Curriculum for B. Tech
Under Autonomy
Computer Science & Engineering
(Artificial Intelligence & Machine Learning)
L - Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

Department of Computer Science & Engineering

Curriculum
for
Computer Science & Engineering
with specialization in
Artificial Intelligence & Machine Learning

1st Semester to 8th Semester

(Effective from 2021-22 Admission Batch)

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First Year First Semester

Sl. N	Category	Course Code	Course Title	Hours per week				Credits
	A. 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	HSMC101	Professional Communication	2	0	0	**2**	2
	B. PRACTICAL							
4	Basic Science course	PH191	Physics-I Lab	0	0	3	3	1.5
5	Engineering ScienceCourses	ME191	Workshop and 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
	C. MANDATORY ACTIVITIES / COURSES							
8	Mandatory Course	MC181	Induction Program				2	
	TOTAL CREDIT							13.0

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First Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	A. THEORY			L	T	P	Total	
1	Basic Science courses	CH201	Chemistry-I	3	0	0	3	3
2	Basic Science courses	M201	Mathematics –II	4	0	0	4	4
3	Engineering Science Courses	EE201	Basic Electrical Engineering	3	0	0	3	3
4	Engineering Science Courses	CS201	Programming for Problem Solving	3	0	0	3	3
	B. PRACTICAL							
5	Basic Science course	CH291	Chemistry-I Lab	0	0	3	3	1.5
6	Humanities and Social Sciences including Management courses	HSMC191	Professional Communication LAB	0	0	2	2	1.0
7	Engineering Science Courses	EE291	Basic Electrical Engineering Lab	0	0	3	3	1.5
8	Engineering Science Courses	ME292	Engineering Graphics and Design Lab	0	0	3	3	1.5
9	Engineering Science Courses	CS291	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
	C. MANDATORY ACTIVITIES / COURSES							
12	Mandatory Course	MC281	NSS/Physical Activities / Meditation and Yoga / Photography				2	
	TOTAL CREDIT							21

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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	Basic Science course	M302	Linear Algebra	3	0	0	3	3
3	Engineering Science Courses	ESC301	Analog and Digital Electronics	3	0	0	3	3
4	Program Core Course	CS301	Data Structures	3	0	0	3	3
5	Program Core Course	CS302	Computer Organization and Architecture	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	HSMC303	Universal Human Values 2: Understanding Harmony	3	0	0	3	3
B. PRACTICAL								
7	Engineering Science Courses	ESC391	Analog and Digital Electronics Lab	0	0	3	3	1.5
8	Engineering Science Courses	ESC392	Problem Solving using PYTHON Lab	0	0	3	3	1.5
9	Program Core Course	CS391	Data Structures Lab	0	0	3	3	1.5
10	Program Core Course	CS392	Computer Organization and Architecture 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	MC301	Environmental Science				2	
	TOTAL CREDIT WITHOUT MOOCS COURSES							25
D.MOOCS COURSES**								
14	MOOCS COURSES	HM301	MOOCS COURSE-I					

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2nd Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	PC	CS401	Operating Systems	3	0	0	3	3
2	PC	CS402	Design and Analysis of Algorithms	3	0	0	3	3
3	PC	CS403	Object Oriented Programming	3	0	0	3	3
4	PC	CS404	Formal Language and Automata Theory	3	0	0	3	3
5	Humanities and Social Sciences including Management courses	HSMC402	Gender Culture and Development	2	0	0	2	2
6	Basic Science course	M401	Probability and Statistics	3	0	0	3	3
B. PRACTICAL								
7	PC	CS491	Operating Systems Lab	0	0	3	3	1.5
8	PC	CS492	Design and Analysis of Algorithms Lab	0	0	3	3	1.5
9	PC	CS493	Object Oriented Programming Lab	0	0	3	3	1.5
10	PC	CS495	IT Workshop (PYTHON/R/MATLAB)	0	0	3	3	1.5
11	PROJECT	PR491	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	MC481	Learning an Art Form [vocal or instrumental, dance, painting, clay modeling, etc.] OR Environmental Protection Initiatives				2	
	TOTAL CREDIT WITHOUT MOOCS COURSES							24
D.MOOCS COURSES								
14	MOOCS COURSES	HM401	MOOCS COURSE-II					

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3rd Year 1st 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	HSMC505	Principles of Management	2	0	0	2	2
2	PC	CS501	Database Management Systems	3	0	0	3	3
3	PC	CS502	Computer Networks	3	0	0	3	3
4	PC	CS503	Artificial Intelligence	3	0	0	3	3
5	PC	CS504	Compiler Design	3	0	0	3	3
B. PRACTICAL								
6	PC	CS591	Database Management Systems Lab	0	0	3	3	1.5
7	PC	CS592	Computer Networks Lab	0	0	3	3	1.5
8	PC	CS593	Artificial Intelligence Lab	0	0	3	3	1.5
10	PROJECT	PR591	Minor Project I	0	0	3	2	1
11	PROJECT	PR592	Skill Development V: Soft Skill and Aptitude II	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC501	Constitution of India				2	
	TOTAL CREDIT WITHOUT MOOCS COURSES							20
D. MOOCS COURSES**								
13	MOOCS COURSES	HM501	MOOCS COURSE-III					

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3rd Year 2nd 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	HSMC604	Economics for Engineers	2	0	0	2	2
2	PC	CS601	Machine Learning	3	0	0	3	3
4	PC	CS602	Digital Image Processing	3	0	0	3	3
5	PC	CS603	Natural Language Processing	3	0	0	3	3
6	OE	CS604	A. Software Engineering B. Operations Research C. Information Theory and Coding	3	0	0	3	3
B. PRACTICAL								
7	PC	CS691	Machine Learning Lab	0	0	3	3	1.5
8	PC	CS692	Digital Image Processing Lab	0	0	3	3	1.5
9	PC	CS693	Natural Language Processing Lab	0	0	3	3	1.5
10	PROJECT	PR691	Minor Project II	0	0	3	2	1
11	PROJECT	PR692	Skill Development VI: Soft Skill and Aptitude-III	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC601	Intellectual Property Right				2	
	TOTAL CREDIT WITHOUT MOOCS COURSES							20
D.MOOCS COURSES**								
13	MOOCS COURSES	HM601	MOOCS COURSE-IV					

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4th Year 1st Semester

Sl No	Course Code	Paper Code	Theory	Contact Hours /Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	PC	CS701	Neural Networks and Deep Learning	3	0	0	3	3
2	PE	CS702	A. Computer Vision B. Information Retrieval and Text Mining C. Wireless Sensor Networks and IoT	3	0	0	3	3
3	OE	CS703	A. Web Technologies B. Mobile Device Programming C. Parallel Computing	3	0	0	3	3
4	PE	CS704	A. Soft Computing B. Bio-informatics C. Cryptography and Network Security	3	0	0	3	3
B. PRACTICAL								
5	PC	CS791	Neural Networks and Deep LearningLab	0	0	0	3	1.5
6	PE	CS792	A. Computer Vision Lab B. Information Retrieval and Text Mining Lab C. Wireless Sensor Networks and IoT Lab	0	0	0	3	1.5
7	OE	CS793	A. Web Technologies Lab B. Mobile Device Programming Lab C. Parallel Computing Lab	0	0	3	3	1.5
8	PROJECT	PR791	Major Project-I	0	0	0	4	2
9	PROJECT	PR792*	Industrial Training / Internship	0	0	0	0	1
10	PROJECT	PR793	Skill Development VII: Seminar and Group Discussion	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
11	MC	MC781	Entrepreneurship and Innovation Skill				2	
TOTAL CREDIT WITHOUT MOOCS COURSES								20
D.MOOCS COURSES**								
12	MOOCS COURSES	HM701	MOOCS COURSE-V					

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***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).**

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4th Year 2nd Semester

Sl No	Course Code	Paper Code	Theory	Contact Hours /Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	PE	CS801	A. Digital Video Processing B. Big Data Analytics C. Cyber Security	3	0	0	3	3
2	PE	CS802	A. Digital Audio and Speech Processing B. Data Mining and Data Warehousing C. Blockchain and CryptocurrencyTechnologies	3	0	0	3	3
3	OE	CS803	A. Soft Skills and Interpersonal Communication B. Human Resource Management & Organizational Behaviour C. Values and Ethics in Profession	3	0	0	3	3
4	OE	CS804	A. Quantum Computing B. Cloud Computing C. Mobile Computing	3	0	0	3	3
B. PRACTICAL								
5	PROJECT	PR891	Major Project-II	0	0	0	12	6
6	PROJECT	PR892	Grand Viva	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
7	MC	MC801	Essence of Indian Knowledge Tradition				2	
TOTAL CREDIT								19

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1ST Year 1st Semester: Semester- 1								
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 Sciencesincluding 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	ME191	Workshop and 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				2	
	TOTAL CREDIT							13.0

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COURSE NAME: PHYSICS –I
Course Code: PH101
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

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

Course Outcomes (COs):

After attending the course students should be able to

CO1: describe various types of mechanical resonance and its electrical equivalence

CO2: explain basic principles of Laser, Optical fibers and Polarization of light

CO3: apply superposition principle to explain interference and diffraction

CO4: analyze different crystallographic structures according to their co-ordination number and packing factors

CO5: 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

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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

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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.

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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

CO-PO Mapping:

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

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Course Name: Mathematics-I
Course Code: M101
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):

On successful completion of the learning sessions of the course, the learner will be able to

CO1: Recall the properties and formula related to matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series.

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.

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.

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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:

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

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

Course Name: Professional Communication
Course Code: HSMC101
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 attending the course students should be able to

CO1: apply the modalities and nuances of communication in a workplace context.

CO2: analyze communication across cultures and societies.

CO3: apply the basic formats, templates of business and official communication.

CO4: employ formal communication modes in meetings and reports.

CO5: justify importance of 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

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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 Résumé
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

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

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Paper Name: Physics I Lab
Paper Code: PH191
Contact Hours: 0:0:3
Credit: 1.5

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

Course Outcomes (COs):

After attending the course students' will be able to

CO1: demonstrate experiments allied to their theoretical concepts

CO2 : conduct experiments using LASER, Optical fiber, Torsional pendulum, Spectrometer

CO3: participates 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

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

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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:

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

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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 this course students will be able to

CO1: Identify and operate various hand tools related to variety of manufacturing operations

CO2: Safely fabricate simple components with their own hands.

CO3: Get practical knowledge of the dimensional accuracies and tolerances applicable for different manufacturing processes.

CO4: Produce small devices of their interest in project or research purpose.

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:

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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.

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CO-PO Mapping:

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

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1ST Year 2nd Semester: Semester-2								
Sl. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**				**Credits**
	THEORY			L	T	P	Total	
1	Basic Science courses	CH201	Chemistry-I	3	0	0	3	3
2	Basic Science courses	M201	Mathematics –II	4	0	0	4	4
3	Engineering Science Courses	EE201	Basic Electrical Engineering	3	0	0	3	3
4	Engineering Science Courses	CS201	Programming for Problem Solving	3	0	0	3	3
	PRACTICAL							
5	Basic Science course	CH291	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	EE291	Basic Electrical Engineering Lab	0	0	3	3	1.5
8	Engineering Science Courses	ME292	Engineering Graphics and Design Lab	0	0	3	3	1.5
9	Engineering Science Courses	CS291	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 and Yoga / Photography				2	
	TOTAL CREDIT							21

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Course Name: Chemistry

Course Code: CH201

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 this course students will be able to

CO1: Describe the fundamental properties of atoms & molecules, atomic structure and the periodicity of elements in the periodic table

CO2: Apply fundamental concepts of thermodynamics in different engineering applications.

CO3: Apply the knowledge of water quality parameters, corrosion control & polymers to different industries.

CO4: Determine the structure of organic molecules using different spectroscopic techniques.

CO5: Evaluate theoretical and practical aspects relating to the transfer of the production of chemical products from laboratories to the industrial scale, in accordance with environmental considerations.

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.

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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

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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

CO	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	2	-	-	-	-	2	2	2	2
CO 2	3	3	3	3	-	-	-	-	2	2	2	3
CO 3	3	3	2	2	-	2	2	-	2	-	3	3
CO 4	3	2	3	2	-	-	2	-	2	2	3	3
CO 5	3	3	3	3	2	2	2	-	2	-	2	3

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Course Name: Mathematics-II
Course Code: M201
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):

On successful completion of the learning sessions of the course, the learner will be able to

CO1: 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.

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 y solvable for x 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.

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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:

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

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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 attending the course students would be able to

CO1: understand and analyze basic electric circuits
CO2: study the working principles of electrical machines.
CO3: introduce the components of low voltage electrical installations
CO4: 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.

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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
CO1	1	2	2	-	-	-	-	-	-	-	-	1
CO2	2	2	2	-	-	-	-	-	-	-	-	1
CO3	-	2	2	-	-	-	-	-	-	-	-	2
CO4	-	2	-	-	-	-	-	-	-	-	-	1

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

Course Name: Programming For Problem Solving

Course Code: CS201

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 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 mathematical/ scientific/ engineering problem leading to lifelong learning.

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 and

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decrement operators, bitwise operators, assignment operators, conditional operators, special operators-type conversion, C expressions, precedence and associativity.

Input and Output: Standard input and output, formatted output–printf, 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

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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
CO1	3	3	3	3	2	-	-	-	-	-	-	-
CO2	2	2	3	2	-	-	-	-	-	-	-	-
CO3	2	3	2	2	-	-	-	-	-	-	-	3
CO4	3	2	2	2	3	-	-	-	-	-	-	-
CO5	2	2	2	2	-	-	-	-	3	2	-	-

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Course Name: Chemistry Lab

Course Code: CH291

Contact: 0:0:3

Credits: 1.5

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

Course Outcomes (COs):

After attending this course, students would be

CO1: able to operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.

CO2: able to analyze and determine the composition of liquid and solid samples working as an individual and also as a team member.

CO3: able to analyze different parameters of water considering environmental issues.

CO4: able to synthesize drug and polymer materials.

CO5: Capable to 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

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CO-PO Mapping

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

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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 would be

CO1: Able to explain advanced skills of Technical Communication in English through Language Laboratory.

CO2: Able to apply listening, speaking, reading and writing skills in societal and professional life.

CO3: Able to demonstrate the skills necessary to be a competent Interpersonal communicator.

CO4: Able to analyze communication behaviours.

CO5: Able to adapt to multifarious socio-economical and professional arenas with the help of effective communication and interpersonal skills.

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

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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

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

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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 this course students will 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 behavior.

CO3: Apply and analyze the basic characteristics of transformers and electrical machines.

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

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CO-PO Mapping

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

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 will be able to

CO1: get introduced with Engineering Graphics and visual aspects of design.

CO2: know and use common drafting tools with the knowledge of drafting standards.

CO3: be able to apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.

CO4: be able to produce part models; carry out assembly operation and show working procedure of a designed 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.

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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.

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CO-PO Mapping:

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

Course name: Programming For Problem Solving Lab
Course Code: CS291
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.

Course Content:

Module-1: Familiarization with some basic commands of DOS and Linux. File handling and Directory structures, file permissions, creating and editing simple C program in different editor and IDE, compilation and execution of C program. Introduction to Code block.

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Module-2: Problem based on

a) Basic data types
b) Different arithmetic operators.
c) printf( ) and scanf( ) 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

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CO-PO Mapping:

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

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2nd Year 1st Semester: Semester-3

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	Basic Science course	M302	Linear Algebra	3	0	0	3	3
3	Engineering Science Courses	ESC301	Analog and Digital Electronics	3	0	0	3	3
4	Program Core Course	CS301	Data Structures	3	0	0	3	3
5	Program Core Course	CS302	Computer Organization and Architecture	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	HSMC303	Universal Human Values 2: Understanding Harmony	3	0	0	3	3
B. PRACTICAL								
7	Engineering Science Courses	ESC391	Analog and Digital Electronics Lab	0	0	3	3	1.5
8	Engineering Science Courses	ESC392	Problem Solving using PYTHON Lab	0	0	3	3	1.5
9	Program Core Course	CS391	Data Structures Lab	0	0	3	3	1.5
10	Program Core Course	CS392	Computer Organization & Architecture 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	MC301	Environmental Science				2	
	TOTAL CREDIT WITHOUT MOOCS COURSES							25
D.MOOCS COURSES**								
14	MOOCS COURSES	HM301	MOOCS COURSE-I	3	0	1	4	4
TOTAL CREDIT WITH MOOCS COURSES								**29**

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

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Course Name: Discrete Mathematics

Course Code: M301

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Higher Secondary Level Mathematics

Course Objectives:

1. Comprehend the fundamental concepts of Set Theory, Mathematical Logic for inferencing and various Proof Techniques, Theory of Numbers, Algebraic Structures. Graph Theory.
2. Formulate problems based on Combinatorial Structures, Algebraic Structures, Graph Theory, Recurrence Relation etc.
3. Use the concepts of Discrete Mathematics to solve problems based on Combinatorial Structures, Algebraic Structures, Graph Theory, Recurrence Relation etc.
4. Provide proofs of theorems using well known Proof Techniques and Mathematical Logic Frameworks to justify a claim.
5. Propose solutions to the complex problems of Discrete Mathematics and Analyze their effectiveness in solving the relevant problems

Course Outcomes:

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.

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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 Binary Relation, Equivalence Relation, Partial Ordering Relation and Poset, Lattice.

Combinatorics and Counting: Sum and product rule, Permutation and Combination Principle of Inclusion Exclusion. Pigeon Hole Principle.

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.

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.

Predicate Logic: Idea of First Order Predicate Logic and Quantifiers, well-formed formula of predicate, Inference theory of Predicate Logic.

Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

MODULE-3: Theory of Numbers [4L]

Well-Ordering Principle, Divisibility theory and properties of Divisibility, Fundamental theorem of Arithmetic, Prime and Composite Numbers.

Greatest Common Divisor and Euclidean Algorithm, Congruence, Residue Classes.

MODULE-4: Algebraic Structures [8L]

Concepts of Groups, Subgroups and Order, Cyclic Groups, Cosets, Normal Subgroups, Permutation and Symmetric groups, Group Homomorphisms.

Elementary properties of Rings and related problems.

Elementary properties of Fields and related problems.

Elementary properties of Vector Space and related problems.

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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.

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.

Tree: Rooted Trees, Binary Search Tree and Tree Sorting, Spanning Tree, Weighted Trees and prefix codes.

Text book:

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 to Computer 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	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	-	2	-	2
CO5	2	2	3	3	-	-	-	-	-	-	-	2	2	2	3

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

Course Name: Linear Algebra

Course Code: M302

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Higher Secondary Level Mathematics

Course Objectives:

1. Understand basic concepts of linear algebra to illustrate its power and utility through applications to computer science and Engineering.
2. Apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
3. Solve problems in cryptography, computer graphics and wavelet transforms

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** the fundamental concepts of System of Linear Equations to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Understand** the fundamental concepts of Vector Spaces and Subspace Properties so that they can **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO3	**Explain or Illustrate** the fundamental Linear Transformations and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO4	**Explain or Illustrate** the fundamental principles of Inner Product Spaces and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO5	**Develop** ideas to **Propose** solutions to the problems of Linear equations 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

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Course Content:

MODULE-1: System of Linear Equations [5L]

Gaussian elimination and Gauss Jordan methods - Elementary matrices- permutation matrix - inverse matrices - System of linear equations - - LU factorizations.

MODULE-2: Vector Spaces [5L]

The Euclidean space and vector space- subspace –linear combination-span linearly dependent-independent- bases - dimensions-finite dimensional vector space.

