

**HERITAGE INSTITUTE OF TECHNOLOGY**  
(An Autonomous Institute Under MAKAUT)

**COURSE STRUCTURE**

**B. Tech in Computer Science and Engineering**  
(Internet of Things and Cyber Security Including Blockchain Technology)  
June, 2022

(Applicable from 2022 admitted batch)

**FIRST YEAR**  
**FIRST SEMESTER**

Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
<b>A. Theory</b>							
1	PHYS1001	Physics-I	3	1	0	4	4
2	MATH1101	Mathematics-I	3	1	0	4	4
3	CSEN1001	Programming for Problem Solving	3	0	0	3	3
<b>Total Theory</b>			<b>9</b>	<b>2</b>	<b>0</b>	<b>11</b>	<b>11</b>
<b>B. Practical</b>							
1	PHYS1051	Physics I Lab	0	0	3	3	1.5
2	CSEN1051	Programming for Problem Solving Lab	0	0	4	4	2
3	MECH105 1	Workshop / Manufacturing Practice	1	0	4	5	3
<b>Total Practical</b>			<b>1</b>	<b>0</b>	<b>11</b>	<b>12</b>	<b>6.5</b>
<b>Total of Semester without Honors</b>			<b>10</b>	<b>2</b>	<b>11</b>	<b>23</b>	<b>17.5</b>
<b>C. Honors</b>							
1	HMTS1011	Communication for Professionals	3	0	0	3	3
2.	HMTS1061	Communication for Professionals Lab	0	0	2	2	1
<b>Total Honors</b>			<b>3</b>	<b>0</b>	<b>2</b>	<b>5</b>	<b>4</b>
<b>Total of Semester with Honors</b>			<b>13</b>	<b>2</b>	<b>13</b>	<b>28</b>	<b>21.5</b>

**FIRST YEAR**  
**SECOND SEMESTER**

Sl.	Code	Subject	Contacts Periods/ Week				Credi Points
			L	T	P	Total	
<b>A. Theory</b>							
1	CHEM1001	Chemistry I	3	1	0	4	4
2	MATH1201	Mathematics II	3	1	0	4	4
3	ELEC1001	Basic Electrical Engineering	3	1	0	4	4
4	HMTS1202	Business English	2	0	0	2	2
<b>Total Theory</b>			<b>11</b>	<b>3</b>	<b>0</b>	<b>14</b>	<b>14</b>
<b>B. Practical</b>							
1	CHEM1051	Chemistry I Lab	0	0	3	3	1.5
2	ELEC1051	Basic Electrical Engineering Lab	0	0	2	2	1
3	MECH1052	Engineering Graphics & Design	1	0	4	5	3
4	HMTS1252	Language Lab	0	0	2	2	1
<b>Total Practical</b>			<b>1</b>	<b>0</b>	<b>11</b>	<b>12</b>	<b>6.5</b>
<b>Total of Semester without Honors</b>			<b>12</b>	<b>3</b>	<b>11</b>	<b>26</b>	<b>20.5</b>

**SECOND YEAR**  
**THIRD SEMESTER**

Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
<b>A. Theory</b>							
1	CSEN2101	Data Structures and Algorithms	4	0	0	4	4
2	CSEN2102	Discrete Mathematics	4	0	0	4	4
3	CSEN2103	Python Programming	3	0	0	3	3
4	ECEN2104	Digital Logic	3	0	0	3	3
5	HMTS2001	Human Values and Professional Ethics	3	0	0	3	3
<b>Total Theory</b>			<b>17</b>	<b>0</b>	<b>0</b>	<b>17</b>	<b>17</b>
<b>B. Practical</b>							
1	CSEN2151	Data Structures and Algorithms Lab	0	0	3	3	1.5
2	CSEN2153	Python Programming Lab	0	0	3	3	1.5
3	ECEN2154	Digital Logic Lab	0	0	2	2	1
<b>Total Practical</b>			<b>0</b>	<b>0</b>	<b>8</b>	<b>8</b>	<b>4</b>
<b>Total of Semester</b>			<b>17</b>	<b>0</b>	<b>8</b>	<b>25</b>	<b>21</b>

**SECOND YEAR**  
**FOURTH SEMESTER**

Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
<b>A. Theory</b>							
1	CSEN2201	Design & Analysis of Algorithms	4	0	0	4	4
2	CSEN2202	Computer Organization and Architecture	4	0	0	4	4
3	CSEN2203	Operating Systems	3	0	0	3	3
4	CSEN2205	Principles of Cryptography	4	0	0	4	4
5	CSEN2206	Ethical Hacking	3	0	0	3	3
6	EVSC2016	Environmental Sciences (Mandatory)	2	0	0	2	0
<b>Total Theory</b>			<b>20</b>	<b>0</b>	<b>0</b>	<b>20</b>	<b>18</b>
<b>B. Practical</b>							
1	CSEN2251	Design & Analysis of Algorithms Lab	0	0	3	3	1.5
2	CSEN2252	Computer Architecture Lab	0	0	2	2	1
3	CSEN2253	Operating Systems Lab	0	0	3	3	1.5
<b>Total Practical</b>			<b>0</b>	<b>0</b>	<b>8</b>	<b>8</b>	<b>4</b>
<b>Total of Semester</b>			<b>20</b>	<b>0</b>	<b>8</b>	<b>28</b>	<b>22</b>

**THIRD YEAR**  
**FIFTH SEMESTER**

Sl	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
<b>A. Theory</b>							
1	CSEN3101	Database Management Systems	4	0	0	4	4
2	CSEN3003	Object Oriented Programming	4	0	0	4	4
3	CSEN3108	Blockchain Technologies	3	0	0	3	3
4	CSEN3109	IoT Architecture and Protocols	4	0	0	4	4
5	CSEN3131- CSEN3140	Professional Elective-I	3	0	0	3	3
	CSEN3132	Data Mining & Knowledge Discovery					
	CSEN3133	Web Technologies					
	CSEN3136	Introduction to Soft Computing					
	CSEN3137	Introduction to Information Retrieval					
	MATH3132	Probability and Statistical Methods					
<b>Total Theory</b>			<b>18</b>	<b>0</b>	<b>0</b>	<b>18</b>	<b>18</b>
<b>B. Practical</b>							
1	CSEN3151	Database Management Systems Lab	0	0	3	3	1.5
	CSEN3053	Object Oriented Programming Lab	0	0	3	3	1.5
2	CSEN3159	IoT Lab	0	0	3	3	1.5
<b>Total Practical</b>			<b>0</b>	<b>0</b>	<b>6</b>	<b>6</b>	<b>3</b>
<b>Total of Semester without Honors</b>			<b>17</b>	<b>0</b>	<b>8</b>	<b>25</b>	<b>22.5</b>

**THIRD YEAR**  
**SIXTH SEMESTER**

Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
<b>A. Theory</b>							
1	CSEN3204	Smart Contracts and Applications	3	0	0	3	3
2	CSEN3205	Cyber Security and Digital Forensics	4	0	0	4	4
3	HMTS3201	Economics for Engineers	3	0	0	3	3
4	CSEN3231 - CSEN3240	Professional Elective-II	3	0	0	3	3
	CSEN3233 CSEN3235 CSEN3236 CSEN3237 CSEN3240	Machine Learning Cloud Computing Big Data and IOT Advanced Operation Research Fog and Edge Computing					
5		Open Elective-I	3	0	0	3	3
	AEIE3221 ECEN3222 ECEN3223 MATH3221 MATH3223 CSEN3222	Fundamentals of Sensors and Transducers Designing with Processors and Controllers Analog and Digital Communication Computational Mathematics Scientific Computing Cloud Computing with AWS					
6	INCO3016	Indian Constitution and Civil Society (Mandatory)	2	0	0	2	0
<b>Total Theory</b>			<b>1</b>	<b>0</b>	<b>0</b>	<b>18</b>	<b>16</b>
<b>B. Practical</b>							
1	CSEN3254	Smart Contracts and Applications Development Lab	0	0	2	2	1
2	CSEN3255	Cyber Security Lab	0	0	2	2	1
<b>Total Practical</b>			<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>	<b>2</b>
<b>C. Sessional</b>							
1	CSEN3293	Term Paper and Seminar	0	0	4	4	2
<b>Total Sessional</b>			<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>	<b>2</b>
<b>Total of Semester</b>			<b>1</b>	<b>0</b>	<b>8</b>	<b>26</b>	<b>20</b>

**FOURTH YEAR**  
**SEVENTH SEMESTER**

Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
<b>A. Theory</b>							
1	HMTS4101	Principles of Management	3	0	0	3	3
2	CSEN4131- CSEN4150	Professional Elective-III	3	0	0	3	3
	CSEN4141 CSEN4142 CSEN4143 CSEN4144 CSEN4145	Introduction to Image Processing Deep Learning Fundamentals of Computer Networks Introduction to Software Engineering Network Security					
3		Open Elective-II	3	0	0	3	3
	AEIE4121 AEIE4122 CHEN4121 CHEN4122 ECEN4121 ECEN4122 BIOT4026 MATH4121	Instrumentation and Telemetry Linear Control Systems and Applications Industrial Total Quality Management Industrial Pollution Control Software Defined Radio Error Control Coding Biology for Engineers Optimization and Multi Valued Analysis					
4		Open Elective-III	3	0	0	3	3
	AEIE4127 MATH4122 BIOT4123 CHEN4123 ECEN4126 ECEN4127	Introduction to Embedded System Advanced Linear Algebra Biosensor Statistical Methods in Design of Experiments Ad Hoc Networks and Security Challenges Introduction to VLSI Design					
<b>Total Theory</b>			<b>12</b>	<b>0</b>	<b>0</b>	<b>12</b>	<b>12</b>
<b>B. Sessional</b>							
1	CSEN4191	Industrial Training / Internship	-	-	-	-	2
2	CSEN4195	Project-I	0	0	8	8	4
<b>Total Sessional</b>			<b>0</b>	<b>0</b>	<b>8</b>	<b>8</b>	<b>6</b>
<b>Total of Semester</b>			<b>12</b>	<b>0</b>	<b>8</b>	<b>20</b>	<b>18</b>
<b>C. Practical</b>							
	CSEN4171- CSEN4180	Professional Elective-III Lab	0	0	2	2	1
1	CSEN4171	Introduction to Image Processing Lab					
2	CSEN4172	Deep Learning Lab	0	0	2	2	1
3	CSEN4173	Computer Networks Lab					
4	CSEN4174	Introduction to Software Engineering Lab					
5	CSEN4175	Network Security Lab					
<b>Total Practical</b>			<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>
<b>Total of Semester</b>			<b>12</b>	<b>0</b>	<b>10</b>	<b>22</b>	<b>19</b>



**FOURTH YEAR**  
**EIGHTH SEMESTER**

Sl.	Code	Subject	Contacts Periods/ Week				Credit Points
			L	T	P	Total	
<b>A. Theory</b>							
1	CSEN4231- CSEN4240	Professional Elective-IV	3	0	0	3	3
	CSEN4038 CSEN4233 CSEN4235 CSEN4236 CSEN4238	Mobile Computing Pattern Recognition Social Network Analysis Computer Vision Power Management for IoT					
2	CSEN4241- CSEN4250	Professional Elective-V	3	0	0	3	3
	CSEN4241 CSEN4242 CSEN4244 CSEN4247	Robotics Business Analytics Web Mining Cyber Laws and Security Policies					
3		Open Elective-IV	3	0	0	3	3
	AEIE4221 AEIE4222 BIOT4221 BIOT4222 CHEN4221 CHEN4222 ECEN4222 PHYS4121	Process Instrumentation Medical Instrumentation Computational Biology Non-conventional Energy Nanotechnology Introduction to Solar and Wind Technology Optical Fiber Communication Quantum Physics					
<b>Total Theory</b>			<b>9</b>	<b>0</b>	<b>0</b>	<b>9</b>	<b>9</b>
<b>B. Sessional</b>							
1	CSEN4295	Project-II	0	0	16	16	8
2	CSEN4297	Comprehensive Viva-voce	-	-	-	-	1
<b>Total Sessional</b>			<b>0</b>	<b>0</b>	<b>16</b>	<b>16</b>	<b>9</b>
<b>Total of Semester</b>			<b>9</b>	<b>0</b>	<b>16</b>	<b>25</b>	<b>18</b>

### Open Electives to be offered by Computer Science and Engineering department for Non-departmental students

Sl.	Semester	Paper Code	Course Title	Contact Hours / Week				Credit Points
				L	T	P	Total	
1	6 <sup>th</sup>	CSEN3221	Fundamentals of RDBMS	3	0	0	3	3
2	7 <sup>th</sup>	CSEN4121	Fundamentals of Operating Systems	3	0	0	3	3
3	7 <sup>th</sup>	CSEN4126	Intelligent Web and Big Data	3	0	0	3	3
4	8 <sup>th</sup>	CSEN4221	Basics of Mobile Computing	3	0	0	3	3

### Credit Summary for B Tech Programme with effect from 2018-2019

Sl.	Course Type	Credit Points
1	Humanities and Social Sciences including Management Courses	12
2	Basic Science Courses	19
3	Engineering Science Courses including Workshop, Drawing, Basics of Electrical / Mechanical / Computer, etc.	20
4	Professional Core Courses	65
5	Professional Elective Courses relevant to chosen Specialization / Branch	15
6	Open Subjects – Electives from other Technical and/or Emerging Subjects	12
7	Project Work, Seminar and Internship in industry or elsewhere	17
8	Mandatory Courses (Non-credit) [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	0
<b>Total</b>		<b>160</b>
9	Honors Courses	24
<b>Grand Total</b>		<b>180</b>

### Honors Course for B. Tech Computer Science & Engineering Students

Sl.	Semester	Paper Code	Course Title	Contact Hours / Week			Credit Points
				L	T	P	
1	1 <sup>st</sup>	HMTS1011	Communication for Professionals	3	0	0	3
2		HMTS1061	Professional Communication Lab	0	0	2	1
3	2 <sup>nd</sup>	ECEN1011	Basic Electronics	3	0	0	3
4		ECEN1061	Basic Electronics Lab	0	0	2	1
5	3 <sup>rd</sup>	MATH2111	Probability and Statistical Methods	4	0	0	4
6	5 <sup>th</sup>	CSEN3113	Fundamentals of Software Engineering	3	0	0	3
7		CSEN3163	Fundamentals of Software Engineering Lab	0	0	2	1
8	7 <sup>th</sup>	CSEN4113	Network Security	3	0	0	3
9		CSEN4163	Network Security Lab	0	0	2	1
<b>Total</b>							<b>20</b>



**Definition of Credit (as per AICTE):**

- 1 Hour Lecture (L) per Week = 1 Credit
- 1 Hour Tutorial (T) per Week = 1 Credit
- 1 Hour Practical (P) per Week = 0.5 Credits
- 2 Hours Practical (Lab) per Week = 1 Credit

**Range of Credits (as per AICTE):**

- A total of 160 credits will be necessary for a student to be eligible to get B Tech degree.
- A student will be eligible to get B Tech degree with Honors if he/she completes an additional 20 credits. These could be acquired through various Honors Courses offered by the respective departments.
- A part or all of the above additional credits may also be acquired through MOOCs. Any student completing any course through MOOC will have to submit an appropriate certificate to earn the corresponding credit.
- For any additional information, the student may contact the concerned HODs.

**Swayam/MOOCs Courses recommended to the students of CSE department**

Sl.	Code	Name	Credit Points	Corresponding Online Course	Offered by	Platform
1	ECEN1011	Basic Electronics	3	Fundamentals of Semiconductor Devices	IISc Bangalore	NPTEL
2	ECEN1061	Basic Electronics Lab	1			
3	HMTS1011	Communication for Professionals	3	Effective Business Communication AND Developing Soft Skills and Personality	IIM Bangalore	Swayam
4	HMTS1061	Professional Communication Lab	1		IIT Kanpur	Swayam
5	MATH2111	Probability and Statistical Methods	4		Stochastic Processes	IIT Delhi
6	CSEN3113	Fundamentals of Software Engineering	3			
7	CSEN3163	Fundamentals of Software Engineering	1			
8	CSEN4113	Network Security	3			
9	CSEN4163	Network Security Lab	1			

**Part-II**

**Detailed Syllabus**

**1<sup>ST</sup> YEAR 1<sup>ST</sup> SEMESTER**

<b>Course Name: PHYSICS I</b>					
<b>Course Code: PHYS1001</b>					
<b>Contact Hours per week</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>4</b>

**Course Outcomes:**

**PHYS1001.1:** Interpret oscillations under different conditions, with the understanding of Resonance phenomena followed by calculation of Q factor

**PHYS1001.2:** Analyze the Quantum phenomenon like Black body radiation , Compton effect and origin of X-ray spectrum

**PHYS1001.3:** Understand the wave character of light through the phenomenon of interference, diffraction and polarization.

**PHYS1001.4:** Study of various crystal structures and classification of different crystal planes.

**PHYS1001.5:** Explain the working principle of LASER, and apply the knowledge in different lasing system and their engineering applications in holography

**PHYS1001.6:** Understand the dual nature of matter, Heisenberg's uncertainty relation and it's various application.

**Module I : Mechanics (7+5)= 12L**

Elementary concepts of grad, divergence and curl. Potential energy function;  $F = -\text{grad } V$ , Equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, Curl of a force field; Central forces ; conservation of angular momentum; Energy equation and energy diagrams; elliptical, parabolic and hyperbolic orbit; Kepler Problem; Application : Satellite manoeuvres .

Non-inertial frames of reference; rotating coordinate system; five term acceleration formula- centripetal and coriolis accelerations; applications: Weather system, Foucault pendulum.

**Module II : Optics (4 +3+ 5) = 12 L****Oscillatory Motion:**

Damped harmonic motion – Over damped, critically damped and lightly damped oscillators; Forced oscillation and resonance. Electrical equivalent of mechanical oscillator, Wave equation, plane wave solution.

**Optics:**

Elementary features of polarization of light waves. Double refraction, Production and analysis of linearly, elliptic and Circularly polarized light, Polaroid and application of polarizations.: Polarimeter.

**Laser & Fiber Optics:**

Characteristics of Lasers, Spontaneous and Stimulated Emission of Radiation, Meta-stable State, Population Inversion, Lasing Action, Einstein's Coefficients and Relation between them, Ruby Laser, Helium-Neon Laser, Semiconductor Diode Laser, Applications of Lasers.

Fiber optics - principle of operation, numerical aperture, acceptance angle, Single mode , graded indexed fiber.

**Module III: Electrostatics ( 8+4) = 12 L****Electrostatics in free space**

Calculation of electric field and electrostatic potential for a charge distribution, Divergence and curl of electrostatic field, Laplace's and Poisson's equation for electrostatic potential. Boundary conditions of electric field and electrostatic potential. Method of images , energy of a charge distribution and its expression in terms of electric field.

**Electrostatics in a linear dielectric medium**

Electrostatic field and potential of a dipole, Bound charges due to electric polarization, Electric displacement, Boundary conditions on displacement, Solving simple electrostatic problem in presence of dielectric – point charge at the centre of a dielectric sphere, charge in front of dielectric slab, Dielectric slab and dielectric sphere in uniform electric field.

**Module IV: (6+3+3)= 12L****Magnetostatics :**

Biot-Savart law, divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; equation for vector potential and its solutions for given current densities .

**Magnetostatics in a linear magnetic medium:**

Magnetization and associated bound currents; Auxiliary magnetic field  $\vec{H}$  ; boundary conditions on  $\vec{B}$  and  $\vec{H}$  . Solving for magnetic field due to simple magnet like a bar magnet; Magnetic susceptibility ; ferromagnetic , paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

**Faraday's Law:**

Differential form of Faraday's law expressing curl of electric field in terms of time derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi static approximation. Energy stored in a magnetic field.

**Books of reference :**

1. Optics – Eugene Hecht Pearson Education India Private Limited
2. Introduction to Electrodynamics, David J. Griffiths, Pearson Education India Learning Private Limited
3. Waves and Oscillations by N.K. Bajaj
4. Principles of Physics, 10ed, David Halliday, Robert Resnick Jearl Walker , Wiley
5. Electricity, Magnetism, and Light, Wayne M. Saslow, Academic Press
6. Classical mechanics, Narayan Rana, Pramod Joag, McGraw Hill Education
7. Introduction to Classical Mechanics, R Takwale, P Puranik, McGraw Hill Education
8. Optics, Ghatak, McGraw Hill Education India Private Limited
9. Refresher Course in B.Sc. Physics – Vol1 and Vol 2 – C.L.Arora

<b>Course Name: MATHEMATICS-I</b>					
<b>Course Code: MATH1101</b>					
<b>Contact Hours per week</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	3	1	0	4	4

**Course Outcomes:**

**MATH1101.1:** Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.

**MATH1101.2:** Develop the concept of eigen values and eigen vectors.

**MATH1101.3:** Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.

**MATH1101.4:** Analyze the nature of sequence and infinite series

**MATH1101.5:** Choose proper method for finding solution of a specific differential equation.

**MATH1101.6:** Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

**Module I [10L]**

Matrix:

Inverse and rank of a matrix; Elementary row and column operations over a matrix; System of linear equations and its consistency; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigen vectors; Diagonalization of matrices; Cayley Hamilton theorem; Orthogonal transformation.

**Module II [10 L]**

Vector Calculus:

Vector function of a scalar variable, Differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, divergence and curl of a vector point function, Directional derivative, Related problems on these topics,

Infinite Series:

Convergence of sequence and series; Tests for convergence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test (statements and related problems on these tests), Raabe's test; Alternating series; Leibnitz's Test (statement, definition); Absolute convergence and Conditional convergence.

**Module III[10 L]**

**First order ordinary differential equations:**

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

**Ordinary differential equations of higher orders:**

General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods, Method of variation of parameters, Cauchy-Euler equations.

**Module IV [10L]**

**Calculus of functions of several variables**

Introduction to functions of several variables with examples, Knowledge of limit and continuity, Determination of partial derivatives of higher orders with examples, Homogeneous functions and Euler's theorem and related problems up to three variables,

**Multiple Integration**



Concept of line integrals, Double and triple integrals. Green's Theorem, Stokes Theorem and Gauss Divergence Theorem.

**Suggested Books:**

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2000.
2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. K. F. Riley, M. P. Hobson, S. J. Bence. Mathematical Methods for Physics and Engineering, Cambridge University Press, 23-Mar-2006.
4. S. L. Ross, Differential Equations", Wiley India, 1984.
5. G.F. Simmons and S.G. Krantz, Differential Equations, McGraw Hill, 2007.
6. Vector Analysis(Schaum's outline series): M.R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education)
7. Engineering Mathematics: S. S. Sastry ( PHI)
8. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP), Indian Edition.
9. Linear Algebra (Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)

<b>Course Code: CSEN1001</b>					
<b>Contact Hours per week</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>

### Course Outcomes:

**CSEN1001.1:** Understand and remember functions of the different parts of a computer.

**CSEN1001.2:** Understand and remember how a high-level language (C programming language, in this course) works, different stages a program goes through.

**CSEN1001.3:** Understand and remember syntax and semantics of a high-level language (C programming language, in this course).

**CSEN1001.4:** Understand how code can be optimized in high-level languages.

**CSEN1001.5:** Apply high-level language to automate the solution to a problem.

**CSEN1001.6:** Apply high-level language to implement different solutions for the same problem and analyze why one solution is better than the other.

### **Module I: [10L]**

#### **Fundamentals of Computer**

History of Computers, Generations of Computers, Classification of Computers.

Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Basic Concepts of Assembly language, High level language, Compiler and Assembler.

Binary & Allied number systems (decimal, octal and hexadecimal) with signed and unsigned numbers (using 1's and 2's complement) - their representation, conversion and arithmetic operations. Packed and unpacked BCD system, ASCII. IEEE-754 floating point representation (half- 16 bit, full- 32 bit, double-64 bit).

Basic concepts of operating systems like MS WINDOWS, LINUX

How to write algorithms & draw flow charts.

### **Module II: [10L]**

#### **Basic Concepts of C**

C Fundamentals:

The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions:

Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Standard input and output, formatted output -- printf, formatted input scanf.

Flow of Control:

Statement and blocks, if-else, switch-case, loops (while, for, do-while), break and continue, go to and labels.

