC-CS-601A
Contact (Periods/Week):3L/Week
Credit Point: 3
No. of Lectures: 36

Prerequisite:

1. Fundamental knowledge in computer networking.
2. Basic knowledge of Microcontroller fundamentals.

Course Outcome(s):

On completion of the course students will be able:

CO1 Understand and differentiate the concepts of Internet of Things and Internet
CO2 Identify appropriate MAC protocols and routing protocols while solving a problem
CO3 Analyze and compare the basic protocols in wireless sensor network and IoT
CO4 Solve different real life problems in different domains based upon the concept of IoT and sensor network
CO5 Implement basic IoT applications on embedded platform

Course Content:

Module 1: [7L]

Fundamental of IoT

The Internet of Things, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Design challenges, Development challenges, Security challenges, Other challenges.

Module 2: [6L]

Wireless Sensor Network

Network & Communication aspects, Wireless medium access issues, MAC protocol , routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination.

Module 3: [7L]

IoT and M2M

A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module 4: [7L]

IoT Architecture

Introduction, ArchitectureReference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module 5: [5L]

IoT Applications for Value Creations

Introduction to Arduino and Raspberry Pi, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities,Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value

Creation from Big Data and Serialization, IoT in health care, Value for Industry, smart home Management.

Module 6: [4L]
Internet of Things Privacy, Security and Governance
Introduction, Overview of Governance, Privacy and Security Issues, Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in smart cities, Security.

Text books:

1. Vijay Madisetti and Arshdeep Bahga, –Internet of Things (A Hands-on-Approach)‖, 1st Edition, VPT, 2014.
2. Francis daCosta, –Rethinking the Internet of Things: A Scalable Approach to Connecting Everything‖, 1st Edition, Apress Publications, 2013.

Reference books:

1. Cuno Pfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 978-1-4493-9357-1
2. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

CO-PO Mapping

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

Name of the Paper: Bio-informatics
Paper Code: OEC-CS- 601B
Contact (Periods/Week): L-T-P=3-0-0
Credit Point: 3
No. of Lectures: 35

Course Outcome(s):

On completion of the course students will be able:

CO1 To acquire the knowledge of Bioinformatics technologies with the related concept of DNA, RNA and their implications

CO2 To develop idea in MOLECULAR BIOLOGY

CO3 To understand the concept and techniques of different types of Data Organization and Sequence Databases with different types of Analysis Tools for Sequence Data Banks

CO4 To acquire the knowledge of the DNA SEQUENCE ANALYSIS

CO5 To analyze the performance of different types of Probabilistic models used in Computational Biology

Course Content:

Module -1: **[7L]**

INTRODUCTION TO MOLECULAR BIOLOGY:

Concepts of Cell, tissue, types of cell, components of cell, organelle.Functions of different organelles. Concepts of DNA: Basic Structure of DNA; Double Helix structure; Watson and crick model. Exons and Introns and Gene Concept.

Concepts of RNA : Basic structure, Difference between RNA and DNA. Types of RNA.

Concept of Protein: Basic components and structure. Introduction to Central Dogma: Transcription and Translation, Introduction to Metabolic Pathways.

Introduction to Bioinformatics. Recent challenges in Bioinformatics.

Module -2: **[10L]**

Introduction to Genomic data, Data Organization and Sequence Databases: Sequence Data Banks - Introduction to sequence data banks - protein sequence data bank. Signal peptide data bank, Nucleic acid sequence data bank - GenBank, AIDS virus sequence data bank. RRNA data bank, structural data banks - protein Data Bank (PDB), The Cambridge Structural Database (CSD) : Genome data bank - Metabolic pathway data : Microbial and Cellular Data Banks.

Introduction to MSDN (Microbial Strain Data Network):Numerical Coding Systems of Microbes, Hibridoma Data Bank Structure, Virus Information System Cell line information system; Protein Sequence Databases,

DNA sequence databases. sequence database search programs like BLAST and FASTA. NCBI different modules: GenBank; OMIM, Taxonomy browser, PubMed;

Module 3: [8L]

DNA SEQUENCE ANALYSIS

DNA Mapping and Assembly : Size of Human DNA ,Copying DNA: Polymerase Chain Reaction (PCR), Hybridization and Microarrays, Cutting DNA into Fragments, Sequencing

Secondary Structure predictions;

prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking.

Tertiary Structure predictions;

prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking.

Module -4: [10L]

Introduction Probabilistic models used in Computational Biology:
Probabilistic Models;
Gene Regulatory Method Application of HMM in Bioinformatics : Genefinding, profile searches, multiple sequence alignment and regulatory site identification.
Applications in Biotechnology
: Protein classifications, Fold libraries, Protein structure prediction: Fold recognition
(threading), Protein structure predictions : Comparative modeling (Homology), Advanced topics: Protein folding, Protein-ligand interactions, Molecular Modeling & Dynamics, Drug Designing.

Text Book:

1. Yi-Ping Phoebe Chen (Ed), –BioInformatics Technologies‖, First Indian Reprint, Springer Verlag, 2007.

References Book:

1. Bryan Bergeron, –Bio Informatics Computing‖, Second Edition, Pearson Education, 2003.
2. Arthur M Lesk, –Introduction to Bioinformatics‖, Second Edition, Oxford University Press, 2005

CO-PO Mapping

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

Paper Name: Robotics
Code: OEC-CS- 601C
Contacts: 3L
Credits: 3
Allotted hours: 35L

Prerequisite:

1. Microprocessor & Microcontroller
2. Computer Organization & Architecture

Course Outcome(s):

After the successful completion of this course, the student will be able to:
CO1 To describe and explain the microcontrollers used the in robots.
CO2. To design the software and build the prototype of robots.
CO3. To apply localization and mapping aspects of mobile robotics.
CO4. To demonstrate self-learning capability.

Course contents:

Module 1[5L]
Brief history, types, classification and usage, Science and Technology of robots, Some useful websites, textbooks and research journals.

Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, commonsensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.

Module 2 [8L]
Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator.

Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-from and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform.

Module 3[8L]
Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics.
Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators.

Module 4[9L]
Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non-linear control of manipulators.

Module 5[5L]
Introduction and some well known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modeling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics and static stability of a three-wheeled WMR_s on uneven terrain, Simulations using Matlab and ADAMS.

Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough-Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Over-constrained mechanisms and deployable structures, Algorithm to obtain redundant links and joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE_s).

Textbooks:
1. Myke Predko, ―Programming Robot Controllers‖ – McGrawHill, 1st edition, 2003.

Reference books:
1. Michael slater, ―Microprocessor – based design: A comprehensive Guide to Effective Hardware Design, Prentice Hall, 1989.
2. Myke Predko, ―Programming and customizing the 8051- micro-controller‖, Tata McGraw-Hill, New Delhi, 2000.

CO-PO Mapping:

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

Course Name: Computer Networks Lab
Course Code: PCC-CS691
Contact: 0:0:3
Credit Point: 1.5

Prerequisites:
1. Familiarity and knowledge of Computer Network and Computer Architecture
2. Also require strong knowledge of programming languages like C, Java and UNIX or Linux environment.

Course Outcomes (COs):

After attending the course students should be able to

CO1	To design and implement small size network and to understand various networking commands.
CO2	To provide the knowledge of various networking tools and their related concepts.
CO3	To understand various application layer protocols for its implementation in client/server environment
CO4	Understand the TCP/IP configuration for Windows and Linux
CO5	Learn the major software and hardware technologies used on computer networks

Course Contents:

1. Familiarization of UNIX or Linux environment, UNIX or Linux general Commands specially Network Commands. Familiarization of Internetworking - Network Cables - Color coding - Crimping. Internetworking Operating Systems - Configurations. **[6L]**
2. Socket Programming using TCP and UDP **[18L]**
3. Implementing routing protocols such as RIP, OSPF. **[2L]**
4. Familiarization of advanced simulators like Packet Tracer, NS2/NS3, OMNET++, TinyOS**[4L]**
5. Server Configuration: only web server (If time permit, Instructor can do more than that) **[6L]**

Textbooks:
1. TCP sockets in C Programs-Practical guide for Programmers ByMicheal, J Donahoo and Kenneth L calvert.
2. Socket Programming by Raj Kumar Buyaa.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PCC-CS691.1	3	3	3	2	3							2
PCC-CS691.2	3	3	3	3	3							2
PCC-CS691.3	3	3	3	3	3							2
PCC-CS691.4	3	3	3	3	3							2
PCC-CS691.5	2	3	2	2	3							2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PCC-CS691.1	3	3	3
PCC-CS691.2	3	3	3
PCC-CS691.3	3	3	3
PCC-CS691.4	3	3	3
PCC-CS691.5	3	3	3

Course Name: Software Engineering Lab
Course Code: CS 692
Contact: 3:0:0
Total Contact Hours: 36
Credits: 1.5

Prerequisites :
Programming for Problem Solving

Course Outcomes (COs):
After attending the course students should be able to

CO1	Understand the basic knowledge of how to apply Software Engineering and mathematical knowledge and designing solution to software engineering problem including the specification.
CO2	Analyze the cost-benefit trade-off.
CO3	Design solutions to the one or more application domains using software engineering approaches that integrates ethical.
CO4	Develop the code from the design and effectively apply relevant standards and perform testing .
CO5	Identify and use of modern software engineering tools necessary for software project management.

Course Content:

Module-1:[6L]

Preparation of requirement document for standard application problems in standard format. (e.g. LibraryManagement System, Railway Reservation system, Hospital management System, University Admission system) .DFD of standard application problems.

Module-2:[6L]

Software Requirement Analysis: Describe the individual Phases/ modules of the project, Identify deliverables. Compute Process and Product Metrics (e.g Defect Density, Defect Age, Productivity, Cost etc.) Estimation of project size using Function Point(FP) for calculation.

Cost Estimation models. L

Module-3: [6L]

Use Case diagram, Class Diagram, Sequence Diagram, Activity Diagram and prepare Software Design Document using tools like Rational Rose.(For standard application problems)

Module-4:[9L]

Software Development, Coding Practice and Debugging, Design Test Script/Test Plan(both Black box and White Box approach)

Module-5:[9L]

Software project management, Project planning and control, configuration control, cost estimation, project scheduling using PERT and GANTT charts, cost-time relations using standard tools.

Text Books:

1. Fundamentals of Software Engineering by Rajib Mall, –PHI-3rd Edition, 2009.
2.SoftwareEngineering-PankajJalote(Wiley-India)

Reference Books:

1.SoftwareEngineering–AgarwalandAgarwal(PHI)
2.Software Engineering, by Ian Sommerville, Pearson Education Inc., New Delhi, (2009).
3. Software Engineering: A Practitioner‟s Approach‖, by Roger S. Pressman, McGraw-Hill.(2005)

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS692.1	3	3	3	3	3				3			3
CS692.2	3	3	3	3	3				3			3
CS692.3	3	3	3	3	3				3			3
CS692.4	3	3	3	3	3				3			3
CS692.5	3	3	3	3	3				3			3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CS692.1	3	3	3
CS692.2	3	3	3
CS692.3	3	3	3
CS692.4	3	3	3
CS692.5	3	3	3

Course Name: Microprocessors & Microcontrollers Lab
Course Code: PEC-CS-T-691
Contact: 0:0:3
Credits: 1.5

Prerequisites:

1. Familiarity with the numbersystem
2. A solid background in digital logic and implementation of digital circuit in a breadboard.

Course Outcomes (COs):

After attending the course students should be able to

CO1	To understand and apply the fundamentals of assembly level programming of microprocessors and Microcontroller.
CO2	To work with standard microprocessor real time interfaces including GPIO, serial ports, digital-to-analog converters and analog-to-digital converters.
CO3	To troubleshoot interactions between software and hardware.
CO4	To analyze abstract problems and apply a combination of hardware and software to address the problem

Course Contents:
Module -1: [3L]

Study of Prewritten programs on 8085 trainer kit using the basic instruction set (data transfer,Load/Store, Arithmetic, Logical).
Or,
Familiarization with 8085 simulator on PC.
Programs using basic instruction set (data transfer,Load/Store, Arithmetic, Logical) on the simulator.

Module -2: [24L]
Programming using kit or Simulator for:

1. Table lookup
2. Copying a block of memory
3. Shifting a block of memory
4. Packing and unpacking of BCD numbers
5. Addition of BCD numbers
6. Binary to ASCII conversion and vice-versa (Using Subroutine Call)
7. BCD to Binary Conversion and vice-versa
8. HCF of two numbers
9. Addition of numbers using subroutine
10. Clearing the flag register

Module -3: [3L]
Study of Prewritten programs on 8051 Microcontroller Kitusing the basic instruction set (datatransfer, Load/Store, Arithmetic, Logical).
Or,

Familiarization with 8051 Simulator on PC.
Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical).

Text Books:

1. MICROPROCESSOR architecture, programming and Application with 8085 - R.Gaonkar (Penram international PublishingLTD.)
2. Fundamentals of Microprocessor and Microcontrollers - B. Ram(Paperback)
3. 8051 Microcontroller – K. Ayala (Cengagelearning)

Reference books:

1. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (PEARSON)

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-T-691.1	3	3	3	2	3				3			
PEC-CS-T-691.2	3	3	3	2	3				3			
PEC-CS-T-691.3	3	3	3	2	3				3			
PEC-CS-T-691.4	3	3	3	2	3				3			
PEC-CS-T-691.5	3	3	3	2	3				3			

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-T-691.1	3	3	3
PEC-CS-T-691.2	2	3	3
PEC-CS-T-691.3	3	3	2
PEC-CS-T-691.4	3	2	3
PEC-CS-T-691.5	3	3	3

Course Name: Advanced Operating Systems Lab
Course Code: PEC-CS-S-691
Contact: 0:0:3
Total Contact Hours: 36
Credits: 1.5

Prerequisites: Operating Systems

Course Outcomes (COs):

After attending the course students should be able to

CO1	Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.
CO2	Understand the concepts of deadlock in operating systems.
CO3	Implement them in Multiprogramming system.
CO4	Create process creation and implement inter process communication
CO5	Analyze the performance of the various page replacement schemes

Course Content:

Preliminaries of Operating System:
6P

managing users, managing systems, file managements, useful commands, Shell scripting : shell syntax, executing shell scripts.

Process :
12P

creating new process, counting maximum number of processes a system can handle at a time, handling system calls; inter process communication through pipes and message passing, zombie process, orphan process.

Process Synchronization:
6P

handling threads and semaphores to achieve synchronization among processes using POSIX standard functions.

Signal :
6P

study of some POSIX signals (SIGINT, SIGILL, SIGFPE, SIGKILL, SIGHUP, SIGALRM, SIGABRT).