MODULE-3: Subspace Properties [5L]

Row and column spaces -Rank and nullity – Bases for subspace – invertibility- Application in interpolation.

MODULE-4: Linear Transformations and applications [6L]

Linear transformations – Basic properties-invertible linear transformation - matrices of linear transformations - vector space of linear transformations – change of bases – similarity.

MODULE-5: Inner Product Spaces [5L]

Dot products and inner products – the lengths and angles of vectors – matrix representations of inner products- Gram-Schmidt orthogonalization.

MODULE-6: Applications of Inner Product Spaces [5L]

QR factorization- Projection - orthogonal projections – relations of fundamental subspaces – Least Square solutions in Computer Codes.

MODULE-7: Applications of Linear equations [5L]

An Introduction to coding - Classical Cryptosystems –Plain Text, Cipher Text, Encryption, Decryption and Introduction to Wavelets (only approx. of Wavelet from Raw data).

Text book:

3. Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Second edition Springer.
4. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R. Hill, 9th Edition Pearson Education

Reference Books:

4. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition, Academic Press
5. Applied Abstract Algebra, Rudolf Lidl, Guter Pilz, 2nd Edition, Springer 2004

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6. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).

CO – PO Mapping:

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

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

Course Name: Analog & Digital Electronics

Course Code: ESC301

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Course Objective(s):

1. To gain fundamental knowledge of different analog circuits and their applications.
2. To acquire the basic knowledge of different digital logic circuits and studies their applications.
3. To prepare students to perform the analysis and design of various electronic circuits.

Pre-requisite:

Concept of basic electronics devices, basic law of circuit analysis, logic gates, truth tables

Course Outcomes:

After completion of the course students will be able to:

CO1	**Understand** the characteristics of BJT, FET, amplifier, transistor and **apply** them in **designing** solution to engineering problems
CO2	**Understand** the working principles of different amplifier, OP-AMP, Multivibrators and other electronic circuits and **demonstrate** the solutions leading to mathematical and engineering problems.
CO3	**Comprehend** and **analyze** binary number system, BCD, ASCII, EBDIC, Gray codes, boolean algebra, karnaugh map based minimization technique and **design** different circuits leading to lifelong learning
CO4	**Understand**, **implement** and **evaluate** the performance of different types of combinational circuits
CO5	**Understand** different types of sequential circuits and **compare** their performances and **solve** related problems possibly as a team

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

Content:

Module1: [6L]

BJT, FET & Amplifier [2]: Introduction to Analog Integrated Circuits, BJT Modeling-hybrid model of transistors; FET Small signal analysis; Different classes of amplifiers (Class A, B, AB and C) - basic concepts, power, efficiency.

Transistor Amplifiers [4]: RC coupled amplifier, derivation of voltage gain, current gain, input impedance and output impedance, frequency response characteristics, lower and upper half frequencies, bandwidth, and concept of wide band amplifier.

Module 2: [6L]

Operational Amplifier [4]: 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, Ideal OPAMP.

Multivibrators[2]: Basic concepts of Feedback and Oscillation; Astable and Monostable Multivibrators; Schimtt Trigger Circuits; 555 Timer.

Module3: [8L]

Binary Number System , BCD, ASCII, EBDIC, Gray codes and their conversions, Introduction and laws of boolean algebra, boolean functions, minterm and maxterm, prime implicants, representation in SOP and POS forms, minimization of logic expressions by Karnaugh map and algebraic method.

Module 4: [8L]

Combinational circuits: Adder and Subtractor (half-full adder & subtractor), Serial & Parallel Adder, Carry look ahead adder and Parity Generator, Encoder, Decoder, Multiplexer, Demultiplexer, Comparator, Code Converters, Parity generator and checker.

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Module 8: [8L]

Sequential Circuits:

Flip-Flops, SR, JK, Master slave JK, D, T and, characteristic Tables, Excitation tables. Basic concept of Synchronous and Asynchronous counters, Up/Down Counters, Ring counter, Johnson counter, Design of Modulo-N Counter, Counter applications Registers (SISO, SIPO, PIPO, PISO).

Text Books:

1. Millman Halkias – Integrated Electronics, McGraw Hill

2. Microelectronics Engineering –Sedra & Smith-Oxford.

3. Principles of Electronic Devices & circuits—B L Thereja & Sedha—S Chand

4. Salivahanan S - Digital Circuits and Design, Oxford

5. Morries Mano - Digital Logic Design- PHI

6. Digital electronics – Kharate – Oxford

Reference Book:

1. R. P. Jain - Modern Digital Electronics, 2/e, Mc Graw Hill
2. Thomas L. Floyd - Digital Fundamentals: A Systems Approach, Pearson
3. Rashid-Microelectronic Circuits- Analysis and Design- Thomson (Cenege Learning)
4. Linear Integrated Circuits – D. Roy Choudhury & Shail B. Jain
5. Analog Integrated Circuits – J. B. Gupta

CO-PO & PSO Mapping:

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

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

Paper Name: Data Structures

Paper Code: CS301

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 Objectives:

The objective of the course is to make the students able to -

1. Understand the concept of data structure and create new data structure and also analyzing the efficiency of the same.
2. Identify and differentiate different types of data structures and implement the appropriate data structure and analyze the same.
3. Understand and implement stack, queue and dequeue by selecting appropriate methods.
4. Understand and implement different non-linear data structures by selecting appropriate methods.
5. Understand different factors of sorting and searching algorithm and select the appropriate algorithm and also implement and analyze the algorithm.

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Course Outcome(s)

On completion of the course students will be able to

CO1	**Understand/Define** 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 and also **analyze** the efficiency of the same.
CO2	**Identify** and **differentiate** different types of data structures and **Design/Develop/Propose** the appropriate data structure after **analyzing** complex engineering problem leading to their lifelong learning.
CO3	**Understand** and **design/develop** stack, queue and dequeue by **selecting** appropriate methods and **propose** appropriate solution for real life and engineering problem **choosing** appropriate modern tools and also **argue, judge and explain** maintaining the professional ethics to validate the same.
CO4	**Show and understand** the working of algorithm and **design/develop/construct** different non-linear data structures by **selecting** appropriate methods and **apply** it for **solving** complex engineering problem and also **argue, judge and explain** maintaining the professional ethics to validate the same.
CO5	**Show** the working of algorithm and **understand** different factors of sorting and searching algorithm; **select** the appropriate algorithm for **solving** complex engineering problem; also **design/develop** and **analyze** the algorithm.

Course Content:

Module I: 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; Algorithm analysis, time and space analysis of algorithms – Asymptotic notations like Big Oh (O), Big Omega(Ω) and Theta(Θ) notation (definition and significance). (3L)

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

Module II: 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 III: 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 IV: 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.

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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 V: Sorting and Searching [8L]

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

Searching: 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 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

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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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1								3	3	3
CO2	3	3	3	3								3	3	3	3
CO3	3	3	3	3	3								3	3	1
CO4	3	3	3	3	1			2					3	3	3
CO5	3	3	3	3	1								3	1	3

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

Course Name: Computer Organization and Architecture
Course Code: CS302
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Perquisites: Digital Electronics

Course Objective:

The objective of the course is to make the students able to

1. Understand the basic concept of computer structure & computer arithmetic
2. Understand the basic concept of Basic Computer Organization and Central processing unit
3. Understand the knowledge on register transfer, micro operation and micro programmed control to design and solve engineering problem.
4. Understand and Compare computer memories.
5. Apply the knowledge on computer Input-output organization to design an optimized model

Course Outcomes:

After completion of the course students will be able to

CO1	**Design** solution for real life engineering problem by **understanding** the basic concept of computer structure & computer arithmetic and **applying** the knowledge.
CO2	**Design** and **implement** mathematical and engineering problem leading to lifelong learning by **understanding** the basic concept of Basic Computer Organization and Central processing unit.
CO3	**Design** and **solve** engineering problem **by understanding and applying** the knowledge on register transfer, micro operation and micro programmed
CO4	**Understand and Compare** computer memories and **apply** this knowledge for **developing** an approach by means of existing and new methods as a team
CO5	**Apply** the knowledge on computer Input-output organization to **design** an optimized model and **build** a new solution as a professional engineering practice as a team.

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

Course Content:

Module – 1 [6L]

Structure of Computers[3L]
Computer types[1L], Functional units, Basic operational concepts[1L], Von Neumann Architecture, Bus Structures, Software, Performance[1L].

Computer Arithmetic[3L]
Fixed-point multiplication - Booth's algorithm. [1L], Fixed-point division - Restoring and non-restoring algorithms. [1L] Floating-point number representation- IEEE 754 format and Floating-point arithmetic operation [1L]

Module – 2 [9L]
Basic Computer Organization and Design[4L]
Instruction codes, Computer Registers [1L], Computer Instructions and Instruction cycle1L]. Timing and Control [1L], Memory-Reference Instructions, Input-Output and interrupt [1L]

Central Processing Unit[5L]
Stack organization[1L], Instruction Formats[1L], Addressing Modes [1L], Data Transfer and Manipulation[1L], Complex Instruction Set Computer (CISC) Reduced Instruction Set Computer (RISC), CISC vs RISC[1L]

Module – 3 [8L]
Register Transfer and Micro-Operations[4L]
Register Transfer Language, Register Transfer[1L], Bus and Memory Transfers[2L], Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations, Arithmetic logic shift unit[1L]

Micro-Programmed Control[4L]
Control Memory[1L], Address Sequencing[1L], Micro-Program example[1L], Design of Control Unit[1L]

Module–4[7L]
Computer Memory [7L]
Memory Hierarchy, Semiconductor Memories, RAM (Random Access Memory), Read Only Memory (ROM), Types of ROM[1L], Main Memory[1L], Cache Memory [1L], Cache coherence and synchronization mechanisms[1L], Mapping Technique in cache memory: Direct, Full Associative and Set Associative [2L], Cache Performance and optimization techniques [1L]

Module – 5 [6L]
Input-Output Organization[6L]
Introduction to I/O operations [1L], Synchronous and asynchronous transfer [1L], Modes of transfer [1L], DMA[1L], Bus Arbitration [1L], Input-output processor [1L]

Text Books:

1. David A. Patterson and John L. Hennessy- Computer Organization and Design: The Hardware/Software Interface

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2. Morris Mano- Computer System Architecture, 3rd Edition, Pearson

Reference Books:

1. Hayes J. P., "Computer Architecture & Organisation", McGraw Hill,
2.William Stallings, Computer Organization and Architecture: Designing for Performance

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	3	3	2	3
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	3	1
CO4	3	3	3	3	-	-	-	-	3	-	-	-	3	2	3
CO5	3	3	3	3	-	-	-	-	3	2	-	-	3	2	3
CO	3	3	3	3	-	-	-	-	3	2	-	3	3	3	3

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

Course Name: Universal Human Values2: Understanding Harmony
Course Code: HSMC 303
Contacts: 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: Develop holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.

CO2: Cultivate the harmony in the human being, family, society and nature/ existence

CO3: Strengthen self-reflection.

CO4: Build commitment and courage to act.

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 othersalient 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.

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

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)

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

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

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

Course Name: Analog & Digital Electronics Lab

Course Code: ESC391

Contact: 0:0:3

Total Contact Hours: 36

Credit: 1.5

Course Objective(s):

This subject will act as prerequisite for computer organization and architecture. The aims of this lab are to make students familiar with the principles of combinational and sequential digital logic design and optimization at a gate level and designing various circuits with ICs.

Pre-requisite:

Basic concepts of logic gates, truth tables, function realization – minimization of logic expressions by K-map, concept of basic components of a digital computer, binary arithmetic

Course Outcomes:

After completion of the course students will be able to:

CO1	**Comprehend** the working principles of the logic gates and analog cum digital circuits like half and full adder circuits and **execute** and **solve** problems related circuit design which **leads** to the solution of engineering problems
CO2	**Understand** the working principle of half and full adder circuit, adder-subtractor composite unit and carry-look-ahead adder circuit and **Demonstrate** the solutions leading to engineering problems
CO3	**Design and compare** different circuits- adder, subtractor, multiplexer, De- multiplexer, decoder, encoder, comparator and flip flop
CO4	**Analyze and implement** sequential circuits like register, counter leading to lifelong learning
CO5	**Understand** different circuits and c**onstruct** digital circuits to verify the operations of DAC and different types of logic families and PLDs and **compare** their performances and **solve** related problems possibly as a team

Curriculum for B. Tech
Under Autonomy
Computer Science & Engineering
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L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

Content:

1. Design of a Class A & class B power amplifier.
2. Design of a Schmitt Triggers using 555 Timer.
3. A) Realization of basic gates and universal gates.
   B) Realization of basic gates using universal gates.
4. Design a Half adder and Full Adder circuit using basic gates and verify its output.
5. Design a Half Subtractor and Full Subtractor circuit using basic gates and verify its output.
6. Design an Adder/Subtractor composite unit.
7. Design of a 'Carry-Look-Ahead' Adder circuit.
8. Realization of a)Encoder, b)Decoder c) Multiplexer , d) De-MUX , e)Comparator and their Truth Table verification.
9. Realization of RS / JK / D flip flops using logic gates.
10. Design of Shift Register using J-K / D Flip Flop.
11. Realization of Synchronous Up/Down counters.
12. Design of MOD- N Counter
13. Study of DAC
14. Study of logic families and PLDs
15. Mini-Project

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. Thomas L. Floyd - Digital Fundamentals: A Systems Approach , Pearson,

CO-PO & PSO Mapping:

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

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

Course Name: Problem solving using PYTHON Lab

Course Code: ESC392

Contact: 3:0:0

Credits: 1.5

Prerequisites: Number system, Boolean Algebra, Programming Concept

Objective of the course:

The objective of the course is to make the students able to –

1. Describe the core syntax and semantics of Python programming language.
2. Discover the need for working with the strings and functions.
3. Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** the fundamental Python syntax and semantics and be fluent in **writing** simple Python programs in the appropriate platform.
CO2	**Develop** proficiency in the handling of strings and be fluent in the **use** of Python control flow statements.
CO3	**Solv**e different problems while **applyin**g the concepts of loops.
CO4	**Develop** different programming skills while **correlating** functions.
CO5	**Articulate** the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python.

Course Content:

Module-I: Fundamentals of Python

• Introduction to Python

• Running Python Programs

• Writing simple Python Code

Module-II: Working with Data

• Data Types and Variables

• Using Numeric Variables

• Using String Variables

Module-III: Input and Output

• Printing with Parameters

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

• Getting Input from a User

• String Formatting

Module-IV: Making Decisions

• Logical Expressions

• The "if" Statement

• Logical Operators

• More Complex Expressions

Module-V: Lists and Loops

• Lists and Tuples

• List Functions

• "For" Loops

• "While" Loops

Module-VI: Functions

• Writing and Calling Functions

• Function Inputs and Outputs

• Local and Global Scope

Module-VII: Working with Strings

• Character Data

• String Functions

• Input Validation with "try / except"

Mini-Project

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

Text books:

1. Gowrishankar S, Veena A, "Introduction to Python Programming", 1st Edition, CRC Press/Taylor & Francis, 2018.

Reference books:

1. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", 1st Edition, O'Reilly Media, 2016.
2. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", 2nd Edition, O'Reilly Media, 2019.
3. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015.
4. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", 2nd Edition, O'Reilly Media, 2018.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	-	-	-	-	-	-	-	1	3	2
CO2	3	2	3	2	-	-	-	-	-	-	-	-	3	2	3
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	2	3
CO4	2	3	3	1	-	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	2	-	-	-	-	-	-	-	3	1	3

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

Course Name: Data Structures Lab

Course Code: CS391

Contact: 0:0:3

Credits: 1.5

Perquisites:

1. Computer Fundamentals and principal of computer programming Lab

Objective of the course:

The objective of the course is to make the students able to –

1. Identify and propose appropriate data structures and data types to implement list using array and linked list.
2. Design and develop effective programs using stack, queue and recursive functions after implementing stack and queue.
3. Implement different data structures like binary tree, heap and use them to explain and organize data and manipulate them.
4. Implement different sorting and searching algorithm selecting appropriate data structures and analyze the efficiency of the resulting program.
5. Prepare laboratory reports on interpretation of experimental results and analyze it for validating the same.

Course Outcomes:

On completion of the course students will 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 collaboration.
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.

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

Course Content:

Module I: Implementing Non-Restricted Linear Data Structure [2 Lab]

Problem based on Implementation of Non-Restricted Linear Data Structure like-

a) Implementation of list as data structure using array.

b) Implementation of list as data structure using linked list of different types.

c) Implementation of polynomial as data structure using array and linked list.

d) Implementation of sparse matrix as data stricture using array.

Module II: Implementing Restricted Linear Data Structure [3 Lab]

Problem based on Implementation of Restricted Linear Data Structure like-

a) Implementation of stack as data structure using array.

b) Implementation of stack as data structure using linked list.

c) Implementation of queue as data structure using array (physical, linear and circular model).

d) Implementation of queue as data structure using linked list.

e) Converting infix to post-fix and evaluating post-fix expression using stack.

f) Implementing Tower-of-Hanoi problem.

Module III: Implementing Non-Linear Data Structure [2 Lab]

Problem based on Implementation of Non-Linear Data Structure like

a) Implementation of Binary Tree as data structure using array and linked list.

b) Implementation of Binary Search Tree (BST) as data structure using linked list.

c) Implementation of Heap as data structure using array.

d) Implementation of Priority Queue as data structure using Heap.

Module IV: Implementing Sorting and Searching algorithm [5 Lab]

Problem based on Implementation of Sorting and Searching algorithm like

a) Implementation of Bubble sort using appropriate data structure.

b) Implementation of Selection sort using appropriate data structure.

c) Implementation of Insertion sort using appropriate data structure.

d) Implementation of Quick sort using appropriate data structure.

e) Implementation of Merge sort using appropriate data structure.

f) Implementation of Heap sort using appropriate data structure.

g) Implementation of Radix sort using appropriate data structure.

h) Implementation of Sequential Search using appropriate data structure.

i) Implementation of Binary Search using appropriate data structure.

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

j) Implementation of hashing with collision resolution using linear and quadratic probing.

Text books:

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

Reference books:

5. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1 Edition, Pearson.
6. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited
7. Data Structures and Program Design In C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson
8. 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	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	-	-	-	3	3	-	-	-	2	2	3
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	2	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	2	3
CO5	-	-	-	-	-	-	-	3	-	3	-	-	3	2	3

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

Course Name: Computer Organization and Architecture Lab
Course Code: CS392
Contact: 0:0:3
Credits:1.5
Prerequisites: Digital Electronics

Course Objective:

The objective of the course is to make the students able to

1. Interpret and use proper method in an appropriate platform to design and to solve problems
2. Use the codes and number systems converting circuits and Compare different types of logic families which are the basic unit of different types of logic gates to design the problem using modern tools
3. Outline different types of digital electronic circuit using various mapping and logical tools and summarize the techniques to prepare the most simplified circuit using various mapping and mathematical methods.
4. Apply the knowledge of digital electronic circuits to design memory and ALU.
5. Interpret the result of the experiments, prepare laboratory reports based on observed output and analyse it.

Course Outcomes:

After completion of the course students will be able to

CO1	**Interpret** and **use** proper method in an appropriate platform to design and to **solve** problems related to Mathematics and Engineering field leading to lifelong learning.
CO2	**Use** the codes and number systems converting circuits and **Compare** different types of logic families which are the basic unit of different types of logic gates to **design** the problem using modern tools for **solvin**g complex engineering problems.
CO3	**Outline** different types of digital electronic circuit using various mapping and logical tools and **summarize** the techniques to prepare the most simplified circuit 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.

