

AC – 11.05.2017

Item No. 4.193

# UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17

Under

## FACULTY OF TECHNOLOGY

### **Computer Engineering**

**Second Year** with Effect from **AY 2017-18**

**Third Year** with Effect from **AY 2018-19**

**Final Year** with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**

with effect from the AY 2016–17

**Co-ordinator, Faculty of Technology's Preamble:**

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

**Dr. S. K. Ukarande**  
**Co-ordinator,**  
**Faculty of Technology,**  
**Member - Academic Council**  
**University of Mumbai, Mumbai**

**Chairman's Preamble:**

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

As the Chairman, Board of Studies in Computer Engineering of the University of Mumbai, I am happy to state here that, the Program Educational Objectives for Undergraduate Program were finalized in a brainstorming session, which was attended by more than 85 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Computer Engineering. The Program Educational Objectives finalized for the undergraduate program in Computer Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals.
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems.
3. To equip the Learner with broad education necessary to understand the impact of Computer Science and Engineering in a global and social context.
4. To encourage, motivate and prepare the Learner's for Lifelong- learning.
5. To inculcate professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process.

In addition to Program Educational Objectives, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

**Dr. Subhash K. Shinde**  
**Chairman, Board of Studies in Computer Engineering,**  
**University of Mumbai, Mumbai.**

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2017-18**

**S. E. Computer Engineering (Semester-III)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC301	Applied Mathematics -III	4+1@	-	-	5	-	-	5
CSC302	Digital Logic Design and Analysis	4	-	-	4	-	-	4
CSC303	Discrete Mathematics	3+1@	-	-	4	-	-	4
CSC304	Electronic Circuits and Communication Fundamentals	4	-	-	4	-	-	4
CSC305	Data Structures	4	-	-	4	-	-	4
CSL301	Digital System Lab	-	2	-	-	1	-	1
CSL302	Basic Electronics Lab	-	2	-	-	1	-	1
CSL303	Data structure Lab	-	2	-	-	1	-	1
CSL304	OOPM(Java) Lab	-	2+2*	-	-	2	-	2
<b>Total</b>		<b>21</b>	<b>10</b>	<b>-</b>	<b>21</b>	<b>5</b>	<b>-</b>	<b>26</b>

@ 1 hour to be taken tutorial as class wise.

\*2 hours shown as practical's to be taken class wise and other 2 hours to be taken as batch wise

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration ( in Hrs)				
		Test 1	Test 2	Avg.						
CSC301	Applied Mathematics -III	20	20	20	80	3	-	-	-	100
CSC302	Digital Logic Design and Analysis	20	20	20	80	3	-	-	-	100
CSC303	Discrete Structures	20	20	20	80	3	-	-	-	100
CSC304	Electronic Circuits and Communication Fundamentals	20	20	20	80	3	-	-	-	100
CSC305	Data Structures	20	20	20	80	3	--	-	-	100
CSL301	Digital System Lab	-	-	-	-	-	25	--	25	50
CSL302	Basic Electronics Lab	-	-	-	-	-	25	25	---	50
CSL303	Data structure Lab	-	-	-	-	-	25	-	25	50
CSL304	OOPM(Java) Lab	-	-	-	-	-	50	--	50	100
<b>Total</b>		<b>100</b>	<b>100</b>	<b>100</b>	<b>400</b>	<b>-</b>	<b>125</b>	<b>25</b>	<b>100</b>	<b>750</b>

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2017-18**

**S. E. Computer Engineering (Semester-IV)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC401	Applied Mathematics- IV	4+1@	-	-	5	-	-	5
CSC402	Analysis of Algorithms	4	-	-	4	-	-	4
CSC403	Computer Organization and Architecture	4	-	-	4	-	-	4
CSC404	Computer Graphics	4	-	-	4	-	-	4
CSC405	Operating System	4	-	-	4	-	-	4
CSL401	Analysis of Algorithms Lab	-	2	-	-	1	-	1
CSL402	Computer Graphics Lab	-	2	-	-	1	-	1
CSL403	Processor Architecture Lab	-	2	-	-	1	-	1
CSL404	Operating System Lab	-	2	-	-	1	-	1
CSL405	Open Source Tech Lab	-	2+2*	-	-	2	-	2
<b>Total</b>		<b>21</b>	<b>12</b>	<b>-</b>	<b>21</b>	<b>6</b>	<b>-</b>	<b>27</b>

@ 1 hour to be taken tutorial as class wise .