Text book:

1. Mukesh Singhal and Niranjan Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill.

Reference Books:

1. Nancy Lynch, Distributed Algorithms, Morgan Kaufmann.

CO-PO Mapping

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-S-691.1	3	3	3	3	3				3			
PEC-CS-S-691.2	3	3	3	3	3				3			
PEC-CS-S-691.3	3	3	3	3	3				3			
PEC-CS-S-691.4	3	3	3	3	3				3			
PEC-CS-S-691.5	3	3	3	3	3				3			

CO-PSO Mapping

Cos	PSO1	PSO2	PSO3
PEC-CS-S-691.1	3	3	3
PEC-CS-S-691.2	3	3	3
PEC-CS-S-691.3	3	3	3
PEC-CS-S-691.4	3	3	3
PEC-CS-S-691.5	3	3	3

Course Name: Machine Learning Lab
Course Code: PEC-CS-D-691
Contact:0:0:3
Total Contact Hours: 36
Credits: 1.5

Prerequisite: Familiarity with JAVA/ Python Programming

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the fundamental concepts of basics of machine learning to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
CO2	Understand the fundamental concepts of regression problems so that they can propose models for predicting values based on exemplary data and Analyze their performances.
CO3	Explain or Illustrate the fundamental strategies of unsupervised machine learning paradigm to solve clustering problems and Analyze their performances.
CO4	Explain or Illustrate the concepts of Mining Frequent Patterns, Associations and Data Streams and Apply them to solve the relevant problems and Analyse their performances.
CO5	Develop ideas to Propose solutions to the problems of supervised learning and Identify problems where students can Apply the concept appropriately and Analyze the effectiveness as well as limitations of solutions making the students aware of its utilitarian importance for further explorations leading towards lifelong learning.

List of Lab Experiments:

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

5. Write a program to implement the naÔve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

6. Assuming a set of documents that need to be classified, use the naÔve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using

k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-D-691.1	3	3	3	3	3							3
PEC-CS-D-691.2	3	3	3	3	3							3
PEC-CS-D-691.3	3	3	3	3	3							3
PEC-CS-D-691.4	3	3	3	3	3							3
PEC-CS-D-691.5	3	3	3	3	3							3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-D-691.1	3	3	3
PEC-CS-D-691.2	3	3	3
PEC-CS-D-691.3	3	3	3
PEC-CS-D-691.4	3	3	3
PEC-CS-D-691.5	3	3	3

Name of the Paper: Web and Internet Technology Lab
Paper Code: PEC-CS-A-691
Contact (Periods/Week): 3P/Week
Credit Point: 2
No. of Lectures: 30

Prerequisite:
Fundamentals of Programming

Course Outcomes (COs):

After attending the course students should be able to

CO1	To develop interactive web pages using HTML, DHTML, CSS and image map
CO2	To procure the knowledge of information interchange formats like XML
CO3	To validate fields of web pages using scripting languages like JavaScript
CO4	To develop web applications using PHP and ASP.net
CO5	To acquire the server side programming concepts using servlet, JSP

List of Experiments:

1. Write a single html program through which you can explain a) anchor tag, b)‘img‘ tag with ‗src‘attribute, c)paragraph d) heading.
2. Write a single html program through which you can draw a table which consists of 3 row and 4columns where 1st row contains 4 different column fields of a student‘s information with red textcolor and Calibri font style with font 12. Rest cells of whole table contain values with blue text colorsand Times new roman font style with font 10.
3. Write a single html program where 1st paragraph can collect its specified style from internal stylesheet describes inside that html program and 2nd paragraph can collect its specified style fromanother file (external stylesheet).
4. Write a single html program which implements image map concept using ‗usemap‘ and <map>.
5. Write a html program to find out Celsius temperature of a given Fahrenheit temperature usingJavaScript.
6. Write a xml parsing technique through which parse a text string into an XML DOM object andextracts the info from it with JavaScript.
7. Write a html program to find out m to the power n (m, n valid integer no) using a function usingJavaScript.
8. Write a simple java script program to print the weekday and time.
9. Write a simple java script program to implement the function using the argument and no argument both.
10. Write a simple program in ASP.net through which you can create a login page of your own website.
11. Write a simple JSP program through which you can print even and odd no separately within agiven range.
12. Create an Online Registration form for individual user of an website using Servlet.

Textbooks:

1. –Web Technology: A Developer's Perspective‖, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013. (Topics covered: html, CSS, imagemap, xml)
2. –Learning PHP, MySQL & JavaScript‖, Robin Nixon, O'Reilly Publication.(Topics covered:Java Script)
3. –Head First Servlet's & JSP‖, Bryan Basham, Kathy Sterra, Bert Bates, O'ReillyPublication. (Topics covered: Servlet, JSP)

Recommended books:

1. "Programming the World Wide Web", Robert. W. Sebesta, Fourth Edition, Pearson Education,2007.
2. –Core Web Programming‖- Second Edition-Volume I and II, Marty Hall and Larry Brown, Pearson Education, 2001.
3. –Web Technologies‖, Black Book, Dreamtech Press

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-A-691.1	3	3	3	3	3				2			3
PEC-CS-A-691.2	3	3	3	3	3				2			3
PEC-CS-A-691.3	3	3	3	3	3				2			3
PEC-CS-A-691C.4	3	3	3	3	3				2			3
PEC-CS-A-691.5	3	3	3	3	3				2			3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-A-691.1	3	3	3
PEC-CS-A-691.2	3	3	3
PEC-CS-A-691.3	3	3	3
PEC-CS-A-691.4	3	3	3
PEC-CS-A-691.5	3	3	3

Course Name: Intellectual Property Right
Course Code: MC 601
Contacts: 2:0:0
Total Contact Hours: 24
Credit : 0

Prerequisite:
None

Course Outcome(s):
On successful completion of the learning sessions of the course, the learner will be able to:
CO1: Explain fundamental aspects of Intellectual property Rights to students
CO2: To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
CO3: To disseminate knowledge on copyrights and its related rights and registration aspects
CO4: To disseminate knowledge on trademarks and registration aspects
CO5: To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design
Protection and their registration aspects
CO6: To aware about current trends in IPR and Govt. steps in fostering IPR

Course Content:

Module 1:
[4L]

Overview of the IPR: Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development
– IPR in abroad - International organizations. Agencies and treaties,

Module 2:[4L]

Patents- Trips Definition, kind of inventions protected by patent-Patentable and Non patentable inventions. Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Le8al requirements for patents — Granting of patent - Rights of a patent-exclusive right. Patent application process: Searching a patent- Drawing of a patent- Filing of a patent- Types of patent applications- Parent document: specification and Claims.
Registration Procedure, Rights and Duties of Patentee, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties

Module 3: [4L]

Trademarks- Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks

- Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - trade mark registration processes.

Module 4:[4L]

Copyrights- Right and protection covered by copyright - Law of copy rights: Fundamental of copyright law.

originality **of material,** rights of reproduction, rights to perform the worth publicly, copy right ownership issues, obtaining copy right registration, notice of copy right. International copy right law. Infringement of Copyright under Copyright Act

The Role arid Liabilities of lPRs in India - Cyberlaw issues: Criminallaw. data safety, online privacy. Health privacy, Freedom of expression and human rights, net neutrality, national security.

Module 5: [4L]

Geographical Indication of Goods: Types, why and how GI need protection and GI laws. Indian GI act. Industrial Designs: protection. Kind of protection provided by industrial designs. Integrated Circuits **Module 6:** [4L]

India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes IPR – Career Opportunities in IP - IPR in current scenario with case studies

Text book:

1. Fundamentals oflP for Engineers: K.Bansl& P.Bansal
2. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
3. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

Reference book:

1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

CO-PO Mapping

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

4th Year 1st Semester: 7th Semester

Sl No	Course Code	Paper Code	Theory	Contact Hours /Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	Professional Elective courses	PEC-CS-T-701	Information Theory and Coding	3	0	0	3	3
		PEC-CS-S-701	Ad-Hoc and Sensor Networks					
		PEC-CS-D-701	Data Mining and Data Warehouse					
		PEC-CS-A-701	Cloud Computing					
2	Professional Elective courses	PEC-CS-T-702	Quantum Computing	3	0	0	3	3
		PEC-CS-S-702	Mobile Computing					
		PEC-CS-D-702	Natural Language Processing					
		PEC-CS-A-702	Cryptography and Network Security					
3	Open Elective courses	OEC-CS-701A	High Performance Computing	3	0	0	3	3
		OEC-CS-701B	Image Processing					
		OEC-CS-701C	Optimization Techniques					
4	Open Elective courses	OEC-CS-702A	Cyber Law and Ethics	3	0	0	3	3
		OEC-CS-702B	Soft Skills and Interpersonal Communication					
		OEC-CS-702C	Foreign Language					
B. PRACTICAL								
5	Professional Elective courses	PEC-CS-T-791	Information Theory and Coding Lab	0	0	0	3	1.5
		PEC-CS-S-791	Ad-Hoc and Sensor Networks Lab					
		PEC-CS-D-791	Data Mining and Data Warehousing Lab					

		PEC-CS-A-791	Cloud Computing Lab					
6	Open Elective courses	OEC-CS-791A	High Performance Computing Lab	0	0	3	3	1.5
		OEC-CS-791B	Image Processing Lab					
		OEC-CS-791C	Optimization Techniques Lab					
7	PROJECT	PR 791	Major Project-I	0	0	0	4	2
8	PROJECT	PR 792*	Industrial Training / Internship	0	0	0	0	1
9	PROJECT	PR 793	Skill Development VII: Seminar & Group Discussion	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 781	Entrepreneurship & Innovation Skill	3	0	0	3	3 Units
TOTAL CREDIT WITHOUT MOOCS COURSES								18.5
D.MOOCS COURSES**								
11	MOOCS COURSES	HM701	MOOCS COURSE-V	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**22.5**

Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s).

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

Course Name: Information Theory and Coding
Course Code: PEC-CS-T-701
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Probability & Statistics

Course Outcomes (COs):

After attending the course students should be able to

CO1	Illustrate the basic concept of information and apply this knowledge to design solution for real life engineering problem.
CO2	Illustrate the basic concept of coding theory and use this knowledge to design and solve mathematical and engineering problem leading to lifelong learning.
CO3	Interpret the concept of channel models to find amount of mutual information in the channels.
CO4	Compare the existing error detection techniques and design a model for building a new solution as a professional engineering practice as a team.
CO5	Understand how convolutional theory works and develop an approach by means of existing and new methods as a team work.

Course Content:

Module 1:

Information Theory [4L]

Introduction, Measure of Information, Average Information Content (Entropy) of a Zero Memory Source, Extension of Zero Memory Source, Entropy of a Source with Memory.

Module 2:

Source Coding [9L]

Introduction, Types of Codes, Prefix Codes, Source Coding Theorem, Shannon‘s Encoding Theorem, Huffman Coding, Arithmetic Coding, Lempel-Ziv Algorithm, Run Length Encoding, An Overview on Speech and Image Compression.

Module 3:

Information Channels[4L]

Introduction, Channel Models, System Entropies, Mutual Information (Trans information), Channel Capacity, Capacity of Channels, Continuous Channels.

Module 4:

Error Control Coding [8L]

Introduction, need for Error Control Coding, Types of Codes, Coding Gain, Linear Block Codes, The Hamming Codes, Probability of an Undetected Error Pattern for an LBC over a BSC, Equivalent Codes, Cyclic Codes, Golay Codes, Shortened Cyclic Codes.

Module 5:

Burst Error Correcting Codes [6L]

Introduction, Burst Errors, Interleaved Codes, Product Codes, Fire Codes, BCH Codes, Non-Binary BCH Codes and Reed-Solomon Codes.

Module 6:

Convolution Codes[5L]

Introduction, Convolution Encoder, Representation of Convolution Code, Transfer Function of a Convolution

Code, Distance Properties of Convolution Codes, Decoding of Convolution Codes, Stack Algorithm, Known Good Convolution Codes.

Textbook:

1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Information and Coding - N Abramson; McGraw Hill.

Reference Books:

1.Introduction to Information Theory - M Mansurpur; McGraw Hill.
2. Information Theory - R B Ash; Prentice Hall.
3. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-T-701.1	3	3	2	-								
PEC-CS-T-701.2	3	3	3	3								
PEC-CS-T-701.3	3	3	3	3								
PEC-CS-T-701.4	3	3	3	3								
PEC-CS-T-701.5	3	3	3	3								

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-T-701.1	**3**	**3**	**3**
PEC-CS-T-701.2	**3**	**2**	**3**
PEC-CS-T-701.3	**3**	**3**	**2**
PEC-CS-T-701.4	**3**	**2**	**3**
PEC-CS-T-701.5	**3**	**2**	**3**

Course name: Ad-Hoc and Sensor Networks
Course code: PEC-CS-S-701
Contact: 0:0:3
Credit Point: 3

Course Outcome(s):

At the end of the course, the student would be able to:
CO1:Know the basics of Ad hoc networks and Wireless Sensor Networks
CO2:Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement
CO3:Apply the knowledge to identify appropriate physical and MAC layer protocols
CO4:Understand the transport layer and security issues possible in Ad hoc and sensor networks.
CO5:Be familiar with the OS used in Wireless Sensor Networks and build basic modules

Course Content:

Module 1

AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS

Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).

Module 2

SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture – Hardware Components, Energy Consumption of Sensor

Nodes, Network Architecture – Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

Module 3

WSN NETWORKING CONCEPTS AND PROTOCOLS

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – S-MAC, The Mediation Device Protocol, Contention based protocols – PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols, Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

Module 4

SENSOR NETWORK SECURITY

Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.

Module 5

SENSOR NETWORK PLATFORMS AND TOOLS

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.

Text Book:

1. C. Siva Ram Murthy, and B. S. Manoj, –Ad Hoc Wireless Networks: Architectures and Protocols –, Prentice Hall Professional Technical Reference, 2008.

References:

1. Carlos De Morais Cordeiro, Dharma Prakash Agrawal –Ad Hoc & Sensor Networks: Theory and Applications‖, World Scientific Publishing Company, 2006.
2. Feng Zhao and Leonides Guibas, –Wireless Sensor Networks‖, Elsevier Publication – 2002.
3. Holger Karl and Andreas Willig –Protocols and Architectures for Wireless Sensor Networks‖, Wiley, 2005
4. Kazem Sohraby, Daniel Minoli, & Taieb Znati, –Wireless Sensor Networks-Technology, Protocols, and Applications‖, John Wiley, 2007.
5. Anna Hac, –Wireless Sensor Network Designs‖, John Wiley, 2003.

Online Resources:

1. www.wirelessnetworksonline.com
2. www.securityinwireless.com
3. www.ida.liu.se/~petel71/SN/lecture-notes/sn.pdf Practice Aspects 1. NS2 Simulator tool

CO-PO Mapping:

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

Course Name: Data Mining and Data Warehousing
Course Code: PEC-CS-D-701
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand and explain the fundamental concepts of the evolving technologies in Data Mining (such as Mining Frequent Patterns and Data Streams, Associations, Supervised and Unsupervised Learning, Graph Mining, Web Mining etc.) and Data Warehousing (such as Data Cube and OLAP)recognizing their utilitarian importance in current technological context for further exploration leading towards lifelong learning.
CO2	Identify and formulate an engineering problem within the scope of Data Mining and Data Warehousing paradigm.
CO3	Explore relevant literature and apply the concepts of Data Mining and Data Warehousing to solve problems of making automated decisions dealing with large scale data.
CO4	Develop ideas for proposing solutions to the challenging problems of Data Mining and Data Warehousing.
CO5	Implement ideas of Data Mining and Data Warehousing through developing feasible algorithms or frameworks and investigate their effectiveness in solving the relevant problems by analyzing the performances using proper techniques.

the relevant problems.