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

Course Content:

Module-1: Study and verify the truth table of

a) Logic gates
b) Universal gates

Module-2: Study and realize the logic gates from universal gates

Module-3: Study and verify the truth table of

a) Half Adder
b) Full Adder

Module-4: Study and verify the truth table of

a) Half Subtractor
b) Full Subtractor

Module-5: Study and verify the truth table of

a) Multiplexer
b) De-Multiplexer

Module-6: Study and verify the truth table of

a) Encoder
b) Decoder

Module-7: Study and verify the truth table of

a) 7 segment Decoder
b) Comparator (1 bit, 2 bits)
c) Carry look ahead adder

Module-8: Study and verify the truth table of

a) SR flip-flop
b) D flip-flop
c) JK flip-flop
d) T flip-flop

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Module-9: Study, design and verify the truth table of 4 bits Serial In-Parallel Out Shift Registers

Module-10: Study, design and verify the 4 bit Synchronous or Asynchronous Counter using JK flip-flop

Module-11: Design a composite ALU for multi bit arithmetic operation

Module-12: Design of RAM

Text book:

1. M. Morris Mano, Digital Design, Prentice-Hall
2. Digital Circuits and Design, S. Salivahanan and S. Arivazhagan, McGraw-Hill Education

Reference book:

1. Hayes J. P., "Computer Architecture & Organisation", McGraw Hill,
2. William Stallings, Computer Organization and Architecture: Designing for Performance

CO-PO Mapping:

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

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

Course Name: Environmental Science
Course Code: MC301
Credits: 0
Total Lectures: 36

Course Outcome(s):

After completion of the course students will be able to

CO1 To understand the natural environment and its relationships with human activities.
CO2 To apply the fundamental knowledge of science and engineering to assess environmental and health risk.
CO3 To develop guidelines and procedures for health and safety issues obeying the environmental laws and regulations.
CO4 Acquire 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].

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

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, *L*10 (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
CO1	2	-	3	2	2	-	2	3	2	-	-	-
CO2	2	3	3	3	-	2		3	-	1	3	-
CO3	-	3	3	2	2	-	2	-	-	1	3	-
CO4	-	3	3	2	2	1	2	-	-	2	3	3
CO5	-	3	3	2	-	-	-	-	-	-	3	-

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

2nd Year 2nd Semester: Semester 4

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	PC	CS401	Operating Systems	3	0	0	3	3
2	PC	CS402	Design & Analysis of Algorithms	3	0	0	3	3
3	PC	CS403	Object Oriented Programming	3	0	0	3	3
4	PC	CS404	Formal Language & 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	M401	Probability & Statistics	3	0	0	3	3
B. PRACTICAL								
7	PC	CS491	Operating Systems Lab	0	0	3	3	1.5
8	PC	CS492	Design & Analysis of Algorithms Lab	0	0	3	3	1.5
9	PC	CS493	Object Oriented Programming Lab	0	0	3	3	1.5
10	PC	CS495	IT Workshop (PYTHON/R/MATLAB)	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	MC481	Learning an Art Form [vocal or instrumental, dance, painting, clay modeling, etc.] OR Environmental Protection Initiatives				2	
	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**

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

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

Course Name: Operating Systems

Course Code: CS401

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites:

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

Course Objectives:

The objective of the course is to make the students able to -

1. Students will learn how Operating System is Important for Computer System.
2. To make aware of different types of Operating System and their services.
3. To learn different process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
4. To know virtual memory concepts.
5. To learn secondary memory management.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** the basic principles of operating systems and compare different type of operating systems.
CO2	**Understand** the main principles and techniques for the implementation of processes, threads as well as the different algorithms for process scheduling and inter process communication.
CO3	S**olve** the main problems related to concurrency and the different synchronization mechanisms.
CO4	**Explain** the device and I/O management functions in operating systems as part of a uniform device abstraction.
CO5	F**ormulate** the rationale view for virtual memory abstractions and explain the disk organization and file system structure.

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

Course Content:

Module I: 4L

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.

Module II: 10L

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). **5L**

Module III: 10L

Process Synchronization: background, critical section problem, synchronization hardware, classical problems of synchronization (producer-consumer, readers-writer, dining philosophers, etc), semaphores, monitors. 5L

Deadlocks: deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock. 5L

Module IV: 6L

Memory Management: 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 V: 6L

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. **2L**

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

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	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	1
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3	1
CO5	3	3	3	3	-	-	-	-	3	2	-	-	3	2	1
CO	3	3	3	3	-	-	-	-	3	2	-	3	3	3	3

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

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

Prerequisites: data-structure and basic programming knowledge

Course Objective(s):

- The aim is to learn how to develop efficient algorithms for simple computational tasks and reasoning about the correctness of them
- Through the complexity measures, different range of behaviors of algorithms and the notion of tractable and intractable problems will be understood.

Course Outcome(s):

After completion of the course students will 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 big-O 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 the mathematical foundation of analysis of algorithms.
CO4	To understand, illustrate and analyze the different algorithmic design strategies of a given problem.
CO5	To discuss, develop and analyze, verify the efficiency of a given algorithms using time and space complexity theory.

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).

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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**.**

Reference Books:

1."Design Analysis and Algorithms" by Hari Mohan Pandey.

2. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi

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CO – PO Mapping:

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

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

Course Name: Object Oriented Programming
Course Code: CS403
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Basic Programming Concept

Course Objectives(s):

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

Course Outcomes(s):

CO1	**Understand** the basic concepts of Object-Oriented Programming to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Understand** the basic concepts of Java Programming to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO3	**Understand** the basic concepts of Inheritance to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve**
CO4	**Understand** the basic concepts of Exception Handling, Multithreading, and Applet to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO5	**Design** object-oriented software applications through **developing** Java programs and **investigate** their effectiveness by **analysing** their performances in solving the relevant problems.

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 - Differencebetween Java and C++; Different features of Java **[1L];**

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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 usingInterface. **[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];** AppletProgramming - 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.

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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	PSO1	PSO2	PSO3
CO1	3	2	3	2	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	2	3	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	-	2	-	2
CO5	2	2	3	3	-	-	-	-	-	-	-	2	2	2	3

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

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

Prerequisites: Digital Logic, Computer Fundamentals

Course Objectives:

The objectives of this course are to enable students to

1. construct finite state machines and the equivalent regular expressions.
2. prove the equivalence of languages described by finite state machines and regular expressions.
3. construct pushdown automata and the equivalent context free grammars.
4. prove the equivalence of languages described by pushdown automata and context free grammars.
5. construct Turing machines and to prove the equivalence of languages described by Turing machines

Course Outcome(s):

After completion of the course students will 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),

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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-Nerode Theorem **[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 Language and Computation", Hopcroft H.E. and Ullman J. D., Pearson Education.

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2. Peter Linz, "An Introduction to Formal Languages and Automata", Sixth Edition, Jones & Bartlett, 2016. ISBN**:** 978-9384323219

Reference Books:

1. "Formal Languages and Automata Theory", C. K. Nagpal, Oxford
2. "Switching and Finite Automata Theory", Zvi Kohavi, 2ndEdition., Tata 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	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	-	2	-	2
CO5	2	2	3	3	-	-	-	-	-	-	-	2	2	2	3

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

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]

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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

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

Course Name: Probability and Statistics
Course Code: M401
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 Objective(s):

The purpose of this course is

1. Recall the distinctive principles of probability and statistics.
2. Understand the theoretical workings of theory of probability and tests of hypotheses.
3. Apply statistical methods to compute and explain point estimators and interval estimators for mean, variance and proportion.
4. Analyze statistical data from engineering experiments.

Course Outcome(s):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1	**Understand** the basic concepts of Probability and Random Variables to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Understand** the basic concepts of Two dimensional random variables to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO3	**Understand** the basic concepts of Sampling Distribution to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to
CO4	**Understand** the basic concepts of Parameter Estimation to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO5	**Understand** the basic concepts of Testing of Hypotheses to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.

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Course Content

Module 1: (Probability and Random Variables) (15L)

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 L)

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 L)

Distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions, problems

Module 4: (Parameter Estimation) (4 L)

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 L)

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.

Text 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).

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Reference Books:

1. N. G. Das: Statistical Methods, TMH.
2. *Sancheti* , D. S. & *Kapoor* ,V.K. : Statistics Theory , Method & Application, Sultan chand & sons , New Delhi
3. N.K.Dutta (2004). Fundamentals of Biostatistics, Kanishka Publishers.

CO-PO Mapping:

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

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

Course Name: Operating Systems Lab

Course Code: CS491

Contact: 0:0:3

Total Contact Hours: 36

Credits: 1.5

Prerequisites: Operating Systems

Course Objectives:

The objective of the course is to make the students able to -

1. Understand and execute basic commands of shell script
2. Implement various CPU scheduling Algorithms
3. Implement process creation and inter process communication

4 Implement Deadlock Avoidance and detection Algorithms

5 Implement Page replacement, file organization and file allocation strategies

Course Outcomes:

After completion of the course students will 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 and implement them in
CO3	**Create** process creation and **implement** inter process communication
CO4	**Analyze** the performance of the various page replacement schemes
CO5	I **Understand** the concepts of file organization and file allocation strategies

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Course Content:

Preliminaries of Operating System: 6L
Basics of UNIX Commands, managing users, managing systems, file managements, useful commands, Shell scripting: shell syntax, executing shell scripts.

CPU Scheduling 12L
FCFS, SJF, SRTF, RR, PRIORITY algorithms. Display/Gantt chart and Compute and print the average waiting time and average turnaround time.

Process Communication: 3L
Inter-Process Communication (using shared memory, pipes or message queues).

Synchronization: 6L
Producer-Consumer problem using semaphores (using UNIX system calls)

Memory Management and File: 9L
Memory management schemes (paging and segmentation) page replacement algorithm, Memory allocation schemes (First fit, best fit and Worst fit)

Mini_Project

Text book:

1. Sri Manikanta Palakollu, Practical System Programming with C: Pragmatic Example Applications in Linux and Unix-Based Operating Systems, Apress
2. W. Stevens and Stephen Rago, Advanced Programming in the UNIX Environment, Addison-Wesley Professional

Reference Books:

1. Mark Sobell and Matthew Helmke; Practical System Programming with C: Pragmatic Example Applications in Linux and Unix-Based Operating Systems, Addison-Wesley Professional.

CO – PO Mapping:

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

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

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

Prerequisite:
Programming knowledge

Course Objectives(s):

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

Course Outcome(s):

After completion of the course students will be able to

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

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CO5	**Develop** ideas to **Propose** solutions to the problems of Data Structures and **Apply** the concept through implementation as executable computer programs with adequate documentation in collaborative environment for successfully carrying out projects and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools and **Assess** the limitations of solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

Course Content:

1. Implementation of various Divide & Conquer Methods; viz. Matrix Multiplication.
2. Implementations of various Dynamic Programming Methods, viz. Matrix Chain Multiplication Method, Travelling Salesman Problem etc.
3. Implementations of various Brunch & Bound Techniques, viz.
4. Implementations of various Backtracking Methods, viz. n-Queen Problem.
5. Implementations of Greedy Method, viz. Fractional Knapsack Problem, Job Sequencing Problem etc.
6. Implementations of String Matching Algorithm viz. Naïve Algorithm, String Matching with Finite Automata etc.
7. Implementations of Various Graph Algorithm, viz. Dijkstra's Algorithm, Floyd Algorithm etc.
8. Implementation of some Real Life Trendy Problems.
9. Mini_Projects

CO – PO Mapping:

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

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Course Name: Object Oriented Programming Lab
Course Code: CS493
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 Objective(s):

1. To demonstrate that how can students change the implementation of an object without affecting any other code by increasing data security and protecting unwanted data access. (Encapsulation).
2. To allow students to have many different functions, all with the same name, all doing the same job, but depending upon different data. (Polymorphism).
3. To guide to write generic code: which will work with a range of data, so you don't have to write basic stuff over, and over again. (Generics).
4. To let write a set of functions, then expand them in different direction without changing or copying them in any way. (Inheritance)

Course Outcome(s):

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 operations.
CO4	Discuss simple Code Reusability notion w.r.t. Inheritance, Package and Interface. Apply Exception handling, Multithreading and Applet (Web program in java) programming concept in Java.
CO5	**Design** applications to solve object oriented problems where students can **Apply** and **Implement** the concept appropriately through programming with adequate documentation in collaborative environment for successfully carrying out projects and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools and **Assess** the limitations of solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

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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.

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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.
   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	PSO1	PSO2	PSO3
CO1	3	2	3	2	-	-	-	-	-	-	-	3	3	-	-
CO2	2	3	2	3	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	2	2	-	2
CO5	2	2	3	3	2	2	2	2	2	2	2	2	2	2	3

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

Course Name: IT Workshop Lab (PYTHON/R/MATLAB)

Course Code: CS495

Contact: 3:0:0

Credits: 1.5

Prerequisites: Basics of Mathematics

Objective of the course:
The objective of the course is to make the students able to –

- Have a solid undergraduate foundation in both probability theory and mathematical statistics
- Develop programs with reusability
- Have an indication of the relevance and importance of the theory in solving practical problems in the real world
- Handle exceptions in programming

Course Outcomes:

After completion of the course students will be able to

CO1	**Articulate** the basic Object-Oriented Programming concepts such as class and objects as used in Python or **understand** the fundamental concepts in MATALB or **modify** data within R and to **create** simple graphs and charts used in introductory statistics.
CO2	**Illustrate** exceptions in Python along with creating their own based on the problems or write programs in MATLAB applying the concepts of functions, flow controls, plot mapping etc. or **Perform** and **interpre**t different distribution using R
CO3	**Understand** the concept of multithreading in Python or **solve** Equations, Curve Fitting, and Numerical Techniques in MATLAB or **perform** hypothesis testing and **evaluate** confidence intervals
CO4	**Develop** applications while applying the concepts of database connections, transactions etc. in Python or **appl**y advanced methods in carrying out projects.

Course Content:

Module-I: Python Object Oriented

- Overview of OOP
- Creating Classes and Objects
- Accessing attributes
- Built-In Class Attributes
- Destroying Objects

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Or Module-I: Introduction to MATLAB

- Getting Started
- Scripts
- Making Variables
- Manipulating Variables
- Basic Plotting

Or Module-I: Introduction to R Programming and Getting Used to R: Describing Data

- Viewing and Manipulating Data
- Plotting Data
- Reading in Your Own Data

Module-II: Python Exceptions Handling

- What is Exception?
- Handling an exception
- try….except…else
- try-finally clause
- Argument of an Exception
- Python Standard Exceptions
- Raising an exceptions
- User-Defined Exceptions

Or Module-II: Visualization and Programming in MATLAB

- Functions
- Flow Control
- Line Plots
- Image/Surface Plots
- Efficient Codes
- Debugging

Or Module-II: Visualizing Data and Probability Distributions, Densities of Random Variables and Binomial Distribution in *R*

- Tables, charts and plots. Visualizing Measures of Central Tendency, Variation, and Shape. Box plots, Pareto diagrams. How to find the mean median standard deviation and quantiles of a set of observations.
- Students may experiment with real as well as artificial data sets.
- Generate and Visualize Discrete and continuous distributions using the statistical environment. Demonstration of CDF and PDF uniform and normal, binomial Poisson distributions.
- Students are expected to generate artificial data using and explore various distribution and its properties. Various parameter changes may be studied
- Off the Shelf Distributions in R
- Matching a Density to Data

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- More about Making Histograms
- Study of binomial distribution. Plots of density and distribution functions. Normal approximation to the Binomial distribution.

Module-III: Python Multithreaded Programming

- What is multithreading?
- Starting a New Thread
- The Threading Module
- Synchronizing Threads
- Multithreaded Priority Queue

Or Module-III: Solving Equations, Curve Fitting, and Numerical Techniques in MATLAB

- Linear Algebra
- Polynomials
- Optimization
- Differentiation/Integration
- Differential Equations

Or Module-III: Building Confidence in Confidence Intervals and Perform Tests of Hypotheses in *R*

- Populations versus Samples
- Large Sample Confidence Intervals
- Simulating Data Sets
- Evaluating the Coverage of Confidence Intervals
- How to perform tests of hypotheses about the mean when the variance is known. How to compute the p-value. Explore the connection between the critical region, the test statistic, and the p-value

Module-IV: Using Databases in Python

- Python MySQL Database Access
- Install the MySQLdb and other Packages
- Create Database Connection
- CREATE, INSERT, READ, UPDATE and DELETE Operation
- DML and DDL Operation with Databases
- Performing Transactions
- Handling Database Errors

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Or Module-IV: Advanced Methods in MATLAB

- Probability and Statistics
- Data Structures
- Images
- File I/O

Or Module-IV: Correlation and Estimating a Linear Relationship in *R*

- How to calculate the correlation between two variables. How to make scatter plots. Use the scatter plot to investigate the relationship between two variables
- A Statistical Model for a Linear Relationship
- Least Squares Estimates
- The R Function lm
- Scrutinizing the Residuals

Mini-Project

Text books:

2. Gowrishankar S, Veena A, "Introduction to Python Programming", 1st Edition, CRC Press/Taylor & Francis, 2018.
3. Maria Dolores Ugarte , Ana F. Militino , Alan T. Arnholt "Probability and Statistics with R" 2nd Edition on, CRC Press, 2016.

Reference books:

5. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015.
6. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", 2nd Edition, O'Reilly Media, 2018.
7. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)
8. Michael Akritas, " Probability & Statistics with R for Engineers and Scientists", 2nd Edition on, CRC Press, 2016.

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CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	2	-	-	-	-	-	-	-	2	1	2
CO2	3	3	2	3	2	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO4	3	3	2	3	2	-	-	-	-	-	-	-	3	2	2
CO5	3	3	3	3	3	2	2	2	2	2	2	2	3	3	3

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3rd Year 1st Semester: Semester 3

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	HSMC505	Principles of Management	2	0	0	2	2
2	PC	CS501	Database Management Systems	3	0	0	3	3
3	PC	CS502	Computer Networks	3	0	0	3	3
4	PC	CS503	Artificial Intelligence	3	0	0	3	3
5	PC	CS504	Compiler Design	3	0	0	3	3
B. PRACTICAL								
6	PC	CS591	Database Management Systems Lab	0	0	3	3	1.5
7	PC	CS592	Computer Networks Lab	0	0	3	3	1.5
8	PC	CS593	Artificial Intelligence Lab	0	0	3	3	1.5
10	PROJECT	PR591	Minor Project I	0	0	3	2	1
11	PROJECT	PR592	Skill Development V: Soft Skill & Aptitude-II	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC501	Constitution of India	3	0	0	3	3Units
	TOTAL CREDIT WITHOUT MOOCS COURSES							20
D. MOOCS COURSES**								
13	MOOCS COURSES	HM501	MOOCS COURSE-III	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**24**

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

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

Course Outcome(s):

After completion of the course students will be able to
CO1: To recall and identify the relevance of management concepts.
CO2: To apply management techniques for meeting current and future management challenges faced by the organization
CO3: To compare the management theories and models critically to solve real-life problems in an organization.
CO4: To apply principles of management in order to execute the role as a manager in an organization.