\*2 hours shown as Practical's to be taken class wise and other 2 hours to be taken as batch wise

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration ( in Hrs)				
		Test 1	Test 2	Avg.						
CSC401	Applied Mathematics- IV	20	20	20	80	3	-	-	-	100
CSC402	Analysis of Algorithms	20	20	20	80	3	-	-	-	100
CSC403	Computer Organization and Architecture	20	20	20	80	3	-	-	-	100
CSC404	Computer Graphics	20	20	20	80	3	-	-	-	100
CSC405	Operating System	20	20	20	80	3	--	-	-	100
CSL401	Analysis of Algorithms Lab	-	-	-	-	-	25	--	25	50
CSL402	Computer Graphics Lab	-	-	-	-	-	25	--	25	50
CSL403	Processor Architecture Lab	-	-	-	-	-	25	25	-	50
CSL404	Operating System Lab	-	-	-	-	-	25	-	25	50
CSL405	Open Source Tech Lab	-	-	-	-	-	25	---	25	50
<b>Total</b>		<b>100</b>	<b>100</b>	<b>100</b>	<b>400</b>	<b>-</b>	<b>125</b>	<b>25</b>	<b>100</b>	<b>750</b>

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2018-19**

**T. E. Computer Engineering (Semester-V)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC501	Microprocessor	4	-	-	4	-	-	4
CSC502	Database Management System	4	-	-	4	-	-	4
CSC503	Computer Network	4	-	-	4	-	-	4
CSC504	Theory of Computer Science	3+1@	-	-	4	-	-	4
CSDLO 501X	Department Level Optional Course -I	4	-	-	4	-	-	4
CSL501	Microprocessor Lab	-	2	-	-	1	-	1
CSL502	Computer Network Lab	-	2	-	-	1	-	1
CSL503	Database & Info. System Lab	-	2	-	-	1	-	1
CSL504	Web Design Lab	-	2+2*	-	-	2	-	2
CSL505	Business Comm. & Ethics	-	2+2*	-	-	2	-	2
	<b>Total</b>	<b>20</b>	<b>14</b>	<b>-</b>	<b>20</b>	<b>7</b>	<b>-</b>	<b>27</b>

@ 1 hour to be taken tutorial as class wise.

\*2 hours shown as Practical's to be taken class wise and other 2 hours to be taken as batch wise

Course Code	Course Name	Examination Scheme							Total
		Theory					TW	Oral & Pract	
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg.					
CSC501	Microprocessor	20	20	20	80	3	-	-	100
CSC502	Database Management System	20	20	20	80	3	-	-	100
CSC503	Computer Network	20	20	20	80	3	-	-	100
CSC504	Theory of Computer Science	20	20	20	80	3	-	-	100
CSDLO 501X	Department Level Optional Course -I	20	20	20	80	3	--	-	100
CSL501	Microprocessor Lab	-	-	-	-	-	25	25	50
CSL502	Computer Network Lab	-	-	-	-	-	25	25	50
CSL503	Database & Info. System Lab	-	-	-	-	-	25	25	50
CSL504	Web Design Lab	-	-	-	-	-	25	25	50
CSL505	Business Comm. & Ethics	-	-	-	-	-	50	-	50
	<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>400</b>	<b>-</b>	<b>150</b>	<b>100</b>	<b>750</b>