### **Module III: [10L]**

#### **Program Structures in C**

Basic of functions, function prototypes, functions returning values, functions not returning values. Storage classes - auto, external, static and register variables – comparison between them. Scope, longevity and visibility of variables.

C preprocessor (macro, header files), command line arguments.

#### **Arrays and Pointers:**

One dimensional arrays, pointers and functions – call by value and call by reference, array of arrays. Dynamic memory usage– using malloc(), calloc(), free(), realloc(). Array pointer duality.

String and character arrays; C library string functions and their use.

#### **Module IV: [10L]**

##### **Data Handling in C**

###### **User defined data types and files:**

Basic of structures; structures and functions; arrays of structures.

Files – text files only, modes of operation. File related functions – fopen(), fclose(), fscanf(), fprintf(), fgets(), fputs(), fseek(), ftell().

##### **Text Books**

1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

##### **Reference Books**

1. C: The Complete Reference – Herbert Schildt
2. The C Programming Language- D.M.Ritchie, B.W. Kernighan

<b>Course Name: PHYSICS I LAB</b>					
<b>Course Code: PHYS1051</b>					
<b>Contact Hours per week</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>1.5</b>

**Course Outcomes:**

**PHYS1051.1:** Transform the theoretical knowledge into experimental set design

**PHYS1051.2:** Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.

**PHYS1051.3:** Analyze the result obtained through experiment.

**PHYS1051.4:** Gain knowledge of new concept in the solution of practical oriented problems and to understand more deep knowledge about the solution to theoretical problems.

**PHYS1051.5:** Understand measurement technology, usage of new instruments and real time applications in engineering studies.

**PHYS1051.6:** Develop skills to impart practical knowledge in real time solution.

**Minimum of six experiments taking at least one from each of the following four groups**

⋮

**Group 1 :Experiments in General Properties of matter**

1. Determination of **Young's modulus** by **Flexure Method**
2. Determination of **bending moment** and **shear force** of a rectangular beam of uniform cross-section.
3. Determination of **modulus of rigidity** of the material of a rod by **static method**
4. Determination of **rigidity modulus** of the material of a **wire by dynamic method.**
5. Determination of **coefficient of viscosity** by Poiseulle's capillary flow method.

**Group 2: Experiments in Optics**

1. Determination of **dispersive power** of the material of a prism
2. Determination of wavelength of light by **Newton's ring** method.
3. Determination of wavelength of light by **Fresnel's biprism method.**
4. Determination of the **wavelength of a given laser** source by diffraction method

**Group 3: Electricity & Magnetism experiments**

1. Determination of dielectric constant of a given dielectric material.
2. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of logarithmic decrement with series resistance.
3. Determination of the thermo-electric power at a certain temperature of the given thermocouple.
4. Determination of specific charge (e/m) of electron.

**Group 4: Quantum Physics Experiments**

1. Determination of Planck's constant.
2. Determination of Stefan's radiation constant.
3. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
4. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum.
5. Determination of Hall co-efficient of semiconductors.
6. Determination of band gap of semiconductors.
7. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.

**Text Books**

1. Advanced Practical Physics (vol. 1 and vol. 2 )

- B. Ghosh and K. G. Mazumdar.  
 2. Advanced course in practical physics  
 D. Chattopadhyay and P.C. Rakshit.

<b>Course Name: PROGRAMMING FOR PROBLEM SOLVING LAB</b>					
<b>Course Code: CSEN1051</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>	<b>2</b>

### Course Outcomes:

After completion of this course the students should be able:

**CSEN1051.1:** To write simple programs relating to arithmetic and logical problems.

**CSEN1051.2:** To be able to interpret, understand and debug syntax errors reported by the compiler.

**CSEN1051.3:** To implement conditional branching, iteration (loops) and recursion.

**CSEN1051.4:** To decompose a problem into modules (functions) and amalgamating the modules to generate a complete program.

**CSEN1051.5:** To use arrays, pointers and structures effectively in writing programs.

**CSEN1051.6:** To be able to create, read from and write into simple text files.

**Software to be used: GNU C Compiler (GCC) with LINUX**

**NB: Cygwin (Windows based) may be used in place of LINUX**

Topic 1: LINUX commands and LINUX based editors

Topic 2: Basic Problem Solving

Topic 3: Control Statements (if, if-else, if-elseif-else, switch-case)

Topic 4: Loops - Part I (for, while, do-while)

Topic 5: Loops - Part II

Topic 6: One Dimensional Array

Topic 7: Array of Arrays

Topic 8: Character Arrays/ Strings

Topic 9: Basics of C Functions

Topic 10: Recursive Functions

Topic 11: Pointers

Topic 12: Structures

Topic 13: File Handling

### **Text Books**

1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

<b>Course Name: WORKSHOP /MANUFACTURING PRACTICES</b>					
<b>Course Code: MECH1051</b>					
<b>Contact Hours per week</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	<b>1</b>	<b>0</b>	<b>4</b>	<b>5</b>	<b>3</b>

**Course Outcomes:**

Upon completion of this course

**MECH1051.1:** The students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

**MECH1051.2:** The students will be able to fabricate components with their own hands.

**MECH1051.3:** They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.

**MECH1051.4:** By assembling different components, they will be able to produce small devices of their interest.

**MECH1051.5:** The students will be able to describe different components and processes of machine tools.

**MECH1051.6:** The students will be able to apply the knowledge of welding technology and they can perform arc and gas welding to join the material.

**(i) Lectures & videos: (13 hours)****Detailed contents**

1. Introduction on Workshop and Safety Precautions. **(1 lecture)**
2. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lectures)**
3. CNC machining, Additive manufacturing **(1 lecture)**
4. Fitting operations & power tools **(1 lecture)**
5. Electrical & Electronics **(1 lecture)**
6. Carpentry **(1 lecture)**
7. Plastic moulding, glass cutting **(1 lecture)**
8. Metal casting **(1 lecture)**
9. Welding (arc welding & gas welding), brazing **(2 lecture)**
10. Viva-voce **(1 lecture)**

**(ii) Workshop Practice :( 52 hours)[ L : 0; T:0 ; P : 4 (2 credits)]**

1. Machine shop **(12 hours)**
2. Fitting shop **(8 hours)**
3. Carpentry **(4 hours)**
4. Electrical & Electronics **(4 hours)**
5. Welding shop (Arc welding 4 hrs + gas welding 4 hrs) **(8 hours)**
6. Casting **(4 hours)**
7. Smithy **(4 hours)**
8. Plastic moulding& Glass Cutting **(4 hours)**
9. Sheet metal Shop **(4 hours)**

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

**Suggested Text/Reference Books:**

- (i) 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.
- (ii) Kalpakjian S. And Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.
- (iii) Gowri P. Hariharan and A. Suresh Babu, “Manufacturing Technology – I” Pearson Education, 2008.
- (iv) Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice Hall India, 1998.
- (v) Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGrawHill House, 2017.

<b>Course Name: COMMUNICATION FOR PROFESSIONALS</b>					
<b>Course Code: HMTS1011</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>

### Course Outcomes:

Students will be able to

**HMTS1011.1:** Write business letters and reports

**HMTS1011.2:** Communicate in an official and formal environment.

**HMTS1011.3:** Effectively use the various channels of communication at work place.

**HMTS1011.4:** Use language as a tool to build bridges and develop interpersonal relations in multi-cultural environment.

**HMTS1011.5:** Learn to articulate opinions and views with clarity.

**HMTS1011.6:** Use various techniques of communication for multiple requirements of globalized workplaces.

### Module- I (9hrs.)

Introduction to Linguistics

- Phonetics- Vowel and Consonant Sounds (Identification & Articulation)
- Word- stress, stress in connected speech
- Intonation (Falling and Rising Tone)
- Voice Modulation
- Accent Training
- Vocabulary Building
- The concept of Word Formation
- Root words from foreign languages and their use in English
- Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives
- Synonyms, Antonyms and standard abbreviations

### Module- II (10hrs.)

Communication Skills

- Definition, nature & attributes of Communication

- Process of Communication
- Models or Theories of Communication
- Types of Communication
- Levels or Channels of Communication
- Barriers to Communication

**Module- III (10hrs.)**

**Professional Writing Skills**

- Letter Writing : Importance, Types , Process, Form and Structure, Style and Tone
- Proposal Writing: Purpose,Types of Proposals, Structure of Formal Proposals.
- Report Writing: Importance and Purpose, Types of Reports, Report Formats, Structure of Formal Reports, Writing Strategies.

**Module- IV (10hrs.)**

**Communication skills at Work**

- Communication and its role in the workplace
- Benefits of effective communication in the workplace
- Common obstacles to effective communication
- Approaches and Communication techniques for multiple needs at workplace: persuading, convincing, responding, resolving conflict, delivering bad news, making positive connections,
- Identify common audiences and design techniques for communicating with each audience

**References:**

- 1 Kumar,S.&Lata, P. Communication Skills, OUP, New Delhi2011
- 2 Rizvi,Ashraf,M. Effective Technical Communication, Mc Graw Hill Education(India) Pvt. Ltd..Chennai,2018
- 3 Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2<sup>nd</sup> Ed., 2011

<b>Course Name: COMMUNICATION FOR PROFESSIONALS LAB</b>					
<b>Course Code: HMTS1061</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>



## **Course Outcomes:**

### **Students will be able to**

**HMTS1061.1:** Communicate in an official and formal environment.

**HMTS1061.2:** Effectively communicate in a group and engage in relevant discussion.

**HMTS1061.3:** Engage in research and prepare presentations on selected topics.

**HMTS1061.4:** Understand the dynamics of multicultural circumstances at workplace and act accordingly.

**HMTS1061.5:** Organize content in an attempt to prepare official documents .

**HMTS1061.6:** Appreciate the use of language to create beautiful expressions.

### **Module- I (4hrs)**

Techniques for Effective Speaking

Voice Modulation: Developing correct tone

Using correct stress patterns: word stress, primary stress, secondary stress

Rhythm in connected speech

### **Module- II (6hrs.)**

Effective Speaking and Social awareness

The Art of Speaking

- Encoding Meaning Using Nonverbal Symbols
  - How to Improve Body Language
  - Eye Communication, Facial Expression, Dress and Appearance
  - Posture and Movement, Gesture, Paralanguage
  - Encoding meaning using Verbal symbols: How words work and how to use words
  - Volume, Pace, Pitch and Pause
  - Cross-Cultural Communication : Multiple aspects/dimensions of culture
  - Challenges of cross-cultural communication
  - Improving cross-cultural communication skills at workplace.

### **Module- III (6hrs)**

- Group Discussion: Nature and purpose
- Characteristics of a successful Group Discussion
- Group discussion Strategies: Getting the GD started, contributing systematically, moving the discussion along, promoting optimal participation, Handling conflict, Effecting closure.

### **Module- IV (10hrs.)**

#### **Professional Presentation Skills**

Nature and Importance of Presentation skills

Planning the Presentation: Define the purpose, analyze the Audience, Analyze the occasion and choose a suitable title.

Preparing the Presentation: The central idea, main ideas, collecting support material, plan visual aids, design the slides

Organizing the Presentation: Introduction-Getting audience attention, introduce the subject, establish credibility, preview the main ideas, Body-develop the main idea, present information sequentially and logically, Conclusion-summaries, re-emphasize, focus on the purpose, provide closure.

Improving Delivery: Choosing Delivery methods, handling stage fright

Post-Presentation discussion: Handling Questions-opportunities and challenges.

## References:

1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001
2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice Hall, 3<sup>rd</sup> Ed., 2004
3. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5<sup>th</sup> Ed., 1999
4. R. Anand, Job Readiness For IT & ITES- A Placement and Career Companion, , McGraw Hill Education.2015
5. Malhotra, A.,Campus Placements, McGraw Hill Education.2015

**1<sup>ST</sup> YEAR 2<sup>ND</sup> SEMESTER**

<b>Course Name :CHEMISTRY-I</b>					
<b>Course Code: CHEM1001</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>4</b>

**Course Outcomes:**

The course outcomes of the subject are

**CHEM1001.1:** Knowledge of understanding the operating principles and reaction involved in batteries and fuel cells and their application in automobiles as well as other sectors to reduce environmental pollution.

**CHEM1001.2:** An ability to analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.for engineering applications.

**CHEM1001.3:** Have knowledge of synthesizing nano materials and their applications in industry, carbon nano tube technology is used in every industry now-a-days.

**CHEM1001.4:** Understanding of bulk properties and processes using thermodynamic considerations.

**CHEM1001.5:** Elementary knowledge of IR, UV, NMR and X-ray spectroscopy is usable in structure elucidation and characterisation of various molecules.

**CHEM1001.6:** Knowledge of electronic effect and stereochemistry for understanding mechanism of the major chemical reactions involved in synthesis of various drug molecules.

**MODULE I :****Atomic structure and Wave Mechanics: 3L**

Brief outline of the atomic structure, Dual character of electron, De Broglies's equation, the Heisenberg uncertainty principle, brief introduction of quantum mechanics, the Schrodinger wave equation, Hermitian operator, solution of the Schrodinger equation for particle in a one dimensional box, interpretation of the wave function  $\Psi$ , concept of atomic orbital.

**Thermodynamics: 4L**

Carnot cycle, 2nd law of thermodynamics, entropy, Clausius inequality, free energy and work function, Clausius Clapeyron Equation, Chemical Potential, Activity and Activity coefficient. Gibbs Duhem Relation.

**Spectroscopic Techniques & Application 3L**

Electromagnetic spectrum: EMR interaction with matter - absorption and emission of radiation.

Principle and application of UV- visible and IR spectroscopy

Principles of NMR Spectroscopy and X-ray diffraction technique

**MODULE II :****Chemical Bonding: 5L**

Covalent bond, VSEPR Theory, hybridization, molecular geometries, Dipole moment, Intermolecular forces, V.B. and M.O. Theory and its application in Homo and Heteronuclear diatomic molecules, Band theory of solids, Pi-molecular orbitals of ethylene and butadiene.

**Periodicity: 3L**

Effective nuclear charge, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electro-negativity, inert pair effect.

### **Ionic Equilibria: 2L**

Acid Base Equilibria, Salt Hydrolysis and Henderson Equation, Buffer solutions, pH indicator, Common ion Effect, Solubility product, Fractional Precipitation .

### **MODULE III :**

#### **Conductance: 3L**

Conductance of electrolytic solutions, Strong and Weak electrolytes, effect of temperature and concentration. Kohlrausch's law of independent migration of ions, transport numbers and hydration of ions. Application of conductance Acid-base and precipitation titration.

#### **Electrochemical Cell**

Thermodynamic derivation of Nernst equation, Electrode potential and its application to predict redox reaction; Standard Hydrogen Electrode, Reference electrode, cell configuration, half cell reactions, evaluation of thermodynamic functions; Reversible and Irreversible cells; Electrochemical corrosion.

Electrochemical Energy Conversion: Primary & Secondary batteries, Fuel Cells.

#### **Reaction dynamics: 3L**

Rate Laws, Order & Molecularity; zero, first and second order kinetics.

Pseudo-unimolecular reaction, Arrhenius equation.

Mechanism and theories of reaction rates (Transition state theory, Collision theory).

Catalysis: Homogeneous catalysis (Definition, example, mechanism, kinetics).

### **MODULE IV :**

#### **Stereochemistry: 4L**

Representations of 3- dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

#### **Structure and reactivity of Organic molecule: 3L**

Inductive effect, resonance, hyperconjugation, electromeric effect, carbocation, carbanion, free radicals, aromaticity.

#### **Organic reactions and synthesis of drug molecule (4 L)**

Introduction to reaction mechanisms involving substitution, addition, elimination and oxidation-reduction reactions. Synthesis of commonly used drug molecules.

#### **Text Books**

1. Atkins' Physical Chemistry, P.W. Atkins (10<sup>th</sup> Edition)
2. Organic Chemistry, I. L. Finar, Vol-1 (6<sup>th</sup> Edition)
3. Engineering Chemistry, Jain & Jain, (16<sup>th</sup> Edition)

4. Fundamental Concepts of Inorganic Chemistry, A. K. Das, (2<sup>nd</sup> Edition)
5. Engineering Chemistry -I, Gourkrishna Dasmohapatra, (3<sup>rd</sup> Edition)

### Reference Books

1. General & Inorganic Chemistry, R. P. Sarkar
2. Physical Chemistry, P. C. Rakshit, (7<sup>th</sup> Edition)
3. Organic Chemistry, Morrison & Boyd, (7<sup>th</sup> Edition)
4. Fundamentals of Molecular Spectroscopy, C.N. Banwell, (4<sup>th</sup> Edition)
5. Physical Chemistry, G. W. Castellan, (3<sup>rd</sup> Edition)
6. Basic Stereo chemistry of Organic Molecules, Subrata Sen Gupta, (1<sup>st</sup> Edition)

<b>Course Name :MATHEMATICS-II</b>					
<b>Course Code: MATH1201</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>4</b>

### Course Outcomes:

**MATH1201.1:** Demonstrate the knowledge of probabilistic approaches to solve wide range of engineering problem.

**MATH1201.2:** Recognize probability distribution for discrete and continuous variables to quantify physical and engineering phenomenon.

**MATH1201.3:** Develop numerical techniques to obtain approximate solutions to mathematical problems where analytical solutions are not possible to evaluate.

**MATH1201.4:** Analyze certain physical problems that can be transformed in terms of graphs and trees and solving problems involving searching, sorting and such other algorithms.

**MATH1201.5:** Apply techniques of Laplace Transform and its inverse in various advanced engineering problems.

**MATH1201.6:** Interpret differential equations and reduce them to mere algebraic equations using Laplace Transform to solve easily.

### **Module-I Fundamentals of Probability (10L)**

- Random experiment, Sample space and events
- Classical and Axiomatic definition of probability
- Addition and Multiplication law of probability
- Conditional probability
- Bayes' Theorem
- Random variables
- General discussion on discrete and continuous distributions

- Expectation and Variance
- Examples of special distribution: Binomial and Normal Distribution

### Module-II Numerical Methods (10L)

- Solution of non-linear algebraic and transcendental equations: Bisection Method, Newton-Raphson Method, Regula-Falsi Method.
- Solution of linear system of equations: Gauss elimination method, Gauss-Seidel Method, LU Factorization Method, Matrix Inversion Method.
- Solution of Ordinary differential equations: Euler's and Modified Euler's Method, Runge-Kutta Method of 4<sup>th</sup> order.

### Module-III Basic Graph Theory (10L)

- Graphs: Digraphs, Weighted graph, Connected and disconnected graphs, Complement of a graph, Regular graph, Complete graph, Subgraph
- Walks, Paths, Circuits, Euler Graph, Cut sets and cut vertices
- Matrix representation of a graph, Adjacency and incidence matrices of a graph
- Graph isomorphism
- Bipartite graph
- Definition and properties of a tree
- Binary tree, Spanning tree of a graph, Minimal spanning tree, properties of trees
- Algorithms: Dijkstra's Algorithm for shortest path problem, Determination of minimal spanning tree using DFS, BFS, Kruskal's and Prim's algorithms

### Module-IV Laplace Transformation (10L)

- Basic ideas of improper integrals, working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations.
- Introduction to integral transformation
- Functions of exponential order, Definition and existence of Laplace Transform(LT) (statement of initial and final value theorem only)
- LT of elementary functions, Properties of Laplace Transformations, Evaluation of sine, cosine and exponential integrals using LT
- LT of periodic and step functions
- Definition and properties of inverse LT
- Convolution Theorem (statement only) and its application to the evaluation of inverse LT
- Solution of linear ODEs with constant coefficients (initial value problem) using LT

### Suggested Books:

1. Advanced Engineering Mathematics, E. Kreyszig, Wiley Publications
2. Introduction to Probability and Statistics for Engineers and Scientists, S. Ross, Elsevier
3. Introductory methods of Numerical Analysis, S.S. Sastry, PHI learning
4. Introduction to Graph Theory, D. B. West, Prentice-Hall of India
5. Engineering Mathematics, B.S. Grewal, S. Chand & Co.

<b>Course Name: BASIC ELECTRICAL ENGINEERING</b>					
<b>Course Code: ELEC1001</b>					
<b>Contact Hours per week</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>4</b>

**Course Outcomes:**

After attending the course, the students will be able to

**ELEC1001.1:** Analyse DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.

**ELEC1001.2:** Analyse DC Machines; Starters and speed control of DC motors.

**ELEC1001.3:** Analyse magnetic circuits.

**ELEC1001.4:** Analyse single and three phase AC circuits.

**ELEC1001.5:** Analyse the operation of single phase transformers.

**ELEC1001.6:** Analyse the operation of three phase induction motors.

**Module-I:**

**DC Network Theorem:** Kirchhoff's law, Nodal analysis, Mesh analysis, Superposition theorem, Thevenin's theorem, Norton theorem, Maximum power transfer theorem, Star-Delta conversion.

[6L]

**Electromagnetism:** Review of magnetic flux, Force on current carrying conductors, Magnetic circuit analysis, Self and Mutual inductance, B-H loop, Hysteresis and Eddy current loss, Lifting power of magnet.

[5L]

**Module-II**

**AC single phase system:** Generation of alternating emf, Average value, RMS value, Form factor, Peak factor, representation of an alternating quantity by a phasor, phasor diagram, AC series, parallel and series-parallel circuits, Active power, Reactive power, Apparent power, power factor, Resonance in RLC series and parallel circuit.

[10L]

**Module-III**

**Three phase system:** Balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams, power measurement by two wattmeter method.

[4L]

**DC Machines:** Construction, EMF equation, Principle of operation of DC generator, Open circuit characteristics, External characteristics, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor, speed control of dc motor.

[7L]

**Module-IV**

**Single phase transformer:** Construction, EMF equation, no load and on load operation and their phasor diagrams, Equivalent circuit, Regulation, losses of a transformer, Open and Short circuit tests, Efficiency

[6L]

**3-phase induction motor:** Concept of rotating magnetic field, Principle of operation, Construction, Equivalent circuit and phasor diagram, torque-speed/slip characteristics, Starting of Induction Motor.

[4L]

**Text Books:**

1. Basic Electrical engineering, D.P Kothari & I.J Nagrath, TMH, Second Edition
2. Basic Electrical Engineering, V.N Mittle & Arvind Mittal, TMH, Second Edition
3. Basic Electrical Engineering, Hughes
4. Electrical Technology, Vol-I, Vol-II, Surinder Pal Bali, Pearson Publication
5. A Text Book of Electrical Technology, Vol. I & II, B.L. Theraja, A.K. Theraja, S.Chand & Company

**Reference Books:**

1. Electrical Engineering Fundamentals, Vincent Del Toro, Prentice-Hall
2. Advance Electrical Technology, H.Cotton, Reem Publication
3. Basic Electrical Engineering, R.A. Natarajan, P.R. Babu, Sitech Publishers
4. Basic Electrical Engineering, N.K. Mondal, Dhanpat Rai
5. Basic Electrical Engineering, Nath & Chakraborti
6. Fundamental of Electrical Engineering, Rajendra Prasad, PHI, Edition 2005.

<b>Course Name : BUSINESS ENGLISH</b>					
<b>Course Code: HMTS1202</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>

**Course Outcomes:**

The learner will

**HMTS1202.1:** Acquire competence in using English language to communicate.

**HMTS1202.2:** Be aware of the four essential skills of language usage-listening, speaking, reading and writing.

**HMTS1202.3:** Be adept at using various modes of written communication at work.

**HMTS1202.4:** Attain the skills to face formal interview sessions.

**HMTS1202.5:** Write reports according to various specifications.

**HMTS1202.6:** Acquire the skill to express with brevity and clarity

**Module- I (6hrs.)**

Grammar (Identifying Common Errors in Writing)

- Subject-verb agreement
- Noun-pronoun agreement
- Misplaced Modifiers
- Articles
- Prepositions



- Redundancies

### **Module- II (6hrs.)**

Basic Writing Strategies

Sentence Structures

- Use of phrases and clauses in sentences
- Creating coherence
- Organizing principles –accuracy, clarity, brevity
- Techniques for writing precisely
- Different styles of writing: descriptive,narrative, expository
- Importance of proper punctuation

### **Module- III (8hrs)**

Business Communication- Scope & Importance

Writing Formal Business Letters:Form and Structure-Parts of a Business letter, Business Letter Formats, Style and Tone, Writing strategies.