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, SWOT analysis, McKinsey's7S Approach.
Organizing for decision making: Nature of organizing, span of control, Organizational structure –line and staff 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, Promotional Strategy (**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)**

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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
CO1	2	-	-	2	-	-	-	-	3	-	3	2
CO2	-	-	-	-	-	2	-	3	3	-	3	3
CO3	2	-	-	2	-	-	-	-	2	-	3	3
CO4	3	-	-	-	-	2	-	2	3	-	3	-

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Paper Name: Database Management Systems
Paper Code: CS501
Contact (Periods/Week): 3:0:0
Total Credit Hours: 36
Credit: 3

Prerequisite:

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

Course Objectives(s):

1. To Understand and Describe the basic concepts and utility of Database management system, different data models of Database management system.
2. 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.
3. To Analyze and Create the relational database for any real-life applications based on normalization.
4. To Apply the query optimization techniques, different file organization techniques and determine whether the transaction satisfies the ACID properties.

Course Outcome(s):

On completion of the course students will 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	**Explore** DBMS based ideas through **developing** software programs with adequate documentation in collaborative environment for successfully carrying out projects on DBMS Problems and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools and **Assess** the limitations of solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

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Course Content:

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:
Graph Based Model [4L]
Concept of graph-based model, difference between relational model and graph-based model, application, overview of Neo4j CQL.

Module 4:
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 5:
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 6:
Internals of RDBMS [8L]
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 7:
File Organization & Index Structures [3L]
File & Record Concept, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes

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Text Books:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
2. ElmasriRamez and NovatheShamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing. Company.

Reference:

1. "Fundamentals of Database Systems", RamezElmasri, ShamkantB.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	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	-	2	-	2
CO5	2	2	3	3	-	-	-	-	-	-	-	2	2	2	3

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

Course Name: Computer Networks
Course Code: CS502
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 Objective(s):

1. To be familiar with the basics of data communication
2. To be familiar with various types of computer networks
3. To have experience in designing communication protocols
4. To be exposed to the TCP/IP protocol suite

Course Outcome(s):

After competition of the course the student able to do

CO1	Understand OSI and TCP/IP models.
CO2	Analyze MAC layer protocols and LAN technologies.
CO3	Design applications using internet protocols.
CO4	Implement routing and congestion control algorithms.
CO5	Develop application layer protocols and understand 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]**

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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 forMobile 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

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

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	-	2	-	-	-	-	2	-	-	-	3	-	-
CO2		2	-	-	2	-	-	-	2	-	-	-	-	1	3
CO3	2	2	-	-	2	-	-	-	2	-	-	-	-	-	3
CO4	2	2	-	-	3	2	-	-	2	-	-	-		1	3
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-

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

Course Name: Artificial Intelligence

Course Code: CS503

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Data Structure, Design and Analysis of Algorithms, Statistics

Course Objectives:

The objective of the course is to enable students to

1. Comprehend the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context
2. Formulate a problem as State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
3. Use the strategies of AI-Heuristics to find acceptable solutions avoiding brute-force techniques.
4. Design AI-Frameworks for Inferencing based on knowledge base.
5. Analyze the effectiveness of an AI-Inferencing Model in offering solutions to the respective problem.

Course Outcomes:

After completion of the course students will be able to

CO1	**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	**Identify** and **formulate** an engineering problem primarily to fit a State-Space Exploration Framework or an Inferencing Model/Agent Design Framework within the scope of Artificial Intelligence paradigm.
CO3	**Explore** relevant literature and **apply** the concept of Heuristic Techniques of Artificial Intelligence to **solve** problems.
CO4	**Develop** Inferencing Models for **proposing** solutions to the problems of Artificial Intelligence.
CO5	**Design** Inferencing Models of Artificial Intelligence through **developing** feasible algorithms and **investigate** their effectiveness by **analyzing** their performances in solving the relevant problems.

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Course Content:

MODULE-1: Introduction to Artificial Intelligence [1L]

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 [5L]

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, Memory-bounded heuristic search: Iterative-deepening A* Search, Recursive Best First Search, Simplified Memory Bounded A* Search.

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

MODULE-4: Adversarial Search for Game Playing [2L]

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-6: Slot-and-Filler Structure for Knowledge Representation [2L]

Weak Slot-and-Filler Structure for Knowledge Representation: Semantic Nets and Frames.

Strong Slot-and-Filler Structure for Knowledge Representation: Conceptual Dependency and Script.

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MODULE-7: Reasoning under Uncertainty [5L]

Bayesian Inferencing and Bayesian Belief Network, Dempster-Shafer Theory, Overview of Fuzzy Logic and Inferencing, Overview of Hidden Markov Model.

MODULE-7: Planning [5L]

Basic Concepts, Problem of Blocks World, Components of a Planning System, Algorithms for Planning: Goal Stack, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Algorithms for Planning as State-Space Search, Heuristics for planning, Planning Graphs and GRAPHPLAN Algorithm.

MODULE-7: Introduction to Natural Language Processing [1L]

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 [2L]

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

Text book:

5. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
6. Rich, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.

Reference Books:

7. Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.
8. 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	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	2	2	-	2
CO5	2	2	3	3	2				-	-	-	2	2	2	3

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

Course Name: Compiler Design

Course Code: CS504

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 Objective(s):

1. To make the student understand the process involved in a compiler
2. To create an overall view of various types of translators, linkers, loaders, and phases of a compiler
3. To understand the concepts of syntax analysis, various types of parsers especially the top-down approach
4. To create awareness among students about various types of bottom-up parsers,
5. To understand the syntax analysis and, intermediate code generation, type checking, the role of symbol table and its organization, Code generation, machine independent code optimization and instruction scheduling

Course Outcome(s):

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

CO1	**Understand and explain** the fundamental concepts of compilers and its utilitarian importance in current technological context for further exploration leading towards lifelong learning.
CO2	**Understand** and **Explain** the fundamental concepts of various parsing techniques and **Apply** them to analyse syntax and **compare** their efficacies.
CO3	**Illustrate** syntax directed translation strategies and **Apply** them appropriately to programming statements.
CO4	**Understand and explain** the fundamental concepts of intermediate code generation techniques and **Apply** them appropriately to programming statements.
CO5	**Identify** the scope of code optimization and **Explore** various code optimization techniques and **investigate** their effectiveness while **analysing** and studying the resulting object code generation.

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

Course Contents:

Module-1: [7L]

Basics of 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 a 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-recursivePredictive 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 directed definitions, Construction of syntax trees, Bottom-up evaluation of S-attributed definitions, L-attributed definitions, Bottom- up evaluation of 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, Indirect triples).

Module-5: [8L]

Consideration for Optimization, scope of optimization, local optimization, loop optimization, folding, DAG representation, Flow Graph, Data flow 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, and Tools.
2. Holub, A. I. (1990). Compiler design in C (Vol. 5). Englewood Cliffs, NJ: Prentice Hall.

Reference Books

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.

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

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	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	-	2	-	2
CO5	2	2	3	3	-	-	-	-	-	-	-	2	2	2	3

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

Paper Name: Database Management Systems Lab
Paper Code: CS591
Contact: 3P/Week
Total Credit Hours: 36
Credits: 1.5

Prerequisite:

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

Course Objective(s):

1. Demonstrate and Explain the database management system and different database languages.
2. Understand and Apply the SQL queries related to management of data and transaction processing for solving real life problems.
3. Explain and Analyze about query processing techniques involved in query optimization.
4. Demonstrate and Apply the PL/SQL programming, the concept of Cursor Management, Error Handling, Package and Triggers for solving real life complex problems.
5. Design DBMS based solutions through developing executable software applications

Course Outcome(s):

On completion of the course students will be able to:

CO1	Demonstrate and Explain the database management system and different database languages.
CO2	Understand and Apply the SQL queries related to management of data and transaction processing for solving real life problems.
CO3	Explain and Analyze about query processing techniques involved in query optimization.
CO4	Demonstrate and Apply the PL/SQL programming, the concept of Cursor Management, Error Handling, Package and Triggers for solving real life complex problems.
CO5	**Design** DBMS based solutions through **developing** executable software applications 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 and **Assess** the limitations of solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

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

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.

- **Mini-Project**

Text Books:

1. Ivan Bayross, SQL, PL/SQL the Programming Language of Oracle, BPB
2. Henry F. Korth and Silberschatz Abraham, “Database System Concepts”, Mc.Graw Hill.
3. ElmasriRamez and NovatheShamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.

Reference:

1. “SQL & PL/SQL for Oracle 11g Black Book”, P.S. Deshpande, Dreamtech Press.
2. Ramakrishnan: Database Management System, McGraw-Hill

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

CO – PO Mapping:

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

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

Course Name: Computer Networks Lab

Course Code: CS592

Contact: L: T: P: 0:0:3

Total Contact Hours: 36

Credits: 1.5

Course Objectives:

1. To design and implement small size network and to understand various networking commands.
2. To provide the knowledge of various networking tools and their related concepts.
3. To understand various application layer protocols for its implementation in client/server environment
4. Understand the TCP/IP configuration for Windows and Linux
5. Learn the major software and hardware technologies used on computer networks

Course Outcome(s)

After competition of the course the student able to do

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	**Apply** the concepts of networking basics through **programs** with adequate documentation in collaborative environment for successfully carrying out projects on Problems of networking and **investigate** their effectiveness by **analyzing** the outputs using proper techniques and tools and **Assess** the limitations of solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

Course Contents:

Module 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.

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Module 2:

Implementation of flow control mechanisms

Module 3:

Socket Programming using TCP and UDP

Module 4:

Implementing routing protocols such as RIP, OSPF

Module 5:

Familiarization of advanced simulators like Packet Tracer, NS2/NS3, OMNET++, TinyOS.

Server Configuration: only web server

- **Mini Projects**

Text books:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH
2. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI

Recommended books:

1. TCP sockets in C programs-Practical guide for Programmers By Micheal J Donahoo and Kenneth Calvert.
2. Socket Programming by Rajkumar Buyaa.

List of A Few Experiments as Sample Assignments

1. Implement the following forms of IPC. a) Pipes b) FIFO
2. Implement file transfer using Message Queue form of IPC.
3. Write a Program to create an integer variable using Shared Memory concept and increment the variable simultaneously by two processes. Use Semaphores to avoid Race conditions.
4. Design TCP iterative Client and Server application to reverse the given input sentence.
5. Design TCP concurrent Client and Server application to reverse the given input sentence.
6. Design TCP Client and Server application to transfer file.

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7. Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call "select".
8. Design a TCP concurrent Server to echo given set of sentences using Poll functions.
9. Design UDP Client and Server application to reverse the given input sentence.
10. Design UDP Client Server to transfer a file.
11. Design using Poll Client Server application to multiplex TCP and UDP requests for converting a given text into upper case.
12. Design RPC application to add and subtract a given pair of integers.

CO – PO Mapping:

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

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

Course Name: Artificial Intelligence Lab

Course Code: CS593

Contact: 3:0:0

Credits: 1.5

Prerequisites: Data Structure, Design and Analysis of Algorithms, Statistics

Course Objectives:

The objective of the course is to enable students to

1. Gain foundational knowledge of PROLOG to implement an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing
2. Formulate a problem by analyzing its characteristics to fit a State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
3. Apply the concepts of Artificial Intelligence to solve a problem by implementing well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.
4. Build expert systems offering solutions to the challenging problems of Artificial Intelligence.
5. Implement Artificial Intelligence based ideas as executable PROLOG programs through developing intelligent heuristic strategies.

Course Outcomes:

After completion of the course students will 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
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 and **Assess** the limitations of solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

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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

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Text book:

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

Reference Books:

9. Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.
10. 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	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	2	2	-	2
CO5	2	2	3	3	2	2	2	2	2	2	2	2	2	2	3

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

Course Name: Constitution of India
Course Code: MC501
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.

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

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

Curriculum for B. Tech
Under Autonomy
Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

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

3rd Year 2nd Semester: Semester 6

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	HSMC604	Economics for Engineers	2	0	0	2	2
2	PC	CS601	Machine Learning	3	0	0	3	3
4	PC	CS602	Digital Image Processing	3	0	0	3	3
5	PC	CS603	Natural Language Processing	3	0	0	3	3
6	OE	CS604	A. Software Engineering B. Operations Research C. Information Theory and Coding	3	0	0	3	3
B. PRACTICAL								
7	PC	CS691	Machine Learning Lab	0	0	3	3	1.5
8	PC	CS692	Digital Image Processing Lab	0	0	3	3	1.5
9	PC	CS693	Natural Language Processing Lab	0	0	3	3	1.5
10	PROJECT	PR691	Minor Project II	0	0	3	2	1
11	PROJECT	PR692	Skill Development VI: Soft Skill & Aptitude-III	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
12	MC	MC601	Intellectual Property Right				2	
	TOTAL CREDIT WITHOUT MOOCS COURSES							20
D.MOOCS COURSES**								
13	MOOCS COURSES	HM601	MOOCS COURSE-IV	3	1	0	4	4
	TOTAL CREDIT WITH MOOCS COURSES							**24**

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

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Course Name: Economics for Engineers
Course Code: HSMC604
Contact: 2:0:0
Total Contact Hours: 24
Credits:2

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

Course Outcome(s):

On completion of the course students will 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

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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	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	2	-
CO2	-	-	-	3	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	1	-

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Course Name: Machine Learning

Course Code: CS601

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Data Structure, Design and Analysis of Algorithms, Statistics, Artificial Intelligence

Course Objectives:

- Comprehend the fundamental concepts of the evolving technologies in machine learning such as Supervised and Unsupervised Learning
- Formulate an engineering problem within the scope of machine learning paradigm.
- Apply the concepts of machine learning to solve problems of making automated decisions dealing with large scale data.
- Develop and Implement ideas for proposing solutions to the challenging problems of machine learning
- Analyze the effectiveness of various machine learning Frameworks.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** the basic concepts 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 analysis 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

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Course Content:

MODULE-1: Introduction to Machine Learning [4L]

Basic Concepts, Various types of Machine Learning Techniques and related applications, Issues in Machine Learning Strategies, Data Exploration for Machine Learning: Data Types, Data Attributes, Statistical Description of Data, Data Visualization, Data Similarity Measures; Data Preprocessing: Data Cleaning, Data Integration, Data Reduction, Data Transformation & Discretization.

MODULE-2: Classification and Regression [14L]

Basic Concepts, assessing and visualizing performance of classification, k-Nearest-Neighbor Classifier, Decision Tree Classifier, Naïve Bayes Classifier; Ensemble Classification, Random Forest Strategy, Linear and Nonlinear Regression Methods and their performance analysis.

MODULE-3: Clustering, Association and Outlier Analysis [10L]

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 Connected Regions with High Density; Outlier Analysis.

MODULE-4: Mining Frequent Patterns, Associations and Data Streams [3L]

Basic Concepts, Association analysis and Frequent Itemset Mining Methods: The Apriori Algorithm, Mining Time Series Data.

MODULE-5: Advanced Concepts [5L]

Introduction to advanced concepts of machine learning like Support Vector Machines and Artificial Neural Network and their applications in solving machine learning problems.

Text book:

- Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
- Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018
- Machine Learning by Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson.

Reference Books:

- Machine Learning using Python, Manaranjan Pradhan and U Dinesh Kumar, Wiley
- Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly
- Han J & Kamber M, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Third Edition.

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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	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	-	2	-	2
CO5	2	2	3	3	-	-	-	-	-	-	-	2	2	2	3

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Course Name: Digital Image Processing

Course Code: CS602

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Design and Analysis of Algorithms, UG Level Mathematics

Course Objectives:

- Understand the basic concepts of digital image processing and identify problems where students can apply the concept appropriately.
- 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.
- Illustrate the fundamental image restoration strategies and apply them appropriately to eliminate noise in the image.
- Illustrate various Image Compression Techniques and Analyze their performances.
- Understand the ideas of Morphological Image Processing and Image Segmentation to propose solutions to the related problems and analyze the effectiveness as well as limitations of solutions underscoring its utilitarian importance for further explorations leading towards lifelong learning.

Course Outcomes:

After completion of the course students will 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** and **explain** 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.

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Course Content:

MODULE-1: Introduction to Digital Image Processing [3L]

Applications of digital image processing, fundamental steps in digital image processing, components of image processing system. Digital Image Fundamentals: A simple image formation model, image sampling and quantization, Some Basic Relationships Between Pixels- Neighbors and Connectivity of pixels in image, Color Image Models.

MODULE-2: Image Enhancement [10L]

Image Enhancement in The Spatial Domain: Some Basic Gray Level Transformations, Histogram Processing, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

Image Enhancement in Frequency Domain:

Introduction, Fourier Transform, Discrete Fourier Transform (DFT) and its relation with image characterization, fundamental steps of image enhancement in Frequency Domain, Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.

MODULE-3: Image Restoration [5L]

Basics of Image restoration and Noise characterization, Estimating the degradation function, Noise removal using spatial and frequency domain filtering, Image Restoration techniques.

MODULE-4: Morphological Image Processing [5L]

Basic Concepts, Erosion, Dilation, Opening, Closing, Skeletonization, Hole filling, Connected components, Boundary Detection.

MODULE-5: Image Compression [5L]

Basic Concepts – Types of redundancy, Types of coding techniques, Lossless Compression: Run-Length Encoding, Huffman Coding, Lossy Compression: Vector Quantization, Sequential DCT-based Compression (JPEG Baseline Algorithm).

MODULE-6: Image Segmentation [8L]

Detection of Points, lines and Edges (Sobel and Canny); Edge Linking, Image Thresholding (Otsu's method), Region based segmentation, color-feature based segmentation in color images.

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Text book:

- Digital Image Processing, Rafael C. Gonzales, Richard E. Woods, Third Edition, Pearson Education, 2010.
- Digital Image Processing, S. Sridhar, Oxford University Press, 2nd Ed, 2016.

Reference Books:

- Fundamentals of Digital Image Processing- Anil K. Jain, 2nd Edition, Prentice Hall of India.
- Image Processing, analysis and Machine Vision, Milan Sonka , Thomson Press India Ltd, Fourth Edition.

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	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	-	2	-	2
CO5	2	2	3	3	-	-	-	-	-	-	-	2	2	2	3

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Course Name: Natural Language Processing

Course Code: CS603

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites:

Statistics, Automata, Compiler Design

Objective of the course:

1. To learn the basics and details of NLP algorithms, principles & application, different NLP techniques and different tools and their uses.
2. To familiarize the concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
3. To learn the fundamental strategies of Language Modelling and Word Sense Disambiguation acquiring enough knowledge to Propose models for Word Prediction & Disambiguation.
4. To learn the concepts of Markov Model for POS Tagging and Probabilistic Context Free Grammars and Probabilistic parsing.
5. To learn the techniques of Syntax & Semantics Analysis for Machine Translation and Identify problems where students can Apply the concept appropriately.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** the basic concepts of NLP to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Understand** the fundamental concepts of Text Preprocessing and Morphology so that they can **Apply** the concept to **Analyze** their CORPUS.
CO3	**Explain or Illustrate** the fundamental strategies of Language Modelling and Word Sense Disambiguation acquiring enough knowledge to **Propose** models for Word Prediction & Disambiguation and **Evaluate** their performances.
CO4	**Explain or Illustrate** the concepts of Markov Model for POS Tagging and Probabilistic Context Free Grammars and Probabilistic parsing so that they can **Apply** them to solve the relevant problems and **Analyze** their performances.
CO5	**Develop** ideas to **Propose** solutions to the problems of Syntax & SemanticsAnalysis for Machine Translation and **Identify** problems where students can **Apply** the concept appropriately and **Analyze** the effectiveness as well as limitations of solutions underscoring the utilitarian importance for further exploration of NLP issues leading towards lifelong learning.