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2018-19**

**T. E. Computer Engineering (Semester-VI)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC601	Software Engineering	4	-	-	4	-	-	4
CSC602	System Programming & Compiler Construction	4	-	-	4	-	-	4
CSC603	Data Warehousing & Mining	4	-	-	4	-	-	4
CSC604	Cryptography & System Security	4	-	-	4	-	-	4
CSDLO 601X	Department Level Optional Course -II	4	-	-	4	-	-	4
CSL601	Software Engineering Lab	-	2	-	-	1	-	1
CSL602	System software Lab	-	2	-	-	1	-	1
CSL603	Data Warehousing & Mining Lab	-	2	-	-	1	-	1
CSL604	System Security Lab	-	2	-	-	1	-	1
CSP605	Mini-Project	-	4	-	-	2	-	2
	<b>Total</b>	<b>20</b>	<b>12</b>	<b>-</b>	<b>20</b>	<b>6</b>	<b>-</b>	<b>26</b>

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CSC601	Software Engineering	20	20	20	80	3	-	-	-	100
CSC602	System Programming & Compiler Construction	20	20	20	80	3	-	-	-	100
CSC603	Data Warehousing & Mining	20	20	20	80	3	-	-	-	100
CSC604	Cryptography & System Security	20	20	20	80	3	-	-	-	100
CSDLO 601X	Department Level Optional Course -II	20	20	20	80	3	-	-	-	100
CSL601	Software Engineering Lab	-	-	-	-	-	25	25	--	50
CSL602	System Software Lab	-	-	-	-	-	25	--	25	50
CSL603	Data Warehousing & Mining Lab	-	-	-	-	-	25	--	25	50
CSL604	System Security Lab	-	-	-	-	-	25	---	25	50
CSP605	Mini-Project	-	-	-	-	-	25	---	25	50
	<b>Total</b>	100	100	100	400	-	150	25	100	750

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2019-20**  
**B. E. Computer Engineering (Semester-VII)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC701	Digital Signal & Image Processing	4	-	-	4	-	-	4
CSC702	Mobile Communication & Computing	4	-	-	4	-	-	4
CSC703	Artificial Intelligence & Soft Computing	4	-	-	4	-	-	4
CSDLO 701X	Department Level Optional Course -III	4	-	-	4	-	-	4
ILO701X	Institute Level Optional Course-I	3	-	-	3	-	-	3
CSL701	Digital Signal & Image Processing Lab	-	2	-	-	1	-	1
CSL702	Mobile App. Development. Tech. Lab	-	2	-	-	1	-	1
CSL703	Artificial Intelligence & Soft Computing Lab	-	2	-	-	1	-	1
CSL704	Computational Lab-I	-	2	-	-	1	-	1
CSP705	Major Project-I	-	6	-	-	3	-	3
	<b>Total</b>	<b>19</b>	<b>14</b>	<b>-</b>	<b>19</b>	<b>7</b>	<b>-</b>	<b>26</b>

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CSC701	Digital Signal & Image Processing	20	20	20	80	3	-	--	-	100
CSC702	Mobile Communication & Computing	20	20	20	80	3	-	--	-	100
CSC703	Artificial Intelligence & Soft Computing	20	20	20	80	3	-	--	-	100
CSDLO 701X	Department Level Optional Course -III	20	20	20	80	3	-	--	-	100
ILO701X	Institute Level Optional Course-I	20	20	20	80	3	--	--	-	100
CSL701	Digital Signal & Image Processing Lab	-	-	-	-	-	25	--	--	25
CSL702	Mobile App. Development. Tech. Lab	-	-	-	-	-	25	--	25	50
CSL703	Artificial Intelligence & Soft Computing Lab	--	-	-	-	--	25	25	--	50
CSL704	Computational Lab-I						25	--	25	50
CSP705	Major Project-I	-	-	-	-	-	50	-	25	75
	<b>Total</b>	100	100	100	400		150	25	75	750