Organizational Communication: Agenda & minutes of a meeting, Notice, Memo, Circular

Organizing e-mail messages, E-mail etiquette

Job Application Letter: Responding to Advertisements and Forced Applications, Qualities of well-written Application Letters: The You-Attitude, Length, Knowledge of Job Requirement, Reader-Benefit Information, Organization, Style, Mechanics – Letter Plan: Opening Section, Middle Section, Closing Section

Resume and CV: Difference, Content of the Resume – Formulating Career Plans: Self Analysis, Career Analysis, Job Analysis, Matching Personal Needs with Job Profile – Planning your Resume – Structuring the Resume: Chronological Resume, The Functional Resume, Combination of Chronological and Functional Resume, Content of the Resume: Heading, Career Goal or Objectives, Education, Work Experience, Summary of Job Skills/Key Qualifications, Activities, Honors and Achievements, Personal Profile, Special Interests, References

### **Module- IV (6hrs)**

Writing skills

- Comprehension: Identifying the central idea, inferring the lexical and contextual meaning, comprehension passage - practice
- Paragraph Writing: Structure of a paragraph, Construction of a paragraph, Features of a paragraph, Writing techniques/developing a paragraph.
- Précis: The Art of Condensation-some working principles and strategies. Practice sessions of writing précis of given passages.
- Essay Writing:Characteristic features of an Essay, Stages in Essay writing, Components comprising an Essay, Types of Essays-Argumentative Essay, Analytical Essay, Descriptive Essays, Expository Essays, Reflective Essays

**References:**

1. Theories of Communication: A Short Introduction, Armand Matterlart and Michele Matterlart, Sage Publications Ltd.
2. Professional Writing Skills, Chan, Janis Fisher and Diane Lutovich. San Anselmo, CA: Advanced Communication Designs.
3. Hauppauge, Geffner, Andrew P. Business English, New York: Barron's Educational Series.
4. Kalia, S. & Agarwal, S. Business Communication, Wiley India Pvt. Ltd., New Delhi, 2015
5. Mukherjee, H.S., Business Communication- Connecting at work., Oxford University Press. 2<sup>nd</sup> Edition. 2015
6. Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2<sup>nd</sup> Ed., 2011.

<b>Course Name :CHEMISTRY-I LAB</b>					
<b>Course Code: CHEM1051</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>1.5</b>

### Course Outcomes:

The course outcomes of the subject are

**CHEM1051.1:** Knowledge to estimate the hardness of water which is required to determine the usability of water used in industries.

**CHEM1051.2:** Estimation of ions like  $\text{Fe}^{2+}$ ,  $\text{Cu}^{2+}$  and  $\text{Cl}^-$  present in water sample to know the composition of industrial water.

**CHEM1051.3:** Study of reaction dynamics to control the speed and yield of various manufactured goods produced in polymer, metallurgical and pharmaceutical industries.

**CHEM1051.4:** Handling physico-chemical instruments like viscometer, stalagmometer, pH-meter, potentiometer and conductometer.

**CHEM1051.5:** Understanding the miscibility of solutes in various solvents required in paint, emulsion, biochemical and material industries.

**CHEM1051.6:** Knowledge of sampling water can be employed for water treatment to prepare pollution free water.

### **Experiments:**

1. Estimation of iron using  $\text{KMnO}_4$  self indicator.
2. Iodometric estimation of  $\text{Cu}^{2+}$ .
3. Determination of Viscosity.
4. Determination of surface tension.
5. Adsorption of acetic acid by charcoal.
6. Potentiometric determination of redox potentials.

7. Determination of total hardness and amount of calcium and magnesium separately in a given water sample.
8. Determination of the rate constant for acid catalyzed hydrolysis of ethyl acetate.
9. Heterogeneous equilibrium (determination of partition coefficient of acetic acid in n-butanol and water mixture).
10. Conductometric titration for the determination of strength of a given HCl solution against a standard NaOH solution.
11. pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
12. Determination of chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

**Reference Books:**

1. Vogel's Textbook of Quantitative Chemical Analysis-G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney.
2. Advanced Practical Chemistry- S. C. Das
3. Practicals in Physical Chemistry- P. S. Sindhu

<b>Course Name: BASIC ELECTRICAL ENGINEERING LABORATORY</b>					
<b>Course Code: ELEC1051</b>					
<b>Contact Hours per week</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>

**Course Outcomes:**

The students are expected to

**ELEC1051.1:** Get an exposure to common electrical apparatus and their ratings.

**ELEC1051.2:** Make electrical connections by wires of appropriate ratings.

**ELEC1051.3:** Understand the application of common electrical measuring instruments.

**ELEC1051.4:** Understand the basic characteristics of different electrical machines.

**List of Experiments:**

1. Characteristics of Fluorescent lamps
2. Characteristics of Tungsten and Carbon filament lamps
3. Verification of Thevenin's & Norton's theorem.
4. Verification of Superposition theorem
5. Verification of Maximum Power Transfer theorem
6. Calibration of ammeter and voltmeter.
7. Open circuit and Short circuit test of a single phase Transformer.
8. Study of R-L-C Series / Parallel circuit
9. Starting and reversing of speed of a D.C. shunt Motor
10. Speed control of DC shunt motor.

11. No load characteristics of D.C shunt Generators  
 12. Measurement of power in a three phase circuit by two wattmeter method.

<b>Course Name: ENGINEERING GRAPHICS &amp; DESIGN</b>					
<b>Course Code: MECH1052</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	<b>1</b>	<b>0</b>	<b>4</b>	<b>5</b>	<b>3</b>

### Course Outcomes:

After going through the course, the students will be able

**MECH1052.1:** To understand the meaning of engineering drawing.

**MECH1052.2:** To have acquaintance with the various standards (like lines, dimensions, scale etc.) and symbols followed in engineering drawing.

**MECH1052.3:** To represent a 3-D object into 2-D drawing with the help of orthographic and isometric projections.

**MECH1052.4:** To read and understand projection drawings.

**MECH1052.5:** To draw the section view and true shape of a surface when a regular object is cut by a section plane.

**MECH1052.6:** To use engineering drawing software (CAD).

### **Lecture Plan (13 L)**

1. Importance and principles of engineering drawing	(1 L)
2. Concepts of Conic sections and Scale	(1 L)
3. Introduction to concept of projection (Projections of points, lines and surfaces)	(4 L)
4. Definitions of different solids and their projections	(1 L)
5. Section of solids and sectional view	(1 L)
6. Isometric projection	(2 L)
7. Introduction to CAD	(2 L)
8. Viva Voce	(1 L)

### **Detailed contents of Lab hours (52 hrs)**

Module 1: Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lines, lettering & dimensioning, Conic section like Ellipse (General method only); Involute; Scales – Plain, Diagonal.  
 (4 hrs + 4 hrs)

Module 2: Orthographic Projections covering, Principles of Orthographic Projections - Conventions - Projections of Points and lines inclined to both planes; Projections on Auxiliary Planes. Projection of lamina.  
 (4 hrs+4 hrs + 4 hrs)

Module 3: Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views.

(4 hrs + 4 hrs)

Module 4: Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids.

(4 hrs)

Module 5: Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

(4 hrs + 4 hrs)

Module 6: Overview of Computer Graphics covering, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids.

(4 hrs)

Module 7: Customisation & CAD Drawing

consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

(2 hrs)

Module 8: Annotations, layering & other functions covering

applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation.

(2 hrs)

Module 9: Demonstration of a simple team design project that illustrates

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame.

(4 hrs)

### References:

1. Bhatt, N.D., Panchal V.M. & Ingle P.R., (2014) “Elementary Engineering Drawing” ; Charotan Publishing House
2. Narayana, K.L. and KannaaiahP “Engineering Graphics”; TMH
3. Lakshminarayanan, V. and Vaishwanar, R.S “Engineering Graphics” Jain Brothers.
4. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
5. Agarwal B. & Agarwal C. M. (2012), Engineering graphics, TMH Publications.

<b>Course Name: LANGUAGE LAB</b>					
<b>Course Code: HMTS1252</b>					
<b>Contact Hours per week</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>

**Course Outcomes:**

The learner will

**HMTS1252.1:** Acquire the techniques to become an effective listener.

**HMTS1252.2:** Acquire the skill to become an effortless speaker.

**HMTS1252.3:** Organize and present information for specific audience.

**HMTS1252.4:** Communicate to make a positive impact in professional and personal environment.

**HMTS1252.5:** Engage in research and prepare authentic, formal, official documents.

**HMTS1252.6:** Acquire reading skills for specific purpose.

**Module- I (4hrs)**

Listening Skills

- Principles of Listening: Characteristics, Stages.
- Types of Listening: Passive listening, Marginal or superficial listening, Projective Listening, Sensitive or Empathetic Listening, Active or Attentive listening.
- Guidelines for Effective Listening
- Barriers to Effective Listening
- Listening Comprehension

**Module- II (8hrs)**

- Interviewing  
Types of Interviews, Format for Job Interviews: One-to-one and Panel Interviews, Telephonic Interviews, Interview through video conferencing.
- Interview Preparation Techniques, Frequently Asked Questions, Answering Strategies, Dress Code, Etiquette, Questions for the Interviewer, Simulated Interviews.

**Module- III (6hrs)**

- Public Speaking: The Speech Process: The Message, The Audience, The Speech Style, Encoding, Feedback.
- Characteristics of a good speech : content and delivery, structure of a speech
- Modes of delivery in public speaking: Impromptu, Extemporaneous, Prepared or Memorized, Manuscript.
- Conversation: Types of conversation: formal and informal, Strategies for effective conversation, Improving fluency.
- Situational conversation practice: Greetings and making introductions, Asking for information and giving instructions, agreeing and disagreeing.
- Conversational skills in the business scenario: One-to-one and Group communication, Gender and Culture Sensitivity, Etiquette, Sample Business Conversation, Telephonic Conversation

**Module- IV (8hrs)**

Presentation Skills

- Speaking from a Manuscript, Speaking from Memory, Impromptu Delivery, Extemporaneous Delivery, Analyzing the Audience, Nonverbal Dimensions of Presentation
- Organizing the Presentation: The Message Statement, Organizing the Presentation: Organizing the Speech to Inform, The Conclusion, Supporting Your Ideas – Visual Aids: Designing and Presenting Visual Aids, Selecting the Right Medium.
- Project Team/Group Presentations

### References:

6. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001
7. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice Hall, 3<sup>rd</sup> Ed., 2004
8. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5<sup>th</sup> Ed., 1999
9. Sen, S.,Mahendra,A. &Patnaik,P.,Communication and Language Skills, Cambridge University Press, 2015
10. Locker,Kitty O. Business and Administrative Communication McGraw-Hill/ Irwin.
11. Chaney,L.andMartin,J., Intercultural Business Communication. Prentice Hall

2<sup>ND</sup> YEAR 3<sup>RD</sup> SEMESTER

<b>Course Name: Data Structures &amp; Algorithms</b>					
<b>Course Code: CSEN2101</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>

**Course Outcomes:**

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

**CSEN2101.1:** Understand and remember the basics of data structures and how time complexity analysis is applicable to different types of algorithms.

**CSEN2101.2:** Understand the significance and utility of different data structures and the context of their application. (For example, the queue in front of ticket counters uses first-in-first-out paradigm in a linear data structure)

**CSEN2101.3:** Apply different types of data structures in algorithms and understand how the data structures can be useful in those algorithms.

**CSEN2101.4:** Analyse the behaviour of different data structures in algorithms. (For example, given an algorithm that uses a particular data structure, how to calculate its space and time complexity.)

**CSEN2101.5:** Evaluate solutions of a problem with different data structures and thereby understand how to select suitable data structures for a solution. (For example, what are the different ways to find the second largest number from a list of integers and which solution is the best.)

**CSEN2101.6:** Evaluate different types of solutions (e.g. sorting) to the same problem.

**Module I [8L]**

**Introduction:** Why do we need data structure? Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type; Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – Big O,  $\Omega$ ,  $\Theta$ , notations.

**Array:** Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.

**Linked List:** Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.

**Module II [8L]**

**Stack and Queue:** Stack and its implementations (using array, using linked list), applications. Queue, circular queue, deque. Implementation of queue- both linear and circular (using array, using linked list), applications. Implementation of deque- with input and output restriction.

**Recursion:** Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle (Concept of Backtracking).

**Module III [13L]**

**Trees:** Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion,



deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B-Trees – operations (insertion, deletion with examples only).

**Graphs:** Graph definitions and Basic concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cut vertex/articulation point, complete graph, simple path, simple cycle). Graph representations/storage implementations – adjacency matrix, adjacency list, Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, forward-edge), applications.

#### **Module IV [11L]**

**Sorting Algorithms:** Bubble sort and its optimizations, Cocktail Shaker Sort, Insertion sort, Selection sort, Quicksort (Average Case Analysis not required), Heap sort (concept of max heap, application – priority queue), Counting Sort, Radix sort.

**Searching:** Sequential search, Binary search, Interpolation search.

**Hashing:** Hashing functions, collision resolution techniques (Open and closed hashing).

#### **1. Textbooks**

1. Fundamentals of Data Structures of C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
2. Data Structures in C, Aaron M. Tenenbaum.
3. Data Structures, S. Lipschutz.
4. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

#### **2. Reference Books**

1. Data Structures and Program Design In C, 2/E, Robert L. Kruse, Bruce P. Leung.

<b>Course Name: Discrete Mathematics</b>					
<b>Course Code: CSEN2102</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>

### 1. Course Outcomes

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

**CSEN2102.1** Interpret the problems that can be formulated in terms of graphs and trees.

**CSEN2102.2** Explain network phenomena by using the concepts of connectivity, independent sets, cliques, matching, graph coloring etc.

**CSEN2102.3** Achieve the ability to think and reason abstract mathematical definitions and ideas relating to integers through concepts of well-ordering principle, division algorithm, greatest common divisors and congruence.

**CSEN2102.4** Apply counting techniques and the crucial concept of recurrence to comprehend the combinatorial aspects of algorithms.

**CSEN2102.5** Analyze the logical fundamentals of basic computational concepts.

**CSEN2102.6** Compare the notions of converse, contrapositive, inverse etc. in order to consolidate the comprehension of the logical subtleties involved in computational mathematics.

#### Module I [10L]

**Graph Theory:** Tree, Binary Tree, Spanning Tree. Walk, Path, Cycle, Hamiltonian Graph, The Travelling Salesman Problem, Euler Graph, The Chinese Postman Problem. Planar Graph, Euler's Formula for Planar Graph and Related Problems. Examples of Non-Planar Graphs. Kuratowski's Theorem. Matching and Augmenting Paths, Hall's Marriage Theorem and Related Problems. Vertex Coloring, Chromatic Polynomials.

#### Module II [10L]

**Number Theory:** Well Ordering Principle, Principle of Mathematical Induction, Divisibility theory and properties of divisibility, Fundamental Theorem of Arithmetic, Euclidean Algorithm for finding greatest common divisor (GCD) and some basic properties of GCD with simple examples, Congruence, Residue classes of integer modulo  $n(\mathbb{Z}_n)$  and its examples.

#### Module III [10L]

**Combinatorics:** Counting Techniques: Permutations and Combinations, Distinguishable and Indistinguishable Objects, Binomial Coefficients, Generation of Permutations and Combinations, Pigeon-hole Principle, Generalized Pigeon-Hole Principle, Principle of Inclusion and Exclusion, Generating Functions and Recurrence Relations: Solving Recurrence Relations Using Generating Functions and other Methods, Divide-and-Conquer Methods, Formulation and Solution of Recurrence Relations in Computer Sorting, Searching and other Application Areas.

#### Module IV [12L]

**Propositional Calculus:** Propositions, Logical Connectives, Truth Tables, Conjunction, Disjunction, Negation, Implication, Converse, Contra positive, Inverse, Biconditional Statements, Logical Equivalence, Tautology, Normal Forms, CNF and DNF, Predicates, Universal and Existential Quantifiers, Bound and Free Variables, Examples of Propositions with Quantifiers.

### 2. Textbooks

1. Discrete Mathematics and its Applications, Kenneth H. Rosen, Tata McGraw- Hill.
2. Discrete Mathematics, T Veerarajan, Tata McGraw- Hill.

### 3. Reference Books

1. Elements of Discrete Mathematics: A Computer Oriented Approach, C L Liu and D P Mohapatra, McGraw Hill.
2. Discrete Mathematical Structure and Its Application to Computer Science, J.P. Tremblay and R. Manohar, McGraw Hill.
3. Discrete Mathematics for Computer Scientists and Mathematicians, J.L.Mott, A. Kandel and T.P.Baker, Prentice Hall
4. Discrete Mathematics, Norman L. Biggs, Seymour Lipschutz, Marc Lipson, Oxford University Press, Schaum's Outlines Series.
5. Higher Algebra(Classical), S.K. Mapa, Sarat Book Distributors.
6. Introduction to Graph Theory (2nd Ed), D G West, Prentice-Hall of India, 2006.

<b>Course Name: Python Programming</b>					
<b>Course Code: CSEN2103</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>

### Course Outcomes

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

**CSEN2103.1.** Learn and understand the basics of the Python Programming Language.

**CSEN2103.2.** Learn about basic Python data structures.

**CSEN2103.3.** Learn about the NumPy and pandas libraries in Python.

**CSEN2103.4.** Learn about the GUI programming using Tkinter and Symbolic computing using SymPy.

**CSEN2103.5.** Learn about plotting and visualization using Matplotlib.

**CSEN2103.6.** Learn how to use SciPy for Equation Solving, Optimization, Interpolation, Integration and Ordinary Differential Equation

**CSEN2103.7.** Learn how to apply Python in building solutions to basic data analysis problems

### Module I [8L]

**Introduction to Python:** History of Python. Setting up the development environment. Variables, Expressions, Statements. Functions, Conditionals, Recursion, Iteration.

**Data Organization:** Files and Exceptions. Classes, objects, inheritances, Object Oriented Programming in Python.

### Module II [9L]

**Manipulating Strings:** Regular Expressions in Python.

**Python Data Structures:** Lists, Tuples, Dictionaries, Sets.

**Effective Python:** Pythonic Thinking and Writing Better Pythonic Code.

### Module III [9L]

**Processing with NumPy:** The Basics of NumPy Arrays. Array Indexing: Accessing Single Elements.

Array Slicing: Accessing Subarrays. Reshaping of Arrays. Array Concatenation and Splitting.

Computation on NumPy Arrays: Universal Functions. The Slowness of Loops. Aggregations: Min, Max, Summing the Values in an Array. Computation on Arrays: Broadcasting. Rules of

Broadcasting. Comparisons, Masks, and Boolean Logic. Working with Boolean Arrays. Boolean Arrays as Masks. Fancy Indexing.

**Data Manipulation with pandas:** Introduction to pandas data structures. Series, Data frames, Index objects. Re-indexing, Selection, Filtering, Axis Indices, Summarizing, Handling missing data, Hierarchical Indexing.

#### Module IV [10L]

##### GUI Programming Using Tkinter

Getting Started with Tkinter, Processing Events, The Widget Classes, Canvas widget for displaying shapes, Geometry Managers, Displaying Images, Menus, Popup Menus, Mouse, Key Events, and Bindings, Animations, Scrollbars, Standard Dialog Boxes.

##### Symbolic Computing using SymPy

##### Plotting and Visualization using Matplotlib

**Using SciPy:** Equation Solving, optimization, interpolation, integration, Ordinary differential equation

### 3. Textbooks

1. Introduction to Programming Using Python, Y. Daniel Liang. Pearson, 2017.
2. Introduction to Python for Engineers and Scientists, Sandeep Nagar, Apress, 2018
3. Python for Data Analysis, Wes McKinney, O'Reilly, 2017.
4. Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy and Matplotlib Book by Robert Johansson, Apress, 2019

### 4. Reference Books

1. Python for Everybody, Charles Severance, 2016.
2. Effective Python, Brett Slatkin, Pearson, 2015.
3. Learn Python The Hard Way, Zed A. Shaw, Addison-Wesley, Third Edition

<b>Course Name: Digital Logic</b>					
<b>Course Code: ECEN2104</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>

### 1. Course Outcomes

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

**ECEN2104.1:** Students will learn Binary Number system, and logic design using combinational gates.

**ECEN2104.2:** Students will design applications of Sequential Circuits.

**ECEN2104.3:** Students will design Finite State Machines.

**ECEN2104.4:** Students will learn Memory classifications.

**ECEN2104.5:** Students will learn basics of CMOS logic.

**ECEN2104.6:** Students will be prepared to learn various digital component design as used in VLSI applications.

#### Module I [10L]

**Binary System, Boolean Algebra and Logic Gates:** Data and number systems; Binary, Octal and Hexadecimal representation and their conversions, BCD, Gray codes, excess 3 codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic. Boolean algebra, De-Morgan's theorem, Various Logic gates- their truth tables and circuits, universal logic gates, Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, Karnaugh-map method, Quine-McCluskey method.

### **Module II [10L]**

**Arithmetic Circuits:** Adder circuit – Ripple Carry Adder, CLA Adder, CSA, and BCD adder, subtractor circuit.

**Combinational Circuit:** Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and parity Generator. Shannon's Expansion Theorem, Realization of logic functions using Mux, Parity Generators.

### **Module III [10L]**

**Sequential Logic:** Basic memory elements, S-R, J-K, D and T Flip Flops, Sequential circuits design methodology: State table and state diagram, State Reduction Method, Circuit Excitation and Output tables, Derivation of Boolean functions; Finite State Machine Design using Sequential circuit design methodology, various types of Registers (with Parallel load, shift Registers) and Counters (asynchronous ripple counters, synchronous counters: binary, BCD, Johnson).

### **Module IV [6L]**

**Memory Systems:** Concepts and basic designs of RAM (SRAM & DRAM), ROM, EPROM, EEPROM, Programmable logic devices and gate arrays (PLAs and PLDs)

**Logic families:** NMOS and CMOS, their operation and specifications. Realization of basic gates using above logic families, Open collector & Tristate gates, wired-AND and bus operations.

## **2. Textbooks**

1. Digital Logic and Computer Design, Morris M. Mano, PHI.
2. Digital Principles & Applications, 5th Edition, Leach & Malvino, Mc Graw Hill Company.
3. Modern Digital Electronics, 2nd Edition, R.P. Jain. Tata Mc Graw Hill Company Limited.
4. Digital Logic Design, Fourth Edition - Brian Holdsworth & Clive Woods.
5. Digital Integrated Electronics, H.Taub&D.Shilling, Mc Graw Hill Company Limited.

## **3. Reference Books**

1. Digital Design: Principles and Practices: John F. Wakerly.
2. Fundamental of Digital Circuits, A. Anand Kumar, PHI.

<b>Course Name: Human Values and Professional Ethics</b>					
<b>Course Code:HMTS2001</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>

### 1. Course Outcomes

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

**HMTS2001.1:** Be aware of the value system and the importance of following such values at workplace.

**HMTS2001.2:** Learn to apply ethical theories in the decision-making process.

**HMTS2001.3:** Follow the ethical code of conduct as formulated by institutions and organizations.

**HMTS2001.4:** Implement the principles governing work ethics.

**HMTS2001.5:** Develop strategies to implement the principles of sustainable model of development.

**HMTS2001.6:** Implement ecological ethics wherever relevant and also develop eco-friendly technology.

### Module I [10L]

**Human society and the Value System:** Values: Definition, Importance and application, Formation of Values: The process of Socialization, Self and the integrated personality, Morality, courage, integrity.

**Types of Values:** Social Values: Justice, Rule of Law, Democracy, Indian Constitution, Secularism; Aesthetic Values: Perception and appreciation of beauty; Organizational Values: Employee: Employer---rights, relationships, obligations; Psychological Values: Integrated personality and mental health; Spiritual Values and their role in our everyday life; Value Spectrum for a Good Life, meaning of Good Life.

**Value Crisis in Contemporary Society:** Value crisis at: Individual Level, Societal Level, Cultural Level; Value Crisis management: Strategies and Case Studies.

### Module II [10L]

Ethics and Ethical Values, Principles and theories of ethics, Consequential and non-consequential ethics, Egotism, Utilitarianism, Kant's theory and other non-consequential perspectives, Ethics of care, justice and fairness, rights and duties.