Course Content:

Module-1:Introduction to Data Mining[5L]

Basic Concepts 1L
Data Exploration: Data Types, Data Attributes, Statistical Description of Data, Data Visualization, Data Similarity Measure 2L
Data Preprocessing: Data Cleaning, Data Integration, Data Reduction, Data Transformation & Discretization 2L

Module-2:Introduction to Data Warehousing [6L]

Basic Concepts 1L
Data Warehouse Modeling: Data Cubeand OLAP (OnLine Analytical Processing) 2L
Data Warehouse Design, Usage, Implementation 2L
Data Generalization by Attribute-OrientedInduction 1L

Module-3:Mining Frequent Patterns,Associations And Correlation Analysis [5L]

Basic Concepts, Frequent Itemset Mining Methods: The Apriori Algorithm, Mining Frequent Item Sets without Candidate Generation, Mining Frequent ItemSets Using Vertical Data Format, Correlation Analysis 4L
Pattern Mining in Multilevel and Multidimensional Space 1L

Module-4:Classification and Regression [6L]

Basic Concepts, k-Nearest-Neighbor Classifier, Decision Tree Classifier, Naïve Bayes Classifier 3L
ANN-Backpropagation Based Classifier, Support Vector Machine Based Classifier, Linear and Nonlinear Regression Methods 3L

Module-5: Clustering and Outlier Analysis [5L]

Basic Concepts, Partitioning Methods: k-Means and k-Medoids, Hierarchical Methods: Agglomerative and

Divisive Hierarchical Clustering, Density-Based Methods: DBSCAN: Density-Based Clustering Based on ConnectedRegions with High Density, Frequent Pattern–Based Clustering Method 4L
Outlier Analysis 1L

Module-6:Mining Data Stream, Time-Series, and Sequence Data [3L]
Basic Concepts of Data Stream Mining 1L
Mining Time Series Data 1L
Mining Sequence Patterns in Biological Data 1L

Module-7:Introduction to Graph Mining, Social Network Analysis,Multi-relational Data Mining, Text Mining and World Wide Web (WWW) Mining 6L
Graph Mining: Methods for Mining Frequent Subgraphs (Apriori-based Approach& Pattern Growth Approach)2L
Basic Concepts of Social Network Analysis and Multi-relational Data Mining2L
Basic Concepts of Text Mining 1L
Basic Concepts of World Wide Web (WWW) Mining 1L

Textbook:
1.Han J & Kamber M, ‒Data Mining: Concepts and Techniques‖, Morgan Kaufmann Publishers, Third Edition.
2.Parteek Bhatia, ‒Data Mining and Data Warehousing: Principles and Practical Techniques‖, Cambridge University Press.

ReferenceBooks:
1.Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, ‒Introduction to Data Mining‖, PearsonEducation.
2.Robert Layton, ‒Learning Data Miningwith Python‖, Packt Publishing

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-D-701.1	3	2	2	2								3
PEC-CS-D-701.2	3	2	2	2								
PEC-CS-D-701.3	3	3	2	2								
PEC-CS-D-701.4	3	2	2	2								
PEC-CS-D-701.5	3	2	2	2								

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-D-701.1	3	3	3
PEC-CS-D-701.2	3	3	3
PEC-CS-D-701.3	3	3	3
PEC-CS-D-701.4	3	3	3
PEC-CS-D-701.5	3	3	3

Paper Name: Cloud Computing
Code: PEC-CS-A-701
Contacts: 3:0:0
Credits: 3
Total Contact hours: 36L

Prerequisite

1. Should have the basic knowledge of Operating Systems.
2. Should be aware of the fundamental concepts of Networking.
3. Should have knowledge of heterogeneous systems and resource management.

Course Outcome(s):

After completion of the course students will be able to

CO1 : To articulate the business model concepts, architecture and infrastructure of cloud computing, including cloud service models and deployment models.

CO2 : To apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms.

CO3 : To explore some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.

CO4: To analyse the core issues of cloud computing such as security, privacy, interoperability, and its impact on cloud application.

Course Contents:

Module 1: Definition of Cloud Computing and its Basics [8L]

Definition of Cloud Computing: Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public, Private, Hybrid and Community Clouds), Service models – Infrastructure as a Service, Platform as a Service, Software as a Service with examples of services/ service providers, Cloud Reference model, Characteristics of Cloud Computing – a shift in paradigm Benefits and advantages of Cloud Computing [3]

Cloud Architecture: Cloud Infrastructure, Architecture of each components, Virtualization versus Traditional Approach, Virtualization Model for Cloud Computing. [2]

Services and Applications by Type [3]

IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos.

PaaS – Basic concept, tools and development environment with examples

SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platform

Identity as a Service (IDaaS) Compliance as a Service (CaaS)

Module 2: Use of Platforms in Cloud Computing [6L]

Concepts of Abstraction and Virtualization [2L]

Virtualization technologies: Types of virtualization, Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing; Classification of Virtualization Environment: Scheduling-based Environment, Load-Distribution-Based Environment, Energy Aware-Based Environment, Operational-Based Environment, Distributed Pattern-Based Environment, Transactional-Based Environment

Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine imaging (including mention of Open Virtualization Format – OVF) [2L]

Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance

Concepts of Platform as a Service [2L]

Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development.Use of PaaS Application frameworks.

Module 3: Cloud Service Models [6L]

Use of Google Web Services [2L]

Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service.

Use of Amazon Web Services [2L]

Amazon Web Service components and services: Amazon Elastic Cloud, Amazon Simple Storage system, Amazon Elastic Block Store, Amazon SimpleDB and Relational Database Service

Use of Microsoft Cloud Services [2L]

Windows Azure platform: Microsoft‘s approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services

Module 4: Cloud Infrastructure [10L]

Types of services required in implementation – Consulting, Configuration, Customization and Support

Cloud Management [3L]

An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle)

Live Migration of Virtual Machines: [2L]

Need of Live Migration of Virtual Machine, A Designing Process of Live Migration, and Security Issues during live migration.

Concepts of Cloud Security [3L]

Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security, Identity and Access Management.

Auditing and Compliance in Cloud Environment: [2L]

Data Security in Cloud Computing Environment, Need for Auditing in Cloud Computing Environment, Third Party Service Provider, Cloud Auditing Outsourcing Lifecycle Phases, Auditing Classification.

Module 5: Concepts of Services and Applications [6L]

Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs [6]

Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs [2]

Cloud-based Storage: Cloud storage definition – Manned and Unmanned. [1]

Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services [1]

Textbooks:

1.Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India)PrivateLimited,2013

2. Fundamentals of Cloud Computing by P. K. Pattnaik, S. Pal, M. R. Kabat, Vikas Publications, 2014.

Reference Books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013

2. Cloud Computing: A Practical Approach, Anthony T. Velte, Tata Mcgraw-Hill

CO-PO Mapping

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

Course Name: Quantum Computing
Course Code: PEC-CS-T-702
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Discrete Structures

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the basic idea of quantum computing including background of mathematics and physics required for developing and solving complex engineering problem in the domain of quantum computing possibly using modern engineering tools.
CO2	Understand and explain the concept of quantum circuits using single and multiple qubit gates and also designing of quantum circuits for solving engineering problem including societal and environmental issues.
CO3	Compare between classical and quantum information theory and explain and apply Bell states, Quantum teleportation, Quantum Cryptography and no cloning theorem in solving engineering problem possibly in a team maintain proper ethics of professional collaboration.
CO4	Understand, explain and apply different quantum algorithms including classical computation on quantum computers like Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search and also relate between quantum and classical complexity classes for solving engineering problem.
CO5	Understand noise and error correction including graph states and codes, quantum error correction, fault-tolerant computation and apply it in designing and solving complex engineering problems leading to their lifelong learning.

Course Content:

Module 1: Introduction to Quantum Computation: 8L
Quantum bits, Bloch sphere representation of a qubit, multiple qubits. Background Mathematics and Physics: Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.

Module 2: Quantum Circuits: 6L
Single qubit gates, multiple qubit gates, design of quantum circuits.

Module 3: Quantum Information and Cryptography: 6L
Comparison between classical and quantum information theory.Bell states.Quantum teleportation.Quantum Cryptography, no cloning theorem.

Module 4: Quantum Algorithms: 8L
Classical computation on quantum computers.Relationship between quantum and classical complexity classes.Deutsch‘s algorithm, Deutsch‘s-Jozsa algorithm, Shor factorization, Grover search.

Module 5: Noise and error correction: 8L
Graph states and codes, Quantum error correction, fault-tolerant computation.

Text book:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific.
3. Pittenger A. O., An Introduction to Quantum Computing Algorithms

Reference Books:

1. P Kaye, R Laflamme and M Mosca, An Introduction to Quantum Computing.
2. Eleanor G. Rieffel , Wolfgang H. Polak , ‒Quantum Computing - A Gentle Introduction‖ (Scientific and Engineering Computation)
3. Yanofsky's and Mannucci, Quantum Computing for Computer Scientists.
4. Riley Tipton Perry, ‒Quantum Computing from the Ground Up‖, World Scientific Publishing Ltd.
5. Scott Aaronson, ‒Quantum Computing since Democritus‖, Cambridge.
6. P. Kok, B. Lovett, ‒Introduction to Optical Quantum Information Processing‖, Cambridge.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-T-702.1	3	3	3	3	2	-	-	-	-	-	-	2
PEC-CS-T-702.2	3	3	3	3	-	2	2	-	-	-	-	2
PEC-CS-T-702.3	3	3	3	3	-	-	-	2	2	-	-	2
PEC-CS-T-702.4	3	3	3	3	-	-	-	-	-	-	-	2
PEC-CS-T-702.5	3	3	3	3	-	-	-	-	-	-	-	3

CO-PSO Mapping

Cos	PSO1	PSO2	PSO3
PEC-CS-T-702.1	3	2	2
PEC-CS-T-702.2	3	2	3
PEC-CS-T-702.3	3	3	2
PEC-CS-T-702.4	3	3	2
PEC-CS-T-702.5	3	3	3

Name of the Paper: Mobile Computing
Paper Code: PEC-CS-S-702
Contact: =3L/Week
Credit Point: 3
No. of Lectures: 36

Prerequisite:

1. Basic concept of computer network and communication engineering
2. Basic programming knowledge

Course Outcomes (COs):

After attending the course students should be able to

CO1	Illustrate the concepts and working of modern communication technologies.
CO2	Demonstrate the various routing algorithms for both infrastructure based and ad hoc networks.
CO3	Develop mobility and bandwidth management in cellular network
CO4	Design and build an energy efficient and secure mobile computing environment using heterogeneous wireless technologies
CO5	Predict the technical issues related to recent mobile computing environment.

Course Content:

Module 1: Introduction [6L]:

Evolution of different types of wireless communication devices; Effects of mobility of devices; Cellular mobile networks – mobility management (call setup, handoff, interoperability and internetworking), bandwidth management, energy management, security; Brief introduction about different generations of wireless communication technology – 1G, 2G, 3G, 4G, 5G.

Module 2: Mobile Data Communication [5L]

Mobile Data Communication, WLANs (Wireless LANs) IEEE 802.11 standard, Bluetooth technology, Bluetooth Protocols, Ad hoc networks initialization, leader election, location identification, communication protocols, energy and security.

Module 3: Mobility Management in Cellular Networks [4L]

Call setup in PLMN (location update, paging), GPRS, Call setup in mobile IP networks; Handoff management; Mobility models- random walk, random waypoint, Brownian, map-based, group-based.

Module 4: Bandwidth Management in Cellular Mobile networks [3L]

Mathematical formulation of the channel assignment problem (CAP); CAP and generalized graph coloring; Benchmark instances; Lower bound on bandwidth, Genetic algorithms for channel assignment- concept of critical block in a hexagonal cellular network, coalesced CAP, fast near-minimal channel assignment algorithm..

Module 5: Localization of Nodes in a Mobile Network [4L]

Different approaches, Indoor and outdoor localizations, LOS and NLOS signals, Outdoor localization techniques – triangulation (TOA-based, AOA- based), errors due to inaccuracies in coordinates of beacon nodes and in measurements, selection of beacon nodes; Location region identification- computational geometric technique.

Module 6: Message Communication in Ad Hoc Networks [6L]

Collision avoidance mechanism (different schemes for a deterministic transmission schedule), collision resolution mechanism – successive partitioning approach; Time slot assignment based on location information, Point-to-point routing in ad hoc networks – proactive, reactive and hybrid approaches, different protocols - DSDV, DSR, AODV, TORA, ZRP

Module 7: Energy-efficient Communication [3L]

Energy efficiency at various layers - Physical layer, MAC layer, Network layer, Application layer, performance analysis in noisy channel environment.

Module 8: Secure Wireless Communication [4L]

Introduction-different types of attacks, internal attacks, external attacks; measures against attacks (authentication, intrusion detection, encryption); RC4 algorithm, Lightweight cryptographic algorithms; antijamming techniques.

Text books:

1. K. Sinha, S.Ghosh and B. P. Sinha, Wireless Networks and Mobile Computing. CRC Press : New York, 2015.
2. J. Schiller, Mobile Communication, Pearson

3. Yi-Bing Lin & Imrich Chlamtac, Wireless and Mobile Networks Architectures, John Wiley & Sons, 2001
4. Raj Pandya, Mobile and Personal Communication systems and services, Prentice Hall of India, 2001
5. 5. XiangYang Li, Wireless Adhoc and Sensor Networks, Cambridge University Press.

Recommended books:

1. Research articles published on secure wireless communication (authentication, mitigation of DoS, DDoS, eavesdropping) published in leading journals.
2. Mark Ciampa, Guide to Designing and Implementing wireless LANs, Thomson learning, Vikas Publishing House, 2001.
3. P.Stavronlakis, Third Generation Mobile Telecommunication systems, Springer Publishers.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-S-702.1	3	3	3	3								
PEC-CS-S-702.2	3	3	3	3								
PEC-CS-S-702.3	3	3	3	3								
PEC-CS-S-702.4	3	3	3	3								
PEC-CS-S-702.5	3	3	3	3								

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-S-702.1	3	3	3
PEC-CS-S-702.2	3	3	3
PEC-CS-S-702.3	2	3	3
PEC-CS-S-702.4	3	3	2
PEC-CS-S-702.5	3	3	3

Paper Name: Natural Language Processing
Paper Code: PEC-CS-D-702
Contact (Periods/Week): 3L/Week
Credit Point: 3
No. of Lectures: 35

Prerequisite:

1. Solid background in Linear algebra,Probability and Statistics,Artificial Intelligence and Neural Networks.
2. Good Exposure of Python packages.