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Course Content:

Module-I: Introduction to NLP [4L]

Introduction to NLP - Various stages of NLP –The Ambiguity of Language: Why NLP Is Difficult Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure. Statistics Essential Information Theory: Entropy, perplexity, The relation to language, Cross entropy.

Module-II: Text Preprocessing and Morphology [5L]

Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis. Inflectional and Derivation Morphology, Morphological analysis and generation using Finite StateAutomata and Finite State transducer.

Module-III: Language Modeling [4L]

Introduction to N-grams, Chain Rule, Smoothing – Add-One Smoothing, Witten-Bell Discounting; Backoff, Deleted Interpolation, N-grams for Spelling and Word Prediction, Evaluation of language models.

Module-IV: Word Sense Disambiguation [5L]

Methodological Preliminaries, Supervised Disambiguation: Bayesian classification, An informationtheoretic approach, Dictionary-Based Disambiguation: Disambiguation based on sense, Thesaurus based disambiguation, Disambiguation based on translations in a second-language corpus.

Module-V: Markov Model and POS Tagging [5L]

Markov Model: Hidden Markov model, Fundamentals, Probability of properties, Parameter estimation, Variants, Multiple input observation. The Information Sources in Tagging: Markov model taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications of Tagging.

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Module-VI: Probabilistic Context Free Grammars and Probabilistic parsing [5L]

The Probability of a String, Problems with the Inside-Outside Algorithm, Parsing for disambiguation, Treebanks, Parsing models vs. language models, Phrase structure grammars and dependency, Lexicalized models using derivational histories, Dependency-based models.

Module-VII: Syntax & Semantics Analysis and Machine Translation [8L]

Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, WordNet, Thematic Roles, Semantic Role Labelling with CRFs. Statistical Alignment and Machine Translation, Text alignment, Word alignment, Information extraction, Text mining, Information Retrieval, NL interfaces, Sentimental Analysis, Question Answering Systems, Social network analysis.

Text book:

1. Speech and Language Processing, Jurafsky and Martin, Pearson Education
2. Foundation of Statistical Natural Language Processing, Manning and Schutze, MIT Press
3. Multilingual Natural Language Processing Applications from Theory to Practice: Bikel, Pearson.
4. Ela Kumar, "Natural Language Processing', Wiley

Reference Books:

1. Allen, James. 1995. – "Natural Language Understanding". Benjamin/Cummings, 2ed. 2.
2. Bharathi, A., Vineet Chaitanya and Rajeev Sangal. 1995. Natural Language Processing- "A Paninian Perspective". Prentice Hll India, Eastern Economy Edition.
3. Hobson lane, Cole Howard, Hannes Hapke, "Natural language processing in action" MANNING Publications, 2019

CO – PO Mapping:

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

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Course Name: Software Engineering
Course Code: CS604A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Programming for Problem Solving, OOP

Course Objectives:

1. To 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
2. To analyze, elicit and specify software requirements through a productive working relationship with various stakeholders of the project
3. To design applicable solutions in one or more application domains using software engineering approaches that integrates ethical, social, legal and economic concerns.
4. To develop the code from the design and effectively apply relevant standards and perform testing, and quality management and practice team work.
5. 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 Outcome(s):

CO1	To 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	To analyze, elicit and specify software requirements through a productive working relationship with various stakeholders of the project
CO3	To design applicable solutions in one or more application domains using software engineering approaches that integrates ethical, social, legal and economic concerns.
CO4	To 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.

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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 modelling 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 modelling.

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 –Agarwal and Agarwal (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)

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CO – PO Mapping:

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

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Course Name: Operations Research
Course Code: CS604B
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 Objective:

1. Understand the basic concepts of Operations Research to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
2. Understand the fundamental concepts of Linear Programming Problem and formulate a real-world problem as Linear Programming Problem for solving.
3. Illustrate the theoretical workings of Game Theory approaches and apply the concept appropriately.
4. Illustrate the concepts of Network Optimization Models, Queuing Theory and Apply them to solve the relevant problems and analyze their performances.
5. Develop ideas to Propose solutions to the problems of Nonlinear programming

Course Outcomes(s):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1	**Understand** the basic concepts of Operations Research to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Understand** the fundamental concepts of Linear Programming Problem and formulate a real-world problem as Linear Programming Problem for solving.
CO3	**Explain or Illustrate** the theoretical workings of Game Theory approaches and **Apply** the concept appropriately.
CO4	**Explain or Illustrate** the concepts of Network Optimization Models, Queuing Theory and Apply them to solve the relevant problems and **Analyse** their performances.
CO5	**Develop** ideas to **Propose** solutions to the problems of Nonlinear programming 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.

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Course Content:

Module 1: [10L]
Linear Programming Problem(LPP): Basics of 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: [2L]
Transportation Problem, Assignment Problem.

Module 3: [5L]
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.

Module 4: [4L]
Network Optimisation Models: CPM PERT (Arrow network), Time estimates, earliest expected time, latest allowable occurrence time, latest allowable occurrence time and stack. Critical path, Probability ofmeeting scheduled date of completion of project.
Calculation of CPM network.Various floats for activities.

Module 5: [2L]
Sequencing: Johnson's Algorithm (1957) For **n** Jobs and **two** machines, **n** Jobs and **three** machines.

Module 6: [4L]
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: [3L]
Inventory Control: Determination of EOQ, Components, Deterministic Continuous & Deterministic Periodic Review Models, Stochastic Continuous & Stochastic Periodic Review Models.

Module 8: [6L]
Nonlinear programming: Unconstrained optimization-direct methods: Powell's Method, conjugate direction, Indirect search methods: steepest descent, Newton's methods.

Constrained optimization: Sequential linear programming, Methods of feasible directions, gradient projection method, penalty function method, Augmented Legrangian multipliers method. Kuhn-Tucker conditions.

Curriculum for B. Tech
Under Autonomy
Computer Science & Engineering
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L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

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:

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

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

Course Name: Information Theory and Coding
Course Code: CS604C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Probability & Statistics

Course Objective(s):

The objective of the course is to make the students able to

1. Understand the basic concept of information and apply this knowledge in designing solution.
2. Understand the basic concept of coding theory and use this knowledge for designing and implementing problem.
3. Understand the concept of channel models to determine the mutual information in the channels.
4. Outline the concept of error detection techniques and design a model for building a new solution.
5. Understand how convolutional theory works and develop a new approach.

Course Outcome(s):

After completion of the course students will be able to

CO1	Understand the basic concept of information and apply this knowledge in designing solution for real life engineering problem.
CO2	Understand the basic concept of coding theory and use this knowledge fo designing and implementing mathematical and engineering problem leading t lifelong learning.
CO3	Understand the concept of channel models to determine the mutual information in the channels.
CO4	Outline the concept of 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 to solve it 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 Speechand Image Compression.

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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.

Text book:
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	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	3	3	2	3
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	3	1
CO4	3	3	3	3	-	-	-	-	3	-	-	-	3	2	3
CO5	3	3	3	3	-	-	-	-	3	2	-	-	3	2	3
CO	3	3	3	3	-	-	-	-	3	2	-	3	3	3	3

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

Course Name: Machine Learning Lab

Course Code: CS691

Contact: 3:0:0

Total Contact Hours: 36

Credits: 1.5

Prerequisites: Data Structure, Design and Analysis of Algorithms, Statistics, Artificial Intelligence, Python Programming

Course Objectives:

6. Comprehend and Implement the fundamental concepts of the evolving technologies in machine learning such as Supervised and Unsupervised Learning
7. Formulate an engineering problem within the scope of machine learning paradigm.
8. Implement the concepts of machine learning to solve problems of making automated decisions dealing with large scale data.
9. Develop and Implement ideas for proposing solutions to the challenging problems of machine learning
10. Analyze the effectiveness of various machine learning Frameworks using appropriate tools.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** and **Apply** the basics concepts of machine learning to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Understand** and **Apply** the fundamental concepts of regression analysis so that they can **propose models** for predicting values based on exemplary data and **Analyze** their performances.
CO3	**Understand** and **Apply** the fundamental strategies of unsupervised machine learning paradigm to solve clustering problems and **Analyze** their performances.
CO4	**Understand** and **Apply** the concepts of Mining Frequent Patterns, Associations and Data Streams and Apply them to solve the relevant problems and **Analyze** their performances.
CO5	**Develop** ideas to **Propose** solutions to the problems of supervised learning and **Identify** problems where students can **Apply** and **Implement** the concept appropriately through programming with adequate documentation in collaborative environment for successfully carrying out projects on machine learning problems and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools and **Assess** the limitations of solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

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

Course Content:

WEEK-1: Introduction to Machine Learning Programming Platform & Python Programming Basics

Introduction to Machine Learning Programming Platform and Python Programming Basics

WEEK-2: Data Exploration

Data Exploration: Data Types, Data Attributes, Statistical Description of Data, Data Visualization, Data Feature Vectors, Data Preprocessing: Data Cleaning, Data Transformation

WEEK -3: Regression

Implementation and Analysis of Linear and Nonlinear Regression Methods

WEEK -4: Classification

Implementation and Analysis of k-Nearest-Neighbor Classifier, Decision Tree Classifier, Naïve Bayes Classifier

WEEK -5: Classification

Implementation and Analysis of ANN-Backpropagation and SVM Based Classifier

WEEK-6: Clustering

Implementation and Analysis of k-Means and k-Medoids

WEEK -7: Association Analysis

Implementation and Analysis of Apriori Algorithm

WEEK -8: Mining Time-Series Data

Implementation and Analysis of Time-Series Data Mining Models

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

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

Text book:

10. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly
11. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
12. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018

Reference Books:

11. Machine Learning by Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson.
12. Machine Learning using Python, Manaranjan Pradhan and U Dinesh Kumar, Wiley

CO – PO Mapping:

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

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

Course Name: Digital Image Processing Lab

Course Code: CS692

Contact: 3:0:0

Total Contact Hours: 36

Credits: 1.5

Prerequisites: Design and Analysis of Algorithms, UG Level Mathematics, Python/MATLAB Programming

Course Objectives:

11. Understand the practical aspects of digital image processing and identify problems where students can implement the concept appropriately.
12. Understand the practical aspects of image enhancement strategies and identify the scope of enhancement where students can apply the appropriate strategy and analyze the performance.
13. Implement the fundamental image restoration strategies and apply them appropriately to eliminate noise in the image.
14. Implement various Image Compression Techniques and Analyze their performances.
15. Understand the ideas of Morphological Image Processing and Image Segmentation and implement them to solve related problems and analyze the effectiveness as well as limitations of the solutions underscoring its utilitarian importance for further explorations leading towards lifelong learning.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** the practical aspects of digital image processing and **identify** problems where students can implement the concept appropriately.
CO2	**Understand** the practical aspects of image enhancement strategies and **identify** the scope of enhancement where students can **apply** the appropriate strategy and analyze the performance.
CO3	**Implement** the fundamental image restoration strategies and **apply** them appropriately to eliminate noise in the image.
CO4	**Implement** various Image Compression Techniques and **Analyze** their performances.
CO5	**Understand** the ideas of Morphological Image Processing and Image Segmentation and **implement** them to **solve** related problems with adequate documentation in collaborative environment demonstrating the ability to carry out projects and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools and **assess** the limitations of the solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

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

Course Content:

WEEK-1: Introduction to Digital Image Processing Basics & Python/MATLAB Programming Basics

Introduction to Digital Image Processing Basics and Python/MATLAB Programming Basics

WEEK-2: Image Enhancement in Spatial Domain

Implementation of various image enhancement strategies in Spatial Domain.

WEEK -3: Image Enhancement in Frequency Domain

Implementation of various image enhancement strategies in Frequency Domain.

WEEK -4: Image Restoration

Implementation of various Image Restoration strategies

WEEK -5: Morphological Image Processing

Implementation of various Morphological Image Processing strategies

WEEK-6: Image Compression

Implementation of various Image Compression strategies**.**

WEEK -7: Image Segmentation: Detection of Points, lines and Edges (Sobel and Canny); Edge Linking

Implementation of various techniques for Detection of Points, lines and Edges (Sobel and Canny); Edge Linking

WEEK-8: Image Segmentation: Image Thresholding (Otsu's method), Region based segmentation, color-feature based segmentation in color images

Implementation of various techniques for Image Thresholding (Otsu's method), Region based segmentation, color-feature based segmentation in color images

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

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

Text book:

- Digital Image Processing using MATLAB, Rafael C. Gonzales, Richard E. Woods, Steven L. Eddins, Pearson Education.
- OpenCV with Python By Example, Prateek Joshi, oreilly.

Reference Books:

- Practical Python and OpenCV: An Introductory, Example Driven Guide to Image Processing and Computer Vision, Adrian Rosebrock, PyImageSearch
- Image Processing, analysis and Machine Vision, Milan Sonka , Thomson Press India Ltd, Fourth Edition.

CO – PO Mapping:

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

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

Course Name: Natural Language Processing Lab

Course Code: CS693

Contact: 3:0:0

Credits: 1.5

Prerequisites: Statistics, Automata, Compiler Design, Python Programming

Objective of the course:

1. To learn the principles of NLP through implementation.
2. To build an application using different algorithms and natural language processing techniques.
3. To learn techniques of Machine translations.
4. To implement the NLP algorithms for extracting meaning of sentences
5. To understand and evaluate expert systems for various NLP problems with moderate complexity

Course Outcomes:

After completion of the course students will be able to

CO1	Analyze text corpora and lexical resources and pre-process of raw text.
CO2	Apply the concepts of Markov Model for POS Tagging to write structured programs for categorizing and tagging of words, segmentation of sentences.
CO3	Classify text and extract information from it.
CO4	Implement the relevant algorithms to analyze meaning of sentences for translating linguistic data
CO5	Design and Implement expert systems for various NLP problems with adequate documentation in collaborative environment for successfully carrying out projects on NLP Problems and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools and **Assess** the limitations of solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

Course Content:

WEEK-1: Introduction to NLP Programming Platform & Python Programming Basics

Introduction to NLP Programming Platform and Python Programming Basics

WEEK-2: Word Analysis and Morphological Processing

Implementation of concepts for Word Analysis and Morphological Processing

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

WEEK -3: N-Gram Modelling for Spelling and Word Prediction

Implementation of concepts for Spelling and Word Prediction.

WEEK -4: POS Tagging: Hidden Markov Model

Implementation and Analysis of Hidden Markov Model

WEEK -5: POS Tagging: Viterbi Decoding

Implementation and Analysis of Viterbi Decoding for POS Tagging.

WEEK-6: Semantic Processing & Sentiment Analysis

Implementation and Analysis of Semantic Processing and Sentiment Analysis strategies.

WEEK -7: Automatic Query Processing System

Implementation and Analysis of automatic query processing system.

WEEK -8: NLP based information retrieval

Implementation and Analysis of NLP based information retrieval models.

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

Text book:

1. Steven Bird, Ewan Klein, and Edward Loper. Natural Language Processing with Python", O'Reilly.
2. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, "Practical Natural Language Processing", O'Reilly.

Reference Books/Sites:

1. Sri Mathangi, "Practical Natural Language Processing with Python', Apress.
2. Rajesh Arumugam, Rajalingappaa Shanmugamani, "Hands-On Natural Language Processing with Python", ", O'Reilly.
3. Natural Language Toolkit documentation (https://www.nltk.org/), Natural Language Processing Lab (https://nlp-iiith.vlabs.ac.in/)

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CO – PO Mapping:

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

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

Course Name: Intellectual Property Right
Course Code: MC601
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, PlantVarieties 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: Criminal law. data safety, online privacy. Health privacy, Freedom of expression and human rights, net neutrality, national security.

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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

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4th Year 1st Semester

Sl No	Course Code	Paper Code	Theory	Contact Hours /Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	PC	CS701	Neural Networks and Deep Learning	3	0	0	3	3
2	PE	CS702	A. Computer Vision B. Information Retrieval and Text Mining C. Wireless Sensor Networks and IoT	3	0	0	3	3
3	OE	CS703	A. Web Technologies B. Mobile Device Programming C. Parallel Computing	3	0	0	3	3
4	PE	CS704	A. Soft Computing B. Bio-informatics C. Cryptography and Network Security	3	0	0	3	3
B. PRACTICAL								
5	PC	CS791	Neural Networks and Deep Learning Lab	0	0	0	3	1.5
6	PE	CS792	A. Computer Vision Lab B. Information Retrieval and Text Mining Lab C. Wireless Sensor Networks and IoT Lab	0	0	0	3	1.5
7	OE	CS794	A. Web Technologies Lab B. Mobile Device Programming Lab C. Parallel Computing Lab	0	0	3	3	1.5
8	PROJECT	PR791	Major Project-I	0	0	0	4	2
9	PROJECT	PR792*	Industrial Training / Internship	0	0	0	0	1
10	PROJECT	PR793	Skill Development VII: Seminar and Group Discussion	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
11	MC	MC781	Entrepreneurship & Innovation Skill				2	
TOTAL CREDIT WITHOUT MOOCS COURSES								20
D.MOOCS COURSES**								
12	MOOCS COURSES	HM701	MOOCS COURSE-V	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**24**

***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**

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

Paper Name: Neural Networks and Deep Learning

Paper Code: CS701

Contact (Periods/Week): 3:0:0

Credit Point: 3

No. of Lectures: 36

Prerequisite:

1. A solid background in Statistics, Calculus, Linear Algebra and Probability.
2. Artificial Intelligence, Machine Learning

Course Objective(s):

- To introduce the fundamental techniques and principles of Neural Networks
- To study the different models in ANN and their applications
- To familiarize deep learning concepts with CNN and RNN

Course Outcome(s):

On completion of the course students will be able to

CO1	**Understand** the basic concepts of Neural Networks and Deep Learning to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Understand** the fundamental concepts of Shallow & Deep Neural Networks so that they can **propose models** based on exemplary data and **Analyze** their performances.
CO3	**Explain or Illustrate** the fundamental strategies of Convolutional Neural Network models to solve computer vision problems and **Analyze** their
CO4	**Explain or Illustrate** the concepts of Recurrent Neural Network models for Sequence data and Apply them to solve the relevant problems and **Analyse** their performances.
CO5	**Develop** ideas to **Propose** solutions to the problems of machine 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

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

Module 1: Introduction to Neural Networks and Deep Learning [7L]

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 [8L]

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 [8L]

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, RCNN, Fast RCNN, Mask-RCNN.

Module 4: Sequence Models & Representation Learning [10L]

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, Representation Learning: Autoencoder Fundamentals, Regularization & Autoencoder, 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, Trigger Word Detection, Transformer Network Intuition, Self-Attention, Multi-Head Attention.

Module 5: Generative Adversarial Network **[3L]**

Basic Concepts, Popular Variants of GAN, Applications of GAN,

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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

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

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Course Name: Computer Vision
Course Code: CS702A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Digital Image Processing, Machine Learning

Course Objective(s):

1. Understand the basic concepts of Computer Vision to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
2. Understand the fundamental concepts of Image Analysis and Image Feature Descriptors, and Etraction Techniques and Analyze their performances.
3. Illustrate the fundamental strategies of Image Registration to solve related problems and analyze their performances.
4. Illustrate the concepts of Shape Matching, Video Processing and Apply them to solve the relevant problems

Course Outcome(s):

After completion of the course students will be able to

CO1	**Understand** the basic concepts of Computer Vision to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Understand** the fundamental concepts of Image Analysis and Image Feature Descriptors, and Etraction Techniques and **Analyze** their performances.
CO3	**Explain or Illustrate** the fundamental strategies of Image Registration to solve related problems and **Analyze** their performances.
CO4	**Explain or Illustrate** the concepts of Shape Matching, Video Processing and Apply them to solve the relevant problems and **Analyse** their performances.
CO5	**Develop** ideas to **Propose** solutions to the problems of Computer Vision 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.