**Ethics:** Standardization, Codification, Acceptance, Application.

**Types of Ethics:** Ethics of rights and Duties, Ethics of Responsibility, Ethics and Moral judgment, Ethics of care

Ethics of justice and fairness, Work ethics and quality of life at work.

**Professional Ethics:** Ethics in Engineering Profession; moral issues and dilemmas, moral autonomy (types of inquiry), Kohlberg's theory, Gilligan's theory (consensus and controversy), Code of Professional Ethics Sample Code of ethics like ASME, ASCE. IEEE, Institute of Engineers, Indian Institute of materials management, Institute of Electronics and telecommunication engineers, Violation of Code of Ethics---conflict, causes and consequences

Engineering as social experimentation, engineers as responsible experimenters (computer ethics, weapons development), Engineers as managers, consulting engineers, engineers as experts, witnesses and advisors, moral leadership, Conflict between business demands and professional ideals, social and ethical responsibilities of technologies.

**Whistle Blowing:** Facts, contexts, justifications and case studies

**Ethics and Industrial Law:** Institutionalizing Ethics: Relevance, Application, Digression and Consequences.

### Module III [10L]

**Science, Technology and Engineering:** Science, Technology and Engineering as knowledge and profession: Definition, Nature, Social Function and Practical application of science; Rapid Industrial Growth and its Consequences; Renewable and Non-renewable Resources: Definition and varieties;

Energy Crisis; Industry and Industrialization; Man and Machine interaction; Impact of assembly line and automation; Technology assessment and Impact analysis; Industrial hazards and safety; Safety regulations and safety engineering; Safety responsibilities and rights; Safety and risk, risk benefit analysis and reducing risk; Technology Transfer: Definition and Types; The Indian Context.

#### Module IV [6L]

**Environment and Eco- friendly Technology:** Human Development and Environment, Ecological Ethics/Environment ethics

Depletion of Natural Resources: Environmental degradation, Pollution and Pollution Control, Eco-friendly Technology: Implementation, impact and assessment, Sustainable Development: Definition and Concept, Strategies for sustainable development, Sustainable Development: The Modern Trends, Appropriate technology movement by Schumacher and later development, Reports of Club of Rome.

#### 2. Reference Books

1. Human Values, Tripathi,A.N., New Age International, New Delhi,2006.
2. Classical Sociological Theory, Ritzer, G., The McGraw Hill Companies, New York,1996.
3. Postmodern Perspectives on Indian Society, Doshi,S.L., Rawat Publications, New Delhi,2008.
4. Sustainable Development, Bhatnagar, D.K., Cyber Tech Publications, New Delhi, 2008.
5. The age of Spiritual Machines, Kurzwell,R., Penguin Books, New Delhi,1999.
6. Social Problems in Modern Urban Society, Weinberg, S.K., Prentice Hall,Inc.,USA, 1970.
7. Sociology, Giddens, Anthony 2009, London: Polity Press (reprint 13th Edition).

<b>Course Name: Data Structure &amp; Algorithms Lab</b>					
<b>Course Code:CSEN2151</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>1.5</b>

#### 1. Course Outcomes

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

**CSEN2151.1:** To understand linear and non-linear data structures.

**CSEN2151.2:** To understand different types of sorting and searching techniques.

**CSEN2151.3:** To know how to create an application specific data structure.

**CSEN2151.4:** To solve the faults / errors that may appear due to wrong choice of data structure.

**CSEN2151.5:** To analyse reliability of different data structures in solving different problems.

**CSEN2151.6:** To evaluate efficiency in terms of time and space complexity, when different data structures are used to solve same problem.

#### Day 1: Time and Space Complexity Lab Assignment

Create three different 10; 000 10; 000 matrices matrixOne, matrixTwo and result-Matrix, using dynamic memory allocation. Initialize matrixOne and matrixTwo by using rand() or srand() function, limit the values from 0 to 9. Multiply matrixOne and matrixTwo into resultMatrix.

While execution, open another terminal and use top command to see the usage of memory by the process. Calculate the time taken for the execution of the program.

Repeat the same exercise for 100,000 x 100,000 matrices.

### Home Assignment

Write a program (WAP) to check whether a matrix is i) identity, ii) diagonal. WAP to reverse the elements of an array without using any other variable.

## Day 2: Array

### Lab Assignment

WAP to add two polynomials using array. Minimize the memory usage as much as you can.

WAP to convert a matrix into its sparse representation (triple format). Once represented in sparse format, do not revert back to the matrix format any-more. Manipulate the sparse representation to find the transpose of the matrix (which should also be in sparse representation).

Calculate and find out whether using triple format for your example is advantageous or not.

### Home Assignment

WAP to multiply two polynomials. Minimize usage of memory.

WAP to add two matrices using sparse representation. Manipulation of data should be done in sparse format.

## Day 3: Singly Linked List

### Lab Assignment

Write a menu driven program to implement a singly linked list with the operations:

- i) create the list (front, end or intermediate)
- ii) insert any element in any given position
- iii) delete an element from any given position (front, end or intermediate)
- iv) display the list

### Home Assignment

Write a menu driven program to implement a singly linked list with the operations:

- i) count the number of nodes
- ii) reverse the list

## Day 4: Circular and Doubly Linked List

### Lab Assignment

Write a menu driven program to implement a circular linked list with the operations:

- i) create the list (front, end or intermediate)
- ii) insert any element in any given position
- iii) delete an element from any given position (front, end or intermediate)
- iv) display the list

### Home Assignment

Write a menu driven program to implement a doubly linked list with the operations:

- i) create the list (front, end or intermediate)
- ii) insert any element in any given position
- iii) delete an element from any given position (front, end or intermediate)
- iv) display the list

## Day 5: Stack, Queue - with array

### Lab Assignment

Write a menu driven program to implement stack, using array, with

- i) push,
- ii) pop,
- iii) display,
- iv) exit operations.

WAP to evaluate a postfix expression.

Write a menu driven program to implement a queue, using array, with



- i) insert,                    ii) delete,            iii) display,            iv) exit operations

### Home Assignment

WAP to convert an infix expression to its corresponding postfix operation.

Write a menu driven program to implement a double-ended queue, using array, with the following operations:

- i) insert (from front, from rear)                    ii) delete (from front, from rear)  
 iii) display                    iv) exit operations

### Day 6: Stack, Queue - with linked list

#### Lab Assignment

Write a menu driven program to implement a stack, using linked list, with

- i) push,                    ii) pop,            iii) exit operations

#### Home Assignment

Write a menu driven program to implement a queue, using linked list, with

- i) insert,                    ii) delete,            iii) exit operations

### Day 7: Circular Queue, Deque - with linked list

#### Lab Assignment

Write a menu driven program to implement a circular queue using linked list with

- i) insert,                    ii) delete,            iii) exit operations

#### Home Assignment

Write a menu driven program to implement a double-ended queue, using linked list, with the following operations:

- i) insert (from front, rear),                    ii) delete (from front, rear),            iii) exit operations

### Day 8: Binary Search Tree (BST)

#### Lab Assignment

Write a program, which creates a binary search tree (BST). Also write the functions to insert, delete (all possible cases) and search elements from a BST.

#### Home Assignment

Write three functions to traverse a given BST in the following orders:

- i) in-order,                    ii) pre-order,            iii) post-order.

Display the elements while traversing.

### Day 9: Searching

#### Lab Assignment

WAP to implement,

- i) Linear Search,                    ii) Binary Search (iterative)

NB: As a pre-processing step, use bubble-sort to sort the elements in the search space.

WAP to generate integers from 1 to n (input parameter) in random order and guarantees that no number appears twice in the list. While the number sequence is being generated, store it in a text file.

#### Home Assignment

WAP to implement binary search recursively.

### Day 10: Sorting

#### Lab Assignment

Write different functions for implementing,

- i) Bubble sort,    ii) Cocktail shaker sort,    iii) Quick Sort.

Plot a graph of n vs. time taken, for n= 100, 1000, 10,000 and 100,000 to compare the performances of the sorting methods mentioned above. Use the second assignment of Day 9 to generate the data, using the given n values.

**Home Assignment**

Write different functions for implementing,  
 i) Insertion sort,                      ii) Merge sort.

**Day 11: Graph Algorithms****Lab Assignment**

Read a graph (consider it to be undirected) from an edge-list and store it in an adjacency list. Use the adjacency list to run DFS algorithm on the graph and print the node labels. Detect and count the back-edges.

**Home Assignment**

WAP to implement BFS algorithm of a given graph (similarly as described for DFS, instead of back-edges count cross-edges).

**2. Textbooks**

1. Fundamentals of Data Structures of C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
2. Data Structures in C, Aaron M. Tenenbaum.
3. Data Structures, S. Lipschutz.
4. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

**3. Reference Books**

1. Data Structures and Program Design In C, 2/E, Robert L. Kruse, Bruce P. Leung.

<b>Course Name: Python Programming Lab</b>					
<b>Course Code: CSEN2153</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>1.5</b>

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

**CSEN2153.1:** Learn and understand how to write simple programs in Python, relating to arithmetic and logical problems.

**CSEN2153.2:** Learn and understand how to implement conditional branching, iteration (loops), recursion and function

**CSEN2153.3:** Learn and understand how to do input/output with files in Python and use exception handling

**CSEN2153.4:** Learn and understand how to manipulate strings, use regular expression, and also use Python data structures viz. Lists, Tuples, Dictionaries and Sets

**CSEN2153.5:** Learn and understand how to do processing with NumPy Arrays

**CSEN2153.6:** Learn and understand how to use Pandas data structures (Series, Data Frames) and other features of Pandas

**2. Detailed Syllabus:**

Topic 1:

- (a) Finding the distance between two points whose coordinates are given
- (b) Finding the impedance of a series R-L-C Circuit
- (c) Finding the roots of a quadratic equation
- (d) Finding the maximum and minimum out of a few numbers given
- (e) Finding the value of sine of a given angle from its series expansion
- (f) Finding the Time period of a pendulum, whose length varies from 100 to 120 cm in steps of 5 cm.

Topic 2:

Implement programs using functions:

- a. Largest number in a list
- b. Area of different shapes
- c. Circulate the values of n variables
- d. Distance between two points whose coordinates are given
- e. Roots of a quadratic equation
- f. Factorial
- g. Fibonacci series
- h. GCD

Topic 3:

Implement programs on File I/O and exception handling:

- a. Copying a file
  1. Take source file name and destination file name from the user
  2. Use exception handling to report error, if any
  3. Copy the source text file to the destination.
  4. Report completion status, number of characters copied etc. to the user
- b. Finding word count and longest word in a file
- c. Use exception handling in nested functions
- d. Write a program to show positive use of exception handling

Topic 4:

- (a) Write programs to use various in-built functions of Python on string manipulation (reverse, palindrome, character count, replacing characters)
- (b) Write programs to show the use of regular expression
- (c) Write programs using Python data structures viz. Lists, Tuples, Dictionaries and Sets

Topic 5:

Write programs using various features provided in the NumPy

Topic 6:

Write programs using Pandas data structures and various features provided in Pandas

**Text Books:**

1. Allen B. Downey, Think Python: How to think like a Computer Scientist, 2<sup>nd</sup> Edition, O'Reilly, 2016
2. Y. Daniel Liang, Introduction to Programming Using Python, Pearson, 2017

### Reference Books:

1. Karl Beecher, Computational Thinking: A Beginners Guide to Problem Solving and Programming, 1<sup>st</sup> Edition, BCS Learning and Development Limited, 2017

<b>Course Name: Digital Logic Lab</b>					
<b>Course Code:ECEN2154</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>

### Course Outcomes:

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

**ECEN2154.1** Use the concept of Boolean algebra to minimize logic expressions by the algebraic method, K-map method etc.

**ECEN2154.2** Construct different Combinational circuits like Adder, Subtractor, Multiplexer, De-Multiplexer, Decoder, Encoder, etc.

**ECEN2154.3** Design various types of Registers and Counters Circuits using Flip-Flops (Synchronous, Asynchronous, Irregular, Cascaded, Ring, Johnson).

**ECEN2154.4** Realize different logic circuits using ICs built with various logic families.

### Choose any ten experiments out of the twelve suggested next:

1. Realization of basic gates using Universal logic gates.
2. Four-bit parity generator and comparator circuits.
3. Code conversion circuits BCD to Excess-3 & vice-versa.
4. Construction of simple 3-to-8 Decoder circuit by 2-to-4 Decoders using logic gates.
5. Design a 4-to-1 Multiplexer using logic gates and use it as a Universal logic module.
6. Realization of SR (Set Reset), JK, and D flip-flops using Universal logic gates.
7. Construction of simple arithmetic logic circuits-Adder, Subtractor.
8. Realization of Asynchronous Up/Down Counter (Count up to 7) using logic gates.
9. Realization of Synchronous Up/Down Counter (Count up to 7) using logic gates.
10. Realization of Shift Registers using logic gates (Serial in Serial out and Parallel in Serial out).
11. Construction of Serial adder circuit using a D Flip-Flop and a Full adder.
12. Design a combinational circuit for BCD to Decimal conversion to drive 7-Segment display using logic gates.

2<sup>ND</sup> YEAR 4<sup>TH</sup> SEMESTER

<b>Course Name: Design &amp; Analysis of Algorithms</b>					
<b>Course Code:CSEN2201</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>

**1. Course Outcomes**

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

**CSEN2201.1** Remember time complexities of various existing algorithms in different situations.

**CSEN2201.2** Understand the basic principles of different paradigms of designing algorithms.

**CSEN2201.3** Apply mathematical principles to solve various problems.

**CSEN2201.4** Analyze the complexities of various algorithms.

**CSEN2201.5** Evaluate the performance of various algorithms in best case, worst case and average case.

**CSEN2201.6** Create/ Design a good algorithm for a new problem given to him/ her.

**Module I [10L]**

**Algorithm Analysis:** Time and space complexity. Asymptotic Notations and their significance. Asymptotic Analysis. Finding time complexity of well-known algorithms like-insertion sort, heapsort, Asymptotic solution to recurrences, Substitution Method, Recursion Tree, Master Theorem.

**Divide-and-Conquer Method:** Basic Principle, Binary Search – Worst-case and Average Case Analysis, Merge Sort – Time Complexity Analysis, quicksort – Worst-case and Average Case Analysis, Concept of Randomized Quicksort.

**Medians and Order Statistics**

**Lower Bound Theory:** Bounds on sorting and searching techniques.

**Module II [16L]**

**Greedy Method:** Elements of the greedy strategy. Fractional Knapsack Problem, Huffman codes.

**Dynamic Programming:** Basic method, use, Examples: 0-1 Knapsack Problem, Matrix-chain multiplication, LCS Problem.

**Graph Algorithms:** Minimum cost spanning trees: Prim's and Kruskal's algorithms and their correctness proofs (Greedy Method). Shortest Path Algorithm: Dijkstra's with correctness proof. (Greedy method), Bellman Ford with correctness proof, All pair shortest path (Floyd-Warshall Algorithm) (Dynamic Programming).

**Module III [10L]**

**Amortized Analysis:** Aggregate, Accounting and Potential methods.

**String matching algorithms:** Different techniques – Naive algorithm, string matching using finite automata, and Knuth , Morris , Pratt ( KMP ) algorithm with their complexities

**Randomized Algorithm:** Skip List.

**Module IV [10L]**

**Disjoint Set Manipulation:** UNION-FIND with union by rank, Path compression.

**Network Flow:** Ford Fulkerson algorithm, Max - Flow Min - Cut theorem (Statement and Illustration)

**NP-completeness:** P class, NP-hard class, NP-complete class. Relative hardness of problems and polynomial time reductions. Satisfiability problem, Vertex Cover Problem, Independent Sets, Clique Decision Problem.

**Approximation algorithms:** Necessity of approximation scheme, performance guarantee. Approximation algorithms for 0/1 knapsack, vertex cover, TSP. Polynomial time approximation schemes: 0/1 knapsack problem.

**2. Textbooks**

1. Introduction to Algorithms by Cormen, Leiserson, Rivest and Stein. Third Edition, 2009. Prentice Hall.
2. Algorithm Design by Jon Kleinberg and Eva Tardos. Addison Wesley, 2005.

**3. Reference Books**

1. Computer Algorithms: Introduction to Design and Analysis by Sarah Basee and Allen van Gelder. 3rd Edition, Addison Wesley.

<b>Course Name: Computer Organization and Architecture</b>					
<b>Course Code:CSEN2202</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>

**1. Course Outcomes**

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

- CSEN2202.1** Understand the basic organization of computer and different instruction formats and addressing modes.
- CSEN2202.2** Analyze the concept of pipelining, segment registers and pin diagram of CPU.
- CSEN2202.3** Understand and analyze various issues related to memory hierarchy.
- CSEN2202.4** Understand various modes of data transfer between CPU and I/O devices.
- CSEN2202.5** Examine various inter connection structures of multi-processor.
- CSEN2202.6** Design architecture with all the required properties to solve state-of-the-art problems.

**Module I [10L]**

**Basics of Computer Organization:** Basic organization of the stored program computer and operation sequence for execution of a program, Von Neumann & Harvard Architecture. RISC vs. CISC based architecture.

Fetch, decode and execute cycle, Concept of registers and storage, Instruction format, Instruction sets and addressing modes.

Basics of Control Unit Design - hardwired and micro programmed control, Horizontal and Vertical micro instruction.

**Module II [11L]**

**Memory and I/O Organization:** Memory system overview, Cache memory organizations, Techniques for reducing cache misses, Hierarchical memory technology: Inclusion, Coherence and locality properties, Virtual Memory, Memory mapped IO.

Introduction to I/O interfaces. Interrupts, Interrupt hardware, Enabling and Disabling interrupts, Concept of handshaking, Polled I/O, Priorities, Daisy Chaining. Vectored interrupts; Direct memory access, DMA control.

**Module III [10L]**

**Pipelined Architecture:** Brief Introduction, Performance Measures - speed up, Efficiency, performance - cost ratio etc.

Static pipelines - reservation tables, scheduling of static pipelines, definitions - minimum average latency, minimum achievable latency, greedy strategy etc. Theoretical results on latency bounds without proof.

**Vector Processing:** Vector registers; Vector Functional Units; Vector Load / Store; Vectorization; Vector operations: gather / scatter; Masking; Vector chaining.

## **Module IV [9L]**

**SIMD Architectures:** Brief introduction, various concepts illustrated by studying detailed SIMD algorithms, viz., Matrix multiplication, Sorting on Linear array.

**Interconnection Networks:** Detailed study of Interconnection Network - Boolean cube, Mesh, Shuffle-exchange, Banyan, Omega, Butterfly, Generalized Hypercube, Delta etc.

### **Textbooks**

1. Computer Organization, 5th Edition, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, MGH.
2. Computer System Architecture, 3rd Edition, Morris M. Mano, Pearson.
3. Computer Organization and Design: The Hardware/Software interface, David A. Patterson and John L. Hennessy, 3rd Edition, Elsevier, 2005.
4. Advanced Computer Architecture and Parallel processing, Hwang & Briggs, MH.
5. Advanced Computer Architecture: Parallelism, Scalability, Programmability, Kai Hwang, McGraw-Hill.

### **Reference Books**

1. Onur Mutlu's lecture materials on Computer Architecture from CMU web site: <https://users.ece.cmu.edu/~omutlu/>.
2. NPTEL materials on Computer Organization.

<b>Course Name: Operating Systems</b>					
<b>Course Code: CSEN2203</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>

### Course Outcomes

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

**CSEN2203.1** Develop knowledge about the importance of computer system resources and the role of operating system in their management policies and algorithms.

**CSEN2203.2** Understand processes and its management policies and scheduling of processes by CPU.

**CSEN2203.3** Acquire an understanding of the need of process synchronization, evaluate the requirement for process synchronization and coordination handled by operating system.

**CSEN2203.4** Analyse the memory management and its allocation policies and compare different memory management approaches.

**CSEN2203.5** Use system calls for managing processes, memory, file system etc.

**CSEN2203.6** Be familiar with different storage management policies and storage technologies.

### Detailed Syllabus

#### Module I [7L]

**Introduction:** Operating system functions, OS Architecture (Monolithic, Microkernel, Layered, Hybrid), Different types of O.S. (batch, multi-programmed, time-sharing, real-time, distributed, parallel).

**System Structure:** Computer system operation, Operating system structure (simple, layered, virtual machine), O/S services, System calls.

**Protection & Security:** Goals of protection, Domain of protection, Access matrix and its representation, Threats and system security.

#### Module II [13L]

**Processes and Threads:** 7 state process model, Process scheduling, Operations on processes, Inter-process communication, Threads overview, Benefits of threads, User and kernel threads.

**CPU Scheduling:** Scheduling criteria, Preemptive & non-preemptive scheduling, Scheduling algorithms (FCFS, SJF, RR, Priority, Multi-level queue, Multi-level feedback queue), Comparative study of the algorithms, Multi-processor scheduling.

**Process Synchronization:** Background, Critical section problem, Software solution – Peterson and Bakery algorithm, Synchronization hardware, Semaphores, Classical problems of synchronization.

**Deadlocks:** System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

#### Module III [9L]

**Primary Memory:** Background, Physical address, Logical address, Virtual address, Contiguous memory allocation (Fixed and Variable partition), Non-contiguous memory allocation techniques (Paging, Segmentation, Segmentation with Paging), Virtual memory, Demand Paging, Performance, Page replacement algorithms (FCFS, LRU, optimal), Thrashing.

**Secondary Storage:** Disk structure, Disk performance, Disk scheduling (FCFS, SSTF, SCAN, C-SCAN), Boot block, Bad blocks.

#### Module IV [7L]



**File Systems:** File concept, Access methods, Directory structure, File system structure, Allocation methods (Contiguous, Linked, Indexed), Free-space management (Bit vector, Linked list, Grouping), Directory Implementation (Linear list, Hash table), Efficiency and Performance.

**I/O Management:** PC Bus Structure, I/O connections, Data transfer techniques (Programmed, Interrupt driven , DMA), Bus arbitration (Daisy chain, Polling, Independent request), Blocking and non-blocking I/O, Kernel I/O subsystem (Scheduling, Buffering, Caching, Spooling and device reservation, Error handling).

### Textbooks

1. Operating System Concepts, 10E, Silberschatz A., Galvin P. B., Gagne G., Wiley Publications.
2. Operating Systems Internals and Design Principles, 9E, Stalling W., Pearson Education.

### Reference Books

1. Operating System: Concept & Design, Milenkovic M., McGraw Hill.
2. Operating System Design & Implementation, Tanenbaum A.S., Prentice Hall NJ.
3. Operating System Concepts, Silberschatz A., Peterson J. L., Wiley Publications.
4. Operating Systems A Concept Based Approach, Dhamdhare D.M., McGraw Hill.

<b>Paper Name: Principles of Cryptography</b>					
<b>Paper Code: CSEN2205</b>					
<b>Contact hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>

**After successfully completing this course the students will be able to:**

**CSEN2205.1:** Understand OSI security architecture and classic encryption techniques

**CSEN2205.2:** To Acquire fundamental knowledge on the concepts of finite fields and number theory

**CSEN2205.3:** To Understand various block cipher and stream cipher models

**CSEN2205.4:** Describe the Principles of public key cryptosystems, hash functions and digital signature

**CSEN2205.5:** To learn about various cryptographic techniques, which include private and public keys algorithms along with attacks types

### Module- I

**10L**

**Basics Of Algebra And Number Theory:** Integer Arithmetic, Modular Arithmetic, Algebraic structures, GF(2n) Fields, Matrices, Prime Numbers, Fermat's and Eulers's Theorem, Primality Testing, Factorization, Chinese Remainder Theorem, Linear and Quadratic Congruence, Discrete Logarithms.

### Module- II

**10L**

**Introduction to Security:-**Security Goals – Security services (Confidentiality, Integrity, Authentication, Non-repudiation, Access control) – Security Mechanisms (Encipherment, Data Integrity, Digital Signature, Authentication Exchange, Traffic Padding, Routing Control, Notarization, Access control)-Security Principles. **Introduction to Cryptography:-**Kerckhoff's Principle -Classification of Cryptosystems Cryptanalytic attacks- Cipher Properties (Confusion, Diffusion).