Course Outcomes (COs):

After attending the course students should be able to

CO1	Analyze and apply the morality and method of Human Languages such as English and other Indian Languages using computers.
CO2	Understand the semantics and pragmatics of English language for text processing
CO3	Create CORPUS linguistics based on digestive approach (Text Corpus method)
CO4	Illustrate, analyze and apply for the modern techniques for statistical approaches to machine translation.
CO5	Analyze and apply the POS tagging for a given natural language and select a suitable language modeling technique based on the structure of the language.

Module 1: Natural Language Processing Basics 8L

What is Natural Language Processing? Different Phases of Natural Language Processing; Linguistics: Language Syntax and Structure, Words, Phrases, Clauses, Grammar, Dependency Grammar, Constituency Grammar, Word-Order Typology; Lemmas and Word forms, Homonyms, Homographs and Homophones, Heteronyms and Heterographs, Polysemes, Capitonyms, Synonyms and Antonyms, Hyponyms and Hypernyms, Stemming and Lemmatization; Representation of Semantics; Text Corpora: Corpora Annotation and Utilities, Accessing Popular Corpora; Parts of Speech Tagging: Training and Building POS Taggers; HMM Part-of-Speech Tagging; NER-Tagging; Relationship Extraction, Temporal Information Extraction, Event Extraction, Template Filling; Conditional Random Fields (CRFs); Shallow Parsing, Chunking; Building Dependency and Constituency Parsers, Application of NLP.

Module 2: Feature Engineering for Text Representation 9L

Pre-processing the Text Corpus;N-gram Language Models, Smoothing; Traditional Feature Engineering Models; Extracting Features for New Documents; Topic Models in Gensim, LDA, LSI, Hierarchical Dirichlet process; Advanced Feature Engineering Models, Word Embedding, Word2Vec Model, The Continuous Bag of Words (CBOW) Model, The Skip-Gram Model; Semantic Analysis: Exploring WordNet, Understanding Synsets, Analyzing Lexical Semantic Relationships, Semantic Relationships and Similarity, Word Sense Disambiguation.

Module 3: Clustering and Classifying Text 9L

Clustering text: Text Similarity, Analyzing Term Similarity, Analyzing Document Similarity; Classifying text: Classification Models, Evaluating Classification Models, Building and Evaluating of the Text Classifier;Sentiment Analysis: Text Pre-processing and Normalization, Unsupervised Lexicon-Based Models, Classifying Sentiment with Supervised Learning, Text Summarization, Question & Answering

Module 4: Deep Learning Architectures for Sequence Processing 9L

Language Models Revisited; Getting words in order with convolutional neural networks (CNNs), Recurrent Neural Networks, Stacked and Bidirectional RNNs; LSTMs and GRUs; Attention, Transformers;Encoder-

Decoder Model, Machine Translation; Beam Search; Text Classification using CNNs and LSTM; Chatbots

Text Books:

1. Bhargav Srinivasa-Desikan, –Natural Language Processing and Computational Linguistics", Packt Publishing
2. Dipanjan Sarkar, –Text Analytics with Python",Apress,ISBN-13 (pbk): 978-1-4842-4353-4
3.Daniel Jurafsky, James H. Martin, "Speech and Language Processing", Pearson Education India,Third Edition.
4. Sumit Raj, "Building Chatbots with Python",Apress,ISBN-13 (pbk): 978-1-4842-4095-3

Reference Books:

1. Francois Chollet, –Deep Learning with Python‖, Manning Publications; 1st edition
2. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, and Harshit Surana, "Practical Natural Language Processing", OReily
3. Hobson Lane, Cole Howard, Hannes Max Hapke, "Natural Language Processing in Action", Manning Publications

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-D-702.1	3	3	3	3								
PEC-CS-D-702.2	3	3	3	3								
PEC-CS-D-702.3	3	3	3	3								
PEC-CS-D-702.4	3	3	3	3								
PEC-CS-D-702.5	3	3	3	3								

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-D-702.1	3	3	3
PEC-CS-D-702.2	3	3	3
PEC-CS-D-702.3	3	3	3
PEC-CS-D-702.4	3	3	3
PEC-CS-D-702.5	3	3	3

Course Name: Cryptography and Network Security
Course Code: PEC-CS-A-702
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites
1. Knowledge of Computer Networks and Operating Systems fundamentals
2. Understanding of Discreet Mathematics concepts

Course Outcomes (COs):

After attending the course students should be able to

CO	Understand cryptography and network security concepts and application.
CO	Apply security principles to system design.
CO	Identify and investigate network security threat
CO	Analyze and design network security protocols.
CO	Conduct research in network security.

Course Contents

Module-1 [7L]

Introduction - Services, Mechanisms, and Attacks, OSI security architecture, Network security model[1L]
Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography) [3L]
Finite Fields and Number Theory: Groups, Rings, Fields, Modular arithmetic, Euclid‘s algorithm[1L]
Polynomial Arithmetic, Prime numbers, Fermat‘s and Euler‘s theorem[1L]
Testing for primality -The Chinese remainder theorem - Discrete logarithms [1L]

Module-2 [9L]

Data Encryption Standard- Block cipher principles, block cipher modes of operation[2L]
Advanced Encryption Standard (AES), Triple DES, Blowfish, RC5 algorithm[3L]
Public key cryptography: Principles of public key cryptosystems, The RSA algorithm[2L]
Key management - Diffie Hellman Key exchange, Elliptic curve arithmetic, Elliptic curve cryptography [2L]

Module-3 [6L]

Authentication requirement, Authentication function, MAC, Hash function [2L]
Security of hash function and MAC, MD5, SHA, HMAC, CMAC [2L]
Digital signature and authentication protocols, DSS, ElGamal, Schnorr [2L]

Module-4 [7L]

Authentication applications, Kerberos, X.509 [1L]
Internet Firewalls for Trusted System: Roles of Firewalls, Firewall related terminology- Types of Firewalls, Firewall designs principles [1L]
SET for E-Commerce Transactions [1L]
Intruder, Intrusion detection system [1L]
Virus and related threats, Countermeasures [1L]
Trusted systems, Practical implementation of cryptography and security [2L]

Module-5 [7L]

E-mail Security: Security Services for E-mail-attacks possible through E-mail, Establishing keys privacy, authentication of the source [1L]
Message Integrity, Non-repudiation, Pretty Good Privacy, S/MIME [2L]
IP Security: Overview of IPSec, IPv4 and IPv6-Authentication Header, Encapsulation Security Payload (ESP) [1L]

Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding) [1L]
Web Security: SSL/TLS Basic Protocol, computing the keys, client authentication [1L]
PKI as deployed by SSL Attacks fixed in v3, Exportability, Encoding, Secure Electronic Transaction [1L]

Textbooks

[1] Kahate, A. (2013). Cryptography and network security.Tata McGraw-Hill Education.
[2] Forouzan, B. A., & Mukhopadhyay, D. (2015). Cryptography and network security. New York, NY: Mc Graw Hill Education (India) Private Limited.

Reference Books

[1] Stallings, W. (2006). Cryptography and network security, 4/E. Pearson Education India.
[2] Daras, N. J., & Rassias, M. T. (Eds.). (2015). Computation, cryptography, and network security (pp. 253-287).Springer.
[3] Kumar, A., & Bose, S. (2017). Cryptography and network security.Pearson Education India.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-A-702.1	3	3	3	2	2							
PEC-CS-A-702.2	3	2	2	2	2							
PEC-CS-A-702.3	2	3	2	2	3							
PEC-CS-A-702.4	2	2	3	2	3							
PEC-CS-A-702.5	3	2	2	2	2							

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-A-702.1	3	3	3
PEC-CS-A-702.2	3	2	2
PEC-CS-A-702.3	2	2	2
PEC-CS-A-702.4	3	3	3
PEC-CS-A-702.5	3	3	3

Course Name: High Performance Computing
Course Code: OEC-CS-701A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:

Computer Architecture Lab, Operating System Lab, Compiler design Lab

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the basic knowledge of Parallel Processing and apply it in solving Complex Engineering Problem.
CO2	Develop and design parallel system with Compute Unified Device Architecture (CUDA) for engineering problem leading to lifelong learning.
CO3	Differentiate and analyze different Design Issues in Parallel Computing and apply the knowledge in solving Complex Engineering Problem including the problem in societal and environmental contexts.
CO4	Understand the limitation of Parallel Computing and apply the knowledge to create and select appropriate techniques, resources, and modern engineering and IT tools to complex engineering problem.
CO5	Understand and distinguish different Power-Aware Computing and Communication system and also different elements of cloud computing services leading to developing new computing system and analyzing of existing one.

Course Content:

Module-I: Parallel Processing Concepts (Quick Overview)[10L]

Levels of parallelism (instruction, transaction, task, thread, memory, function); Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation etc); Architectures: N-wide superscalar architectures, multi-core, multi-threaded.

Module -2: Parallel Programming with CUDA (Compute Unified Device Architecture)[8L]

Processor Architecture, Interconnect, Communication, Memory Organization, and Programming Models in high performance computing architectures: (Examples: IBM CELL BE, Nvidia Tesla GPU, Intel Larrabee Microarchitecture and Intel Nehalem microarchitecture); Memory hierarchy and transaction specific memory design; Thread Organization.

Module -3: Fundamental Design Issues in Parallel Computing :[6L]

Synchronization; Scheduling; Job Allocation; Job Partitioning; Dependency Analysis; Mapping Parallel Algorithms onto Parallel Architectures; Performance Analysis of Parallel Algorithms.

Module -4: Fundamental Limitations Facing Parallel Computing [4L]

Bandwidth Limitations; Latency Limitations; Latency Hiding/Tolerating Techniques and their limitations

Module-5: Power-Aware Computing and Communication [6L]

Power-aware Processing Techniques; Power-aware Memory Design; Power-aware Interconnect Design; Software Power Management.

Module-6: Microservice Architecture- [2L]

Introduction to Docker, Kubernetes and Jenkins.

Textbook:

1. High Performance Cluster Computing, Volume 1, Architecture and Systems, Rajkumar Buyya, Pearson Education.
2. Berman, Fox and Hey, Grid Computing – Making the Global Infrastructure a Reality, Wiley India.
3. Hurwitz, Bllor, Kaufman, Halper, Cloud Computing for Dummies, Wiley India.

Reference Books:

1. Ronald Krutz, Cloud Security, Wiley India.
2. Cloud Computing, A Practical Approach, Anthony Velte, Toby Velte, Robert Elsenpeter, McGrawHill.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
OEC-CS-701A.1	3	3	3	3	2							
OEC-CS-701A.2	3	3	3	3	2							
OEC-CS-701A.3	3	3	3	3	2							
OEC-CS-701A.4	3	3	3	3	2							
OEC-CS-701A.5	3	3	3	3	2							

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
OEC-CS-701A.1	3	3	3
OEC-CS-701A.2	3	3	3
OEC-CS-701A.3	3	3	3
OEC-CS-701A.4	3	3	3
OEC-CS-701A.5	3	3	3

Course Name: Image Processing
Course Code: OEC-CS-701B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:
1. Fourier analysis
2. Linear algebra
3. Probability

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the basic concepts of digital image processing to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
CO2	Understand the fundamental concepts of image enhancement strategies and Identify the scope of enhancement where students can Apply the appropriate strategy and Analyze the performance.
CO3	Illustrate the fundamental image restoration strategies and Apply them appropriately to eliminate noise in the image.
CO4	Illustrate various Image Compression Techniques and Apply them to compress the images and Analyze their performances.
CO5	Understand and Develop ideas to Propose solutions to the problems of Morphological Image Processing and Image Segmentation and Analyze the effectiveness as well as limitations of solutions underscoring its utilitarian importance for further explorations leading towards lifelong learning.

Course Contents:

Module -1: Introduction:[5L]

Digital Image Fundamentals **:** Overview, Computer imaging systems , Digital Image Representation, Fundamental steps in Image Processing **[1L]**, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display **[1L]**. Digital Image Formation: A Simple Image Model, Use and Analysis of Color Models in Image Processing **[2L]**, Sampling & Quantization - Uniform & Non-uniform **[1L]**.

Module -2: Mathematical Preliminaries : [5L]

Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure **[1L]**; Distance Measures, Arithmetic/Logic Operations, Discrete Signals and Systems **[1L]-** A Review – Fourier Transformation, Properties of The Two Dimensional Fourier Transform **[2L]**, Discrete Fourier Transform, Discrete Cosine & Sine Transform **[1L]**.

Module 3: Image Enhancement : [6L]

Spatial Domain: Gray level transformations – Histogram processing **[2L]** Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering – Frequency Domain **[2L]**– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters **[2L]**.

Module -4: Image Restoration, Segmentation and Filtering :[14L]

Image Restoration and Segmentation:Image restoration: noise removal: mean & adaptive filters, degradation model, inverse filter **[2L]**. Discrete Formulation, Algebraic Approach to RestorationUnconstrained & Constrained **[1L]**; Constrained Least Square Restoration, Restoration by

Homomorphic Filtering **[1L]**, Geometric Transformation - Spatial Transformation, Gray Level Interpolation **[1L]**. Image Segmentation : Point Detection, Line Detection, Edge detection, Combined detection **[2L]**,

Module -5: Edge Linking, Boundary Detection and Image compression : [5L]

Edge Linking & Boundary Detection- Local Processing, Global Processing via The Hough Transform **[2L]**; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding**[2L]**; Region Oriented Segmentation - Basic Formulation, Region Growing by PixelAggregation, Region Splitting & Merging **[2L]**, Image compression: system model, lossless methods, lossy methods [2L]

Module -6: Image Representation and Recognition :**[5L]**

Image Representation and Recognition :Boundary representation – Chain Code – Polygonal approximation **[1L]**, signature, boundary segments – Boundary description **[1L]** – Shape number- Fourier Descriptor **[1L]**, moments- Regional Descriptors –Topological feature **[1L]**, Texture – Patterns and Pattern classes – Recognition based on matching **[1L]**.

Text Books:

1. Chanda & Majumder , Digital Image Processing & Analysis, PHI

Reference books:

1. Malay K. Pakhira, Digital Image Processing and Pattern Recognition, First Edition,PHI Learning Pvt. Ltd.,2011.
2. Rafael C. Gonzales and Richard E. Woods, Digital Image Processing, Third Edition,Pearson Education,2010.

CO-PO Mapping

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
OEC-CS-701B.1	3	2	2	2								
OEC-CS-701B.2	3	3	2	3								
OEC-CS-701B.3	3	3	2	2								
OEC-CS-701B.4	3	2	3	2								
OEC-CS-701B.5	3	2	2	2								

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
OEC-CS-701B.1	3	3	3
OEC-CS-701B.2	3	3	3
OEC-CS-701B.3	3	3	3
OEC-CS-701B.4	3	3	3
OEC-CS-701B.5	3	3	3

Course Name: Optimization Techniques
Course Code: OEC-CS-701C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:
Basic Knowledge of Function, plotting of Equation and inequations, Formulation of Mathematical Problem. Finding maximum and minimum from row or column or from Matrix.