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Course Content:

Module 1: Introduction to Computer Vision [2L]

Basics of Computer Vision Systems, Computer Vision Problems, Computer Vision Solution Models.

Module 2: Image Analysis and Image Feature Descriptors [10L]

Image Analysis Basics, Edge Detection and Hough Transform – Definition Edges, Edges in real image, Gradient, Steps in Edge Detection, Different Edge Detectors, Second Derivative Operators, Laplacian Operator, Laplacian of Gaussian, Canny Edge Detector, Hough Transform, Hough space, Finding Circles by Hough Transform, Generalized Hough Transform.

Image Feature Descriptors and Extraction Techniques – Image Object Shape Descriptors, HOG, Harris Corner Detector, Scale Invariant Feature Transform (SIFT), SIFT-PCA, Speeded Up Robust Features (SURF).

Module 3: Texture Analysis [6L]
Definition and Applications, Texture Definition - Statistical Approach, Edge Density and Direction, Local Binary Pattern, Gray Level Co-occurance Matrix, Co-occurrence Features, Laws' Texture Energy Features, Law's texture masks, LBP: Applications to Medical Images.

Module 4: Image Registration [3L]

Transformation, Registration algorithms - Point-based Method, Landmark based Method, Intensity based Method, Surface-based Method, Similarity Measures

Module 5: Shape Descriptor & Shape Matching [3L]

Geometric Transformation, Shape Contexts, Shape Matching, Thin-Plate Spline Model, Hierarchical Matching of Deformable Shapes, The Shape Tree, Deformation Model, Elastic Matching

Module 6: Video Processing Basics [4L]

Digital Video Formation basics, Background subtraction in video, Object Tracking in video, Video Surveillance Applications.

Module 7: Advanced Computer Vision Applications [8L]

Image Object Detection and Recognition: Face Detection and Recognition, Image Object Segmentation, Image Retrieval, Document Image Processing.

Text Book:

1) David A. Forsyth and Jean Ponce, Computer Vision: A Modern Approach, Pearson Education, 2003
2) Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1989 - Technology & Engineering
3) Simon J.D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.

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Reference(s):

1 Insight into Images: Principles and Practice for Segmentation, Registration, and Image Analysis, By: T. S. Yoo, 2004 (Hardcopy)
2 Biomedical Images Analysis, by: R. M. Rangayya, 2004, eBook.

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	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	-	2	-	2
CO5	2	2	3	3	-	-	-	-	-	-	-	2	2	2	3

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

Course Name: Information Retrieval & Text Mining

Course Code: CS702B

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites:

1. Prior knowledge of elementary linear algebra, Machine Learning, NLP
2. Basic concept of statistical analysis

Objective of the course:

1. Understand the role of social media data and analytics
2. Draw meaningful insights and provide actionable and strategic recommendations based on thorough social media data analysis;
3. Develop social media measurement plans and analytics reports, and communicate findings and recommendations effectively;
4. Examine the ethical and legal implications of leveraging social media data

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** the basic concepts of Information Retrieval & Text Mining to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Understand** the fundamental concepts of Query Processing Models 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 Text Mining to solve clustering problems and **Analyze** their performances.
CO4	**Explain or Illustrate** the concepts of Text Categorization and Clustering and Apply them to solve the relevant problems and **Analyse** their performances.
CO5	**Develop** ideas to **Propose** solutions to the problems of Text Mining 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.

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Course Content:

Module-I [6L] Introduction to Information Retrieval

Goals and history of IR. Basic IR Model, Boolean and vector-space retrieval models; ranked retrieval; text-similarity metrics; TF-IDF (term frequency/inverse document frequency) weighting; cosine similarity.

Basic Tokenizing, Indexing, and Implementation of Vector-Space Retrieval

Simple tokenizing, stop-word removal, and stemming; inverted indices; efficient processing with sparse vectors.

Module-II [6L]

Experimental Evaluation of IR

Performance metrics: recall, precision, F-measure, and NDCG; Evaluations on benchmark text collections.

Query Operations and Languages

Relevance feedback; Query expansion; Query languages.

Module-III [4L]

Introduction to Text Mining

Basic concept of Text Mining, Representation of Structured and unstructured data, Analysis of Structured and Unstructured Data, Conversion Technique from unstructured to structured data, visualizations forexploring and presenting data.

Module-IV [10L]

Text Categorization and Clustering: Categorization algorithms: naive Bayes; decision trees; and nearest neighbor. Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM). Applications to information filtering; organization; and relevance feedback.

Module-V [10L]

Topic modeling: Probabilistic Latent Semantic Indexing (pLSI) and Latent Dirichlet Allocation (LDA), and their variants for different application scenarios, including classification, imagine annotation, collaborative filtering, and hierarchical topical structure modeling.

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Advanced Topics: Document summarization, Social media and network analysis, Text visualization.

Text book:

1. Mining Text Data. Charu C. Aggarwal and ChengXiang Zhai, Springer, 2012.
2. Speech & Language Processing. Dan Jurafsky and James H Martin, Pearson Education India, 2000.

Reference Books:

1. Introduction to Information Retrieval. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schuetze, Cambridge University Press, 2007

CO – PO Mapping:

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

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

Name of the Paper: Wireless Sensor Networks & IoT
Paper Code: CS702C
Contact: 3L/Week
Credit Point: 3
No. of Lectures: 36

Prerequisite:

- Basic concept of computer network and communication engineering
- Basic knowledge of Microcontroller fundamentals

Course Objective(s)

The objective of the course is to make the students able to –

- understand and illustrate the principles of sensor networks and IOT and their impact on protocol design
- Design the networks for various application setups.
- Develop appropriate data dissemination protocols and model links cost
- Evaluate the performance of the networks and identify bottlenecks.

Course Outcome(s)

After completion of the course students will be able to

CO1	**Understand** and **explain** the Fundamental Concepts and applications of wireless sensor networks and Internet of Things
CO2	**Describe** and **analyze** the basic protocols in wireless sensor network and IOT
CO3	**Design** and **develop** the M2M communication protocols
CO4	**Explain** the concepts of network architecture for WSN and IOT
CO5	**Develop** IOT applications in different domain on embedded platforms and able to **analyze** their performance

Course Content:

Module I: Wireless Sensor Networks (WSNs) and MAC Protocols [7L]

Single node architecture: hardware and software components of a sensor node -WSN Network architecture: typical network architectures -data relaying and aggregation strategies -MAC layer protocols: self-organizing - Hybrid TDMA/FDMA and CSMA based MAC -IEEE 802.15.4. Schedule based

protocols (LEACH, SMACS, TRAMA) Address and Name Management in WSNs, Assignment of MAC Addresses.

Module II: WSN Routing, Localization & QOS [12L]

Issues in WSN routing –OLSR - Localization –Indoor and Sensor Network Localization - absolute and relative localization - triangulation - QOS in WSN - Energy Efficient Design – Synchronization. Routing Protocols- Energy-Efficient Routing, Geographic Routing, Hierarchical networks by clustering. Sensor deployment & Node discovery, data aggregation & dissemination.

Module III: Fundamentals on IoT [6L]

Definition of IoT and Characteristics of IoT, Physical and logical design of IoT, Functional blocks of IoT, Communication models &APIs: Internet connectivity, Internet-based communication,IPv4, IPv6,6LoWPAN protocol, IP Addressing in the IoT, Application layer protocols: HTTP, HTTPS, FTP,TELNET and ports.

Module IV: Message to Message Communication and IoT [5L]

M2M communication and Modified OSI Model for the IoT/M2M Systems, Data enrichment, data consolidation and device management at IoT/M2M Gateway, Web communication protocols used by connected IoT/M2M devices, Message communication protocols (CoAP-SMS, CoAP-MQ, MQTT,XMPP) for IoT/M2M devices.

Module V: IoT Prototyping and Security [6L]

Introduction to Prototyping Embedded device software [1L] Programming Embedded Device Arduino Platform using IDE [1L] Reading data from sensors and devices, Devices, Gateways [2L] Internet and Web/Cloud services software development [1L] Introduction to IoT privacy and security [2L] Vulnerabilities, security requirements and threat analysis.

Text books:

1) Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley
2) Vijay Madisetti, Arshdeep Bahga, “Internet of Things: A Hands-On Approach”, Orient BlackSwan

Reference books:

1. Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication
2. Holger Karl and Andreas Willig “Protocols and Architectures for Wireless Sensor Networks”, Wiley, 2005
3. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, Rowan Trollope, “IoT Fundamentals : Networking Technologies, Protocols and Use Cases for the Internet of Things”, Pearson
4. C. Siva Ram Murthy, B. S. Manoj, “Ad Hoc Wireless Networks: Architectures and Protocols”, Prentice Hall
5. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks Technology, Protocols, and Applications”, John Wiley, 2007.
6. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

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

CO-PO Mapping

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	-	-	3	2	3	2	2	2
CO2	3	3	3	3	2	1	1	-	-	3	2	3	2	2	2
CO3	3	3	2	3	2	1	1	-	-	3	2	3	2	2	2
CO4	3	3	2	2	2	1	1	-	-	3	2	3	2	2	2
CO5	3	3	3	3	2	1	1	-	-	3	2	3	2	2	2

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

Course Name: Soft Computing
Course Code: CS704A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:
Discrete Mathematics, Probability and Statistics

Course Objective(s):

1 The primary objective of this course is to provide an introduction to the basic principles, techniques, and applications of soft computing.
2 Upon successful completion of the course, students will have an understanding of the basic areas of Soft Computing including Fuzzy Logic and Genetic Algorithms.
3 Gain understanding of various evolutionary computation techniques, Identify algorithms suitable for solving certain evolutionary-computation problems.
4 Aim of this course is to develop some familiarity with current research problems and research methods in Soft Computing by working on a research or design project.

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

CO1	Understand the basic concept of soft computing and hard computing and apply them in designing solution to engineering problem.
CO2	Understand appropriate learning rules for each of the architectures and learn soft computing paradigms and its applications to solving engineering and other problems.
CO3	Classify and differentiate problem solving methods and tools.
CO4	Apply fuzzy logic and reasoning to handle uncertainty and solving interdisciplinary engineering problems
CO5	Design and implement GA, PSO and ACO algorithms for optimization problems in Engineering problem

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

Course Content:

Module-1: Introduction to Soft Computing: 9L

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

Artificial Neural Network: Back propagation, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications

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: Evolutionary algorithms 7L

A History of Evolutionary Computation, Introduction to Evolutionary Algorithms

Evolutional Strategies, Evolutionary Programming, – Different Components of Evolutionary Algorithms. – Experimental (statistical) Methods for the analysis of Evolutionary Algorithms – Theoretical Analysis of Evolutionary Algorithms – Interactive Evolutionary Algorithms – Experiment design and analysis involving Evolutionary Algorithms

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: Swarm Intelligence Algorithms 6L

Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Differential Evolution (DE), Artificial Bee Colony (ABC), 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 A. E. Eiben and J. E. Smith, “An Introduction to Evolutionary Computing”, Natural Computing Series, Springer, 2 nd Edition, 2015.
4.“An Introduction to Genetic Algorithm”, Mitchell Melanie, Prentice Hall, 1998.

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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	PSO1	PSO2	PSO
CO1	3	3	3	3								2			
CO2	3	3	3	3	2	2						2			
CO3	3	3	3	3	2	2						2			
CO4	3	3	3	3	2							2			
CO5	3	3	3	3		2			2	2		2			

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

Name of the Paper: Bio-informatics

Paper Code: CS704B

Contact (Periods/Week): L-T-P=3-0-0

Credit Point: 3

No. of Lectures: 35

Course Objective(s):

The objective of the course is to make the student able to:

1. Familiar with the basic concept of the Bioinformatics and Molecular Biology and also Familiar with a variety of currently available genomic and proteomic databases.
2. Search and retrieve information from genomic and proteomic databases (e.g. GenBank, Swiss-Prot), and to analyze their search results using software available on the internet (e.g. BLAST, ClustalW).
3. Familiar with the principles and applications of microarrays and locate consensus sequences, genes and open reading frames within biological sequences.
4. Learn how to compare and analyze biological sequences and how to interpret the results of their analyses and how to construct phylogenetic trees based on biological sequence data.
5. Perform elementary predictions of protein structure and function and use the scientific method of inquiry, through the acquisition of scientific knowledge.

Course Outcomes:

After completion of the course students will be able to

CO1	Acquire the knowledge of Bioinformatics technologies with the related concept of DNA, RNA and their implications
CO2	Develop idea in Molecular Biology
CO3	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	Acquire the knowledge of the DNA Sequence Analysis
CO5	Analyze the performance of different types of Probabilistic models used in Computational Biology

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Course Content:

Module -1: **Introduction to Molecular Biology [7L]**

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: **Introduction to Genomic and MSDN [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: DNA Sequence Analysis [8L]

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

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Module 4: Introduction Probabilistic models used in Computational Biology [10L]

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		1
CO3	1	2		2	2				1			
CO4	2					2	2			1	1	
CO5		3		1		3		1			2	

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Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

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

Paper Name: Cryptography and Network Security
Paper Code: CS704C
Contact (Periods/Week): 3:0:0
Credit Point: 3
No. of Lectures: 36

Prerequisite:

1. The student must have basic knowledge about Computer Network and mathematics.

Course Objective(s):

1. To provide introduction to the concept of Network Security Model and Cryptography systems.
2. To give the knowledge of Digital Signature and other Security Measures available.
3. To familiarize with the various techniques like PGP and S/MIME.
4. To showcase IP Security Architecture & Transport Layer Security to identify the vulnerability of the Internet systems and recognize the mechanisms of the attacks.
5. To explain the firewall design principles and various intrusion detection system.

Course Outcome(s)

CO1	Understand cryptography and network security concepts and application.
CO2	Apply security principles to system design.
CO3	Identify and investigate network security threat
CO4	Analyze and design network security protocols.
CO5	**Develop** ideas to **Propose** solutions to the problems of network security 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

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]

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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.

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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	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	-	2	-	2
CO5	2	2	3	3	-	-	-	-	-	-	-	2	2	2	3

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

Name of the Paper: Web Technologies
Paper Code: CS703A
Contact (Periods/Week): 3L/Week
Credit Point: 3
No. of Lectures: 36

Course Objective(s):

- To impart the design, development, and implementation of Static and Dynamic Web Pages.
- To develop programs for Web using Scripting Languages and .net framework.
- To give an overview of Server-Side Programming in Web.

Course Outcomes:

After completion of the course students will be able to:

CO1	**Understand** networks, IP, DNS, routing and other related technologies used in internet and e**xecute** and **solve** problems related to them leading to engineering problems solutions
CO2	**Understand** different web based technologies like HTML, DHTML, CSS, XML and **demonstrate** their use in design of web based solutions leading to engineering problems
CO3	**Comprehend** and **analyze** different client and server side technologies like JavaScript, Servlet, CGI and **design** appropriate engineering solutions leading to life long learning
CO4	**Understand** and **implement** different types of technologies like JSP, JavaBean, JDBC and ODBC and **evaluate** their performances
CO5	**Understand** different web based applications and network security techniques and **apply** them to protect the network against different attacks and **solve** related problems preferably as a team

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 and attributes of image area [1L]; Introduction to CSS, basic syntax and structure of CSS, different types internal, external and inline CSS [1L]; Basic Introduction of DHTML, Difference between HTML and DHTML, Documentary

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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, methods in JSP [1L]; JSPdirective (Taglib and Include), JavaBean- inserting JavaBean in JSP [1L]; JSP Action 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

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CO-PO & PSO Mapping:

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

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

Course Name: Mobile Device Programming

Course Code: CS703B

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites:

Object-oriented programming

Course Objectives:

The objective of the course is to make the students able to -

1. Understand android SDK
2. Gain a basic understanding of Android application development
3. Inculcate working knowledge of Android Studio development tool

Course Outcomes:

After completion of the course students will be able to

CO1	Analyze architecture of android and current trends in mobile operating systems.
CO2	Apply suitable software tools and APIs for the development User Interface of a particular mobile application.
CO3	Apply intents and broadcast receivers in android application
CO4	Design apps for mobile devices
CO5	Develop apps for mobile devices using SQLite Database.

Course Content:

MODULE-I [6L]

Introduction to Android Operating System: Android OS and Features – Android

development framework; Installing and running applications on Android Studio, Creating AVDs, Types of Android application; Creating Activities, Activity Life Cycle, Activity states, monitoring state changes;

MODULE- II [6L]

Android application components – Android Manifest file, Externalizing recourses like

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Simple Values, Drawables, Layouts, Menus, etc,

Building User Interfaces: Fundamental Android UI design, Layouts – Linear, Relative, Grid and Table Layouts. User Interface (UI) Components

MODULE-III [9L]

Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities,

MODULE-IV [9L]

Intents and Broadcasts: Using intents to launch Activities, Types of Intents, Passing data to Intents, Getting results from Activities, Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters;

MODULE-V [6L]

Database: Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and deleting data;

TEXT BOOKS:

1. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox), 2012

2. Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013

REFERENCEs:

1. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013

2. Android Application Development (with Kitkat Support), Black Book, Pradeep Kothari, 2014, Dreamtech Press publisher, Kogent Learning Inc.,2014

3. Android Programming: Pushing the Limits, Erik Hellman, 1st Edition,Wiley Publications, 2014

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Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	1
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3	2
CO5	3	3	3	3	-	-	-	-	3	2	-	-	3	2	1
CO	3	3	3	3	-	-	-	-	3	2	-	3	3	3	3

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

Course Name: Parallel Computing

Course Code: CS703C

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisite:

- The student has the basic knowledge of Computer Organization Architecture, Distributed System and Operating System.

Course Objective(s)

1. To introduce the concepts of Modern Processors.
2. To introduce Optimization techniques for serial code.
3. To introduce Parallel Programming using OpenMP and MPI.

Course Outcome(s)

After competition of the course the student able to do

CO1	Understand of the parallel architecture and Programming
CO2	Design parallel programs
CO3	Analyze and apply various parallel algorithms.
CO4	To understand the various parallel programming models and the challenges involved in parallel programming and learn the parallel programming techniques with OpenMP and MPI
CO5	Capable to optimize algorithms for better performance

Course Content:

Module 1: Introduction of Parallel Programming: [3L]

Introduction: [3L] Need of high-speed computing – increase the speed of computers – history of parallel computers and recent parallel computers, Scope, issues, applications and challenges of Parallel.

Solving problems in parallel – temporal parallelism – data parallelism – comparison of temporal and data parallel processing – data parallel processing with specialized processors – inter-task dependency- The need for parallelcomputers - models of computation - analyzing algorithms –expressing algorithms

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Module 2: Parallel Algorithm Design and Communication Operations [9L]

Parallel Programming Platforms: [3L] Implicit Parallelism: Trends in Microprocessor Architectures, Dichotomy of Parallel Computing Platforms, Physical Organization, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, GPU, co-processing.

Principles of Parallel Algorithm Design: [3L] Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing.

Basic Communication Operations: [3L] One-to-all broadcast and all to-one reduction – all-to-all broadcast reduction – all-reduce and prefix-sum operations – scatter and gather – all to-all personalized communication – circular shift – improving the speed of some communication operations.

Module 3: Parallel Programming Models [9L]

Analytical Modelling of Parallel Programs: [3L] Sources of overhead in parallel programs – performance metrics for parallel systems – scalability of parallel systems – minimum execution time and minimum cost-optimal execution time.