**Traditional Secret Key Ciphers:-**Substitution Ciphers (mono alphabetic ciphers, poly alphabetic ciphers)-Transposition Ciphers-Stream and Block Ciphers. **Modern Secret Key Ciphers:-** Substitution Box-Permutation Box Product CiphersData Encryption Standard (DES) (Fiestel and Non-Fiestel Ciphers,

Structure of DES, DES Attacks, 2-DES, 3-DES) - Advanced Encryption Standard (AES) (Structure, Analysis)-Cryptographic Hash Functions– Properties - Secure Hash Algorithm-Message Authentication Code (MAC).

**Module- III**

**10L**

**Public Key Cryptosystems (PKC):** - Types of PKC –Trapdoor - one way functions -RSA Cryptosystem (Integer Factorisation Trapdoor, Key Generation, Encryption, Decryption) - El Gamal Cryptosystem (Discrete Logarithm Trapdoor, Key Generation, Encryption, Decryption) - DiffieHellman Key Exchange Protocol, Man in the Middle attack on DiffieHellman Protocol.

**Module- IV**

**10L**

**Digital Signature:-**Signing – Verification - Digital signature forgery (Existential forgery, Selective forgery, Universal forgery) - RSA Digital Signature Scheme - ElGamal Signature Scheme - IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload- Intruders, Intrusion Detection, Distributed Denial of Service attacks

**Text Books:**

1. Behrouz A. Forouzan, Dedeep Mukhopadhyay “Cryptography & Network Security”, Second Edition, Tata McGraw Hill, New Delhi, 2010
2. Douglas R. Stinson, “Cryptography: Theory and Practice”, Third Edition, CRC Press.
3. William Stallings, “Cryptography and Network Security – Principles and Practices”, Pearson Education, Fourth Edition, 2006.
4. Atul Kahate, “Cryptography and Network Security”, 2nd Edition, Tata McGraw Hill, 2003

**Reference Books:**

1. Bernard Menezes, Network Security and Cryptography-Cengage Learning India, 2011
2. Bruce Schneier, “Applied Cryptography: Protocols, Algorithms, and Source Code in C”, Second Edition, John Wiley and Sons Inc, 2001.
3. Thomas Mowbray, “Cybersecurity : Managing Systems Conducting Testing, and Investigating Intrusions”, John Wiley, 2013
4. Wenbo Mao, “ Modern Cryptography- Theory & Practice”, Pearson Education, 2006.

<b>Course Name: Ethical Hacking</b>					
<b>Course Code:CSEN2206</b>					
	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>

<b>Contact Hours per week:</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>
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### Course Outcomes

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

**CSEN2206.1:** To master information security governance, and related legal and regulatory issues

**CSEN2206.2:** Learn various hacking methods and perform system security vulnerability testing.

**CSEN2206.3:** Perform system vulnerability exploit attacks.

**CSEN2206.4:** Learn various issues related to hacking.

### MODULE I – [9L]

Introduction Security mindset, Computer Security Concepts (CIA), Threats, Attacks, and Assets, Software Security: Vulnerabilities and protections, malware, program analysis.

Network Security: Network security issues, Sniffing, IP spoofing, Common threats, E-Mail security, IPSec, SSL, PGP, Intruders, Virus, Worms, Firewalls-need and features of firewall, Types of firewall, Intruder Detection Systems.

### MODULE II – [9L]

Hacking Windows BIOS Passwords, Windows Login Passwords, Changing Windows Visuals, Cleaning Your Tracks, Internet Explorer Users, Cookies, URL Address Bar, Netscape Communicator, Cookies, URL History, The Registry, Baby Sitter Programs

### MODULE III – [9L]

Advanced Windows Hacking Editing your Operating Systems by editing Explorer.exe, The Registry, The Registry Editor, Description of .reg file, Command Line Registry Arguments, Other System Files, Some Windows & DOS Tricks, Customize DOS, Clearing the CMOS without opening your PC, The Untold Windows Tips and Tricks Manual, Exiting Windows the Cool and Quick Way, Ban Shutdowns: A Trick to Play, Disabling Display of Drives in My Computer, Take Over the Screen Saver, Pop a Banner each time Windows Boots, Change the Default Locations, Secure your Desktop Icons and Settings.

### MODULE IV – [9L]

Getting Past the Password Passwords: An Introduction, Password Cracking, Cracking the Windows Login Password, The Glide Code, Windows Screen Saver Password, XOR, Internet Connection Password, Sam Attacks, Cracking Unix Password Files, HTTP Basic Authentication, BIOS Passwords, Cracking Other Passwords.

### Text Books:

1. William Stallings; Lawrie Brown “Computer Security: Principles and Practice”, 4TH Edition 2018 Pearson Education.
2. Patrick Engbreton: “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy”, 1st Edition, Syngress publication, 2011.
3. Ankit Fadia : “Unofficial Guide to Ethical Hacking”, 3rd Edition , McMillan India Ltd, 2006.

### Reference Books:

1. Buchmann J. A., Introduction to Cryptography, Springer Verlag (2001).

2. Stallings William, Cryptography and Network Security, Pearson Education (2006).

3. Simpson/backman/corley, “Hands On Ethical Hacking & Network Defense International”, 2nd Edition, Cengageint, 2011

<b>Course Name: Environmental Sciences (Mandatory)</b>					
<b>Course Code:EVSC2016</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>

### Course Outcomes:

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

**EVSC2016.1** Understand the natural environment and its relationships with human activities.

**EVSC2016.2** Characterize and analyze human impacts on the environment.

**EVSC2016.3** Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.

**EVSC2016.4** Educate engineers who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.

**EVSC2016.5** Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.

**EVSC2016.6** Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

### Module I [6L]

**Socio Environmental Impact:** Basic ideas of environment and its component

**Population growth:** exponential and logistic; resources; sustainable development.

**Concept of green chemistry:** green catalyst, green solvents

**Environmental disaster and social issue:** environmental impact assessment, environmental audit, environmental laws and protection act of India.

### Module II [6L]

**Air Pollution:** Structures of the atmosphere, global temperature models, Greenhouse effect, global warming; acid rain: causes, effects and control. Lapse rate and atmospheric stability; pollutants and contaminants; smog; depletion of ozone layer; standards and control measures of air pollution.

### Module II [6L]

**Water Pollution:** Hydrosphere; pollutants of water: origin and effects; oxygen demanding waste; thermal pollution; pesticides; salts. Biochemical effects of heavy metals; eutrophication: source, effect and control. Water quality parameters: DO, BOD, COD. Water treatment: surface water and wastewater.

### Module IV [6L]

**Land Pollution:** Land pollution: sources and control; solid waste: classification, recovery, recycling, treatment and disposal.

**Noise Pollution:** Noise: definition and classification; noise frequency, noise pressure, noise intensity, loudness of noise, noise threshold limit value; noise pollution effects and control.

### Textbooks

1. Basic Environmental Engineering and Elementary Biology, GourKrishna Das Mahapatra, Vikas Publishing House P. Ltd.
2. Environmental Chemistry, A. K. De, New Age International.
3. Environmental Chemistry with Green Chemistry, A. K. Das, Books and Allied P. Ltd.

### Reference Books

1. Environmental Science, S. C. Santra, New Central Book Agency P. Ltd.
2. Fundamentals of Environment & Ecology, D. De, D. De, S. Chand & Company Ltd.

<b>Course Name: Design &amp; Analysis of AlgorithmsLab</b>					
<b>Course Code:CSEN2251</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>1.5</b>

### Course Outcomes

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

**CSEN2251.1** Understand and Apply different types of algorithm designing paradigms like divide and conquer, greedy, dynamic programming etc.

**CSEN2251.2** Realize and Apply underlying mathematical principles of algorithms in the corresponding implemented program.

**CSEN2251.3** Analyse and Evaluate the performance of various algorithms by observing the actual running time and main memory consumption of the corresponding implemented programs for best case, worst case and average case input data.

**CSEN2251.4** Create / Design a good algorithm for solving real life computing problems, by using various design techniques and data structures, learnt in this course.

### A tentative list (non-exhaustive) of the practical topics are given below:

1. **Divide and Conquer:** Implement Quick Sort and **randomized version** of quick sort using Divide and Conquer approach. Check the running time for each of the  $n!$  combinations or input sequences of a particular set of integers to observe the best, worst and average cases.
2. **Divide and Conquer:** Implement Merge Sort using Divide and Conquer approach. Check the running time for each of the  $n!$  combinations or input sequences of a particular set of integers to observe the best, worst and average cases.
3. Implement Heapsort algorithm. Check the running time for each of the  $n!$  combination or input sequences of a particular set of integers to observe the best, worst and average cases.
4. **Dynamic Programming:** Find the minimum number of scalar multiplications needed for chain of Matrices.

5. **Dynamic Programming:** Implement Bellman Ford Algorithm to solve Single Source shortest Path problem of a graph.
6. **Dynamic Programming:** Implement Floyd- Warshall Algorithm to solve all pair Shortest path for a graph.
7. **Dynamic Programming:** Solve 0/1 Knapsack problem using dynamic problem.
8. **Dynamic Programming:** Solve Longest Common Subsequence problem using dynamic problem.
9. **Greedy method:** Implement Dijkstra's algorithm to find Minimum Spanning Tree of a graph by using minimum priority Queue or minimum heap data structure.
10. **Greedy method:** Implement Prim's algorithm to find Minimum Spanning Tree of a graph by using minimum priority Queue or minimum heap data structure.
11. **Greedy method:** Implement Kruskal's algorithm to find Minimum Spanning Tree of a graph by implementing and using various operations of Disjoint-set forest data structure.
12. **Greedy method:** Implement Huffman coding using greedy approach.
13. **Realization of Amortized Analysis:** Implement a Queue using Stacks.
14. Implement KMP algorithm for string matching
15. Implement Ford-Fulkerson algorithm to get maximum flow in a given flow network.
16. **Randomized Algorithm:** Implement Skip-List).

### Textbooks

1. Introduction to Algorithms, Cormen, Leiserson, Rivest and Stein. Third Edition, 2009. Prentice Hall.
2. Algorithm Design, Jon Kleinberg and Eva Tardos. Addison Wesley, 2005.

### Reference Books

1. Computer Algorithms: Introduction to Design and Analysis, Sarah Basee and Allen van Gelder. 3rd Edition, Addison Wesley.

<b>Course Name: Computer Architecture Lab</b>					
<b>Course Code: CSEN2252</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>

### Course Outcomes:

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

- CSEN2252.1.** Students would be able to have adequate knowledge of basics of computer architecture.
- CSEN2252.2.** Students would be able to understand detailed implementation of machine instructions, their classifications and their relevance to programming paradigms.
- CSEN2252.3.** Students would have sufficient knowledge of design implementations of various arithmetic operations such as adder, multiplier etc.
- CSEN2252.4.** Students would be able to design and simulate various combinatorial and sequential logic circuits using Vivado/Xilinx.
- CSEN2252.5.** Students would be able to understand various memory functions.
- CSEN2252.6.** Students would be able to design a formal testbench from informal system requirements.

### Programming using VHDL

1. All Logic Gates (Data flow and Behavioral model)
2. Half adder and half subtractor (Data flow and Behavioral Model)
3. Combinatorial Designs (Data flow and Behavioral Model)
  - a. 2:1 Multiplexer
  - b. 4:1 Multiplexer
  - c. 3:8 Decoder
  - d. Comparator
4. Full adder and full subtractor (Data flow, Behavioral and Structural Model)
5. Sequential design of flip flops (SR, JK, D, T)
6. ALU design
7. Ripple carry adder (Structural Model)
8. Adder subtractor composite unit (Structural Model)
9. 4 bit synchronous and asynchronous counters.
10. Small projects like stepper motor.

**Text books:**

1. VHDL: Programming by Example, Douglas L. Perry, Fourth Edition, McGraw Hill.

**Reference Books:**

1. Introduction to Logic Circuits & Logic Design with VHDL, LaMeres, Brock J, Springer.

<b>Course Name: Operating Systems Lab</b>					
<b>Course Code: CSEN2253</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>1.5</b>

**Course Outcomes:**

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

**CSEN2253.1.** Understand and implement basic services and functionalities of the operating system using system calls.

**CSEN2253.2.** Will be able to describe and create user defined processes.

**CSEN2253.3.** Understand the benefits of thread over process and implement them.

**CSEN2253.4.** Synchronization programs using multithreading concepts.

**CSEN2253.5.** Use modern operating system calls and synchronization libraries in software to implement process synchronization.

**CSEN2253.6.** Implementation of Inter-process communication using PIPE.

1. **Shell programming:** Creating a script, making a script executable, shell syntax (variables, Conditions, control structures, functions and commands).
2. **Process:** starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.
3. **Signal:** signal handling, sending signals, signal interface, signal sets.
4. **Semaphore:** programming with semaphores (use functions semctl, semget, semop, set\_semvalue, del\_semvalue, semaphore\_p, semaphore\_v).

5. **POSIX Threads:** programming with pthreadfunctions(viz. pthread\_create, pthread\_join, pthread\_exit, pthread\_attr\_init, pthread\_cancel)
6. **Inter-process communication:** pipes (use functions pipe, popen, pclose), named pipes (FIFOs, accessing FIFO).

**Text books:**

7. Your Unix The Ultimate Guide, Sumitabha Das, MH

**Reference books:**

1. Beginning Linux Programming, Neil Matthew, Richard Stones, Wrox.



**3<sup>RD</sup> YEAR 5<sup>TH</sup> SEMESTER**

Paper Name: <b>Database Management Systems</b>					
Paper Code: <b>CSEN3101</b>					
Contact hours per week:	L	T	P	Total	Credit Points
	4	0	0	4	4

**Course Outcomes:**

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

**CSEN3101.1.** Identify the basic concepts and various data model used in database design. Be able to model an application's

data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model.

**CSEN3101.2.** Formulate relational algebra expression for queries and evaluate it using the concept of query processing and optimization.

**CSEN3101.3.** Create RDBMS schema mapping various business validations and formulate queries based on that schema using SQL to satisfy business requirements.

**CSEN3101.4.** Apply normalization and various types of dependencies for evaluating a relational database design.

**CSEN3101.5.** Apply and relate the concept of transaction, concurrency control and recovery in database.

**CSEN3101.6.** Understand with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

**Module I [10L]:**

**Introduction:** An overview of database management system, Database system Vs file system, ACID properties, Advantage of database, Data Independency, Integrity constraints, Evolution of DBMS, Different types of database, Database Languages, Three-schema architecture of a database, Different users of Database, Role of DBA.

**Relational Database Design using ER Model:** Data modeling concepts, Notations for ER diagram (entity, different types of attributes, relationship, cardinality and degree of relationship, weak entity), Concepts of Super Key candidate key and primary key, Mapping Constraints (Mapping Cardinality constraint, Participation Constraints, Key Constraints), Design Issues, Generalization, aggregation, Extended E-R features (Generalization & Specialization, Aggregation, Attribute Inheritance ), Examples of Drawing ER diagram, Convert ER diagrams into tables.

**Relational Data Model:** Concept of relations, Relational Algebra Operators: Selection, Projection, Union, Intersection, Set difference, Cross product, Rename, Assignment, Various types of joins, Division.

**Module II [10L]:**

**Introduction to SQL:** DDL ,DML, DCL, TCL, Data definition in SQL, Table, Primary key and foreign key definitions, DDL syntax and semantics – Create/Alter/Drop/Truncate, Implementing various constraints in DDL (Data Types, Null, Primary Key, Unique Key, Referential Integrity Constraints using foreign key, Complex business rules using trigger and assertions), Creating and using views, Creating Index.

**Data manipulation in SQL:** Insert, Edit, Delete and Basic select- from- where block and its semantics, Update behaviors, Complex Querying using inner and outer join, Nested queries - correlated and uncorrelated, Aggregate functions group by and having clauses, Unions, Intersection, Minus. Cursors, Trigger, Procedures and Functions in SQL/PL SQL, Using JSON functions in Oracle.

**Dependency theory:** (functional dependencies, Armstrong's axioms for FDs, Closure of a set of FDs, Minimal

covers: irreducible set of Functional Dependencies or Canonical Cover), Attribute Closure, Determine candidate Keys of a relation.

### **Module III [10L]:**

**Data Base Design & Normalization:** Different anomalies in designing a Database, Normalization and different Normal Forms, Definitions of 1NF, 2NF, 3NF and BCNF and using various normal form during design, Decompositions and desirable properties of them, Lossy and Loss-less join decompositions, Dependency preservation, Normalization using multi-valued dependencies and 4NF, Join dependency, Definition of 5NF.

### **Module IV [13L]:**

**Concurrency control and Recovery Management:** Transaction Fundamentals: OLTP environments, Concurrency issues, Need for transactions, Necessary properties of transactions (ACID properties), and Transaction states. Concurrency control schemes (Pessimistic scheme, Optimistic scheme, pros and cons), Scheduling Transactions for concurrent execution, Anomalies with Interleaved Execution, Various schedules (Serial, Conflict serializability, View serializability), Testing of conflict serializability. Recoverability and recoverability of Schedule (Irrecoverable schedule, Recoverable with cascading rollback), Lock-Based Concurrency Control, Lock Based Protocols, Two Phase Locking and how it works, Deadlock in DBMS, Wait-for graph, Detecting deadlocks using wait-for graphs, Schemes of Deadlock prevention (explain with example Wait-Die Scheme, Wound wait scheme). Transaction Support in SQL.

**File Organization & Index Structures:** File Organization: Fixed-Length and Variable-Length Records Organization of Records in Files (Sequential File Organization, Clustering File Organization. Index: Basic Concept, Various types (Ordered, Hash), Ordered Indexing Methods (Primary Index - Dense index, Sparse index), Multilevel and Secondary Indices, Using B-trees as dynamic multi-level indexes, Introduction to B+ tree index and various operation in B+ tree index. Creating Indexes using SQL - Function-Based Index, Bitmap Indexing.

**Query Processing and Optimization:** Different steps of processing a high-level query, Notation for Query Trees and Query Graphs, Translating SQL into relational algebra, Query Optimizer Concepts, Measures of Query Cost, Different Query Algorithms used (no details), Concepts of Materialization and Pipelining, Heuristic Optimization of Query Trees, Statistical Information for Cost Estimation, Steps used for Cost-Based Optimization.

### **Textbooks:**

1. Database System Concepts, Henry F. Korth and Silberschatz Abraham, Mc.Graw Hill.
2. Fundamentals of Database Systems, ElmasriRamez and Navathe Shamkant, Benjamin Cummings Publishing Company.
3. Database Management System, Ramakrishnan, McGraw-Hill.
4. Transaction Processing: Concepts and Techniques, Gray Jim and Reuter Address, Moragan Kauffman Publishers.

5. Advanced Database Management System, Jain, CyberTech.
6. Introduction to Database Management, Vol. I, II, III, Date C. J., Addison Wesley.
7. Principles of Database Systems, Ullman JD., Galgottia Publication.

### Reference Books:

1. Principles of Database Management Systems, James Martin, 1985, Prentice Hall of India, New Delhi.
2. Database Management Systems, Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill.

<b>Course Name: Object Oriented Programming</b>					
<b>Course Code:CSEN3003</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>4</b>

### Course Outcomes

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

**CSEN3003.1:** Understand the principles of object-oriented programming.

**CSEN3003.2:** Compare the relative merits of C++ and Java as object-oriented programming languages.

**CSEN3003.3:** Understand the importance of error management and incorporate exception-handling in object-oriented programs.

**CSEN3003.4:** Apply multithreading techniques to improve performance.

**CSEN3003.5:** Apply the features of C++ and Java supporting object-oriented programming to develop modular applications.

**CSEN3003.6:** Analyse problems and estimate when object-oriented programming is an appropriate methodology to design and develop object-oriented software using C++ and Java.

### Module I [10L]

**Overview of Object-Oriented Programming Concepts:** Difference between OOP and procedural programming – advantages & disadvantages. class, object, message passing, inheritance, encapsulation, polymorphism.

**OOP with C++:** Basic Programming Concepts: Data Types, Operators, Control Statements & Loops, Functions & Parameters Arrays, Pointers & References. Class & Object, Abstraction / Encapsulation, Access Specifier. Static Member, Friend Function. Constructor and Destructor.

### Module II [10L]

**OOP with C++:** Function and Operator Overloading. Inheritance and Derived Class: Abstract Class, Runtime Polymorphism, Virtual Base Class, Overriding. Exception Handling. Namespaces, Class Template and Function Template.

**Module III [10L]**

**OOP with Java:** Features of Java, Byte Code & JVM, Concepts of Java Application and Applet. Basic Programming Concepts: Data Types, Operators, Control Statements & Loops, Functions & Parameters, Array. String Handling Concepts & related Functions, Command Line Arguments. User Input through Scanner. Class & Object, Access Specifier, Static Members, Constructor, Garbage Collector, Nested & Inner Class: Function Overloading, Inheritance, Runtime Polymorphism, Abstract Class.

**Module IV [11L]**

**Package and Interface. Exception Handling:** Types of Exception Classes, Use of Try & Catch with Throw, User-defined Exceptions Classes. Threads, Communication and Synchronization of Threads: Multithreading, Thread Lifecycle, Thread Priorities, Inter-thread Communication. Applet Programming (using Swing): Applet Lifecycle, Application & Applet, Parameter Passing, Event Model & Listener, I/O.

**Textbooks**

1. The C++ Programming Language, Stroustrup, Addison Wesley.
2. Object Oriented Programming in C++, R. Lafore, SAMS.
3. Java 2.0 Complete Reference, H. Schildt, McGrawHill.

**Reference Books**

1. JAVA How to Program, Deitel and Deitel, Prentice Hall.
2. Programming with Java: A Primer, E. Balagurusamy, 3rd Ed. – TMH.

Paper Name: <b>Blockchain Technologies</b>					
Paper Code: <b>CSEN3108</b>					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

**Course Outcomes:**

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

**CSEN3108.1:** Understand emerging abstract models for blockchain technology

**CSEN3108.2:** Analyse the concept of bit coin and mathematical background behind it

**CSEN3108.3:** Apply the tools for understanding the background of crypto currencies

**CSEN3108.4:** Identify major research challenges and technical gaps existing between theory and practice in crypto currency domain

**CSEN3108.5:** Understand Ethereum blockchain and smart contract applications.

**CSEN3108.6:** Understand of latest advances and its applications in blockchain technology.

**Module I [9L] INTRODUCTION**

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

**Module II [9L] CRYPTOGRAPHIC FUNDAMENTALS**

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

**Module III [9L] BIT COIN**

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

**Module IV [9L] ETHEREUM**

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

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

**Text Books:**

1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, first edition – 2015.
2. Daniel Drescher, “Block Chain Basics”, Apress; 1st edition, 2017
3. Anshul Kaushik, “Block Chain and Crypto Currencies”, Khanna Publishing House, Delhi.
4. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing, first edition – 2012.

**Reference Books:**

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

Paper Name: <b>IoT Architecture and Protocols</b>					
Paper Code: <b>CSEN3109</b>					
Contact hours per week:	L	T	P	Total	Credit Points

	4	0	0	4	4
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### Course Outcomes:

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

**CSEN3109.1:** Understand the architectural overview of IoT.

**CSEN3109.2:** Identify business processes in IoT, and M2M and IoT technology fundamentals.

**CSEN3109.3:** Understand the IoT reference architecture with different types of views.

**CSEN3109.4:** Analyze real-world IoT design constraints with data representation and visualization.

**CSEN3109.5:** Identify the IoT data link and network layer protocols.

**CSEN3109.6:** Understand the IoT transport and session layer protocols, and the functionalities of application layer.

### Module I [10L]

IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management.

### Module II [11L]

IoT Architecture-State of the Art – Introduction, Reference Model and architecture, IoT reference Model - IoT Reference Architecture - Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints - hardware design, Data representation and visualization, Interaction and remote control.

### Module III [12L]

IoT Data Link Layer and Network Layer Protocols, PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), WirelessHART, ZWave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP

### Module IV [12L]:

Transport and Session Layer Protocols - Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer HTTP, CoAP, XMPP, AMQP, MQTT.

Service Layer Protocols & Security Service Layer - oneM2M, ETSI M2M,OMA, BBF – Security in IoT Protocols – MAC 802.15.4 , 6LoWPAN, RPL, Application Layer.

### Text Books:

1. Internet Of Things (IoT) Technologies Applications Challenges And Solutions by BK Tripathy and J Anuradha, Taylor & Francis first Edition, 2017.
2. Internet of Things: Architectures, Protocols and Standards,by Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, First edition 2018.