Course Outcomes(s):
On successful completion of the learning sessions of the course, the learner will be able to:
CO1: Recall the distinctive characteristics of different types of decision-making problem to formulate and solve a real-world problem a prototype of mathematical problem.
CO2: Understand the theoretical workings of appropriate decision making approaches and tools to identify the optimal strategy in competitive world.
CO3:Apply the principles of different Methods/Model of Operations Research to solve practical problems.
CO4:Analyze different engineering problems linked with Optimization Technique.

Course Content:

Module 1: **10L**

Linear Programming Problem(LPP): Basicsof Linear Programming Problem(LPP) and its Applications. General Mathematical Formulation of LPP; Definitions: Convex set, Solution, Feasible Solution, Basic and Non-Basic Variables, Basic Feasible Solution, Degenerate and Non-Degenerate solution, Optimum/Optimal Solution; Solution of LPP by Graphical Analysis/Method, Simplex Method, Charnes' Big M-Method; Duality Theory.

Module 2:
Transportation Problem, Assignment Problem. **6L**

Module 3:
Game Theory: Introduction**;** Two person Zero Sum game, Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point; Graphical Method; Principle of Dominance. **5L**

Module 4: **5L**
Network Optimisation Models: CPM PERT (Arrow network), Timeestimates, earliest expected time, latest allowable occurrence time, latest allowable occurrence time and stack. Critical path, Probability of meeting scheduled date of completion of project. Calculation of CPM network.Various floats for activities.

Module 5:
Sequencing: Johnson's Algorithm (1957) For **n** Jobs and **two** machines, **n** Jobs and **three** machines. 2**L**

Module 6: . **5L**
Queuing Theory: Introduction and Basic Structure of Queuing Theory; Basic Definations and Notations; Birth and Death Model (Poisson / Exponential distribution); Poisson Queue Models: (M/M/1):(∞/FIFO)and(M/M/1):(N/FIFO) and Problems.

Module 7:
Inventory Control: Determination of EOQ, Components, Deterministic Continuous & Deterministic Periodic Review Models, Stochastic Continuous & Stochastic Periodic Review Models. **3L**

Project Domain:
1. Study on Real life Problem Solve by Simplex Method.
2. Study on Real life Distribution Problem Solve by Transportation Problem.

3. Study on Real life Game / Marketing Problem Solve by Game Theory.
4. Study on Real life Network / Queueing Problem Solve by PERT/CPM and Queueing Theory.
5. Study on Real life Inventory Control Problem Solve by Inventory Control.

Text Books:

1. Operations Research by Kanti Swaroop and P.K. Man Mohan, Sultan Chand and Sons
2. Linear Programming and Theory of Games by Ghosh and Chakraborty, Central Book Agency
3. Linear Programming and Theory of Games by P.M.Karak, ABS Publishing House
4. Operations Research, D.K.Jana & T.K.Roy, Chhaya Prakashani Pvt. Ltd.
5. Operations Research, Kalavati,VIKAS
6. Operations Research,Humdy A Taha,PHI / Pearson

Reference Books:

1. Operations Research Theory and Applications by J.K.Sharma, Macmillan India Limited.
2. Operations Research, Vijayakumar, Scitech
3. Operations Research by S.D. Sharma, Kedar Nath Ram Nath Publishers.
4. Operations Research by A.P. Verma, S. K. Kataria & Sons.
5. Operations Research by P.K. Gupta & Hira, S.Chand
6. Operations Research by V.K. Kapoor

CO-PO Mapping:

PO / CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO2	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO3	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	2	3	1	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

Course Name: Cyber Law and Ethics
Course Code: OEC-CS-702A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:
1. Familiarity in computer Networking.
2. Basic concepts about network security.

Course Outcome(s):
After completion of the course students will be able to
CO1 To **understand the importance of professional practice, Law and Ethics in their personal lives and professional careers.**
CO2 To acquire in depth knowledge of information technology act, security policies, and legal framework of right to privacy, data security and data protection
CO3 Todevelop the understanding of relationship between commerce and cyberspace
CO4 To be familiar with network security threats and countermeasures

Course Contents:
Module – 1: Introduction of Cybercrime [5]
Cybercrime, Forgery, Hacking, Software Piracy, Computer Network intrusion
Criminals plan attacks, passive attack, Active attacks, cyber stalking.

Module – 2: Cybercrime Mobile & Wireless devices[8]
Security challenges in mobile devices, cryptographic security for mobile devices, Attacks on mobile/cell phones, Theft, Virus, Hacking. Bluetooth; Different viruses on laptop.

Module -3: Tools and Methods used in Cyber-crime[7]
Proxy servers, Password checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: Buffer over flowAttacks, Scripts Kiddies and Packaged Defense.

Module – 4: Cybercrime & Cyber security[6]
Phising methods, ID Theft; Online identity method Legal aspects, Indian laws, IT act, Public key certificate, Design of Cyber Security Policy of an Organization ,Unicitral Model Law
Jurisdiction to prescribe/Legislative Jurisdiction; Jurisdiction to adjudicate to enforce; Cyber Jurisdiction in Civil, Criminal & International Cases.

Module -5: Cyber Ethics[5]

The Importance of Cyber Law, Significance of cyber Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block chain Ethics.

Text Books:
1. Cyber security by Nina Gobole&SunitBelapune; Pub: Wiley India.
2. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).
3. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012).
4. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)

Recommended Books:
1. Kenneth J. Knapp, –Cyber Security and Global Information Assurance:
Threat Analysis and Response Solutions‖, IGI Global, 2009.
2. Jonathan Rosenoer, –Cyber law: the Law of the Internet‖, Springerverlag, 1997

3. Sudhir Naib, The Information Technology Act, 2005: A Handbook, OUP, New York,
4. Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi, (2003) .

CO PO Mapping:

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

Course Name: Foreign Language
Course Code: OEC-CS-702C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

French (Open Elective)

Pre-requisites: Basic high school level reading, writing and communication skills in English.

Course Outcomes (COs):

After attending the course students should be able to

CO1	Read basic French and interpret the meaning
CO2	Construct simple sentences in French
CO3	Interact with others and hold simple conversations in French
CO4	Demonstrate a basic knowledge of French culture, manners, geography and world view

Course Content:
Module 1:[6L]
Vocabulaire

- L‘ alphabet français (The Alphabets)
- Les nombres (cardinaux et ordinaux) (Numbers)
- Les mois de l‘année (The Months of the Year)
- Les saisons (The Seasons)
- Les jours de la semaine (The Days of the Week)
- Les couleurs (The Colours)

- La famille (The Family)
- Les nationalités (The Nationalities)

Grammaire

- Les Verbes—*être*, *avoir* et *aller*
- Nouns—Gender and Number
- Les articles (définis, indéfinis, contracté et partitif)
- Les adjectifs—possessifs et demonstraifs

Français Intéractif (Listening and Speaking)

- Les salutations
- Les forms de politesse
- Présentez-vous (About Yourself)

Module:[6L]
Vocabulaire

- L‘heure (the time)
- La maison (the house)
- Le corps (the body)
- Les vêtements (clothes)
- Les professions (professions)

- Les loisirs (pastimes)
- Le sport (Sports)

Grammaire

- Le Verbes—*voir, savoir, venir, aller, sortir, connaître, partir.*
- Les négations
- Le futur
- Les interrogatifs

Français Intéractif (Listening and Speaking)

- Décrivez les images
- La dictée
- Liséz le journal

Module : [6L]

Vocabulaire

- La nourriture (Food)
- Les repas (Meals)
- Les légumes (Vegetables)
- Les fruits (Fruits)
- Les fleurs (Flowers)
- Les animaux (Animals)
- Les oiseaux (Birds)

Grammaire

- Les adverbes
- Les adjectifs
- Les prépositions

***Français Intéractif* (Listening and Speaking)**

- Ecoutez la radio/la télévision
- Dialogues—À la médecin, au café, a la gare

Module: [6L]

Vocabulaire

- Le jardin (The Garden)
- Le temps (the weather)
- Les voyages (Travel)
- La ville (the City)
- Les vacances (Holidays)

Grammaire

- Pronoms interrogatifs
- Mood—subjonctif et l'impératif

Français Intéractif (Listening and Speaking)

- Se présenter (expressing ideas/opinions on general topics)
- Ecoutez le programme sur la radio/la télévision

Module 5: [6L]

Vocabulaire

- Les modes de transport (Transport)

- L‘Ecole (the School)
- À la Campagne (in the Country)
- À la restaurant (at the Restaurant)
- Le Cinema (at the Cinema)
- La Marché (at the Market)

Grammaire

- Passé Composé
- Passé Récent

Ecrivez en Françáis (Writing)

- Decrivez votre ville
- Decrivez votre maison/appartement
- Qu‘est que son métier?

Module 6:[6L]

En France

- Les villes de France (the Cities of France)
- Les montagnes et rivières de France (Mountains and Rivers)
- La geographie de France (Geography of France)
- La gastronomie françáise (French Food and Gastronomy)
- Le fêtes (Festivals of France)

Grammaire

- Les Verbes Pronominaux
- Les Pronoms Personnels

Ecrivez en Franćais (Writing)

- Decrivez votre vacation à l'mer
- Quels sont les loisirs préféres?
- Les magazins de supermarché

Recommended Texts:

1. *Le Nouveau Sans Frontières-1 (*Paris: CLE International, 1999)
2. Dondo, *Modern French Course* (1930, Oxford:Oxford UP, 1999)
3. Dictionnaire Larousse

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
OEC-CS-702C.1						3	3					
OEC-CS-702C.2						3	3					
OEC-CS-702C.3						3	3					
OEC-CS-702C.4						3	3					
OEC-CS-702C.5						3	3					

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
OEC-CS-702C.1	2	2	2
OEC-CS-702C.2	2	2	2
OEC-CS-702C.3	2	2	2
OEC-CS-702C.4	2	2	2
OEC-CS-702C.5	2	2	2

Course Name: Information Theory and Coding Lab
Course Code: PEC-CS-T-791
Contact: 0:0:3
Credits: 1.5

Prerequisites: Knowledge of C programming and MATLAB

Course Outcome(s):

After completion of the course students will be able to

CO1 Understand and use proper code in appropriate platform using suitable syntax for developing program to solve problems related to Mathematics and Engineering field leading to lifelong learning.

CO2 Identify and use variables, constants, data type, operator, expression, statements, loops, vector, matrix, array, function, file handling to design the problem using modern tools for solving complex engineering problems.

CO3 Apply a top-down, modular, and systematic approach to construct the programs to solve the problem as a professional engineering practice.

CO4 Apply a variety of common numeric techniques to solve and analyse engineering-related computational problems.

CO5 Interpret the result of the experiments, prepare laboratory reports based on observed output and analyse it to validate professional ethics and responsibilities and norms of the engineering practice.

Course Content:

Module-1:

Revision on programming using C language. Familiarization with MATLAB environment setup, syntax, variables, commands, data types, operators, decisions, loops, vectors, matrix, arrays, functions, and advanced part, creating and editing basic MATLAB program in an editor, compilation and execution of MATLAB program.

Module-2:

Determination of various entropies and mutual information using C/MATLAB of the following channels
Noise free channel
Noisy channel

Module-3: Generation and evaluation of following variable source coding using C/MATLAB
Shannon – Fano coding
Huffman Coding and Decoding
Lempel Ziv Coding and Decoding

Module-4: Coding &Decoding of the following codes using C/MATLAB
Linear block codes
Cyclic codes
Convolutional codes

Module-5: Coding &Decoding of the following codes using C/MATLAB
BCH code
RS code

Module-6: Problem based on
Coded and uncoded communication system (Calculate the error probability) using C/MATLAB.
Source coding and channel coding for transmitting a text file using C/MATLAB.

Text book:

1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Process Control – A First Course with MATLAB - Pao C. Chau; Cambridge University Press

Reference Books:

1.Introduction to Information Theory - M Mansurpur; McGraw Hill.
2. Information Theory - R B Ash; Prentice Hall.
3. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.
4. Information and Coding - N Abramson; McGraw Hill.

CO-PO Mapping:

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

Paper Name: Ad-Hoc and Sensor Networks Lab
Paper code: PEC-CS-S-791
Contact: 0:0:3
Credit Point: 1.5

Course Outcome(s):
At the end of the course, the student would be able to:

CO1:Know the basics of Ad hoc networks and Wireless Sensor Networks
CO2:Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement
CO3:Apply the knowledge to identify appropriate physical and MAC layer protocols
CO4:Understand the transport layer and security issues possible in Ad hoc and sensor networks.
CO5:Be familiar with the OS used in Wireless Sensor Networks and build basic modules

List of Experiments:

1 Introduction of Wireless sensor network applications and its simulation

2 Network Simulator installation of wireless sensor network.

3 Implementation of routing protocol in NS2 for DSR protocol

4 Study other wireless sensor network simulators (Mannasim. Contiki)

5 Implementation of routing protocol in NS2 for AODV protocol for TORA protocol

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

Course Name: Data Mining and Data Warehousing Lab
Course Code: PEC-CS-D-791
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Data Structure& Programming, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence, Python Programming

Course Outcomes:
After completion of the course students will be able to
CO1: Understand and use the fundamental concepts of the evolving technologies in Data Mining and Data Warehousing through implementing them using proper techniques and tools to recognize their utilitarian importance in current technological context for further exploration leading towards lifelong learning.
CO2 :Identify and formulate an engineering problem by exploring contextual data and its characteristics within the scope of Data Mining and Data Warehousing paradigm.
CO3 :Explore relevant literature and apply the concepts of Data Mining and Data Warehousing by implementing well-known algorithmic solutions using proper techniques and tools to solve contextual problems.
CO4 :Develop ideas and propose technical solutions to the challenging problems of Data Mining and Data Warehousing.
CO5 :Plan and Implement Data Mining based ideas as executable programs(preferably termed as models)by developing suitable algorithms with adequate documentation in collaborative environment for successfully carrying out projects on Data Mining and Data Warehousing and investigate their effectiveness by analyzing the performances using proper techniques and tools.