**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2019-20**

**B. E. Computer Engineering (Semester-VIII)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC801	Human Machine Interaction	4	-	-	4	-	-	4
CSC802	Distributed Computing	4	-	-	4	-	-	4
CSDLO 801X	Department Level Optional Course -IV	4	-	-	4	-	-	4
ILO801X	Institute Level Optional Course-II	3	-	-	3	-	-	3
CSL801	Human Machine Interaction Lab	-	2	-	-	1	-	1
CSL802	Distributed Computing Lab	-	2	-	-	1	-	1
CSL803	Cloud Computing Lab	-	4	-	-	2	-	2
CSL804	Computational Lab-II	-	2	-	-	1	-	1
CSP805	Major Project-II	-	12	-	-	6	-	6
	<b>Total</b>	<b>15</b>	<b>22</b>	<b>-</b>	<b>15</b>	<b>11</b>	<b>-</b>	<b>26</b>

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration ( in				
		Test 1	Test 2	Avg.						
CSC801	Human Machine Interaction	20	20	20	80	3	-	-	-	100
CSC802	Distributed Computing	20	20	20	80	3	-	-	-	100
CSDLO 801X	Department Level Optional Course -IV	20	20	20	80	3	-	-	-	100
ILO801X	Institute Level Optional Course-II	20	20	20	80	3	-	-	-	100
CSC801	Human Machine Interaction Lab						25	25	-	50
CSL802	Distributed Computing Lab	-	-	-	-	-	25	25	-	50
CSL803	Cloud Computing Lab	-	-	-	-	-	50	--	25	75
CSL804	Computational Lab-II	-	-	-	-	-	50	--	25	75
CSP805	Major Project-II						50		50	100
	<b>Total</b>	100	100	100	400	--	150		100	750

Sem.	Department Level Optional Course (DLOC)	Institute Level Optional Course (ILOC)
V	CSDLO5011: Multimedia System CSDLO5012: Advance Operating System CSDLO5013: Advance Algorithm	-----
VI	CSDLO6021: Machine Learning CSDLO6022: Advance Database System CSDLO6023: Enterprise Resource Planning CSDLO6024: Advance Computer Network	-----
VII	CSDLO7031: Advance System Security & Digital Forensics CSDLO7032: Big Data & Analytics CSDLO7033: Robotics	ILO7011. Product Lifecycle Management ILO7012. Reliability Engineering ILO7013. Management Information System ILO7014. Design of Experiments ILO7015. Operation Research ILO7016. Cyber Security and Laws ILO7017. Disaster Management & Mitigation Measures ILO7018. Energy Audit and Management ILO7019. Development Engineering
VIII	DLO8011: High Performance Computing DLO8012: Natural Language Processing DLO8013: Adhoc Wireless Network	ILO8021. Project Management ILO8022. Finance Management ILO8023. Entrepreneurship Development and Management ILO8024. Human Resource Management ILO8025. Professional Ethics and CSR ILO8026. Research Methodology ILO8027. IPR and Patenting ILO8028. Digital Business Management ILO8029. Environmental Management

Course Code	Course Name	Credits
CSC301	Applied Mathematics-III	5

**Course objectives:**

1. To understand the concept of complex variables, C-R equations, harmonic functions and its conjugate and mapping in complex plane.
2. To learn the complex mapping, standard mappings, cross ratios and fixed point.
3. To learn the Laplace Transform, Inverse Laplace Transform of various functions, its application and Z-transform.
4. To understand the concept of Fourier Series, its complex form and enhance the problem solving skill.

**Course outcomes:** On successful completion of course learner will be able to:

1. Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic function.
2. Plot the image of the curve by a complex transformation from z-plane to w-plane.
3. Expand the periodic function by using Fourier series and complex form of Fourier series.
4. Understand the concept of Laplace transform and inverse Laplace transform of various functions and its application to solve ordinary differential equations.
5. Apply the concept of Z- transformation and its inverse of the given sequence.
6. Apply the concept of Correlation and Regression to the engineering problems.