### Reference Books:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press,2014.
2. Peter Waher, “Learning Internet of Things”, PACKT publishing, BIRMINGHAM –MUMBAI, First Edition – 2015.
3. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer first edition – 2011.

### Professional Elective-I

Paper Name: <b>Data Mining &amp; Knowledge Discovery</b>					
Paper Code: <b>CSEN3132</b>					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

#### Course Outcomes:

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

- CSEN3105.1.** Learn and understand basic knowledge of data mining and related models.
- CSEN3105.2.** Understand and describe data mining algorithms.
- CSEN3105.3.** Understand and apply Data mining algorithms.
- CSEN3105.4.** Suggest appropriate solutions to data mining problems.
- CSEN3105.5.** Analyze data mining algorithms and techniques.
- CSEN3105.6.** Perform experiments in Data mining and knowledge discovery using real-world data.

#### Module I [9L]

**Introduction and Rule-based Classification:** What is Data Mining? Why do we need data mining? Data Mining System- Architecture and Processes. Challenges in Data Mining, Pre-processing of data. Decision Tree: General approach for solving a classification problem, Decision Tree Induction, overfitting Pruning.

Rule-based Classification: How a rule-based classifier works, rule-ordering schemes, how to build a rule-based classifier, direct and indirect methods for rule extraction.

#### Module II [9L]

**Advanced Classification Techniques:** Bayes Classifier: Bayes theorem, Naïve Bayes classifier. Support Vector Machines (SVM): Maximum margin hyperplanes, Linear SVM: separable case, non-separable case, Non-linear SVM.

#### Module III [9L]

**Ensemble Methods, Association Rule Mining:** Ensemble Methods: Bagging, Boosting, Random Forests

Association Rule Mining: Introduction, Frequent item-set generation, (Apriori principle, candidate generation and pruning), Rule generation, Compact representation of frequent item sets, FP-growth algorithm, Sub-graph mining.

#### Module IV [9L]

**Cluster Analysis:** Introduction: Motivations, objectives and applications of clustering. Different types of clustering. Partitional Clustering: K-means, K-means++. Hierarchical Clustering: Agglomerative, Divisive, MIN, MAX, dendrogram representation.

Density-based Clustering: DBSCAN. Cluster evaluation, further reading – OPTICS, DENCLUE, CHAMELEON, BIRCH, CURE, ROCK.

#### 3. Textbooks:

1. Data Mining Concepts and Techniques, 3rd, Edition, J. Han and M. Kamber, Morgan Kaufmann Publishers, July 2011.

#### 4. Reference Books:

1. Introduction to Data Mining, P. N. Tan, M. Steinbach and V. Kumar, Pearson Publishers.
2. Pattern Recognition and Machine Learning, Third Edition, C. Bishop, Springer, 2006.
3. Neural Networks and Learning Machines, Third Edition, S. Haykin, PHI Learning, 2009.
4. Pattern Classification, Second Edition, R. Duda, P. Hart and D. Stock, Wiley-Interscience, 2000.

Paper Name: <b>Web Technologies</b>					
Paper Code: <b>CSEN3133</b>					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

#### Course Outcomes:

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

**CSEN3133.1.** Understand the basic tags of HTML, CSS, java script and DHTML.

**CSEN3133.2.** Connect a server-side program using servlet and JSP to a DBMS and perform insert, update and delete operations on DBMS table.

**CSEN3133.3.** Write a server-side program using servlet and JSP to store the data sent from client, process it and store it on database.

**CSEN3133.4.** Prepare a well formed / valid XML document, schema to store and transfer data.

**CSEN3133.5.** Understand various types of attacks and their characteristics.

**CSEN3133.6.** Get familiar with network security designs using available secure solutions (such as PGP, SSL, IPsec).

#### Module 1 [8L]:



**Introduction:** Commonly used protocols: HTTP, HTTPs, TELNET, Electronic Mail-POP3, SMTP etc., WWW-Evolution and its characteristics.

Basics of Web Technology: Static web page, Dynamic web page, Active web page.

HTML and CSS: Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue. Image Maps.

### Module 2 [10L]:

**Web page scripting, server and client side:** Java Script: Data types, variables, operators, conditional statements, array object, date object, string object.

Extensible Markup Language (XML): Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief.

Java Servlet: Servlet environment and role, HTML support, Servlet API, The servlet life cycle, Cookies and Sessions.

### Module 3 [10L]

**Advanced Java Server Side Programming:** JSP: JSP architecture, JSP servers, JSP tags, understanding the layout in JSP, Declaring variables, methods in JSP, inserting java expression in JSP, processing request from user and generating dynamic response for the user, using include and forward action, Creating ODBC data source name, introduction to JDBC, prepared statement and callable statement. J2EE: An overview of J2EE web services.

### Module 4 [8L]

**Network Security:** Threats: Malicious code-viruses, Trojan horses, worms; Active and Passive attacks: eavesdropping, spoofing, modification, denial of service attacks.

Network security techniques: Password and Authentication; VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL).

Firewall: Introduction, Packet filtering, Stateful, Application layer, Proxy.

### Textbooks

1. Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, ASP.NET, XML and Ajax, Dreamtech Press; first edition.
2. Web Technologies, Godbole and Kahate, Tata McGraw-Hill Education.
3. Web Technologies: A Computer Science Perspective, Jeffrey C. Jackson, Pearson,2011.

### Reference Books:

1. Introduction to Web Technology By Pankaj Sharma
2. Web Technology By Gopalan and Akilandeswari

Paper Name: <b>Introduction to Soft Computing</b>					
Paper Code: <b>CSEN3136</b>					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

### 1. Course Outcomes:

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

- CSEN3136.1. Learn about soft computing techniques and their applications.
- CSEN3136.2. Understand Local and Global optimal solutions for complex optimization problems.
- CSEN3136.3. Analyze various neural network architectures.
- CSEN3136.4. Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic.
- CSEN3136.5. Understand the genetic algorithm concepts for real life problems.
- CSEN3136.6. Identify and select a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution.

### 2. Detailed Syllabus

#### Module I [9L]:

**Introduction:** Introduction to Soft Computing, Different tools and Techniques, Usefulness and applications.

**Fuzzy sets and Fuzzy logic:** Introduction - Definition, Fuzzy sets versus crisp sets, Fuzzy Membership Functions, Fuzzification & De-Fuzzification, Fuzzy set theoretic operations, Fuzzy Arithmetic, Extension Principle, Fuzzy numbers, Linguistic variables, Fuzzy logic, Linguistic hedges, Fuzzy rules and fuzzy reasoning, Fuzzy inference systems, Introduction to Rough Set.

#### Module II [9L]:

**Artificial Neural Network:** Introduction, Supervised & Unsupervised Learning, basic models, Hebb's learning, Perceptron, Multilayer feed forward network, Back propagation algorithm, Competitive learning, Self-Organizing Feature Maps, Introduction to Convolution and Recurrent neural network,

#### Module III [9L]:

**Evolutionary Algorithms:** Introduction to Genetic Algorithm (GA), GA operators, different types of encoding, selection rules, elitist model, Schema theorem and convergence of Genetic Algorithm, Introduction to MOOA, Pareto optimal front, Multi-Objective Genetic Algorithm (MOGA). VEGA, NSGA, NSGA-II.

#### Module IV [9L]:

**Swarm Intelligence Techniques:** Introduction, Key Principles of Swarm, Overview of Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Artificial Bee Colony Optimization (ABC) techniques with Applications, Introduction to Granular Computing.

**Advance Neural Network Systems:** Genetic Algorithm for Neural Network Design and Learning, Basic idea of 3rd generation Neural networks, Spike Neural networks.

### 3. Textbooks:

1. Davis E. Goldberg, Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley

2. Cin- Teng- Lin , C. S. George Lee, Prentice Hall, Neural Fuzzy Systems: A neuro Fuzzy Synergism to intelligent Systems,
3. B.Yegnanarayana, Artificial Neural Networks, PHI
4. S. RajasekaranandG.A.VijaylakshmiPai.Neural Networks FuzzyLogic, and Genetic Algorithms, Prentice Hall of India

**4. Reference Books:**

1. TimothyJ.Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill
2. K.H.Lee. First Course on Fuzzy Theory and Applications, Springer-Verlag.

Paper Name: <b>Introduction to Information Retrieval</b>					
Paper Code: <b>CSEN3137</b>					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

**Course Outcomes:**

After completion of course, students would be able to:

- CSEN3137.1. Identify basic theories and analysis tools as they apply to information retrieval.
- CSEN3137.2. Develop understanding of problems and potentials of current IR systems.
- CSEN3137.3. Learn and appreciate different retrieval algorithms and systems.
- CSEN3137.4. Apply various indexing, matching, organizing, and evaluating methods to IR problem
- CSEN3137.5. Be aware of current experimental and theoretical IR research.
- CSEN3137.6. Analyze and design solutions for some practical problems.

**Module I: (9L)**

Information retrieval model, Information retrieval evaluation; Document Representation – Boolean Model, Posting Lists,

Inverted Indices, Skip Lists; Query languages and query operation – proximity search, Phrase Queries Meta- data search;

Tolerant Retrieval – B-Trees, Permuterm Index, Edit Distance – Different variations

**Module II: (9L)**

Indexing Construction and Searching – BSBI, SPIMI, Heap’s Law Zip’s Law; Scoring and ranking feature vectors, tf-idf

various schemes; Evaluation and computations of scores and ranked retrieval; Relevance feedback

### Module III: (9L)

Text and multimedia languages, Language Models – Query Likelihood Models; Text Classification and Naïve Bayes-Bernoulli model, feature selection; Vector Space Classification – kNN, Rocchio Classification

### Module IV: (9L)

Flat Clustering – K means, K medoids, Evaluation of clustering, Models for clustering; Hierarchical Clustering – Single

Link, Complete Link, Group Average and Centroid, Inversion Points, Divisive Clustering – Basics; Latent Semantic Analysis

– SVD, Low Rank Approximations;

Web Search Basics, Link Analysis – Page Rank, HITS.

### Text Books:

1. C. D. Manning, P. Raghavan and H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008 (available at <http://nlp.stanford.edu/IR-book/>).
2. Chakrabarti, S. (2002). Mining the web: Mining the Web: Discovering knowledge from hypertext data. Morgankaufman.  
B. Croft, D. Metzler, T. Strohman, Search Engines: Information Retrieval in Practice, AddisonWesley, 2009 (available at <http://ciir.cs.umass.edu/irbook/>).

### Reference Books:

1. R. Baeza-Yates, B. Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley, 2011 (2ndEdition).

<b>Course Name: Probability and Statistical Methods</b>					
<b>Course Code: MATH3132</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>

### Course Outcomes:

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

**MATH3132.1** Articulate the axioms (laws) of probability.

**MATH3132.2** Compare and contrast different interpretations of probability theory and take a stance on which might be preferred.

**MATH3132.3** Formulate predictive models to tackle situations where deterministic algorithms are intractable.

**MATH3132.4** Summarize data visually and numerically.

**MATH3132.5** Assess data-based models.

**MATH3132.6** Apply tools of formal inference.

### Module I [10L]

**Probability-I (Single variable probability distributions):** Review of basic probability: Axiomatic definition, Addition and Multiplication law, Conditional probability and Bayes' Theorem, Expectation and Variance of single variable discrete and continuous distributions, Normal approximation to Binomial and Poisson Distribution, Exponential and Multinomial distribution, Moment generating and characteristic functions, Limit theorems: Markov's inequality and Chebyshev's inequality with examples.

### Module II [10L]

**Probability-II (Joint Distribution and Markov Chains):** Joint distribution using joint probability mass/density function, Finding marginal pmf/pdf from joint distribution, Multiplicative property of joint pmf/pdf in case of independent random variables, Markov Chains: Introduction, Chapman-Kolmogorov equations, Classification of states, Some applications: Gambler's Ruin Problem.

### Module III [10L]

**Statistics-I:** Moments, Skewness and Kurtosis, Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Covariance, Correlation and Regression, Spearman's Rank Correlation coefficient, Curve fitting: Straight line and parabolas.

### Module IV [10L]

**Statistics-II:** Population and Samples, The sampling distribution of mean (standard deviation known), The sampling distribution of mean (standard deviation unknown), Point and Interval estimation, Tests of Hypotheses, Null Hypotheses and Tests of Hypotheses with examples.

### Textbooks

1. Probability and Statistics for Engineers, Richard A Johnson, Pearson Education.
2. Groundwork of Mathematical Probability and Statistics, Amritava Gupta, Academic Publishers.

### Reference Books

3. Introduction to Probability Models, S.M. Ross, Elsevier.
4. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand and Sons.
5. An Introduction to Probability theory and its applications Vol-I, W. Feller, John Wiley and Sons.

Paper Name: <b>Database Management System Lab</b>					
Paper Code: <b>CSEN3151</b>					
Contact hours per week:	L	T	P	Total	Credit Points
	0	0	3	3	1.5

### Course Outcomes:

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

**CSEN3151.1.** Learn to use Entity Relationship Diagram (ERD) model as a blueprint to develop the corresponding relational model in a RDBMS system like Oracle DBMS.

**CSEN3151.2.** Apply DDL component of Structured query language (SQL) to create a relational database from scratch through implementation of various constraints in Oracle RDBMS system.

**CSEN3151.3.** Apply DML component of Structured query language (SQL) for storing and modification of data in Oracle RDBMS system.

**CSEN3151.4.** Apply DQL component of Structured query language (SQL) to construct complex queries for efficient retrieval of data from existing database as per the user requirement specifications.

**CSEN3151.5.** Conceptualize and apply various P/L SQL concepts like cursor, trigger in creating database programs.

**CSEN3151.6.** Develop a fully-fledged database backend system using SQL and P/L SQL programming to establish overall integrity of the database system.

### **Creation of a database using a given ERD Model as blueprint:**

SQL Data Definition Language - Create (and Alter) table structure, Apply (and Alter) constraints on columns/tables viz., primary key, foreign key, unique, not null, check. Verify/ Review the table structure (along with applied constraints) using appropriate data dictionary tables like user\_constraints, user\_cons\_columns, etc. Create view, materialized view using one or more table.

SQL Data Manipulation Language - Insert into rows (once at a time/ and in bulk) from a table, Update existing rows of a table, Delete rows (a few or all rows) from a table.

### **Data Query Language (DQL):**

Basic select-from-where structure - Usage of Top, Distinct, Null keywords in query, Using String and Arithmetic Expressions, Exploring Where Clause with various Operators and logical combination of various conditions, Sorting data using Order By clause. Usage of IN, LIKE, ALL keywords.

Introduction to Joins -Natural Joins, equi-join, non-equi-join, Self-Join, Inner Join, Outer (left, right) Join.

Set operations- Unions, Intersect, minus set operations on table data using SQL.

Using single row functions in Queries - NVL function (to handle ambiguity of null data), upper, lower, to\_date, to\_char functions, etc.

Using group/multiple row functions in Queries like Count, Sum, Min, Max, Avg, etc, using Group By and Having Clause, using Group By with Rollup and Cube.

Sub-query - Working with various nested structure of Sub Queries - use in from or where clause with more than one level of nesting, correlated sub-query- Ranking table data using correlated sub-query.

### **P/L SQL:**

Stored Procedures and Functions- Basic programming constructs of PL / SQL like if, else, else-if, loop, while, for structure. Populate stored procedure variables with the data fetched from table using SQL command.

Working with Cursors - Creating Cursors, parameterized cursor, Locks on cursors, Exploring advantages of cursors.

Introduction to triggers - Constraints vs Triggers, Creating, Altering, Dropping triggers, use of for/ after/ instead of triggers, using trigger to validate/ rollback a Transaction, Automatically populate integer data based primary key columns (e.g., Id.) using trigger.

### Textbooks

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

### Reference Books

1. SQL, PL/SQL: The Programming Language of Oracle (With CD-ROM) (English) 4th Revised Edition, Ivan Bayross, BPB Publications.

<b>Course Name: Object Oriented Programming Lab</b>					
<b>Course Code:CSEN3053</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>0</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>1.5</b>

### Course Outcomes

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

**CSEN3053.1**Apply object-oriented principles or features in software design process to develop C++ and Java programs for real life applications.

**CSEN3053.2**Reduce the complexity of procedural language by employing operator overloading, inheritance and exception handling techniques for developing robust and reusable software.

**CSEN3053.3** Develop programs using stream classes for various I/O operations and design concurrent programs using threads to maximize the use of processing power.

**CSEN3053.4** Design applications for text processing using String class and develop user interactive applications using event handling.

**CSEN3053.5** Analyse the difference between two object-oriented programming languages C++ and Java.

**Assignments on C++:**

**Day 1**

1. Introduction to OOPs concepts, Difference between Structure and Class and Destructor
2. Use of Constructor

**Day 2**

1. Function overloading, Friend Function, Friend Class

**Day 3**

1. Operator Overloading without using friend function
2. Operator Overloading with using friend function

**Day 4**

1. Inheritance: Single, Multilevel, Multiple, Hybrid

**Day 5**

1. Virtual Base class, Virtual Function, Abstract Class

**Day 6**

1. Exception Handling
2. Templates and namespace

**Assignments on Java:**

**Day 7**

1. Understanding Java platform, compilation, and execution of a java program.
2. Implement class, object, constructor, methods, and other OOP features.

**Day 8**

1. Inheritance Basics, more uses of constructor, method overriding, use of final.

**Day 9**

1. Object class, practical use of abstract class.
2. Using Interface for achieving multiple inheritance, implementation of package.

**Day 10**

1. Exception handling fundamentals, java built-in exceptions, Use of Scanner class for console input, use of own Exception subclass.

**Day 11**

1. Java thread life cycle model and implementation approach, thread priority, implementation of synchronization.
2. I/O Basics, byte stream and character streams, reading and writing files.

**Day 12**

1. Applet life cycle implementation, text processing using Java predefined String, StringBuilder and StringBuffer classes.

**Day 13**

1. GUI basics and Window fundamentals, working with different Component, Container and Layout Managers.

**Day 14**

1. Event handling for interactive GUI application.

**Textbooks**

1. The C++ Programming Language, Stroustrup, Addison Wesley.
2. Object Oriented Programming in C++, R. Lafore, SAMS.
3. Java 2.0 Complete Reference, H. Schildt, McGrawHill.

**Reference Books**



1. JAVA How to Program, Deitel and Deitel, Prentice Hall.
2. Programming with Java: A Primer, E. Balagurusamy– 3rd Ed. – TMH.

<b>Course Name: IoT Lab</b>					
<b>Course Code: CSEN3159</b>					
<b>Contact Hours per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>

#### Course Outcomes:

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

**CSEN3159.1** Demonstrate the prototyping of IoT solutions using development platforms such as Arduino, or Raspberry Pi, integrating sensors and actuators to build functional IoT devices.

**CSEN3159.2** Apply the principles of data processing, including data collection, storage, transmission, and analysis for IoT applications.

**CSEN3159.3** Explore various wireless communication technologies used in IoT, such as Wi-Fi or Bluetooth, to configure appropriate communication modules for IoT.

**CSEN3159.4** Demonstrate the integration of IoT devices with cloud platforms for data storage, management, and analysis.

**CSEN3159.5** Develop simple IoT applications and prototypes, using frameworks/libraries such as MQTT.

**CSEN3159.6** Develop real-world applications and use cases of IoT-based applications.

1. Interface LED and Buzzer with Arduino/Raspberry Pi and write a program to ‘turn ON’ LED and Buzzer for 1 sec after every 2 seconds.
2. Interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to ‘turn ON’ LED when push button is pressed or at sensor detection.
3. Interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings. Interface OLED with Arduino/Raspberry Pi and write a program to print the temperature and humidity readings on it.
4. Interface motor using relay with Arduino/Raspberry Pi and write a program to ‘turn ON’ motor when push button is pressed.
5. Interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smart phone using Bluetooth.
6. Write a program on Arduino/Raspberry Pi to upload/receive temperature and humidity data to/from thingspeak cloud.
7. Install MySQL database on Raspberry Pi and perform basic SQL queries.
8. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
9. Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.
10. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
11. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
12. Design a cloud-based email notification system that generates a notification when the temperature falls under a threshold temperature.

13. Design a home automation prototype.
14. Design a velocity management system for vehicles.

### Textbooks:

1. Building Arduino Projects for the Internet of Things: Experiments with Real-World Applications, Adeel Javed, Apress.
2. Raspberry Pi IoT Projects: Prototyping Experiments for Makers, John C. Shovic, Ruth Suehle, O'Reilly Media.
3. Practical MQTT with Paho, Craig Van Slyke, Manning Publications.

### Reference Books:

1. Internet of Things (A Hands-on-Approach), Arshdeep Bahga, Vijay Madisetti, VPT.

## 3<sup>RD</sup> YEAR 6<sup>TH</sup> SEMESTER

Paper Name: <b>Smart Contracts and Applications</b>					
Paper Code: <b>CSEN3204</b>					
Contact hours per week:	L	T	P	Total	Credit Points
	4	0	0	4	4

### Course Outcomes

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

**CSEN3204.1** Understand Blockchain platform

**CSEN3204.2** Basics of smart contracts, decentralized apps, and decentralized anonymous organizations (DAOs)

**CSEN3204.3** To understand and Create new crypto-currency (token/coin)

**CSEN3204.4** Recognize different Smart Contracts" programming languages and their execution environments.

**CSEN3204.5** Identify the key features of different Smart Contracts" programming languages.

**CSEN3204.6** Implement Smart Contracts in Ethereum using Solidity.

**Module I [12L]**

Introduction to Ethereum, concepts of Smart Contracts, Dapps, And DAOs, What is Ethereum Virtual Machine (EVM), Ethereum Technology Overview, Architectural Overview, Ethereum Block chain Platform, Current and Potential Uses of Ethereum.

**Module II [12L]**

Introduction to Programming Smart Contracts, A Simple Smart Contract, Account Types, Gas, and Transactions, Accessing Contracts and Transactions, Mix, Dapps, Developer Tools, Ethereum Tests, Web3 Base Layer Services, Installing, Building, Testing, & Deploying Ethereum nodes.

**Module III [12L]**

Introduction to Solidity Programming, Layout of a Solidity Source File, Structure of a Contract, Types, Units and Globally Available Variables, Input Parameters and Output Parameters, Control Structures, Function Calls, Creating Contracts via new, Order of Evaluation of Expressions, Assignment, Scoping and Declarations, Error handling: Assert, Require, Revert and Exceptions.

Solidity Programming –Contracts, Creating Contracts, Visibility and Getters, Function Modifiers, Constant State Variables, Functions, Inheritance, Abstract Contracts, Interfaces, Libraries.

**Module IV [12L]**

Introduction to Decentralized Apps (Dapps), Decentralized Application Architecture, Connecting to the Block chain and Smart Contract, Decentralized Apps – Coding Details, Voting Contract and App, Blind Auction Contract and App, Coding Style Guide, Design Patterns, Coding Style Guide, Code Layout, Naming Conventions, Common Design Patterns, Withdrawal from Contracts, State Machine.

**Text Books:**

1. Andreas M. Antonopoulos, Dr.Gavin wood “Mastering Ethereum” O’Reilly Media Inc, 2019.

**Reference Books:**

1. Draft version of “S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, „Blockchain Technology: Cryptocurrency and Applications“, Oxford University Press, first edition -2019.

<b>Paper Name: Cyber Security and Digital Forensics</b>					
<b>Paper Code: CSEN3205</b>					
Contact hours per week:	L	T	P	Total	Credit Points
	4	0	0	4	4

**Course Outcomes**

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

CSEN3205.1: Understand the fundamental concepts of cybercrimes, IT laws, and ethical principles, including hacking, viruses, piracy, and legal frameworks related to cybersecurity.

CSEN3205.2: Apply forensic methodologies, including evidence collection, storage, transport, and analysis, while adhering to ethical practices and investigative processes.

CSEN3205.3: Analyze digital evidence using scientific forensic methods and tools, such as data recovery, media file analysis, and report preparation, while ensuring quality control.

CSEN3205.4: Differentiate techniques for hardware, network, and mobile forensics, including anti-forensic strategies, virtual systems, and digital watermarking protocols.