Course Content:
WEEK-1:
Introduction to Data Mining Programming Platform 3L
Introduction to Data Mining Programming Platform and Data Exploration: Data Types, Data Attributes, Statistical Description of Data, Data Visualization, Data Feature Vectors, Data Preprocessing: Data Cleaning, Data Transformation 3L

WEEK -2:
Affinity Analysis 3L
Implementation and Analysis of Recommending Engine 3L

WEEK -3:Association Analysis 3L Implementation
and Analysis of Apriori Algorithm 3L

WEEK -4:Regression 3L
Implementation and Analysis of Linear and Nonlinear Regression Methods 3L

WEEK -5:Classification 3L
Implementation and Analysis of k-Nearest-Neighbor Classifier, Decision Tree Classifier, Naïve Bayes Classifier 3L

WEEK -6:Classification 3L
Implementation and Analysis of ANN-Backpropagation and SVM Based Classifier

WEEK-7: Clustering 3L
Implementation and Analysis of k-Means and k-Medoids 3L

WEEK -8:Mining Time-Series Data 3L
Implementation and Analysis of Time-Series Data Mining Models 3L

WEEK -9:
DiscussiononProject Problems and Allocation (Problem Description Report Submission) 3L

WEEK -10: DesigningSolution Model and Proposal Report Submission 3L

WEEK -11:ProjectImplementation, Verification and Documentation 3L

WEEK -12: Project Demonstration and Project Report Review 3L

Textbook:
1. Han J &Kamber M, ‒Data Mining: Concepts and Techniques‖, Morgan Kaufmann Publishers, Third Edition.
2. Parteek Bhatia, ‒Data Mining and Data Warehousing: Principles and Practical Techniques‖, Cambridge University Press.

Reference Books:
1. Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, ‒Introduction to Data Mining‖, PearsonEducation.
2. Robert Layton, ‒Learning Data Miningwith Python‖, Packt Publishing

CO–PO Mapping:

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

Paper Name: Cloud Computing Lab
Code: PEC-CS-A-791
Contacts: 0:0:3
Credits: 1.5

Prerequisite:

1. Should have basic knowledge on C and JAVA programming.
2. Prior knowledge on Operating System

Course Outcome (s):

On completion of this course, the students will be able to:
CO1 Configure various virtualization tools such as Virtual Box, VMware workstation.
CO2 Design and deploy a web application in a PaaS environment.
CO3 Learn how to simulate a cloud environment to implement new schedulers.
CO4 Install and use a generic cloud environment that can be used as a private cloud.

Experiments:

1. Installation of VMware Workstation on windows OS (version windows 7 to 10).
2. Installation of C compiler and execute simple programs of C using virtual machine.
3. Create a hello world application and other simple web applications using python/java in Google App Engine.
4. Launching of web applications using GAE launcher.
5. Creating a cloud environment using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Transferring the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
8. Install Hadoop single node cluster and run simple applications like wordcount.

CO-PO Mapping:

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

Course Name: High Performance Computing Lab
Course Code: OEC-CS-791A
Contact: 0:0:3
Total Contact Hours: 36
Credits: 1.5

Prerequisites:

Computer Architecture Lab, Operating System Lab, Compiler design Lab

Course Outcome(s):

After completion of the course students will be able to
CO1 :Understand, design and develop effective programs for engineering and mathematical problems applying device Query, Vector Addition, different Matrix Multiplication, different Image processing algorithms using Xeon Phi Programming or modern programming tools leading to lifelong learning.
CO2 :Understand, design and develop effective programs for engineering and mathematical problems applying device Query, Vector Addition, different Matrix Multiplication, different Image processing algorithms using OpenMPI programming or modern programming tools leading to lifelong learning.
CO3 :Design and develop effective programs for engineering and mathematical problems like DAXPY, Matrix Multiply, Calculation of pi using work sharing and reduction, Producer consumer problem, Molecular dynamics simulation using Open MPI programming possibly as a team maintaining proper ethics of collaboration.
CO4 :Implement and analyze program for engineering and mathematical problems like DAXPY, Calculation of π - MPI Bcast and MPI Reduce, Ocean Kernel, and also for different Large Matrices using MPI programming leading to lifelong learning.
CO5: Prepare laboratory reports on interpretation of experimental results and analyze it for validating the same maintaining proper ethics of collaboration.

Course Content:

Device Query, Vector Addition, Matrix Multiplication, Tiled Matrix Multiplication, Picture Scaling, Image Blur, Image Grayscaling. 1D, 2D, and 3D Stencil Operations. Histogramming, Convolution, Scan, Reduction using Xeon Phi Programming (3 Labs)

Vector Addition, Matrix Multiplication, Tiled Matrix Multiplication, Picture Scaling, Image Blur, Image Grayscaling. 1D, 2D, and 3D Stencil Operations. Histogramming, Convolution, Scan, Reduction using OpenMPI programming (3 Labs)

DAXPY, Matrix Multiply, Calculation of pi using worksharing and reduction, Producer consumer problem, Molecular dynamics simulation problem using Open MPI programming (3 Labs)

DAXPY, Calculation of π - MPI Bcast and MPI Reduce, Ocean Kernel, Reduction example, Collective Communication - Scatter – Gather, MPI Derived Datatypes, Matrix Multiplication on a Cartesian Grid (2D Mesh) using Cannon‘s Algorithm, Martix Multiplication using Cannon‘s Algorithm for Large Matrices using MPI programming. (3 Labs)

Textbook:
1. High Performance Cluster Computing, Volume 1, Architecture and Systems, Rajkumar Buyya, Pearson Education.
2. Berman, Fox and Hey, Grid Computing – Making the Global Infrastructure a Reality, Wiley India.
3. Hurwitz, Bllor, Kaufman, Halper, Cloud Computing for Dummies, Wiley India.

Reference Books:
1. Ronald Krutz, Cloud Security, Wiley India.
2. Cloud Computing, A Practical Approach, Anthony Velte, Toby Velte, Robert Elsenpeter, McGrawHill.

CO–PO Mapping:

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

Course Name: Image Processing Lab
Course Code: OEC-CS-791B
Contact: 0:0:3
Contact Hours: 33
Credits: 1.5

Prerequisite:
Should have prior knowledge on syntaxes of programming like C++, JAVA.

Course Outcome(s):

After completion of the course students will be able to
CO1: Acquire the fundamental concepts of a digital image processing system such as image acquisition, enhancement, segmentation, transforms, compression, morphology, representation and description.
CO2: Analyze images in the spatial domain.
CO3: Analyze images in the frequency domain through the Fourier transform.
CO4: Design and implement with MATLAB algorithms for digital image processing operations such as point processing, histogram processing,
CO5: Spatial and frequency domain filtering, denoising, transforms, compression, and morphological processing.

Experiments:
1. W.A.P in MATLAB to extract different attributes of an Image.
2. W.A.P in MATLAB program for Image Negation.
3. W.A.P in MATLAB for Power Law Transformation.
4. W.A.P in MATLAB for Histogram Mapping and Equalization.
5. W.A.P in MATLAB for Image Smoothening and Sharpening.
6. W.A.P in MATLAB for Edge Detection using Sobel, Prewitt and Roberts Operators.
7. W.A.P in MATLAB for Morphological Operations on Binary Images.
8. W.A.P in MATLAB for Pseudo Colouring of images.
9. W.A.P in MATLAB for Chain Coding applied on images.
10. W.A.P in MATLAB for DCT/IDCT Computation.

CO-PO Mapping:

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

Course Name: Optimization Techniques Lab
Course Code: OEC-CS-791C
Contact: 0:0:3
Contact Hours: 33
Credits: 1.5

Course Outcome(s):

After the completion of the course, the students will be able to
1. Demonstrate the basic principles and concepts of Python
2. Explore the applicability of programming skills in Python.
3. Summarize various optimization techniques like LPP models.
4. Analyse the transportation, inventory and assignment problems.
5. Explain the concepts of sequencing, game theory and dynamic programming.

List Of Experiments (Includes but Not Limited to)

1. Matrix Operations
2. Minimum Cost Path
3. Finding Maximum Number in An Array
4. Array Sorting
5. Linear Programming Problem
6. Queuing Problem
7. Sequencing Problem
8. Game Theory
9. Assignment Problem
10. Dynamic Programming Problem
11. Inventory Problem

Recommended Books :

1. Foulds, L. R. (2012). Optimization techniques: an introduction. Springer Science & Business Media.
2. Onwubolu, G. C., & Babu, B. V. (2013). New optimization techniques in engineering (Vol. 141). Springer.
3. Lopez, C. (2014). MATLAB optimization techniques. Apress.

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

Course Name: Entrepreneurship & Innovation skill
Course Code: MC701
Contacts: 2L:0T:0P
Total Contact Hours: 24
Credit: 0

Prerequisite: None

Course Outcome(s):

After the completion of the course, the students will be able to:
CO1: Comprehend the role of bounded rationality, framing, causation and effectuation in entrepreneurial decision making.
CO2: Demonstrate an ability to design a business model canvas.
CO3: Evaluate the various sources of raising finance for startup ventures.
CO4: Explain the fundamentals of developing and presenting business pitching to potential investors.

Course Content

Module 1:[4L]

Introduction to Entrepreneurship: Entrepreneurs; entrepreneurial personality and intentions - characteristics, traits and behavioral; entrepreneurial challenges. Entrepreneurial Opportunities: Opportunities. discovery/ creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering.

Module 2: [4L]

Entrepreneurial Process and Decision Making: Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches, Effectuation and Causation; Advantage and Limitations of Entrepreneurship; Process of Entrepreneurship.

Module 3:[4L]

Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer focused innovation; building and analyzing business models; Business model canvas, Introduction to lean startups, Business Pitching.

Module 4: [4 L]

Organizing Business and Entrepreneurial Finance: Forms of business organizations; organizational structures; Evolution of Organisation, sources and selection of venture finance options and its managerial implications.Policy Initiatives and focus; role of institutions in promoting entrepreneurship.

Module 5: [4L]

Entrepreneurs as problem solvers: Innovations and Entrepreneurial Ventures – Global and Indian; Role of Technology – E-commerce and social media; Social Entrepreneurship – Concept; Entrepreneurship – The Indian Scenario

Module 6: [4 L]

Project/Case Study: (Any One)

1. Visit of the District Industries Centre and prepare a report of activities and programs undertaken by them
2. Conduct a case study of any entrepreneurial venture in your nearby area.
3. Field Visit: Visit any business firm near your locality; interact with the owner of the business firm and prepare a field report on parameters like: type of business, scale of business, product/service dealing in, target customer, problems faced and measures to solve the faced challenges. 4. Know your State Handicraft and Handlooms as a means of economic activity

Text Books:

1. Bessant, J. (2003) High Involvement Innovation: Building and Sustaining Competitive Advantage Through Continuous Change. Chicester: John Wiley & Sons.
2. Bygrave, W and Zackarakis, A (2013) Entrepreneurship, 3rd Edition, John Wiley and Co. Drucker, P. (1999) Innovation and Entrepreneurship, Butterworth Heinemann, Oxford.

Reference Books:

1. Fagerberg, J, Mowery, DC and Nelson, RR (2005) The Oxford Handbook of Innovation, Oxford University Press, NY.
2. Hisrich, R.D., Peters, M.P., and Shepherd, D. (2013) Entrepreneurship, McGraw-Hill Irwin, Boston.
3. Kuratko, D. (2013) Entrepreneurship: Theory, Process, and Practice, 9th Edition, Wiley online library.
4. Moore, Geoffrey, (1999) Crossing the Chasm, Harper & Collins.
5. Porter, ME, Competitive Advantage: Creating and Sustaining Superior Performance, Free Press, New York, NY, 1985

CO-PO Mapping:

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

4th Year 2nd Semester: 8th Semester								
Sl No	**Course Code**	**Paper Code**	**Theory**	**Contact Hours /Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A. THEORY								
1	Professional Elective courses	PEC-CS-T-801	Advance Graph Algorithms	3	0	0	3	3
		PEC-CS-S-801	Real Time System					
		PEC-CS-D-801	Data Analytics					
		PEC-CS-A-801	Computer Graphics					
2	Open Elective courses	OEC-CS-801A	Human Resource Development and Organizational Behavior	3	0	0	3	3
		OEC-CS-801B	VLSI					
		OEC-CS-801C	Simulation and Modeling					
3	Open Elective courses	OEC-CS-802A	Values and Ethics in Profession	3	0	0	3	3
		OEC-CS-802B	History of Science					
		OEC-CS-802C	Economic Policies in India					
B. PRACTICAL								
4	PROJECT	PR 891	Major Project-II	0	0	0	12	6
5	PROJECT	PR 892	Grand Viva	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
6	MC	MC 801	Essence of Indian Knowledge Tradition	0	0	3	3	3 Units
TOTAL CREDIT								16

Course Name: Advanced Graph Algorithms
Course Code: PEC-CS-T-801
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Discrete Mathematics, Graph Theory

Course Outcomes (COs):
After attending the course students should be able to

CO1	To understand the basic concept of Graph theory and Graph Algorithm and apply them in designing solution to Computer Science and engineering domain problem.
CO2	To demonstrate the basic concept of graph implementation programming and use of data structure to represent graph for developing the solution to the graph based problems in computer science domain
CO3	To formulate graph algorithms and programs in solving Computer science and engineering problem leading to lifelong learning and Analyze the efficiency of algorithms using time and space complexity.
CO4	To apply the graph theory principles and concepts to design an efficient algorithm and use suitable data structure for problem solving.
CO5	To develop better algorithm in compare to some existing algorithm and create new efficient data structures for solving many graph based real life problem in Computer science domain.

Course Content:

Module- 1:[6L]
Fundamental concept of Graph :Definition of Graphs, Representations of graphs, degree sequences, distance in graphs, complete, regular and bipartite graphs, basic properties of Paths, Cycles, and Trails, Connection,Bipartite Graphs, Eulerian Circuits, Vertex Degrees and Counting, Degree-sum formula**.**

Module- 2:[5L]
Graph traversal algorithm-Introduction to Graphs & its Applications:Breadth-first search and tree, Depth-first search and tree , Topological sort, Strongly connected components

Module-3:[5L]
Trees and connectivity –Properties of trees, vertex and edge,connectivity, Mengers theorem, Minimum Spanning Trees, Growing a minimum spanning tree, The algorithms of Kruskal and Prim

Module-4: [5L]
Shortest Paths problem: Single-source shortest paths in directed acyclic graphs, Dijkstra‘s algorithm, The Bellman-Ford algorithm, All-Pairs Shortest Paths, The Floyd-Warshall algorithm

Module -5: [7L]
Flow networks problem: The Ford-Fulkerson method, Maximum bipartite matching, Cuts and Connectivity, k-Connected Graphs, Max-Flow Min-cut Theorem, Menger's Proof using Max-Flow Min-Cut Theorem.