Module No.	Unit No.	Topics	Hrs.
1.0		<b>Laplace Transform</b>	09
	1.1	<b>Laplace Transform of Standard Functions:</b> Introduction, Definition of Laplace transform, Laplace transform of $1, e^{at} \sin(at), \cos(at), \sinh(at), \cosh(at), t^n \operatorname{erf}(t)$ , Heavi-side unit step, dirac-delta function, LT of periodic function.	
	1.2	<b>Properties of Laplace Transform:</b> Linearity, first shifting property, second shifting property, multiplication by $t^n$ , division by $t$ , Laplace Transform of derivatives and integrals, change of scale property. (without proof)	
2.0		<b>Inverse Laplace Transform</b>	08
	2.1	Inverse Laplace Transform by Partial fraction method, Convolution theorem	
	2.2	Application to solve initial and boundary value problem involving	

		ordinary differential equations with one dependent variable and constant coefficients.	
<b>3.0</b>		<b>Fourier Series</b>	<b>10</b>
	<b>3.1</b>	Dirichlet's conditions, Fourier series of periodic functions with period $2\pi$ and $2L$ , Fourier series for even and odd functions.	
	<b>3.2</b>	Half range sine and cosine Fourier series, Parseval's identities (without proof)	
	<b>3.3</b>	Complex form of Fourier series, Orthogonal and Orthonormal set of functions.	
<b>4.0</b>		<b>Complex Variable &amp; mapping</b>	<b>09</b>
	<b>4.1</b>	Functions of a complex variable, Analytic functions, Cauchy-Riemann equations in Cartesian co-ordinates & Polar co-ordinates.	
	<b>4.2</b>	Harmonic functions, Analytic method and Milne Thomson methods to find $f(z)$ , Orthogonal trajectories.	
	<b>4.3</b>	<b>Mapping:</b> Conformal mapping, bilinear transformations, cross ratio, fixed points, bilinear transformation of straight lines and circles.	
<b>5.0</b>		<b>Z-transform</b>	<b>06</b>
	<b>5.1</b>	Z-transform of standard functions such as $Z(a^n)$ , $Z(n^p)$ .	
	<b>5.2</b>	Properties of Z-transform :Linearity, Change of scale, Shifting property, Multiplication of K, Initial and final value, Convolution theorem ( without proof)	
	<b>5.3</b>	<b>Inverse Z transform:</b> Binomial Expansion and Method of Partial fraction	
<b>6.0</b>		<b>Correlation &amp; regression, Curve Fitting</b>	<b>10</b>
	<b>6.1</b>	Scattered diagrams, Karl Pearson's coefficient of correlation, covariance, Spearman's Rank correlation(non-repeated and repeated ranks)	
	<b>6.2</b>	Regression coefficient & Lines of Regression.	
	<b>6.3</b>	Fitting of curves: Least square method. Fitting of the straight line $y = a + bx$ , parabolic curve $y = a + bx + cx^2$ , & exponential curve $y = ab^x$	
		<b>Total</b>	<b>52</b>

**Text Books:**

1. Higher Engineering Mathematics by Grewal B. S. 38<sup>th</sup> edition, Khanna Publication 2005.
2. Advanced Engineering Mathematics by Kreyszig E. 9<sup>th</sup> edition, John Wiley.
3. A Text Book of Applied Mathematics Vol. I & II by P.N.Wartilar &
4. J.N.Wartikar, Pune, Vidyarthi Griha Prakashan., Pune.

**Reference Books:**

1. Advanced Engg. Mathematics by C. Ray Wylie & Louis Barrett.TMH International Edition.
2. Mathematical Methods of Science and Engineering by Kanti B. Datta, Cengage Learning.
3. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledgewar.
4. Laplace Transforms by Murry R. Spieget, Schaun's out line series-McGraw Hill Publication.

**Assessment:****Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

- 1 Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC302	Digital Logic Design and Analysis	4

**Course Objectives:**

1. To introduce the fundamental concepts and methods for design of digital circuits and a pre-requisite for computer organization and architecture, microprocessor systems.
2. To provide the concept of designing Combinational and sequential circuits.
3. To provide basic knowledge of how digital building blocks are described in VHDL.