CSEN3205.5: Understand and apply modern forensic tools and reporting methods to interpret cyber threats in applications, email, social media, and cloud environments.

CSEN3205.6: Apply and analyze defensive strategies and countermeasures for cybersecurity by leveraging tactics used by governments, industries, and private organizations to combat information warfare and enhance cyber resilience.

## **2. Detailed Syllabus**

### **Module I [9L]**

Introduction to IT laws & Cyber Crimes – Internet, Hacking, Cracking, Viruses, Virus Attacks, Pornography, Software Piracy, Intellectual property, Legal System of Information Technology, Social Engineering, Mail Bombs, Bug Exploits, and Cyber Security.

Legal and Ethical Principles : Introduction to Forensics – The Investigative Process – Code of Ethics, Ethics of Investigations, Evidence Management – Collection, Transport, Storage, access control, disposition

### **Module II [9L]**

Forensic Science: Principles and Methods – Scientific approach to Forensics, Identification and Classification of Evidence, Location of Evidence, Recovering Data, Media File Forensic Steps, Forensic Analysis – Planning, Case Notes and Reports, Quality Control

### **Module III [10L]**

Digital Forensics: Hardware Forensics – Hidden File and Anti- forensics - Network Forensics – Virtual Systems - Mobile Forensics Digital Watermarking Protocols: A Buyer-Seller Watermarking Protocol, an Efficient and Anonymous Buyer-Seller Watermarking Protocol, Extensions of Watermarking Protocols, Protocols for Secure Computation

### **Module IV [9L]**

Application Forensics, Tools and Report Writing – Application Forensics, Email and Social Media Investigations, Cloud Forensics, Current Digital Forensic Tools, Report Writing for Investigations

Counter Measures: Defensive Strategies for Governments and Industry Groups, Tactics of the Military, Tactics of Private Companies, Information Warfare Arsenal of the future, and Surveillance Tools for Information Warfare of the Future.

### **Text Books:**

1. Bill Nelson, Christopher Steuart, Amelia Philips, “Computer Forensics and Investigations”, Delmar Cengage Learning; 5th edition January 2015
2. Chuck Eastom, “Certified Cyber Forensics Professional Certification:”, McGraw Hill, July 2017
3. Nilakshi Jain, Dhananjay Kalbande, “Digital Forensic : The fascinating world of Digital Evidences” Wiley India Pvt Ltd 2017.

4. John R.Vacca, “Computer Forensics: Computer Crime Scene Investigation”, Laxmi Publications, 2015.

### Reference Books:

1. MarjieT.Britz, “Computer Forensics and Cyber Crime”: An Introduction”, 3rd Edition, Prentice Hall, 2013.
2. Clint P Garrison “Digital Forensics for Network, Internet, and Cloud Computing A forensic evidence guide for moving targets and data , Syngress Publishing, Inc. 2010

Paper Name: <b>Economics for Engineers</b>					
Paper Code: <b>HMTS3201</b>					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

### Course Outcomes

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

**HMTS3201.1.** Evaluate a project and estimate the total cost of the project

**HMTS3201.2.** Apply financial analytical methodologies to prepare a report regarding the financial performance of an organization

**HMTS3201.3.** Participate actively in an organization’s capital budgeting process

**HMTS3201.4.** Provide vital inputs regarding the pricing of a product

**HMTS3201.5.** Apply the knowledge of the interplay of various economic variables and indicators in workplace

**HMTS3201.6.** Provide insight about different accounting concepts and apply broader concepts like costs, revenues, assets, liabilities, capital, profit, investment and interest.

### Module I [8L]

Market: Meaning of Market, Types of Market, Perfect Competition, Monopoly, Monopolistic and Oligopoly market. The basic concept of economics – needs, wants, utility. National Income-GDP, GNP. Demand & Supply, Law of demand, Role of demand and supply in price determination, Price Elasticity. Inflation: meaning, reasons, etc.

### Module II [8L]

Business: Types of business, Proprietorship, Partnership, Joint-stock company, and cooperative society – their characteristics. Banking: role of commercial banks; credit and its importance in industrial functioning. Role of central bank: Reserve Bank of India. International Business or Trade Environment.

### Module III [12L]

Financial Accounting-Journals. Ledgers, Trial Balance, Profit & Loss Account, Balance Sheet. Financial Statement Analysis (Ratio and Cash Flow analysis). Cost Accounting- Terminology, Fixed, Variable and Semi-variable costs. Break Even Analysis. Cost Sheet. Budgeting and Variance Analysis. Marginal Cost based decisions.

**Module IV [8L]**

Time Value of Money: Present and Future Value, Annuity, Perpetuity. Equity and Debt, Cost of Capital. Capital Budgeting: Methods of project appraisal - average rate of return – payback period - discounted cash flow method: net present value, benefit cost ratio, internal rate of return. Depreciation and its types, Replacement Analysis, Sensitivity Analysis.

**Reference Books**

1. Financial Accounting- A Managerial Perspective, R. Narayanswami, Prentice-Hall of India Private Limited. New Delhi
2. Fundamentals of Financial Management, Horne, James C Van, Prentice-Hall of India Private Limited, New Delhi
3. Modern Economic Theory, H. L. Ahuja., S. Chand. New Delhi.
4. Engineering Economic Analysis, Newman, Donald G., Eschenbach, Ted G., and Lavelle, Jerome P., New York: Oxford University Press. 2012.

**Professional Elective-II**

Paper Name: <b>Machine Learning</b>					
Paper Code: <b>CSEN3233</b>					
Contact hours per week:	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	3	0	0	3	3

**1. Course Outcomes**

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

**CSEN3233.1.** Learn and understand the basics of machine learning approaches and paradigm.

**CSEN3233.2.** Understand and describe various machine learning algorithms.

**CSEN3233.3.** Understand complexity of Machine Learning algorithms and their limitations.

**CSEN3233.4.** Mathematically analyze various machine learning approaches and paradigms

**CSEN3233.5.** Analyze various machine learning techniques to get an insight of when to apply a particular machine learning approach.

**CSEN3233.6.** Apply common Machine Learning algorithms in practice and implementing their own using real-world data.

### **Module I [9L]**

**The learning Problem:** Example of learning, Components of learning, A simple model, Types of learning;

**The Linear Model I:** Input Representation, Linear Classification, Linear and Logistic Regression, Nonlinear Transformation.

### **Module II [9L]**

**Error and Noise:** Training vs Testing: From Training to Testing, Dichotomies, Growth Function, key notion: Break Points;

**The VC Dimension:** The definition, VC Dimension of Perceptrons, Interpreting the VC Dimension, Utility of VC Dimension.

**Bias-Variance Tradeoff:** Bias and Variance, Learning Curves.

### **Module III [10L]**

**The linear Model II:** Logistic Regression, Nonlinear Transformation, Likelihood measure, Gradient Descent;

**Neural Networks:** Neural Network Model, Backpropagation algorithm; Introduction to Radial Basis Function, Recurrent Neural Network, Convolution Neural Network and Deep Neural Network.

### **Module IV [9L]**

**Support Vector Machines (SVM):** The Margin, Maximizing the Margin, The solution, Support Vectors, Nonlinear Transform; Kernel Methods: The Kernel methods, Soft-margin SVM; Overfitting: What is overfitting? Dealing with overfitting; Regularization: Regularization - informal, Regularization – formal, Weight decay, Choosing a regularizer.

### **Textbooks**

1. Learning from Data - A short Course, Y. S. Abu-Mostafa, M. Magdon-Ismael, H. T. Lin, AMLbook.com.
2. Computational Intelligence Principles, Techniques and Applications, Konar, Springer, 2012.
3. Machine Learning, First Edition, T. Mitchell, McGraw-Hill, 1997.

### **Reference Books**

1. Neural Networks and Learning Machines, Third Edition, S. Haykin, PHI Learning, 2009.
2. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 2010.
3. Deep Learning, Ian Goodfellow, YoshuaBengio, Aaron Courville, Francis Bach, MIT Press, 2017.

Paper Name: <b>Cloud Computing</b>					
Paper Code: <b>CSEN3235</b>					
Contact hours per week:	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	3	0	0	3	3

### Course Outcomes:

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

**CSEN3235.1.** Appreciate the benefits and limitations of cloud-based computing environments.

**CSEN3235.2.** Understand the underlying principles of cloud virtualization, cloud storage, cloud security.

**CSEN3235.3.** Analyze the suitability and/or applicability of various cloud computing models, platforms, services, solution offerings and tools from some industry leaders.

**CSEN3235.4.** Gain insight into various distributed computing issues (like performance, scalability, availability, reliability) in light of distributed file systems (such as HDFS, GFS).

**CSEN3235.5.** Identify security and privacy issues in cloud computing.

**CSEN3235.6.** Apply Knowledge to provide solution for real life problems.

### Module I [7L]:

**Basics of Cloud Computing:** Defining a Cloud, Cloud Types – NIST Cloud Reference Model, Cloud Cube Model, Deployment Models – Public, Private, Hybrid, and Community Clouds, Service Models – Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS), Characteristics of Cloud Computing, Benefits and Limitations of Cloud Computing.

### Module II [10L]:

**Cloud Services and/or Applications:** IaaS – Basic Concept and Characteristics, Virtual Machine Instances / Images, examples of IaaS solutions, PaaS – Basic Concept and Characteristics, Tools and Development Environment with examples, SaaS – Basic Concept and Characteristics, Open SaaS and SOA, examples of SaaS solutions, Identity as a Service (IDaaS).

### Module III [10L]:

**Cloud Solution Offerings:** Concepts of Abstraction and Virtualization; Virtualization: Taxonomy of Virtualization

Techniques; Hypervisors: Machine Reference Model for Virtualization. Solution Offerings from Industry Leaders; Amazon: some AWS Components and Services – Compute (EC2), Storage [Simple Storage Service (S3), Elastic Block Store (EBS), Simple Queue Service (SQS)], Database (Relational, NoSQL, SimpleDB), Content Distribution (CloudFront), Deployment (Elastic Beanstalk) Google: quick look at Google Applications Portfolio – AdWords, Analytics, overview of GWT, a few Google APIs, some key services of GAE.

### Module IV [9L]:



**Cloud Storage and Security:** Cloud-based Storage: Block Devices and File Devices, Managed Storage and Unmanaged Storage, File Systems – GFS and HDFS. Cloud Security: Security Concerns, Security Boundary, Security Service Boundary, Security Mapping Overview, Data Security – Storage Access, Storage Location, Tenancy, Encryption, Auditing, Compliance, Identity Management (awareness of Identity Protocol Standards).

### Textbooks:

1. Cloud Computing Bible, Barrie Sosinsky, Wiley India Pvt. Ltd, 2012.
2. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, McGraw Hill, 2013.
3. Cloud Computing: Theory and Practice, Dan Marinescu, Morgan Kaufmann, 2014.
4. Cloud Computing: A Hands-on Approach, A Bahga and V Madiseti, 2014.
5. Cloud Computing: A Practical Approach for Learning and Implementation, A Srinivasan and J Suresh, Pearson, 2014.
6. Cloud Computing, U S Pande and Kavita Choudhary, S Chand, 2014.
7. Cloud Computing for Dummies, J Hurwitz, M Kaufman, F Halper, R Bloor, John Wiley & Sons, 2014.
8. Cloud Computing, Kris Jamsa, Jones & Bartlett Learning, 2015.

### Reference Books:

1. The NIST Definition of Cloud Computing: Recommendations of the National Institute of Standards and Technology, Peter Mell and Timothy Grance, National Institute of Standards and Technology Special Publication 800-145, 2011.
2. Introduction to Cloud Computing Architecture: White Paper (1st Edition), Sun Microsystems Inc., 2009.
3. A Survey on Open-source Cloud Computing Solutions, Patrícia Takako Endo, GlaucoEstácio Gonçalves, Judith Kelner, Djamel Sadok, VIII Workshop on Clouds, Grids and Applications at UFPE, Brazil.
4. GFS: Evolution on Fast-Forward – Kirk McKusick (BSD/BFFs) interviews Sean Quinlan (former GFS Tech Leader), CACM, 2009-2010.
5. The Google File System (GFS), Sanjay Ghemawat, Howard Gobioff, Shun-Tak Leung, 2011.
6. The Hadoop Distributed File System: Architecture and Design, Dhruba Borthakur, Apache Software Foundation, 2007.

Paper Name: <b>Big Data and IOT</b>					
Paper Code: <b>CSEN3236</b>					
Contact hours per week:	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	3	0	0	3	3

### Course Outcomes:

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

**CSEN3236.1.** Develop understanding of the MapReduce paradigm.

**CSEN3236.2.** Solve Matrix-Vector problems using the MapReduce paradigm.

**CSEN3236.3.** Solve Relational Algebra operations using the MapReduce paradigm.

**CSEN3236.4.** Solve basic algorithmic problems in Graph Theory using the MapReduce paradigm.

**CSEN3236.5.** Solve problems in Text Processing using the MapReduce paradigm.

**CSEN3236.6.** Implement MapReduce solutions using the Hadoop framework.

### **Module I [9L]:**

**Introduction:** Big Data Analysis. The new software stack. Distributed file system. Physical organization of compute nodes. Large-scale file system organization; Introduction to the MapReduce paradigm. Map tasks. Grouping by keys. Reduce tasks. Combiners. Details of MapReduce execution. Coping with node failures; Basic MapReduce Algorithm Design Local Aggregation. Pairs and Stripes. Computing Relative Frequencies. Secondary Sorting.

### **Module II [9L]:**

**Matrix and Relational Algebra Operations Using MapReduce:** Matrix-Vector Multiplication by MapReduce. Case of large vectors. Matrix Multiplication using cascade of two MapReduce operations. Single pass matrix multiplication; Relational Algebra Operations. Computing Selections by MapReduce. Computing Projections by MapReduce. Union, Intersection, and Difference by MapReduce. Computing Natural Join by MapReduce. Grouping and Aggregation by MapReduce.

### **Module III [9L]:**

**Advanced Processing using MapReduce:** Graph Algorithms using MapReduce: Shortest Paths, Friends-of-Friends.

PageRank computation in MapReduce. Parallel Breadth First Search. Issues in Graph Processing; Text Processing

Using MapReduce. EM Algorithms. Hidden Markov Models. Viterbi, Forward and Backward Algorithms. HMM Training in

MapReduce. Word Alignment with MapReduce; Design Patterns using MapReduce. Summarization patterns, Filtering patterns, Data organization patterns, Join Patterns, Meta patterns, Input output patterns.

### **Module IV [9L]:**

**Big Data Solution Frameworks:** Starting Hadoop. Components of Hadoop. HDFS. Working with files in HDFS. MapReduce

using Hadoop. Streaming in Hadoop. Advanced MapReduce: Chaining MapReduce jobs, Joining data from different sources.

MapReduce programs in local mode and pseudo-distributed mode. Moving data into and out of Hadoop. Applying MapReduce

patterns to Big Data. Streamlining HDFS for Big Data. The Hadoop Ecosystem. Pig, Hive, HBase, Sqoop, Zookeeper, Flume, Oozie, Avro. Fast Big Data Processing with Apache Spark.

### **Textbooks:**

1. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeff Ullman. Cambridge University Press. 2011.

2. Hadoop – The Definitive Guide, Tom White. 4th Edition, 2015.
3. Data-Intensive Text Processing with MapReduce, Jimmy Lin and Chris Dyer. Morgan and Claypool Publishers. 2010.

### Reference Books:

1. Hadoop in Action, Chuck Lam. Manning Publishers. 2011.
2. Hadoop in Practice, Alex Holmes. Manning Publishers. 2012.
3. MapReduce Design Patterns, Donald Miner and Adam Shook. O’Reilly, 2012.

Paper Name: <b>Advanced Operation Research</b>					
Paper Code: <b>CSEN3237</b>					
Contact hours per week:	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	3	0	0	3	3

### Detailed Syllabus:

#### Advanced Linear Programming:

The Revised Simplex Algorithm, Complexity of the Simplex Algorithm, Bounded Variable Technique, Decomposition Principle, Karmarkar Interior Point Algorithm

#### Sensitivity Analysis:

Introduction, Change in the Cost Vector, Changes in the Right – Hand Side Vector, Change in the Constraint Matrix, Special Cases, Parametric Programming

#### Project Management:

Introduction, Critical Path Method, Critical Path Determination, Optimal Scheduling by CPM, Project Evaluation & Review Technique

#### Sequencing Problems:

Introduction, Problem of  $n$  – Jobs & 2 Machines, Problem of  $n$  – Jobs &  $m$  – Machines, 2 – Jobs on Ordered  $m$  – Machines

#### Integer Programming:

Introduction, Branch & Bound Algorithm, Traveling Salesman Problem, Cargo Loading Problem

#### Dynamical Programming:

Introduction, Formulation, Recursive Relations, Continuous Cases, Discrete Cases, Forward Recursions, Linear Programming vs Dynamic Programming

#### Non – Linear Programming:

Introduction, Lagrange Multipliers Method, Convex Non- Linear Programming Problem, Kuhn – Tucker Theory, Quadratic Programming, Separable Programming, Duality in Non – Linear Programming

#### Search Techniques:

Unimodal Function, Dichotomous Search Method, Fibonacci Search Method, Golden Section Method, Steepest Descent Method, Conjugate Gradient Method

#### Geometric Programming:

Introduction, Unconstrained Posynomial Optimization, Constrained Posynomial Optimization, Goal Programming:

Introduction, Standard Form of LGPP, Partitioning Algorithm, Grouping Algorithm

Random Number & Simulation:

(a) Random Number

Introduction, Random Number Generations – Methods, Generation of Pseudo Random Numbers

[ a) Mid - Square Method, b) Congruential Method ], Problems

(b) Simulation

Introduction, Advantages and Limitations of Simulations Techniques, Monte Carlo Simulation, Application

### Books:

1. H. A. Taha: Operation Research-An Introduction, Maxwell Macmillan.
2. Wayne L. Winston: Operation Research-Applications and Algorithms, Thomson.
3. Hiller Liberman: An Introduction to Operation Research, TMH
4. H. S. Kasana and K. D. Kumar: Introductory Operations Research [Theory and Application] Springer International Edition.
5. S. Bhaskar: Operations Research, Anuradha Agencies
6. K. Kannan: Operarions Research, Anuradha Agencies
7. V. K. Kapoor: Operarions Research, Anuradha Agencies
8. Kanti Swaroop: Operarions Research, Anuradha Agencies

Paper Name: <b>Fog and Edge Computing</b>					
Paper Code: <b>CSEN3240</b>					
Contact hours per week:	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	3	0	0	3	3

### Course Outcome:

**CSEN3240.1:** To become familiar with the concepts of Fog and Edge computing

**CSEN3240.2:** To understand the architecture and its components and working of components and its performance

**CSEN3240.3:** To explore Fog and Edge computing on security, multimedia and smart data

**CSEN3240.4:** To create a model in fog and edge computing scenario

**CSEN3240.5:** Get familiar on security & privacy issues related to area of fog & edge computing, IoT, and big data.

**CSEN3240.6:** Exploit fog and edge computing in implementing real time applications

### Module I :

**INTRODUCTION TO FOG AND EDGE COMPUTING** Fog and Edge Computing(FEC)-Definition-FEC Completing the Cloud - Advantages of FEC-Hierarchy of FEC-Business Models-Opportunities and Challenges- Addressing the Challenges in Federating Edge Resources – Introduction – The networking challenge- The management challenge

**Module II :**

**MIDDLEWARE** Introduction-Need for Fog and Edge Computing Middleware- Design Goals- State-of-the-Art Middleware Infrastructures-System Model-Proposed Architecture-Case Study Example-Future Research Directions. Lightweight Container Middleware for Edge Cloud Architectures-Introduction-Clusters for Lightweight Edge Clouds-Architecture Management – Storage and Orchestration- IoT Integration- Security Management for Edge Cloud Architectures -Future Research Directions

**Module III:**

**DATA MANAGEMENT AND PREDICTIVE ANALYSIS IN FOGCOMPUTING** Introduction to data management- Fog Data Management-Future Research Directions- Predictive Analysis to Support Fog Application Deployment-Introduction-Motivating Example: Smart Building- Predictive Analysis with FogTorch- Motivating Example (continued)-Future Research Directions - Survey of ML Techniques for Defending IoT Devices - Machine Learning in Fog Computing - Future Research Directions

**Module IV:**

**OPTIMIZATION PROBLEMS IN FOG AND EDGE COMPUTING** The Case for Optimization in Fog Computing- Formal Modeling- Framework for Fog Computing Metrics -Optimization Opportunities along the Fog Architecture - Optimization Opportunities along the Service Life Cycle - Toward a Taxonomy of Optimization Problems in Fog Computing -optimization Techniques

**CASE STUDIES** Smart Surveillance Video Stream Processing at the Edge for Real-Time -Smart Transportation Applications-Intelligent Traffic Lights Management (ITLM) System -Fog Orchestration Challenges and Future Directions.

**Text Books:**

1. Rajkumar Buyya, Satish Narayana Srirama, “Fog and Edge Computing: Principles and Paradigms”, Wiley series on Parallel and Distributed Computing.

**Reference Books:**

1. Fog Computing: A Platform for Internet of Things and Analytics, Flavio Bonomi, Rodolfo Milito, Preethi Natarajan and Jiang Zhu, Springer International.
2. Fog Computing and Its Role in the Internet of Things, Flavio Bonomi, Rodolfo Milito, Jiang Zhu, Sateesh Addepalli, MCC’12, August 17, 2012, Helsinki, Finland
3. A Survey of Fog Computing: Concepts, Applications and Issues ,Shanhe Yi, Cheng Li, Qun
4. Li, Mobidata’15, June 21, 2015, Hangzhou, China.

**Open Elective-I**

Paper Name: <b>Fundamentals of Sensors and Transducers</b>					
Paper Code: <b>AEIE3221</b>					
Contact hours per week:	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	3	0	0	3	3

**Course Outcomes:**

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

**AEIE3221.1.** Use different methods for converting a physical parameter into an electrical quantity

**AEIE3222.1.** Select the best fit transducers, including those for measurement of temperature, strain, motion, position and light intensity

**AEIE3223.1.** Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like displacement stress, force, acceleration flow, etc.

**AEIE3224.1.** Acquire knowledge on high temperature sensing systems used in steel, aluminum, copper plants.

**AEIE3225.1.** Acquire knowledge on Smart sensors.

**AEIE3226.1.** Identify different types of sensors used in real life applications and paraphrase their importance.

### Module I [10L]

Definition, principle of sensing & transduction, classification of transducers.

**Resistive Transducers:** Potentiometric transducer; Construction, symbol, materials, Loading effect, error calculations, sensitivity. Strain gauge; Theory, type, materials, gauge factor, temperature compensation and dummy gauge, adhesive,

**Inductive sensor:** Principle, common types, Reluctance change type, Mutual inductance change type, transformer action type

**LVDT:** Construction, material, I/O characteristics curve offset, discussion.

### Module II [6L]

**Capacitive sensors:** Variable distance-parallel plate type, variable area- parallel plate, variable dielectric constant type, calculation of sensitivity.

**Piezoelectric transducers:** piezoelectric effect, charge and voltage co-efficient and relationships, crystal model, materials, natural & synthetic type, charge amplifier, ultrasonic sensors: Liquid velocity and level measurements, Microphone, response characteristics.

### Module III [12L]

**Thermal sensors:** Resistance Temperature Detector (RTD): materials, temperature range, R-T characteristics configurations, applications

**Thermistors:** materials, shape, R-T characteristics, ranges and accuracy specification.

**Thermocouple:** Thermo laws, types, temperature ranges, series and parallel configurations, cold junction compensation, compensating cables.

**Thermal Radiation sensors:** types, constructions and comparison. Semiconductor type IC and PTAT type.

### Module IV [8L]

**Radiation sensors:** LDR, Photovoltaic cells, photodiodes, photo emissive cell types, materials, construction, response, applications. Geiger counters, Scintillation detectors, Introduction to smart sensors.

### Textbooks

1. Sensor and transducers, D. Patranabis, 2nd edition, PHI
2. Transducers and Instrumentation, D.V.S Murty, 2nd edition, PHI.

**Reference Books**

1. Instrument transducers, H.K.P. Neubert, Oxford University press.
2. Measurement systems: application & design, E.A.Doebelin, Mc Graw Hill.