Programming using the Message-Passing Paradigm: [3L] principles of message-passing programming – the building blocks – MPI – topologies and embedding – overlapping communication with computation – collective communication and computation operations – groups and communicators.

Programming Shared Address Space Platforms: [3L] Thread basics – synchronization primitives in Pthreads – controlling thread and synchronization attributes – composite synchronization constructs – tips for designing asynchronous programs – Case study Open MP, CUDA programming model

Module 4: Parallel Algorithms: [9L]

Dense Matrix Algorithms: [3L] Matrix-Vector Multiplication, Matrix-Matrix Multiplication, solving a system of linear equations – FFT, Issues in Sorting on Parallel Computers, Bubble Sort and Variants, Quick Sort, Other Sorting Algorithms

Graph Algorithms: [3L] Minimum Spanning Tree: Prim's Algorithm, Single-Source Shortest Paths: Dijkstra's Algorithm, All-Pairs Shortest Paths, Transitive Closure, Connected Components, Algorithms for Sparse Graph.

Search Algorithms for Discrete Optimization Problems: [3L] Sequential Search Algorithms, Parallel Depth-First Search, Parallel Best-First Search, Speedup Anomalies in Parallel Search Algorithms. Dynamic Programming: Serial Monadic DP Formulation-Non serial Monadic DP Formulation-Serial Polyadic DP Formulations-Non serial Polyadic DP Formulations Fast Fourier Transform: Serial Algorithm-The Binary Exchange algorithm-The Transpose algorithm

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Text books:

1. Selim G. Akl, The Design and Analysis of Parallel Algorithms, Prentice-Hall of India, 1999.
2. A Grama, A Gupra, G Karypis, V Kumar. Introduction to Parallel Computing (2nd ed.). Addison Wesley, 2003. 2. C Lin, L Snyder.
3. Principles of Parallel Programming. USA: Addison-Wesley Publishing Company, 2008. 3. J Jeffers, J Reinders. Intel Xeon Phi Coprocessor High-Performance Programming.

Reference Books

1. Morgan Kaufmann Publishing and Elsevier, 2013. 4. T Mattson, B Sanders, B Massingill. Patterns for Parallel Programming. Addison-Wesley Professional, 2004.
2. Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, Introduction to Parallel Computing, Pearson Education, Second edition, 2004. 2
3. V. Rajaraman and C. Siva Ram Murthy, Parallel Computers – Architecture and Programming, Prentice- Hall of India, 2003.
4. M.J. Quinn, Parallel Computing – Theory and Practice, McGraw-Hill, 1994.
5. Michael Jay Quinn, Parallel Programming in C with MPI and OpenMP McGraw-Hill, 2003

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	-	-	-	2	2	2	3	-	-
CO2	2	3	3	2	2	1	-	-	-	1	2	3	-	1	3
CO3	2	2	3	1	3	2	2	-	-	1	3	2	-	-	3
CO4	1	3	1	3	2	3	2	-	-	3	1	1		1	3
CO5	2	1	2	3	2	2	3	-	-	1	2	3	3	-	-

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

Paper Name: Neural Networks and Deep Learning Lab
Paper Code: CS791
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 Objective(s):

- To introduce the Keras/Tensorflow API for Neural Networks and Deep Learning.
- To build Convolutional Neural Network models using Keras/Tensorflow API
- To build Recurrent Neural Network models using Keras/Tensorflow API

Course Outcome(s):

On completion of the course students will be able to

CO1	**Apply** the basic concepts of in Neural Networks and Deep Learning through implementation to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Apply** the fundamental concepts of Shallow & Deep Neural Networks s through implementation o that they can **propose models** based on exemplary data and **Analyze** their performances.
CO3	**Apply** the fundamental strategies of Convolutional Neural Network models to solve computer vision problems and **Analyze** their performances.
CO4	**Apply** the concepts of Recurrent Neural Network models for Sequence data 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** and **Implement** the concept appropriately with adequate documentation in collaborative environment for successfully carrying out projects on machine learning problems and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools and **Assess** the limitations of solutions underscoring utilitarian importancefor further explorations leading towards lifelong learning

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

WEEK-1: Introduction to Keras/Tensorflow/PyTorch Platform

Introduction to Keras/Tensorflow/PyTorch platform

WEEK-2: Review of Machine Learning Basics: Regression, Classification, Clustering

Implementation and Analysis of Linear and Nonlinear Regression Methods, Implementation and Analysis of k-Nearest-Neighbor Classifier, Decision Tree Classifier, Naïve Bayes Classifier, K-Means Clustering

WEEK -3: ANN- Classification

Implementation and Analysis of ANN Classification

WEEK -4: CNN- Classification

Implementation and Analysis of CNN Classification for Computer Vision Applications

WEEK -5: Representation Learning

Implementation and Analysis of Representation Learning

WEEK-6: Sequenced Based Models: LSTM

Implementation and Analysis of Sequenced Based Models: LSTM

WEEK -7: R-CNN & YOLO Algorithms

Implementation and Analysis of R-CNN & YOLO Algorithms

WEEK -8: Generative Adversarial Networks (GAN)

Implementation and Analysis of GAN

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

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List of a Few Sample-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

Reference Books:

1. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly
2. Machine Learning using Python, Manaranjan Pradhan and U Dinesh Kumar, Wiley

CO-PO Mapping

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

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

Course Name: Computer Vision Lab
Course Code: CS792A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 1.5

Prerequisites: Digital Image Processing

Course Objective(s):

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

CO1	**Implement** the basic concepts of Computer Vision to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Implement** the fundamental concepts of Image Analysis and Image Feature Descriptors, and Etraction Techniques and **Analyze** their performances.
CO3	**Implement** the fundamental strategies of Image Registration to solve related problems and **Analyze** their performances.
CO4	**Implement** the concepts of Shape Matching, Video Processing and Apply them to solve the relevant problems and **Analyse** their performances.
CO5	**Develop** ideas to **Propose** solutions to the problems of Computer Vision 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

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

Course Content:

Week - 1: Introduction to Computer Vision & Python-OpenCV

Week - 2: Image Analysis Basics

Image Analysis Basics, Edge Detection and Hough Transform – Definition Edges, Edges in real image, Gradient, Steps in Edge Detection, Different Edge Detectors, Second Derivative Operators, Laplacian Operator, Laplacian of Gaussian, Canny Edge Detector, Hough Transform, Hough space, Finding Circles by Hough Transform, Generalized Hough Transform.

Week - 3: Image Feature Descriptors

Image Feature Descriptors and Extraction Techniques – Image Object Shape Descriptors, HOG, Harris Corner Detector, Scale Invariant Feature Transform (SIFT), SIFT-PCA, Speeded Up Robust Features (SURF), Texture

Week - 4: Shape Matching

Week - 5: Video Processing Basics

Week -6: Advanced Computer Vision Applications

Image Object Detection and Recognition: Face Detection and Recognition

Week -7: Advanced Computer Vision Applications

Image Object Segmentation

Week -8: Advanced Computer Vision Applications

Image Retrieval

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

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

Text Book:

1) David A. Forsyth and Jean Ponce, Computer Vision: A Modern Approach, Pearson Education, 2003
2) Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1989 - Technology & Engineering
3) Simon J.D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.
2) OpenCV with Python By Example, Prateek Joshi, oreilly

Reference(s):

1 Insight into Images: Principles and Practice for Segmentation, Registration, and Image Analysis, By: T. S. Yoo, 2004 (Hardcopy)
2 Biomedical Images Analysis, by: R. M. Rangayya, 2004, eBook.

CO–POMapping:

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

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

Course Name: Information Retrieval & Text Mining Lab

Course Code: CS792B

Contact: 0:0:2

Credits: 1.5

Prerequisites: Basic Programming Knowledge of Python and R, NLP basics

Objective of the course:

6. Learn to program models in R at a small scale using the base package and a minimal number of other packages
7. Use the tools from research design to assist in model development
8. Validate models of observational data in comparison to an appropriate baseline model
9. Develop simulation-based models for large scale, observational data
10. Develop and validate measurement (e.g., latent variable models, structural topic models) and classification models (e.g., neural networks) of text and image-based data

Course Outcomes:

After completion of the course students will be able to

CO1	To understand, analyze and implement of various classification algorithm.
CO2	To understand, analyze and implement of various Clustering algorithm on text
CO3	To recap the python and R programming
CO4	To understand the data collection procedure from various social media.
CO5	To understand the statistical analysis using regression and correlation using R Programming Method.

Course Content:

1. Basic IR Models: Boolean and vector-space retrieval models; ranked retrieval; text-similarity metrics; TF-IDF (term frequency/inverse document frequency) weighting; cosine similarity.
2. Basic Tokenizing Indexing, and Implementation of Vector-Space Retrieval: Simple tokenizing, stop- word removal, and stemming; inverted indices; efficient processing with sparse vectors; python implementation.
3. Text Representation: Word statistics; Zipf's law; Porter stemmer; morphology; index term selection; using thesauri. Metadata and markup languages (SGML, HTML, XML).
4. Web Search: Search engines; spidering; metacrawlers; directed spidering; link analysis (e.g. hubs and authorities, Google PageRank); shopping agents.
5. Text Categorization and Clustering: Categorization algorithms: naive Bayes; decision trees; and nearest neighbor. Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM).

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Applications to information filtering; organization; and relevance feedback.

6. Recommender Systems: Collaborative filtering and content-based recommendation of documents and products.
7. Information Extraction and Integration: Extracting data from text; XML; semantic web; collecting and integrating specialized information on the web.
8. Mini Project

CO – PO Mapping:

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

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

Name of the Paper: Wireless Sensor Networks and IoT Lab

LabPaper Code: CS792C

Contact: 3P/Week

Credit Point: 1.5

Prerequisite:

3. Basic concept of computer network and communication engineering
4. Basic knowledge of Microcontroller fundamentals

Course Objective(s)

The objective of the course is to make the students able to –

- understand and illustrate the principles of sensor networks and IOT and their impact on protocol design
- Design the networks for various application setups.
- Develop appropriate data dissemination protocols and model links cost
- Evaluate the performance of the networks and identify bottlenecks.

Course Outcome(s)

After completion of the course students will be able to

CO1	**Understand** and **explain** the Fundamental Concepts and applications of wireless sensor networks and Internet of Things
CO2	**Design** and **analyze** the basic protocols in wireless sensor network and IOT
CO3	**Design** and **develop** the M2M communication protocols and **analyze** performance
CO4	**Describe** and **analyze** the challenges in designing network architectures for WSN and IOT
CO5	**Develop** IOT applications in different domain on embedded platforms and able to **analyze** their performance

Sensor Network lab:

All the Experiments of Sensor Network lab may be Conducted using Network Simulation software like NS-2/ NSG2.1/ ONE Simulator/ Wire SHARK/ SDR etc.

1) Introduction of sensor network applications and its simulation
2) Network Simulator installation for wireless sensor network.
3) Evaluation of the performance of various LAN Topologies
4) Evaluation of the performance of various routing protocols of ad-hoc network

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5) Evaluation of the performance of IEEE 802.11 and IEEE 802.15.4
6) Capturing and Analysis of TCP and IP Packets

IoT lab

1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module
5. Introduction to Raspberry PI platform and python programming
6. Interfacing sensors to Raspberry PI

CO-PO Mapping

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	-	-	3	2	3	2	2	2
CO2	3	3	3	3	2	1	1	-	-	3	2	3	2	2	2
CO3	3	3	2	3	2	1	1	-	-	3	2	3	2	2	2
CO4	3	3	2	2	2	1	1	-	-	3	2	3	2	2	2
CO5	3	3	3	3	2	1	1	-	-	3	2	3	2	2	2

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

Name of the Paper: Web Technologies Lab
Paper Code: CS793A
Contact (Periods/Week): 3P/Week
Credit Point: 1.5

Prerequisite:
Fundamentals of Programming

Course Objective(s):
- To impart the design, development and implementation of Static and Dynamic Web Pages
- To develop programs for Web using Scripting Languages and .net framework
- To give an overview of Server Side Programming in Web

Course Outcomes:

After completion of the course students will be able to:

CO1	**Understand** the working principles of the Internet, and web based applications and e**xecute** and **solve** proble related to them leading to engineering problems solutions
CO2	**Understand** different web based technologies like HTML, DHTML, CSS, XML and **demonstrate** their use design of web based solutions leading to engineering problems
CO3	**Comprehend** and **analyze** different client and server side technologies and **design** the dynamic web pages applying appropriate engineering solutions leading to life long learning
CO4	**Analyze** web based applications, **apply** this advanced knowledge to **develop** complex web applications a **evaluate** their performances
CO5	**Understand** different technologies and **construct** web based projects preferably as a team

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 programs in html which will create complex design.
3. Write a single html program where use of internal style sheet will be shown
4. Write a single html program which implements image map concept
5. Write a html program which will show use of JavaScript.
6. Write a xml parsing technique which will parse a text string into an XML DOM object and extracts 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 using JavaScript.
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.

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10. Write a simple program in JSP through which you can create a login page of your own website
11. Write a simple JSP program which will show database connectivity property
12. Create an Online Registration form for individual user for a user.

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, Dream tech Press

CO-PO & PSO Mapping:

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

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Course Name: Mobile Device Programming Lab

Course Code: CS793B

Contact: 0:0:3

Total Contact Hours: 36

Credits: 1.5

Prerequisites:

Object-oriented programming

Course Objectives:

The objective of the course is to make the students able to -

1. Learn how to develop Applications in android environment.
2. Learn how to design android application
3. Learn how to develop user interface applications.
4. Learn how to develop URL related applications.

Course Outcomes:

After completion of the course students will be able to

CO1	Identify various concepts of mobile programming that make it unique from programming for other platforms
CO2	Critique mobile applications on their design pros and cons,
CO3	Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces,
CO4	Program mobile applications for the Android operating system that use basic and advanced phone features
CO5	. Deploy applications to the Android marketplace for distribution

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Course Content:

WEEK-01

Installation of Android studio. Development Of Hello World Application

WEEK-02

Create an application that takes the name from a text box and shows hello message along with the name entered in text box, when the user clicks the OK button.

WEEK-03

Create a screen that has input boxes for User Name, Password, Address, Gender(radio buttons for male and female), Age (numeric), Date of Birth (Date Picket), State (Spinner) and a Submit button. On clicking the submit button, print all the data below the Submit Button (use any layout)

WEEK-04

Design an android application to create page using Intent and one Button and pass the Values from one Activity to second Activity.

WEEK-05

Design an android application Send SMS using Intent. Create an android application using Fragments. Design an android application Using Radio button.

WEEK-06

Design an android application for menu.

WEEK-07

Create a user registration application that stores the user details in a database table.

WEEK-08 To WEEK -12: Mini Project

TEXT BOOKS:

1. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox), 2012

2. Android Application Development for Java Programmers, James C Sheusi, Cengage

Learning, 2013

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REFERENCES:

1. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013

2. Android Application Development (with Kitkat Support), Black Book, Pradeep Kothari, 2014, Dreamtech Press publisher, Kogent Learning Inc.,2014

3. Android Programming: Pushing the Limits, Erik Hellman, 1st Edition,Wiley Publications, 2014

Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	2	1
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3	2
CO5	3	3	3	3	-	-	-	-	3	2	-	-	3	2	1
CO	3	3	3	3	-	-	-	-	3	2	-	3	3	3	3

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

Course Name: Parallel Computing Lab

Course Code: CS793C

Contact: 3:0:0

Total Contact Hours: 36

Credits: 1.5

Prerequisite:

- The student has the basic knowledge of Computer Organization Architecture, Distributed System and Operating System and its related programming concepts.

Course Objective(s)

1. Analyse a given problem for possibilities of parallel computations
2. Select algorithms and hardware for the solution of high-performance applications
3. Select program computers with shared and distributed memory architectures
4. Understand the Introduction of GPU- and Concept of related Applications

Course Outcomes:

After the course students will be able to –

CO1	Analyse a given problem for possibilities of parallel computations
CO2	Select algorithms and hardware for the solution of high-performance applications
CO3	Select program computers with shared and distributed memory architectures
CO4	Understand the Introduction of GPU- and Concept of related Applications
CO5	**Develop** ideas to for executing parallel programs on different hardware architectures and software environments and **Identify** problems where students can **Apply** and **Implement** the concept appropriately with adequate documentation in collaborative environment for successfully carrying out projects on machine learning problems and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools and **Assess** the limitations of solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

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Course Content:

- Basics of MPI (Message Passing Interface)
- To learn Communication between MPI processes
- To get familiarized with advance communication between MPI processes
- Study of MPI collective operations using 'Synchronization'
- Study of MPI collective operations using 'Data Movement'
- Study of MPI collective operations using 'Collective Computation'
- To understand MPI Non-Blocking operation
- Basics of OpenMP API (Open Multi-Processor API)
- To get familiarized with OpenMP Directives
- Sharing of work among threads using Loop Construct in OpenMP
- Clauses in Loop Construct
- Sharing of work among threads in an OpenMP program using 'Sections Construct'
- Sharing of work among threads in an OpenMP program using 'Single Construct'
- Use of Environment Variables in OpenMP API
- Parallel Computing with NVIDIA CUDA
- Mini Project

Reference Books

1. LECTURES: NOTES from COS 598A: Parallel Architecture and Programming Spring 2007, Princeton University Princeton notes
2. LECTURE NOTES from CS258, Berkeley: Parallel Processors BERKELEY Notes

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

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

Course Name: Entrepreneurship & Innovation skill
Course Code: MC781
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 exemplarmodel, 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

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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

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4th Year 2nd Semester

Sl No	Course Code	Paper Code	Theory	Contact Hours /Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	PE	CS801	A. Digital Video Processing B. Big Data Analytics C. Cyber Security	3	0	0	3	3
2	PE	CS802	A. Digital Audio and Speech Processing B. Data Mining and Data Warehousing C. Blockchain & Cryptocurrency Technologies	3	0	0	3	3
3	OE	CS803	A. Soft Skills and Interpersonal Communication B. Human Resource Management and Organizational Behaviour C. Values and Ethics in Profession	3	0	0	3	3
4	OE	CS804	A. Quantum Computing B. Cloud Computing C. Mobile Computing	3	0	0	3	3
B. PRACTICAL								
5	PROJECT	PR891	Major Project-II	0	0	0	12	6
6	PROJECT	PR892	Grand Viva	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
7	MC	MC801	Essence of Indian Knowledge Tradition	0	0	0	2	
TOTAL CREDIT								19

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

Course Name: Digital Video Processing
Course Code: CS801A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Digital Image Processing

Course Objective(s):

1. Understand theory and models in Image and Video Processing
2. Comprehend different methods, models for video processing and motion estimation
3. Explain the need of Video Acquisition and sampling for motion analysis and segmentation
4. Illustrate quantitative models of video segmentation
5. Explain and apply the concept of video compression, video summarization, object tracking

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

CO1	Understand theory and models in Image and Video Processing
CO2	Comprehend different methods, models for video processing and motion estimation
CO3	Explain the need of Video Acquisition and sampling for motion analysis and segmentation
CO4	Illustrate quantitative models of video segmentation
CO5	Explain and apply the concept of video compression, video summarization, object tracking

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

Course Content:

Module 1: [10L]

Introduction- Video Formation, Perception and Representation, a. Video Capture and Display Principles of Color Video, Video Cameras, Video Display, Composite versus Component Models, Gamma Connection. Analog Video Raster- Progressive vs Interlaced scans, Characterization of Video Raster.
Spatial and Temporal resolution, Signal Bandwidth, Multiplexing of Luminance, Chrominance and Audio.