Module-6: [4L]
Planar Graphs, Characterization of Planar Graphs, Kuratowski's Theorem, Wagner's Theorem,Graph-coloring, Hamiltonian Graph, Traveling Salesman Problem

Module- 7: [4L]
Matchings and Covers: Hall's Condition, Min-Max Theorem, Independent Sets, Covers and Maximum Bipartite Matching, Augmenting Path Algorithm, Weighted Bipartite Matching, Hungarian Algorithm, Stable Matchings and Faster Bipartite Matching, Factors & Perfect Matching in General

Text Books:
1. Graph Theory, by J. A. Bondy and U. S. R. Murthy, Springer Verlag (2008.)
2. Introduction to Graph Theory,by D. B. West, PHI, 2004.
3. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, ‐Introduction to Algorithms‖

Reference Books:
1 Graph Theory, by R. Diestel : Springer Verlag (Free Download available).(2003)
N. Deo, Graph Theory, Prentice Hall of India, 1974.
2. E.M.Reingold, J.Nievergelt and N.De0‐Combinational AlgorithmsTheory and Practice‖, Prentice Hall.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-T-801.1	2	2	2	2								2
PEC-CS-T-801.2	3	3	3	3								2
PEC-CS-T-801.3	3	3	3	3								2
PEC-CS-T-801.4	3	3	3	3								2
PEC-CS-T-801.5	3	3	3	3								2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-T-801.1	3	3	3
PEC-CS-T-801.2	3	3	3
PEC-CS-T-801.3	3	3	3
PEC-CS-T-801.4	3	3	3
PEC-CS-T-801.5	3	3	3

Course Name: Real Time Systems
Course Code: PEC-CS-S-801
Contact: 3:0:0
Total Contact Hours:36
Credit:3

Prerequisites:

1. Concepts of Operating systems and Algorithm.
2. Knowledge of Distributed System basics.

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the concepts of Real-Time systems
CO2	Recognize the characteristics of a real-time system
CO3	Understand and develop document on an architectural design of a real-time system.
CO4	Develop and document Task scheduling, resource management, real-time operating systems and fault tolerance applications of real-time systems.
CO5	Apply the basics of RTOS in interpretation of real time systems.

Course Contents:

Module-1: Introduction [8L]

Definition, Typical Real Time Applications: Digital control, High Level Controls, Signal processing etc. , Release Times, Deadline period and time constraints, Hard and soft real time systems, Reference models for RTOS: Processors and Resources, Temporal parameters of Real-time workload, Periodic Task Model, Precedence Constraints and Data Dependency.

Module-2: Real Time Scheduling. [8L]

Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Stack-Time-First (LST) algorithms, Rate Monotonic algorithm, Offline versus Online Scheduling.

Module-3: Resources Sharing. [8L]

Effect of Resource Contention and Resource Access Control (RAC), Non-pre-emptive Critical Sections, Basic Priority- Inheritance and Priority-Ceiling Protocols, Stack based Priority Ceiling Protocol, Use of Priority Ceiling Protocol in Dynamic priority systems, Pre-emption Ceiling Protocol, Access control in Multiple Module Resources, Controlling Concurrent Accesses to Data Objects.

Module-4: Real Time Communication. **[6L**]

Basic Concepts of Real time Communication, Soft and Hard real-time Communication systems, Model of Real-time Communication, Priority based service and Weighted Round Robin Service disciplines for switched Networks, Medium Access control protocols for broadcast networks, Internet and resource reservation protocols

Module-5: Real Time Operating Systems and Databases. **[6L]**

Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic of temporal data, temporal consistency, on-currency Control, and Overview of Commercial Real Time databases.

Text Books

1. Real Time Systems – Jane W. S. Liu, Pearson Education Publication

Reference Books

1. Real Time Systems – Mall Rajiv, Pearson Education
2. Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-S-801.1	3	3	3	3	2							3
PEC-CS-S-801.2	3	3	3	3	2							3
PEC-CS-S-801.3	3	3	3	3	2							3
PEC-CS-S-801.4	3	3	3	3	2							3
PEC-CS-S-801.5	3	3	3	3	2							3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-S-801.1	3	3	3
PEC-CS-S-801.2	3	3	3
PEC-CS-S-801.3	3	3	3
PEC-CS-S-801.4	3	3	3
PEC-CS-S-801.5	3	3	3

Course Name: Big Data Analytics
Course Code: PEC-CS-D-801
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence, Programming skills of Python.

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand and explain the fundamental concepts of the Big Data Analytics which are primarily explored for making automated decisions using machine learning strategies on analyzing large scale structured as well as unstructured data distributed across multiple locations (Map Reduce, Hadoop and No SQL Framework) underscoring the utilitarian importance in current technological context for further exploration leading towards lifelong learning.
CO2	Identify and formulate an engineering problem of analyzing large scale data distributed across multiple locations to make automated meaningful decisions within the scope of Big Data Analytics Frameworks.
CO3	Explore relevant literature and apply the concepts of Big Data Analytics to solve problems of making automated decisions dealing with large scale structured as well as unstructured data using Map Reduce, Hadoop and advanced SQL Frameworks.
CO4	Excogitate ideas for proposing solutions to the challenging problems of Big Data Analytics.
CO5	Implement ideas of Big Data Analytics through developing feasible algorithms or frameworks and investigate their effectiveness in solving the relevant problems by analyzing the performances using proper techniques.

Course Content:

Module – 1: Introduction to Basic Analytics [10L]

Introduction: Big data overview, Analyst‘s perspective on data repositories, Current analytical architecture, Drivers of big data, Examples of big data analytics.

Life Cycle of Data Analytics:Phase 1: Discovery, Phase 2: Data preparation, Phase 3: Model planning, Phase 4: Model building, Phase 5: Communication of results, Phase 6: Making operational.

Basic Analytic Methods: Visualization, Dirty data, Data exploration versus presentation, Statistical methods for evaluation – hypothesis testing, difference of means, rank sum test, type I and type II errors, ANOVA.

Module - 2: Advanced Analytic Methods I [8L]

Clustering: Overview, K-means, Determining the number of clusters, Diagnostics.

Association Rules: Overview, Apriori algorithm, Evaluation of candidate rules, Application of association rules, Validation and testing, Diagnostics.

Regression: Linear regression - model description, Logistic regression – model description, Other regression models.

Classification: Decision trees – overview, General algorithm, Decision tree algorithms, Evaluating a decision tree, Naïve Bayes – Bayes theorem, Naïve Bayes classifier, Diagnostics of classifiers.

Module – 3: Advanced Analytic Methods II [8L]

Time Series Analysis: Overview, Box-Jenkins methodology, Autocorrelation function (ACF), Autoregressive model, Moving average model, ARMA and ARIMA model, Building and evaluating an ARIMA model.

Text Analysis: Steps in text analysis, Collecting raw text, Representing text, Term Frequency-Inverse Document Frequency (TFIDF), Categorizing documents by types, Determining sentiments.

Map Reduce and Hadoop:Analytics for unstructured data – map reduce, Apache Hadoop, Hadoop Ecosystem – Pig, Hive, Hbase, Mahout.

Module – 4: Advanced Analytic Methods III [10L]

Technology and Tools: SQL essentials - Join, Set, Grouping extensions, Advanced SQL – Window functions, User-defined functions, Ordered aggregates, MADlib, NoSQL.

Integration of Techniques: Communicating and operationalizing an analytic project.

Creating final deliverables – Developing core materials, project goals, Main findings, Approach, Model description and model details, Recommendations, Providing technical specifications and code.

Data visualization basics - Key points, evolution of a graph, common representation methods, how to clean up a graphic.

Textbook:

1. EMC Education Services (Editor), Data Science and Big Data Analytics. John Wiley & Sons, 2015.
2. Mike Barlow, Real-Time Big Data Analytics: Emerging Architecture. O'Reilly, 2013.

ReferenceBooks:

1. Nathan Marz and James Warren, Big Data: Principles and Best Practices for Scalable Real-time Data Systems. Manning Publications, 2015.

2. Venkat Ankam, Big Data Analytics. Packt Publishing Ltd., UK, 2016.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-D-801.1	3	2	2	1								3
PEC-CS-D-801.2	3	3	3	2								3
PEC-CS-D-801.3	3	3	2	3								3
PEC-CS-D-801.4	2	3	2	2								3
PEC-CS-D-801.5	3	2	2	3								3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-D-801.1	3	2	2
PEC-CS-D-801.2	3	3	2
PEC-CS-D-801.3	3	2	3
PEC-CS-D-801.4	2	2	3
PEC-CS-D-801.5	2	3	3

Course Name: Computer Graphics
Course Code: PEC-CS-A-801
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Mathematics,ComputerFundamentals&PrincipleofComputerProgramming

Course Outcomes (COs):
After attending the course students should be able to

CO1	Understand the fundamental concept of Computer graphics and mathematical knowledge and explain the foundations of computer graphics and different display technology and devices.
CO2	Demonstrate different scan conversion algorithms, drawing algorithms, polygon filling algorithms, curves and surface drawing algorithms, clipping algorithms, surface removal algorithms using graphics tools.
CO3	Understand the basic concept of graphics programming and implement clipping with the comprehension of windows, view-ports in relation to images display on screen.
CO4	Analyze and compare different drawing algorithms, polygon filling algorithms, curves and surface drawing algorithms hidden surface illumination methods
CO5	Develop the concept of geometric models, mathematical and algorithmic approach necessary for programming computer graphics leading to lifelong learning.

Course Content:
Module – 1: [4L] Introduction:Objective, applications, GKS/PHIGS, normalized co-ordinate system, aspect ratio.

Module -2 :[4L] Graphics System:Vector and raster graphics, various graphics display devices, graphics interactive devices, segmented graphics, attribute table.

Module -3 :[4L] Raster Scan Graphics:Line drawing algorithms, circle/ellipse drawing algorithms, polygon filling algorithms.

Module -4 :[4L] Geometric Transformation: Homogeneous co-ordinate system, 2D and 3D transformations, projection— orthographic and perspective.

Module – 5 :[4L] Curves and Surfaces: Curve approximation and interpolation, Lagrange, Hermite, Bezier and BSpline curves/surfaces and their properties, curves and surface drawing algorithms.

Module – 6 :[4L] Geometric modelling: 3D object representation and its criteria, edge/vertex list, constructive solid geometry, wire-frame model, generalized cylinder, finite element methods.

Module – 7 :[4L] Clipping :Window and viewport, 2D and 3D clipping algorithms.

Module –8:[4L] Hidden Lines and Hidden Surfaces:Concept of object- and image-space methods, lines and surface removal algorithms.

Module – 9 :[4L] Intensify, Coloring and Rendering:RGB, YIQ, HLS and HSV models and their conversions, gamma correction, halftoning. Illumination models, polygon mesh shading, transparency, shadow, texture.

Text Books

1. D. Hearn and P. M. Baker: Computer Graphics, 2nd ed. Prentice Hall of India, New Delhi, 1997.
2. W. M. Newman and R. F. Sproull: Principles of Interactive Computer Graphics, McGraw Hill, New Delhi, 1979.

Reference Books

1. F. S. Hill: Computer Graphics, McMillan, New York, 1990.
2. D. P. Mukherjee: Fundamentals of Computer Graphics and Multimedia, Prentice Hall of India, New Delhi, 1999.
3. J. D. Foley et al.: Computer Graphics, 2nd ed., Addison-Wesley, Reading, Mass., 1993.
4. W. K. Giloi: Interactive Computer Graphics: Data Structure, Algorithms, Languages, Prentice Hall, Englewood Cliffs, 1978.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC-CS-A-801.1	3	3	3	3	3							3
PEC-CS-A-801.2	3	3	3	3	3							3
PEC-CS-A-801.3	3	3	3	3	3							3
PEC-CS-A-801.4	3	3	3	3	3							3
PEC-CS-A-801.5	3	3	3	3	3							3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PEC-CS-A-801.1	3	3	3
PEC-CS-A-801.2	3	3	3
PEC-CS-A-801.3	3	3	3
PEC-CS-A-801.4	3	3	3
PEC-CS-A-801.5	3	3	3

Paper Name: Human Resource Development and Organizational Behaviour
Paper Code: OEC-CS-801A
Contacts: 3:0:0
Credits: 3
No. of lectures: 36

Course Outcome(s):

At the end of the course students are able to:
CO1:To understand key functions in management as applied in practice.
CO2:To identify and analyse major practices associated with HRD in modern work and organisations;
CO3:To evaluate the connections between the HRD process and the contemporary performance management concerns of organisations
CO4:To analyse the behaviour of individuals and groups in organisations in terms of the key factors that influence organisational behaviour.

CO5:To assess the potential effects of organisational-level factors (such as structure, culture and change) on organisational behaviour.
CO6:To evaluate the potential effects of important developments in the external environment (such as globalisation and advances in technology) on organisational behaviour
CO7: To analyse organisational behavioural issues in the context of organisational behaviour theories, models and concepts.
CO8: To develop theoretical and practical insights and problem-solving capabilities for effectively managing the organisational processes

Course Contents:

Module – 1 HRD-Macro Perspective: HRD Concept, Origin and Need, HRD as a Total System; Approaches to HRD; Human Development and HRD; HRD at Macro and Micro Climate. **3L**

Module -2 HRD–Micro Perspective: Areas of HRD; HRD Interventions Performance Appraisal, Potential Appraisal, Feedback and Performance Coaching, Training, Career Planning, OD or Systems Development, Rewards, Employee Welfare and Quality of Work Life and Human Resource Information; Staffing for HRD: Roles of HR Developer; Physical and Financial Resources for HRD; HR Accounting; HRD Audit, Strategic HRD **6L**

Module – 3 Instructional Technology for HRD: Learning and HRD; Models and Curriculum; Principles of Learning; Group and Individual Learning; Transactional Analysis; Assessment Centre; Behaviour Modeling and Self Directed Learning; Evaluating the HRD.**5L**

Module – 4 Human Resource Training and Development: Concept and Importance; Assessing Training Needs; Designing and Evaluating T&D Programmes; Role, Responsibilities and challenges to Training Managers.**4L**

Module – 5 Organisational Effectiveness (OE): Concept; Approaches to O E; Adoptive Coping Cycle for Effectiveness; Achieving OE; Organisational Climate: Concept, Determinants of Organisational Climate.**3L**

Module-6 Organization Theory: Classical Theory; Neo-Classical Theory, Modern Behavioural Theories, contingency theory, system theory, modern structural models; Organizational Culture; Creating and Sustaining Culture; Work Culture.**6L**

Module –7 Motivation: Types of Motives; Theories of Maslow; Herzberg, McGregor, Alderfers, Porter and Lawler‘s Model; Job Enlargement, Job Enrichment, Behaviour Modification. **3L**

Module– 8(a) Group & Group Dynamics - concept, importance, classification of groups, reason for group, formation, group cohesiveness. (b) Team work: meaning, concept, types, creating, and an effective team. (c)

Leadership: Concept, Leader vs. Manager; Classical Studies on Leadership; Trait Theories; Behavioral Theories; Group and Exchange Theories; Contingency Theory of Leadership; Leadership Styles.**6L**

References:

1) Rao, T.V and Pareek, Udai: Designing and Managing Human Resource Systems, Oxford IBH Pub. Pvt.Ltd., New Delhi , 2005
2) Viramani, B.R and Seth, Parmila: Evaluating Management Development, Vision Books, New Delhi.
3) Rao, T.V: Human Resource Development, Sage Publications, New Delhi.
4) Luthans, Fred: Organisational Behaviour, Tata McGraw-Hill Co. New Delhi, 2004.
5) Stephen, P. Robins: Organisational Behaviour, Prentice-Hall of India Pvt., Ltd., 2004.
6) John, W. Mewstrom & Davis, Keith : Organisational Behavior (Human Behavior at Work), Tata McGraw-Hill, New Delhi , 2002

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	2	3	3	3	2	3	2	2
CO2	2	-	-	2	-	-	2	-	3	-	3	-
CO3	2	-	3	2	-	3	-	-	2	-	-	-
CO4	-	2	-	3	2	3	-	2	-	-	-	-
CO5	2	-	-	-	3	2	-	-	2	-	3	-
CO6	2	2	-	-	-	-	-	3	3	-	2	-
CO7	2	2	-	-	-	-	-	-	2	-	3	3
CO8	2	-	3	3	-	2	-	-	2	-	-	-

Course Name: VLSI
Course Code: OEC-CS-801B
Contacts: 3:0:0
Credits: 3
Total Contact Hours: 36

Prerequisite: Concept of courses Solid State Devices; Analog Electronic Circuit; Digital Electronic and Circuit

Course Outcome(s):

After completion of the course students will be able to

CO1: Understand scale of integration and VLSI design flow and VLSI Design steps.