Paper Name: <b>Designing with Processors and Controllers</b>					
Paper Code: <b>ECEN3222</b>					
Contact hours per week:	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	3	0	0	3	3

**Course Outcomes:**

After completing the course the student will be able to:

**ECEN3222.1.** Understand microprocessors and microcontrollers – their operation and programming.

**ECEN3222.2.** Identify RISC processors from CISC processors and apply them in circuits.

**ECEN3222.3.** Analyse operations of different serial and parallel buses and interrupts.

**ECEN3222.4.** Evaluate different hardware designs and memory configurations.

**ECEN3222.5.** Write RTOS for complex processor-based designs.

**ECEN3222.6.** Design processor and controller based intelligent systems for real life problems.

**Detailed Syllabus:****Module I [8L]:**

Designing with microprocessors and microcontrollers- the issues and solutions, Embedded systems VS General computing systems, Purpose of Embedded systems, optimizing design metrics, prominent processor and controller technology, RISC vs CISC.

**Module II [10L]:**

Devices and Communication Buses: I/O types, serial and parallel communication devices, wireless communication devices, timer and counting devices, watchdog timer, real time clock, serial bus communication protocols UART RS232/RS85, parallel communication network using ISA, PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth. Different types of I/O devices and interfacing: Keypad, LCD, VGA. Introduction to I/O interfaces: Interrupts, Interrupt hardware, Enabling and disabling interrupts, Concepts of handshaking, Polled I/O, Memory mapped I/O, Priorities, Stack and Queues. Vectored interrupts, Direct memory access, few types of Sensors and actuators.

**Module III [10L]:**

Memory: SRAM, DRAM, EEPROM, FLASH, CACHE memory organizations, (direct, associative, set associative mapping), Virtual memory, organization, mapping and management techniques, Fundamental issues in Hardware software co-design, Unified Modeling Language (UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system. Introduction to ARM architecture, Processor design, ARM organization and implementation.

**Module IV [8L]:**

Real Time Operating Systems: Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS. Resource Management/scheduling paradigms: static priorities, static schedules, dynamic scheduling, best effort current best practice in scheduling (e.g. Rate Monotonic vs. static schedules), Real-world issues: blocking, unpredictability, interrupts, caching, Examples of OSs for embedded systems - RT Linux, VRTX, Mobile phones, RFID.

### Text Books:

1. David Simon, "An Embedded Software Primer", (Addison Wesley), 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", (Newnes), 1999.
3. G. Osborn, —Embedded microcontroller and processor design, (Pearson)
4. S. Heath, —Embedded System design —, (Elsevier)
5. Steve Furber, ARM System-on-Chip Architecture, (Pearson)

### Reference Books:

1. Shibu, —Introduction to Embedded Systems, K. V. (TMH)
2. Frank Vahid, Tony Givargis, —Embedded System Design – A unified hardware and software introduction, (John Wiley)
3. Rajkamal —Embedded Systems, (TMH)
4. L. B. Das —Embedded Systems, (Pearson)
5. RTS: Real-Time Systems, by C.M. Krishna and Kang G. Shin, McGraw-Hill, 1997, ISBN 0-07-057043.
6. J. A. Stankovic and K. Ramamritham, Advances in Hard Real-Time Systems, IEEE Computer Society Press, Washington DC, September 1993, 777 pages. Selected papers and references

Paper Name: <b>Analog and Digital Communication</b>					
Paper Code: <b>ECEN3223</b>					
Contact hours per week:	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	3	0	0	3	3

### Course Outcomes:

After completing the course the student will be able to:

**ECEN3223.1.** Explain the necessity of communication, its history, evolution, the role of efficient communication in the present day.

**ECEN3223.2.** Understand & apply the concepts of various types of signals, techniques for signal transmission and signal modulation from the knowledge gathered earlier.

**ECEN3223.3.** Identify various parameters associated with Amplitude and frequency Modulation, time and frequency domain representations, side band frequencies etc and apply these knowledge to solve numerical problems.

**ECEN3223.4.** Apply sampling theorem to sample analog signal properly and differentiate among pulse modulation & demodulation techniques and understand PCM, DPCM.

**ECEN3223.5.** Analyze performance of various digital modulation & demodulation techniques and understand concept of OFDM and Spread Spectrum Modulation system.

**ECEN3223.6.** Analyze various multiplexing and Multiple access techniques and compare modern multiple access schemes, explain the concept of frequency reuse, channel assignment strategies and make use of wireless communication tools



**Detailed Syllabus:****Module I –[10L]**

Introduction-Signal Analysis and Transmission: Overview of communication- base-band transmission, various types of signals, analog signal, digital signal, fundamental limitations in communication system- noise, power and bandwidth. Fourier series and Fourier Transformation representations, ; Modulation and its need and types; Time domain and frequency domain analysis.

AMPLITUDE MODULATION: Modulation principle and definitions, spectrum and power considerations, DSB, SSB, VSB and AM principles. Different type of modulator circuits. DEMODULATOR Basic principle of coherent detections, envelope detectors.

FREQUENCY AND PHASE MODULATION Principles and definitions, Relationship between frequency and phase modulations. Phase and frequency deviations, Spectrum of FM signal, bandwidth considerations. Effect of modulation index on bandwidth, Narrow band and sideband FM and PM principles, RADIO RECEIVER Basic block diagram of TRF, Superhetrodyne principle,

**Module II –[10L]**

Digital Transmission: Sampling theorem, sampling rate, aliasing and aperture effect; analog pulse modulation -PAM (ideal, natural & flat topped sampling), PWM, PPM; basic concept of pulse code modulation, block diagram of PCM; quantizer; non-uniform quantizer, conceptual idea of A-law &  $\mu$ -law companding; encoding, coding efficiency, source, line coding channel coding & properties, NRZ & RZ, AMI, manchester coding PCM, DPCM, Delta modulation, adaptive delta modulation (basic concept and applications); baseband pulse transmission, matched filter (its importance and basic concept), error rate due to noise;, nyquist criterion for distortion-less transmission.

**Module III –[8L]**

Digital Modulation Techniques: Types of Digital Modulation, coherent and non-coherent Binary Modulation Techniques, Bit rate, baud rate; information capacity generation and detection, digital carrier modulation techniques: ASK, PSK and FSK, DPSK . Concept of QAM and M-ary Communication, M-ary phase shift keying, (QPSK), Generation, detection, , Offset Quadrature Phase shift Queuing (OQPSK), Minimum Shift Keying (MSK), Basic Concept of OFDM and Spread Spectrum Modulation.

**Module IV –[8L]**

Multiplexing -TDM, FDM. Multiple Access Techniques and Radio Communication: Multiple access techniques, TDMA, FDMA and CDMA in wireless communication systems, advanced mobile phone system (AMPS), global system for mobile communications (GSM), cellular concept and frequency reuse, channel assignment and handoff, Bluetooth, introduction to satellite communication.

**Text Books:**

1. Taub and Schilling , —Principles of Communication Systems, 2nd ed., Mc-Graw Hill
2. B.P.Lathi -Communication Systems- BS Publications
3. V Chandra Sekar – Analog Communication- Oxford University Press

**Reference Books:**

1. Carlson—Communication System,4/e , Mc-Graw Hill
2. Proakis& Salehi Fundamentals of Communication Systems- Pearson
3. Singh & Sapre—Communication Systems: 2/e, TMH
4. P K Ghosh- Principles of Electrical Communications- University Press
5. L.W.CouchII, —Digital and Analog Communication Systems, 2/e, Macmillan Publishing
6. Blake, Electronic Communication Systems- Cengage Learning

## 7. S Sharma, Analog Communication Systems- Katson Books

Paper Name: <b>Computational Mathematics</b>					
Paper Code: <b>MATH3221</b>					
Contact hours per week:	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	3	0	0	3	3

**Course Outcomes:**

MATH3221.1. Identify patterns in data in the form of recurrences and using the latter to evaluate finite and infinite sums.

MATH3221.2. Explain combinatorial phenomena by using binomial coefficients, generating functions and special numbers.

MATH3221.3. Solve computational problems by applying number theoretic concepts such as primality, congruences, residues etc.

MATH3221.4. Analyze the properties of networks by invoking graph theoretic concepts such as connectivity, matchings, colouring etc.

MATH3221.5. Combine the concepts of recurrences, sums, combinatorics, arithmetic and graph theory in order to comprehend computational methods.

MATH3221.6. Interpret mathematically the algorithmic features of computational situations.

**Detailed Syllabus:****Module I:**

Sums: Sums and recurrences, manipulation of sums, multiple sums, general methods, finite and infinite calculus, infinite sums 9L

**Module II:**

Binomial coefficients and special numbers: Basic identities involving binomial coefficients. Bernoulli numbers, Euler numbers, harmonic numbers, Fibonacci numbers, recurrence relations for these numbers. 9L

**Module III:**

Integer functions and arithmetic: Floors and ceilings, the binary operation  $\_mod$ , divisibility, primes, relative primality, the congruence relation  $\_mod$ , residues, Euler phi function, Fermat's Little Theorem, Wilson Theorem, primitive roots, the law of quadratic reciprocity, (Statement only). 9L

**Module IV:**

Generating functions: Basic manoeuvres, well-known sequences and their generating functions, using generating functions to solve recurrences, generating functions for special numbers. 9L

**3. Text Books:**

1. Ronald Graham, Donald Knuth, Oren Patashnik, Concrete Mathematics, Addison-Wesley

**4. Reference Books:**

## 2. Douglas B. West, Introduction to Graph Theory', Pearson

Paper Name: <b>Scientific Computing</b>					
Paper Code: <b>MATH3223</b>					
Contact hours per week:	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	3	0	0	3	3

**Course Outcomes:**

After successfully completing this course the students will be able to:

MATH3223.1: Analyze certain algorithms, numerical techniques and iterative methods that are used for solving system of linear equations.

MATH3223.2: Implement appropriate numerical methods for solving advanced engineering problems dealing with interpolation, integration and differentiation.

MATH3223.3: Apply the knowledge of matrices for calculating eigenvalues and eigenvectors and their stability for reducing problems involving Science and Engineering

MATH3223.4: Develop an understanding to reduce a matrix to its constituent parts in order to make certain subsequent calculations simpler.

MATH3223.5: Develop the concept of predictor-corrector methods in solving Initial Value Problems numerically.

MATH3223.6: Apply numerical techniques in solving Boundary Value Problems where the analytical methods fail.

**Detailed Syllabus:****Module I**

System of Linear Equations:

- Linear systems, solving linear systems
- Gauss elimination, pivoting and scaling, Gauss-Jordan method
- Symmetric positive definite systems and indefinite systems, Cholesky factorization
- Iterative method: Gauss Jacobi and Gauss Seidel, Error prediction and acceleration

**Module II**

Eigen Value problems:

- QR algorithm
- Power Method
- Linear least square data fitting
- Singular Value Decomposition

**Module III**

Interpolation, Integration &amp; Differentiation:

- Purpose of interpolation
- Choice of interpolating function, Polynomial interpolation
- Piecewise polynomial interpolation: cubic spline interpolation
- General form of quadrature rule; Newton-Cotes rule, Gaussian quadrature rule
- Numerical Differentiation: Methods Based on Finite Difference approximations

**Module IV**

Initial Value &amp; Boundary Value Problem:

- Multistep method to solve Initial Value Problem and its stability
- Predictor-corrector method: Adam Moulton method, Milne's Method
- Solving Boundary Value Problems: Finite Difference Method, Shooting Method

**Text Books:**

1. Trefethen L. N. and Bau D. Numerical Linear Algebra, SIAM
2. Watkins D. S. Fundamentals of Matrix Computation, Wiley
3. Smith G. D. Numerical Solutions to Partial Differential Equations, Oxford University Press
4. Jain M. K. and Iyengar S.R.K. Numerical methods for scientific and engineering computation
5. Conte S. D. and Boor C. D. Elementary Numerical Analysis - An Algorithmic Approach, McGraw Hill
6. Atkinson K. E. Introduction to Numerical Analysis, John Wiley

**Reference Books:**

1. Golub G. H. and Van Loan C.F. Matrix Computation, John Hopkins U. Press, Baltimore
2. Stewart G. W. Introduction to Matrix Computations, Academic Press
3. Demmel J.W. Applied numerical linear algebra, SIAM, Philadelphia
4. Jain M.K. Numerical Solutions of Differential Equations
5. Smith, Numerical solutions of partial Differential Equations (Finite difference methods)
6. Heath M. T., Scientific Computing: An Introductory Survey, McGraw Hill
7. Joe D. Hoffman, Numerical Methods for Engineers and Scientists, McGraw Hill
8. W. Layton and M. Sussman, Numerical Linear Algebra.

<b>Course Name: Cloud Computing with AWS</b>					
<b>Course Code: CSEN3222</b>					
<b>Contact Hours per week</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	<b>2</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>3</b>

## Course Outcomes

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

**CSEN3222.1.** Appreciate the benefits and limitations of cloud-based computing environments.

**CSEN3222.2.** Understand the underlying principles of cloud virtualization, cloud storage, cloud security.

**CSEN3222.3.** Analyze the suitability and/or applicability of various cloud computing models, platforms, services, solution offerings and tools such as AWS.

**CSEN3222.4.** Gain insight into various distributed computing issues (like performance, scalability, availability, reliability) in light of distributed file systems (such as HDFS, GFS).

**CSEN3222.5.** Identify security and privacy issues in cloud computing with provided security products and services.

**CSEN3222.6.** Apply Knowledge to provide solution for real life problems using learnt tools.

## Detailed Syllabus

### Module I [6L]

**Basics of Cloud Computing:** Defining a Cloud, Cloud Types – NIST Cloud Reference Model, Cloud Cube Model, Deployment Models – Public, Private, Hybrid, and Community Clouds, Service Models – Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS), Characteristics of Cloud Computing, Benefits and Limitations of Cloud Computing.

### Module II [7L]

**Cloud Services and Insight:** IaaS – Basic Concept and Characteristics, Concepts of Abstraction and Virtualization; Virtualization: Taxonomy of Virtualization Techniques; Hypervisors: Machine Reference Model for Virtualization,

Virtual Machine Instances / Images, examples of IaaS solutions

PaaS – Basic Concept and Characteristics, Tools and Development Environment with examples,

SaaS – Basic Concept and Characteristics, Open SaaS and SOA, examples of SaaS solutions, Identity as a Service (IDaaS).

### Module III [5L +7x2P]

#### Cloud Solution Offerings:

**Amazon Fundamental-I:** AWS Global Infrastructure- Regions, Availability Zones, Edge Locations, Amazon CloudFront, AWS Global Accelerator, Billing and Pricing. [2L]

Security & Compliance-Shared Responsibility Model, Well- Architected Framework, Encryption [1L]

CloudWatch, AWS Config, and AWS CloudTrail, [1x2hr Lab]

#### Offerings:

**Compute:** Amazon EC2, Auto Scaling, Load Balancer, AWS Lambda Deep Dive, API Gateway, Network-Launch VPC

#### [3x2hr Labs]

**Containers:** ECR, Amazon ECS Deep Dive. [1x2 Lab]

**Cloud-based Storage:** Block Devices and File Devices, Managed Storage and Unmanaged Storage Amazon S3, EBS, EFS, S3 Glacier, Snowball, Gateway, Amazon RDS, Amazon DynamoDB, [2x2hr Labs]

#### Labs]

Google: quick look at Google Applications Portfolio – AdWords, Analytics, overview of GWT, a few Google APIs, some key services of GAE. [2L]

### Module IV [6L+5x2P]

**Cloud Storage and Security:**

Distributed File Systems – GFS and HDFS. [2L]

Cloud Security: Security Concerns, Security Boundary, Security Service Boundary, Security Mapping Overview[2L]

Data Security – Storage Access, Storage Location, Tenancy, Encryption, Auditing, Compliance, Identity Management (awareness of Identity Protocol Standards). [2L]

AWS Marketplace, AWS Trusted Advisor- IAM, MFA, Security groups, Network ACLs, AWS WAF, AWS Cognito, IAM, MFA, Security groups. **[2x2 Lab]**

Version Control with Git and AWS CodeCommit:

What is Version Control • Types of Version Control System • Introduction to Git • Git Lifecycle • Common Git Commands • Recording Changes to the Repository • Working with Remotes • Branching and Merging in Git • Resolving Merge Conflicts • Git Workflow.

**[3x2hr Labs]**

**Textbooks:**

1. Cloud Computing Bible, Barrie Sosinsky, Wiley India Pvt. Ltd, 2012.
2. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill, 2013.
3. Cloud Computing: Theory and Practice, Dan Marinescu, Morgan Kaufmann, 2014.
4. Cloud Computing: A Hands-on Approach, A Bahga and V Madisetti, 2014.

**Reference Books**

1. The NIST Definition of Cloud Computing: Recommendations of the National Institute of Standards and Technology, Peter Mell and Timothy Grance, National Institute of Standards and Technology Special Publication 800-145, 2011.
2. Introduction to Cloud Computing Architecture: White Paper (1st Edition), Sun Microsystems Inc., 2009.
3. A Survey on Open-source Cloud Computing Solutions, Patrícia Takako Endo, Glauco Estácio Gonçalves, Judith Kelner, Djamel Sadok, VIII Workshop on Clouds, Grids and Applications at UFPE, Brazil.
4. GFS: Evolution on Fast-Forward – Kirk McKusick (BSD/BFFs) interviews Sean Quinlan (former GFS Tech Leader), CACM, 2009-2010.
5. The Google File System (GFS), Sanjay Ghemawat, Howard Gobioff, Shun-Tak Leung, 2011.
6. The Hadoop Distributed File System: Architecture and Design, Dhruba Borthakur, Apache Software Foundation, 2007.

Paper Name: <b>Indian Constitution and Civil Society (Mandatory)</b>					
Paper Code: <b>INCO3016</b>					
Contact hours per week:	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit Points</b>
	2	0	0	2	0

### Course Outcomes

The learner will be able to:

1. Analyze the historical, political and philosophical context behind the Indian Constitutionmaking process
2. Appreciate the important principles characterizing the Indian Constitution and institute comparisons with other constitutions
3. Understand the contemporaneity and application of the Indian Constitution in present times
4. Critique the contexts for constitutional amendments in consonance with changing times and society
5. Establish the relationship between the Indian Constitution and civil society at the collective as well as the individual levels
6. Consciously exercise the rights and the duties emanating from the Indian Constitution to one's own life and work

### Detailed Syllabus:

#### Module 1- 6L

Introduction to the Constitution of India-Historical Background, Making of Indian Constitution -the process of framing the constitution, the constituent assembly

#### Module II-6L

Salient Features of the Indian constitution. Comparison with the constitutions of other countries

#### Module III-6L

Relevance of the Constitution of India. Constitution and Governance. Constitution and Judiciary. Constitution and Parliament-Constitutional amendments.

#### Module IV-6L

Constitution and Society- democracy, secularism, justice. Constitution and the individual citizen-Fundamental Rights, Directive Principles of state policy and Fundamental Duties

### Reference Books

1. C.M.Elliot, (ed.), Civil Society and Democracy, OUP, Oxford, 20012..
2. David Held et.al (ed),The Idea of the Modern State, Open Univ. Press, Bristol, 1993
3. Neera Chandoke, State and Civil Society, Sage, Delhi, 19953

<b>Course Title : Smart Contracts and Applications Development Lab</b>					
<b>Course Code : CSEN3254</b>					
<b>Contact hrs. per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>

**Course Outcomes:**

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

**CSEN3254.1** Demonstrate Ethereum development environment setup and decentralized applications.

**CSEN3254.2** Apply solidity programming in writing smart contracts on blockchain.

**CSEN3254.3** Apply common tools, frameworks, and development environments for smart contract developments.

**CSEN3254.4** Explore tools for interacting with local or remote Ethereum nodes.

**CSEN3254.5** Demonstrate best practices in secure smart contract developments.

**CSEN3254.6** Explore real-world applications and use cases of smart contracts and DApps.

**Detailed Syllabus**

1. Ethereum Development Environment Setup
  - i) Installing Ethereum client (e.g., Ganache)
  - ii) Setting up development tools (e.g., Remix, Truffle)
2. Solidity Programming Language
  - i) Syntax and data types
  - ii) Functions and modifiers
  - iii) Events and error handling
3. Writing and Deploying Smart Contracts
  - i) Writing smart contract applications
  - ii) Compiling and deploying contracts
  - iii) Interacting with deployed contracts
4. Working with Truffle Framework
  - i) Overview and installation
  - ii) Project structure and configuration
  - iii) Testing smart contracts
5. Web3.js and Frontend Development
  - i) Introduction to Web3.js library
  - ii) Connecting frontend to smart contracts
  - iii) Building a simple DApp interface
6. Practices for Secure Smart Contract Developments
7. Use cases of smart contracts and DApps

**Text books:**

1. Mastering Ethereum: Building Smart Contracts and DApps, Andreas M. Antonopoulos, Gavin Wood, O'Reilly Media.
2. Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and Blockchain, Ritesh Modi, Packt Publishing.
3. Building Ethereum Dapps: Decentralized Applications on the Ethereum Blockchain, Roberto Infante, Manning Publications.

**Reference books:**

1. Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, Imran Bashir, Packt Publishing.



2. Ethereum Smart Contract Development: Build blockchain-based decentralized applications using Solidity, Mayukh Mukhopadhyay, Packt Publishing.
3. Blockchain Development for Beginners: The Dummies Guide to Blockchain Technology and Cryptocurrency, Leonard Eddison, Independently published.

<b>Course Title : Cyber Security Lab</b>					
<b>Course Code : CSEN3255</b>					
<b>Contact hrs. per week:</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>	<b>Credit points</b>
	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>

**Course Outcomes:**

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

CSEN3255.1: Understand and apply techniques for network reconnaissance and footprinting to gather and analyze target information effectively using suitable tools.

CSEN3255.2: Experiment with network monitoring tools to perform real-time traffic analysis, packet logging, and intrusion detection for identifying potential threats.

CSEN3255.3: Apply and analyse mechanisms to detect, monitor, and mitigate potential threats in network environments, and analyze common web security vulnerabilities.

CSEN3255.4: Demonstrate the use of cryptographic methods to implement secure data storage, secure data transmission, and digital signature schemes for data integrity and authentication.

CSEN3255.5: Apply and analyze forensic analysis of digital systems by examining system logs, memory dumps, file types, and network activity using appropriate tools.

CSEN3255.6: Design and evaluate strategies for enhancing cybersecurity, including mechanisms to defend against denial-of-service attacks and secure password generation.

**Detailed Syllabus:**

**List of experiments are given below:**

1. Perform an Experiment for port scanning with nmap.
2. Perform practical approach to implement Footprinting-Gathering target information using Dmitry-Dmagic, UAtester.
3. Working with sniffers for monitoring network communication (Wireshark).
4. Using Snort, perform real time traffic analysis and packet logging.
5. Set Up a honeypot and monitor the honeypot on the network.
6. Install Jscript/Cryptool tool (or any other equivalent) and demonstrate Asymmetric, Symmetric crypto algorithm, Hash and Digital/PKI signatures.
7. Implement the Signature Scheme for Digital Signature Standard.

8. Demonstrate how to provide secure data storage, secure data transmission and for creating digital signatures (GnuPG).
9. Generate minimum 10 passwords of length 12 characters using OpenSSL command.
10. Perform email analysis using the Autopsy tool.
11. Perform Registry analysis and get boot time logging using process monitor tool.
12. Perform File type detection using Autopsy tool.
13. Perform Memory capture and analysis using FTK imager tool.
14. Perform Network analysis using the Network Miner tool.
15. Demonstrate intrusion detection system (ids) using any tool (snort or any other s/w).
16. Perform web application vulnerabilities using tools like SQL injection.

**Text Books:**

1. Real Digital Forensics for Handheld Devices, E. P. Dorothy, Auerback Publications, 2013.
2. The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics, J. Sammons, Syngress Publishing, 2012.

**Reference Books:**

1. Handbook of Digital Forensics and Investigation, E. Casey, Academic Press, 2010.
2. Malware Forensics Field Guide for Windows Systems: Digital Forensics Field Guides, C. H. Malin, E. Casey and J. M. Aquilina, Syngress, 2012.
3. The Best Damn Cybercrime and Digital Forensics Book Period, J. Wiles and A. Reyes, Syngress, 2007.