Digital Video – Notation, ITU-R.BT.601 Digital Video Format, Other Digital Video Formats and Applications, Digital Video Quality Measure.

Module 2: [8L]

Video Acquisition and sampling - sampling and Representation, Motion analysis, Video Object Tracking, Video Filtering, enhancement, Video stabilization and super-resolution. Video Sampling and Interpolation, Video Compression.

Module 3: [9L]

Motion Detection and Estimation, Motion Detection and Estimation, Optical Flow Methods, Motion Compensated Filtering, Dynamic Scene Analysis - Image filtering and enhancement, Tracking, Feature detection, establish feature correspondence, Motion parameter estimation (local and global), Structure estimation (optional), Predict occurrence in next frame.

Module 4: **[4L]**

Video Enhancement and Restoration - Video Quality Assessment, Restoration, Super-resolution.

Module 5: [5L]

Video Segmentation - Motion Segmentation, Video content recognition and segmentation, video deblurring, Content based Video retrieval.

Text Books:

1. The Essential Guide to Video Processing Al Bovik (Alan C Bovik), Academic Press, Second Edition, 2009
2. Handbook of Image and Video processing - Al Bovik (Alan C Bovik), Academic Press, Second Edition, 2005.
3. Digital Video Processing - A. Murat Tekalp, Prentice Hall, 1995

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

References

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. IEEE-T-CSVT (IEEE Transactions on Circuit Systems and VIdeo Technology).

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	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	-	2	-	2
CO5	2	2	3	3	-	-	-	-	-	-	-	2	2	2	3

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Computer Science & Engineering
(Artificial Intelligence & Machine Learning)

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

Course Name: Big Data Analytics

Course Code: CS801B

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 Objectives:

- Comprehend the fundamental concepts of the Big Data Analytics exploring machine learning strategies such as Supervised and Unsupervised Learning etc. for analyzing various types of large scale structured as well as unstructured data distributed across multiple locations (Map Reduce,Hadoop and NoSQL Framework).
- Formulate an engineering problem of analyzing large scale data distributed across multiple locations to make automated meaningful decisions
- Apply the concepts of Big Data Analytics to solve problems of making automated decisions dealing with large scale structured as well as unstructured data distributed across multiple locations.
- Excogitate and Implement ideas to address the challenging issues of Big Data Analytics.
- Analyze the effectiveness of various Big Data Analytics Frameworks.

Course Outcomes:

After completion of the course students will 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 NoSQL 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 decisionswithin 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
CO4	**Excogitate** ideas for **proposing** solutions to the challenging problems of Big Data Analytics.
CO5	**Apply** the concepts 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.

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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.

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Data visualization basics - Key points, evolution of a graph, common representation methods, how to clean up a graphic.

Text book:

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.

Reference Books:

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	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	3	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	2	2	-	2
CO5	2	2	3	3	2	2	2	-	-	-	-	2	2	2	3

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

Course Name: Cyber Security

Course Code: CS801C
Total Contact Hours: 36
Contact: 3:0:0
Credits: 3

Prerequisite:

- The student has the basic knowledge of Computer Network and Network Security.

Course Objectives:

1. Understand the vulnerabilities in the computer and network security.
2. Use the tools for vulnerability assessment and defence of the network.
3. Identify the software bugs that pose cyber security threats.
4. Articulate the cyber-crime and cyber law
5. Explain the investigation process of the cyber-crime and computer forensics

Course Outcome(s)

After competition of the course the student able to do

CO1	Understand the vulnerabilities in the computer and network security.
CO2	Use the tools for vulnerability assessment and defence of the network.
CO3	Identify the software bugs that pose cyber security threats.
CO4	Articulate the cyber-crime and cyber law
CO5	Explain the investigation process of the cyber-crime and computer forensics

Course Content:

Module 1: [9L]

Systems Vulnerability Scanning Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning - Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools. Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping Kismet

Module 2: [9L]

Network Défense tools Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall

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Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address

Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection System

Module 3: [9L]

Web Application Tools Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools – John the Ripper, L0htcrack, Pwdump, HTC-Hydra

Machine Learning Techniques for Cyber Security.

Module 4: [5L]

Introduction to Cyber Crime and law Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.

Module 5: [4L]

Introduction to Cyber Crime Investigation Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks

Text Books:

1. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw Hill.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and Sunit Belpure, Publication Wiley

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

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		2		3	1									2	3
CO3		3	2												
CO4	3						3								
CO5		2	3											2	

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

Paper Name: Digital Audio and Speech Processing

Paper Code: CS802A

Contact (Periods/Week): 3:0:0

Credit Point: 3

No. of Lectures: 36

Prerequisite:

- A solid background in Statistics, Calculus, Linear Algebra and Probability.
- Machine Learning, NLP

Course Objective(s):

1. Understand the basic concepts of Digital Audio & Speech Processing and Understand the fundamental concepts of Linear-predictive model and fundamental frequency so that they can Apply the concept to Analyze their audio signal.
2. Explain or Illustrate the fundamental strategies of Digital Coding of Audio Signal
3. Explain or Illustrate the concepts of Speech Recognition and Speaker Recognition systems and Analyze the effectiveness as well as limitations of solutions underscoring the utilitarian importance for further exploration of various issues leading towards lifelong learning
4. Develop ideas to Propose solutions to the problems of Music Signal Analysis for Classification and Retrieval

Course Outcome(s):

On completion of the course students will be able to

Understand the basic concepts of Digital Audio & Speech Processing to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
Understand the fundamental concepts of Linear-predictive model and fundamental frequency so that they can **Apply** the concept to **Analyze** their audio signal.
Explain or Illustrate the fundamental strategies of Digital Coding of Audio Signal
Explain or Illustrate the concepts of Speech Recognition and Speaker Recognition systems and **Analyze** the effectiveness as well as limitations of solutions underscoring the utilitarian importance for further exploration of various issues leading towards lifelong learning
Develop ideas to **Propose** solutions to the problems of Music Signal Analysis for Classification and Retrieval and **Identify** problems where students can **Apply** the concept appropriately and **Analyze** the effectiveness as well as limitations of solutions underscoring the utilitarian importance for further exploration of various issues leading towards lifelong learning.

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

Module 1: Introduction to Digital processing of audio signals and Pre-processing [6L]

Digital Recording Format: sampling, quantization, Speech spectra, Fourier transform, Random signals, power spectral density, Modification of speech, linear filters, Frequency response of a filter. Dc removal, preemphasis, frames, basic parameters. Spectrogram. Speech production: articulatory organs - vocal cords andvocal tract vs. excitation and filter. Characteristics in time and frequency, Influence of excitation and filter, long- and short-term spectrograms, Separating excitation and filter; cepstrum, MFCC.

Module 2 Linear-predictive model and fundamental frequency [8L]

Separation of vocal tract characteristics from excitation - applications in coding and recognition, Prediction of a sample from past samples - linear prediction (LP), Error of LP; Obtaining the error using a single filter, Determination of vocal tract characteristics using LP analysis, Spectrum estimated by LP, Features derived from LP - LAR and LSF, LPC-cepstrum, Characteristics of F0 for males, females and children, fundamental frequency determination methods based on autocorrelation function, NCCF. Long-term predictor and cepstral analysis for F0 determination.

Module 3: Digital Coding of Audio Signal [4L]

Aims of coding, Bit-rate, objective and subjective measurements of quality, Classification of coders according to bit-rate, Waveform coders, Vocoders – LPC, Vector quantization in speech coding

Module 4: Speech Recognition [8L]

Auditory Features and extraction, Linguistic Features - Phones and Phonemes, Articulatory Features, Phonological Models, Deterministic Sequence Recognition - Isolated Word Recognition, Statistical Sequence Recognition – HMM, Forward-Backward Training, Viterbi Training, Local Acoustic Probability Estimators, HMM-ANN Based Model.

Module 5: SPEAKER VERIFICATION [4L]

Introduction, General Design of a Speaker Recognition System, System Components – Features, Models, Score normalization, Fusion and calibration, Evaluation.

Module 6: MUSIC SIGNAL ANALYSIS & RETRIEVAL [6L]

The Information in Music Audio, Music Transcription, Note Transcription, Score Alignment, Chord Transcription, Structure Detection, Music Fingerprinting, Query by Humming, Cover Song Matching, Music Classification and Auto tagging.

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Text Books:

1. Speech and Audio Signal Processing: Processing and Perception of Speech and Music, Ben Gold, Nelson Morgan, Dan Ellis, Wiley.
2. Speech and Audio Processing, Dr. Shaila D. Apte, Wiley

Reference Books:

1. Rabiner, L. R., and Juang, B.-H, 1993, Fundamentals of Speech Recognition, Prentice-Hall, New Jersey.
2. Audio Processing and Speech Recognition: Concepts, Techniques and Research Overviews, Soumya Sen, Anjan Dutta, Nilanjan Dey, Springer Singapore

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	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	-	2	-	2
CO5	2	2	3	3	-	-	-	-	-	-	-	2	2	2	3

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

Course Name: Data Mining and Data Warehousing

Course Code: CS802B

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 Objectives:

- Comprehend 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)
- Formulate an engineering problem within the scope of Data Mining and Data Warehousing paradigm.
- Apply the concepts of Data Mining and Data Warehousing to solve problems of making automated decisions dealing with large scale data.
- Develop and Implement ideas for proposing solutions to the challenging problems of Data Mining and Data Warehousing.
- Analyze the effectiveness of various Data Mining and Data Warehousing Frameworks.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand and explain** the fundamental concepts of the evolving technologiesin Data Mining (such as Mining Frequent Patterns and Data Streams, Associations, Supervised and Unsupervised Learning, Graph Mining, Web Miningetc.) 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.

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

Course Content:

MODULE-1: Introduction to Data Mining [5L]

Basic Concepts, Data Exploration: Data Types, Data Attributes, Statistical Description of Data, Data Visualization, Data Similarity Measures; Data Preprocessing: Data Cleaning, Data Integration, Data Reduction, Data Transformation & Discretization.

MODULE-2: Introduction to Data Warehousing [6L]

Basic Concepts, Data Warehouse Modeling: Data Cube and OLAP (OnLine Analytical Processing); Data Warehouse Design, Usage, and Implementation; Data Generalization by Attribute-Oriented Induction.

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 Item Sets Using Vertical Data Format, Correlation Analysis; Pattern Mining in Multilevel and Multidimensional Space.

MODULE-4: Classification and Regression [6L]

Basic Concepts, k-Nearest-Neighbor Classifier, Decision Tree Classifier, Naïve Bayes Classifier; ANN-Backpropagation Based Classifier, Support Vector Machine Based Classifier, Linear and Nonlinear Regression Methods.

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 Connected Regions with High Density, Frequent Pattern–Based Clustering Method; Outlier Analysis.

MODULE-6: Mining Data Stream, Time-Series, and Sequence Data [3L]

Basic Concepts of Data Stream Mining; Mining Time Series Data; Mining Sequence Patterns in Biological Data.

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); Basic Concepts of Social Network Analysis and Multi-relational Data Mining; Basic Concepts of Text Mining; Basic Concepts of World Wide Web (WWW) Mining.

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Text book:

- Han J & Kamber M, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Third Edition.
- Parteek Bhatia, "Data Mining and Data Warehousing: Principles and Practical Techniques", Cambridge University Press.

Reference Books:

- Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, "Introduction to Data Mining", Pearson Education.
- Robert Layton, "Learning Data Mining with Python", Packt Publishing

CO – PO Mapping:

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

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

Course Name: Blockchain & Cryptocurrency Technologies

Course Code: CS802C

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Data Structures & Algorithms, Networking, Cryptography & Network Security.

Course Objectives:

1. Understand and explain the fundamental concepts of the evolving technologies in Blockchain & Cryptocurrency Technologies recognizing their utilitarian importance in current technological context for further exploration leading towards lifelong learning.
2. Identify and formulate an engineering problem within the scope of Blockchain & Cryptocurrency Technologies paradigm.
3. Explore relevant literature and apply the concepts of Blockchain & Cryptocurrency Technologies to solve problems of making automated decisions dealing with large scale data.
4. Develop ideas for proposing solutions to the challenging problems of Blockchain & Cryptocurrency Technologies.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand and explain** the fundamental concepts of the evolving technologiesin Blockchain & Cryptocurrency Technologies 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 Blockchain & Cryptocurrency Technologies paradigm.
CO3	**Explore** relevant literature and **apply** the concepts of Blockchain & Cryptocurrency Technologies to **solve** problems of making automated decisions dealing with large scale data.
CO4	**Develop** ideas for **proposing** solutions to the challenging problems of Blockchain & Cryptocurrency Technologies.
CO5	**Implement** ideas of Blockchain & Cryptocurrency Technologies through **developing** feasible algorithms or frameworks and **investigate** their effectiveness in solving the relevant problems by **analyzing** the performances using proper techniques.

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

Course Content:

MODULE-1: Introduction to Cryptography and Cryptocurrencies [5L]

Basic Concepts, Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency.

MODULE-2: Blockchain Operating Principles [8L]

Decentralization-Centralization vs. Decentralization-Distributed consensus, Consensus with- out identity using a blockchain, Incentives and proof of work. Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

MODULE-3: Mechanics of Bitcoin [5L]

Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bit- coin network, Limitations and improvements.

MODULE-4: Bitcoin Mining [4L]

Anonymity Basics, How to De-anonymize Bitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash.

MODULE-5: Community, Politics, and Regulation [8L]

Consensus in Bitcoin, Bitcoin Core Software, Stakeholders: Who's in Charge, Roots of Bitcoin, Governments Notice on Bitcoin, Anti Money Laundering Regulation, New York's Bit License Proposal. Bitcoin as a Platform: Bitcoin as an Append only Log, Bitcoins as Smart Property, Secure Multi Party Lotteries in Bitcoin, Bitcoin as Public Randomness, Source-Prediction Markets, and Real-World Data Feeds.

MODULE-6: Altcoins and the Cryptocurrency Ecosystem [6L]

Altcoins: History and Motivation, A Few Altcoins in Detail, Relationship Between Bitcoin and Altcoins, Merge Mining-Atomic Cross chain Swaps-6 Bitcoin Backed Altcoins, Side Chains, Ethereum and Smart Contracts**.**

Text book:

- Narayanan, A., Bonneau, J., Felten, E., Miller, A., and Goldfeder, S. (2016). Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press.
- Franco, P. (2014). Understanding Bitcoin: Cryptography, engineering and economics. John Wiley and Sons.

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Reference Books:

- Antonopoulos, A. M. (2014). Mastering Bitcoin: unlocking digital cryptocurrencies. OReilly Media, Inc

CO – PO Mapping:

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

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

Paper Name: Human Resource Development and Organizational Behaviour
Paper Code: CS803B
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 TrainingManagers.**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**

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

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	-	-	-

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

Course Name: Values and Ethics in Profession
Course Code: CS803C
Contact: 3L:0T: 0P
Credit: 3
No. of Lectures: 36

Prerequisites: Basic knowledge of engineering and management.

Course Outcome(s):

On Completion of this course student will be able to

CO1: Understand the core values that shape the ethical behaviour 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 **8L**

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.

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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:

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

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

Course Name: Quantum Computing

Course Code: CS804A

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Discrete Structures

Objective of the course:

The objective of the course is to make the students able to –

1. Understand the basic idea of quantum computing including background of mathematics and physics.
2. Understand and explain the concept of quantum circuits using single and multiple qubit gates and also designing of quantum circuits.
3. Compare between classical and quantum information theory and explain and apply Bell states, Quantum teleportation, Quantum Cryptography and no cloning theorem.
4. 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. Understand noise and error correction including graph states and codes, quantum error correction, fault-tolerant.

Course Outcomes:

After completion of the course students will 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.

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Course Content:

Module1: 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.

Module2: Quantum Circuits: 6L

Single qubit gates, multiple qubit gates, design of quantum circuits.

Module3: Quantum Information and Cryptography: 6L

Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.

Module4: 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.

Module5: 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.

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

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	-	-	2	3	1	1
CO2	3	3	3	3	-	2	2	-	-	-	-	2	3	1	3
CO3	3	3	3	3	-	-	-	2	2	-	-	2	3	3	1
CO4	3	3	3	3	-	-	-	-	-	-	-	2	3	3	1
CO5	3	3	3	3	-	-	-	-	-	-	-	3	3	3	3

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

Course Name: Cloud Computing

Course Code: CS804B
Total contact hours: 36
Contact: 3:0:0
Credits: 3

Prerequisite:

1. The student must have basic knowledge in Computer Network and Distributed System

Course Objectives(s):

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. Understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing.
3. Understand the importance of protocols and standards in computing.

Course Outcome(s)

After competition of the course the student able to do

CO1	Identify the appropriate cloud services for a given application
CO2	Assess the comparative advantages and disadvantages of Virtualization technology
CO3	Analyze authentication, confidentiality and privacy issues in cloud computing
CO4	Identify security implications in cloud computing.
CO5	Understand the importance of protocols and standards in management for cloud services.

Course Content:

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

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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 GoogleApp 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

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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]

Text Book

1. Kai Hwang, Geoffrey C Fox, Jack J Dongarra: Distributed and Cloud Computing – From Parallel Processing to the Internet of Things, Morgan Kaufmann Publishers – 2012.
2. Barrie Sosinsky, “Cloud Computing Bible”, Wiley India Edition.

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Reference books

1. Anthony Velte, tobyVelte, Robert Elsenpeter, "Cloud Computing – A Practical Approach", Tata McGraw-Hill Edition.
2. Alex Amies, Harm Sluiman, Qiang Guo Tong and Guo Ning Liu: Developing and Hosting Applications on the cloud, IBM Press, 2012.
3. George Reese: Cloud Application Architectures: Building Applications and Infrastructure in the Cloud (Theory in Practice), O'Reilly Publications, 2009
4. Haley Beard: Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing – applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008
5. Michael Miller: Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Pearson Education, 2009.
6. Richard N. Katz: The Tower and The Cloud, Higher Education in the Age of Cloud Computing, 2008.

CO-PO mapping

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

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

Name of the Paper: Mobile Computing

Paper Code: CS804C

Contact: 3L/Week

Credit Point: 3

No. of Lectures: 36

Prerequisite:

5. Basic concept of computer network and communication engineering
6. Basic programming knowledge

Course Objective(s)

The objective of the course is to make the students able to –

- Understand and illustrate the basic concepts and principles in mobile computing
- Understand and demonstrate the various routing algorithms for both infrastructure based and ad hoc networks.
- Identify and develop mobility and bandwidth management in cellular network
- Design and build an energy efficient and secure mobile computing environment using heterogeneous wireless technologies
- Predict and explain the technical issues related to recent mobile computing environment

Course Outcome(s)

After completion of the course students will 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.

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Course Content:

Module I: 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 II: 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 III: 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 IV: 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.

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Module V: 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.

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Module VI: 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 VII: Energy-efficient Communication [3L]
Energy efficiency at various layers - Physical layer, MAC layer, Network layer, Application layer, performance analysis in noisy channel environment.

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Module VIII: Secure Wireless Communication [5L]

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

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	-	-	3	2	3	2	2	2
CO2	3	3	3	3	2	1	1	-	-	3	2	3	2	2	2
CO3	3	3	2	3	2	1	1	-	-	3	2	3	2	2	2
CO4	3	3	2	2	2	1	1	-	-	3	2	3	2	2	2
CO5	3	3	3	3	2	1	1	-	-	3	2	3	2	2	2