CO2: Calculate and analyze the different parameters related to the different MOS devices and to design the combinational and sequential logic circuits.

CO3: Describe fabrication steps of IC and construct stick diagram & layout of CMOS inverter and basic gates based on Layout design rules.

CO4: Understand the VHDL basics and to construct the combinational and sequential logic circuits.

Course Content:

Module –1: Introduction to VLSI Design: [9L]

Historical perspective development of VLSI from discrete electronic circuit to VLSI.IC, MSI, LSI, Microelectronics & VLSI.

Types of VLSI Chips (General purpose, ASIC, PLA, FPGA),photo-resist Basic CMOS Technology – (Steps in fabricating CMOS), Basic n-well CMOS procVLSI Design Concepts, Moor's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI – basic idea only), Types of VLSI Chips (Analog & Digital VLSI chips, General purpose, ASIC, PLA, FPGA), Design principles (Digital VLSI – Concept of Regularity, Granularity etc), Design Domains (Behavioral, Structural, Physical), Y-Chart, Digital VLSI Design Steps.

Module-2: MOS structure: [2L]

E-MOS & D-MOS, Charge inversion in E-MOS, Threshold voltage, Flat band voltage, Potential balance & Charge balance, Inversion, MOS capacitances. Three Terminal MOS Structure: Body effect. Four Terminal MOS Transistor: Drain current, I-V characteristics. Current-voltage equations (simple derivation).Scaling in MOSFET, General scaling, Constant Voltage & Field scaling.] CMOS: CMOS inverter, Simple Combinational Gates - NAND gate and NOR Gate using CMOS.

Module-3: Micro-electronic Processes for VLSI Fabrication: [10L]

Silicon Semiconductor Technology- An Overview, Wafer processing, Oxidation, Epitaxial deposition, Ion-implantation & Diffusion, Cleaning, Etching, Photo-lithography – Positive & Negative ess, p-well CMOS process, Twin tub process, Silicon on insulator Layout Design Rule: Stick diagram with examples, Layout rules.

Module –4: Hardware Description Language:[6L]

VHDL or Verilog Combinational & Sequential Logic circuit Design.

Text Books:

1. Digital Integrated Circuit , J.M.Rabaey, Chandrakasan, Nicolic, Pearson Education
2. CMOS Digital Integrated Circuits Analysis and Design , S.M.Kang & Y.Leblebici,TMH.

Reference Books:

1. Microelectronic Circuits , Sedra & Smith , Oxford
2. Introduction to VLSI Circuits and System , Uyemura , Wiley

CO-PO Mapping:

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

Course Name: Simulation and Modeling
Course Code: OEC-CS-801C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
1. Programming and Data Structures
2. Discrete Mathematics and Probability theory
3. Game theory
4. Numerical Analysis

Course Outcome(s):
On completion of the course students will be able to
CO1: Student will be able to summarize the issues in Modeling and Simulation and to explain the System Dynamics & Probability concepts in Simulation.
CO2: Student will be able to solve the Simulation of Queuing Systems
CO3: Student will be able to analyze the Simulation output.
CO4: Student will be able to identify the application area of Modeling and Simulation, and apply them.
CO5: Student will be able to implement new model by applying their knowledge

Course Contents:
Module-1: Introduction to Modeling and Simulation [7L]
Nature of Simulation. Systems , Models and Simulation, Continuous and Discrete Systems, system modeling, Components of a simulation study, Introduction to Static and Dynamic System simulation , Application areas, Advantages ,Disadvantages and pitfalls of Simulation.

Module –2: System Dynamics & Probability concepts in Simulation [10L]
Exponential growth and decay models, Generalization of growth models , Discrete and Continuous probability functions, Continuous Uniformly Distributed Random Numbers, Generation of a Random numbers, Generating Discrete distributions, Non-Uniform Continuously Distributed Random Numbers, Rejection Method.

Module-3: Simulation of Queuing Systems and Discrete System Simulation [14L]

Poisson arrival patterns, Exponential distribution, Service times, Normal Distribution Queuing Disciplines, Simulation of single and two server queue. Application of queuing theory in computer system. Discrete Events ,Generation of arrival patterns ,Simulation programming tasks
Gathering statistics, Measuring occupancy and Utilization , Recording Distributions and Transit times .

Module-4 : Analysis of Simulation output [5L]
Sensitivity Analysis, Validation of Model Results

Text Books:
1**.** Jerry Banks, John Carson, B.L.Nelson and D.M.Nicol ― Discrete Event System Simulation‖, Fifth Edition, Pearson.
2. NarsinghDeo, 1979, System Simulation with Digital Computers, PHI.

Reference Books:
1. Averill M. Law and W.DavidKelton, ―Simulation Modeling and Analysis‖, Third Edition, McGraw Hill
5. J. N. Kapoor.. Mathematical Modeling, Wiley eastern Limited
2. Geoffrey Gordon, ―System Simulation‖, PHI.

CO-PO Mapping:

CO	PO1	PO2	POP3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	1	-	-	-	-	-	-
CO2	2	3	2	2	3	-	-	-	-	-	-	-
CO3	2	2	3	1	3	2	-	-	-	-	-	-
CO4	1	3	1	1	3	1	-	-	-	-	-	-
CO5	2	3	2	2	1	2	-	-	-	-	-	-

Course Name: Values and Ethics in Profession
Course Code: OEC-CS-802A
Contact: 3L:0T: 0P
Credit: 3
No. of Lectures: 34

Prerequisites: Basic knowledge of engineering and management.

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the core values that shape the ethical behavior of an engineer and Exposed awareness on professional ethics and human values.
CO2	Understand the concept of profession, professional ethics, and various moral issues.
CO3	Understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field.
CO4	Aware of responsibilities of an engineer for safety and risk benefit analysis, professional rights and responsibilities of an engineer.
CO5	Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives.

Course Content:

Module: 1: Introduction **6L**
Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

Module 2: Theories of Self Development **6L**
Emotional Intelligence (EI): Concept, Johari Window, Importance and Measurement, Concept of Motivation, Maslow‘s theory, Kohlberg‘s theory,Gilligan‘s theory – towards a comprehensive approach to moral behaviour – truth – approach to knowledge in technology.

Module 3: Moral and Ethical Concerns **4L**
Variety of Moral Issues, Moral Dilemmas, Nature of values, Value Crisis in contemporary society, Value Spectrum of a good life, Steven Covey‘s Pursuit of Excellence.

Module 4: Professional Practices in Engineering **8L**
Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession, Ethical and Unethical practices – case studies, Whistle blowing and beyond and Case studies.

Module 5:Global issues in Professional Ethics **10L**
Introduction – Current Scenario, Technology Globalization of MNCs, International Trade, World Summits, Issues, Business Ethics and Corporate Governance, Sustainable Development Ecosystem, Energy Concerns, Ozone Deflection, Pollution, Ethics in Manufacturing and Marketing, Media Ethics; Bio Ethics, Intellectual Property Rights.

Reference Books

1. 1. Govindarajan M, Natarajan S, Senthil Kumar V S, –Engineering Ethics‖ PHI India, 2004

2. P Aarne Vesblind, Alastair S Gunn, – Engineering Ethics and the Environment‖
3. Edmund G Seebauer, Robert L Barry, – Fundamentals of Ethics for scientists and engineers‖ Oxford University Press 2001
4. Mike W Martin, Roland Schinzinger, – Ethics in Engineering‖, Tata McGraw -Hill, 2003
5. Professional Ethics: R. Subramanian, Oxford University Press
6. . Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, 4e , Cengage learning, 2015
7. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
OEC-CS-802A.1		2				2	3	3				3
OEC-CS-802A.2		2				2	3	3				3
OEC-CS-802A.3		2				2	3	3				3
OEC-CS-802A.4		2				2	3	3				3
OEC-CS-802A.5		2				2	3	3				3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
OEC-CS-802A.1	2	2	2
OEC-CS-802A.2	2	2	2
OEC-CS-802A.3	2	2	2
OEC-CS-802A.4	2	2	2
OEC-CS-802A.5	2	2	2

Course Name: History of Science and Technology in India
Course Code: OEC-CS-802B
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: None

Course Outcome(s):
After completion of the course students will be able to
CO1: To understand the development of science and technology in ancient India.
CO2:To understand that development is not solo pursuit rather an interactive and collective process.
CO3: To familiarize with the evolution of scientific ideas and technical solution and their linkages with the socio-culture necessities.
CO4:To analyse the socio-cultural and philosophical context in which the various scientific and technological ideas got developed in India. and thereby help in repositioning India's contributions in science and technology.

Course Content:
Module 1:Historical Perspective [5L]
The nature of science and technology, Roots of science and technology in India, Science and society, Scientists and society, Science and Faith and the rise of applied sciences.

Module 2:Policies and Plans after Independence [7L]
Nehru's vision of science for independent independent India, Science and technology developments in the new era science and technology developments during the Five Year Plan Periods and science and technology policy resolutions.

Module 3:Research and Development (R&D) in India [7L]
Expenditure in R&D, Science and Technology Education, Research activities and promotion of technology development, Technology mission, Programs aimed at technological self-reliance, activities of council of scientific and industrial research (CSIR).

Module 4:Science and Technological Developments in Major Areas [11L]
Space – Objectives of space programs, Geostationary Satellite Services – INSAT system and INSAT services remote sensing applications, Launch Vehicle Technology
Ocean Development – Objectives of ocean development, Biological and mineral resources, Marine research and capacity building
Defence Research – Spin-off technologies for civilian use,
Biotechnology – Applications of biotechnology in medicine, Biocatalysts, Agriculture, Food, Fuel and Fodder, Development of biosensors and animal husbandry
Energy – Research and development in conservation of energy, India's nuclear energy program, technology spin-offs.

Module 5:Nexus between Technology Transfer and Development [6L]
Transfer of Technology – Types, Methods, Mechanisms, Process, Channels and Techniques, Appropriate technology, Technology assessment, Technological forecasting, Technological innovations and barriers of technological change.

Textbooks:
1. Kalpana Rajaram, Science and Technology in India, Published and Distributed by Spectrum Books (P) Ltd., New Delhi – 58.
2. Srinivasan, M., Management of Science and Technology (Problems & Prospects), East-West Press (P) Ltd.,

New Delhi.

Reference Books:

1. Ramasamy, K.A., and Seshagiri Rao, K., (Eds), Science, Technology and education for Developlemnt, K., Nayudamma Memorial Science Foundation, Chennai – 8.
2. Kohili, G.R., The Role and Impact of Science and Technology in the Development of India, Surjeet Publications.
3. Government of India, Five Year Plans, Planning Commission, New Delhi.
4. Sharma K.D., and Quresh M.A., Science, Technology and Development, Sterling Publications (P) Ltd., New Delhi.

CO-PO Mapping:

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

Course Name: Economic Policies in India
Course Code: OEC-CS-802C
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisite: None

Course Outcome(s):

After completion of the course students will be able to
CO1 :To understand the basic characteristics of Indian economy, it's potential
CO2 :To understand the importance, causes and impact of population growth and its distribution, translate and relate them with economic development.
CO3 :Tounderstand the importance of planning undertaken by the government of India, have knowledge on the various objectives, failures and achievements as the foundation of the ongoing planning and economic reforms taken by the government
CO4 :To analyse the progress and changing nature of different sectors and their contribution to the economy as a whole.
CO5: To analyse the developmental trends of Indian economy.

Course Content

Module 1: Introduction:[4L]
Indian Economy on the eve of Independence, British rule and its impact on Indian Economy, Emergence and development of Planning exercise in India – historical debates, plan models and shift in focus over time
Module 2: Issues in Growth, Development and Sustainability[4L]
Output (National Income) and Employment Structure of Indian Economy; Composition and relative rates of growth of agriculture, industry and services sectors; Sub-sectoral analysis.

Module 3: Factors in development: Capital formation (physical and human)[12L]
Trends and patterns in structure of population over time – growth rate, gender, rural-urban, literacy, regional; Structure and trends of Poverty and Inequality (interpersonal and regional); Inflation – trends, structure and causes; Unemployment – trends, structure and types.

Module 4: Trends in Agricultural Production and Productivity [6L]
Firm size and productivity, Land Reforms – Genesis, Progress and current status, new agricultural strategies**.**

Module 5: Trends and Patterns of Industrial Sector[6L]
Changes in the structure of Indian Industry; Small Scale Industries – Growth, Structure and its contribution in national economy; Public Sector – Growth, Structure, Historical role, Evolution and Dilution.

Module-6: Trends in Exports and Imports[4L]
Composition and Direction of Foreign Trade; Balance of Payments – Current Status

References:

1) R Dutta and K P M Sundaram: Indian Economy, S Chand
2) A.N.Agarwal: Indian Economy, Problems of Development and Planning, New Age.
3) Mishra and Puri: Indian Economy, Himalaya.
4) Planning Commission: Eleventh Five Year Plan, Vol I, II and III, Academic Foundation.
5) Government of India: Economic Survey (latest issue)

CO-PO Mapping:

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

Course Name: Essence of Indian Knowledge Tradition
Course Code: MC 801
Contact: 3L:0T:0P
Total Contact Hours: 36

Prerequisite: None

Course Outcome(s) :

At the end of the course, student will be able to:
CO1: Identify the concept of Traditional knowledge and its importance.
CO2: Explain the need and importance of protecting traditional knowledge.
CO3: Interpret the concepts of Intellectual property to protect the traditional knowledge.
CO4: Illustrate the various enactments related to the protection of traditional knowledge.
CO5: Explain the importance of Traditional knowledge in Agriculture and Medicine.

Course Content:

Module 1:[7L]
Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge.

Module 2:[8L]
Protection of traditional knowledge: The need for protecting traditional knowledge Significance of traditional knowledge Protection, value of TK in global economy, Role of Government to harness traditional knowledge.

Module 3:[6L]
Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

Module 4:[7L]
Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge.

Module 5:[8L]
Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of traditional knowledge.

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

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

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

CO-PO Mapping

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