**Course Outcomes:** At the end of the course student should be able-

1. To understand different number systems and their conversions.
2. To analyze and minimize Boolean expressions.
3. To design and analyze combinational circuits.
4. To design and analyze sequential circuits
5. To understand the basic concepts of VHDL.
6. To study basics of TTL and CMOS Logic families.

Module	Detailed Content	Hours
1	<p><b>Number Systems and Codes</b></p> <p>Introduction to number system and conversions: Binary, Octal, Decimal and Hexadecimal number Systems, Binary arithmetic: addition, subtraction (1's and 2's complement), multiplication and division.</p> <p>Octal and Hexadecimal arithmetic: Addition and Subtraction (7's and 8's complement method for octal) and (15's and 16's complement method for Hexadecimal).</p> <p>Codes: Gray Code, BCD Code, Excess-3 code, ASCII Code.</p> <p>Error Detection and Correction: Hamming codes.</p>	8
2	<p><b>Boolean Algebra and Logic Gates:</b></p> <p>Theorems and Properties of Boolean Algebra, Boolean functions, Boolean function reduction using Boolean laws, Canonical forms, Standard SOP and POS form.</p> <p>Basic Digital gates: NOT , AND , OR , NAND , NOR , EXOR , EX-NOR, positive and negative logic, K-map method 2 variable, 3 variable, 4 variable, Don't care condition, Quine-McClusky Method, NAND-NOR Realization.</p>	8
3	<p><b>Combinational Logic Design:</b></p> <p>Introduction, Half and Full Adder, Half subtractor Full Subtractor, Four Bit Ripple adder, look ahead carry adder, 4 bit adder subtractor, one digit BCD Adder, Multiplexer, Multiplexer tree, Demultiplexer, Demultiplexer tree, Encoders Priority encoder, Decoders, One bit, Two bit , 4-bit Magnitude Comparator, ALU IC 74181.</p>	8

4	<p><b>Sequential Logic Design:</b> Introduction: SR latch, Concepts of Flip Flops: SR, D, J-K, T, Truth Tables and Excitation Tables of all types, Race around condition, Master Slave J-K Flip Flops, Timing Diagram, Flip-flop conversion, State machines, state diagrams, State table, concept of Moore and Mealy machine.</p> <p>Counters : Design of Asynchronous and Synchronous Counters, Modulus of the Counters, UP- DOWN counter, Shift Registers: SISO, SIPO, PIPO, PISO Bidirectional Shift Register, Universal Shift Register, Ring and twisted ring/Johnson Counter, sequence generator.</p>	15
5	<p><b>Introduction to VHDL:</b> Introduction: Fundamental building blocks Library, Entity, Architecture, Modeling Styles, Concurrent and sequential statements, simple design examples for combinational circuits and sequential circuits.</p>	6
6	<p><b>Digital Logic Families:</b> Introduction: Terminologies like Propagation Delay, Power Consumption, Fan in and Fan out , current and voltage parameters, noise margin, with respect to TTL and CMOS Logic and their comparison</p>	3

**Text Books:**

1. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill.
2. M. Morris Mano, "Digital Logic and computer Design", PHI.
3. Norman Balabanian, "Digital Logic Design Principles", Wiley.
4. J. Bhasker. "VHDL Primer", Pearson Education.

**Reference Books:**

1. Donald p Leach, Albert Paul Malvino, "Digital principles and Applications", Tata McGraw
2. Yarbrough John M. , "Digital Logic Applications and Design ", Cengage Learning.
3. Douglas L. Perry, "VHDL Programming by Example", Tata McGraw Hill.

**Internal Assessment:** Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC303	Discrete Mathematics	4

**Course Objectives:**

1. Cultivate clear thinking and creative problem solving.
2. Thoroughly train in the construction and understanding of mathematical proofs. Exercise common mathematical arguments and proof strategies.
3. Thoroughly prepare for the mathematical aspects of other Computer Engineering courses

**Course Outcomes:** At the end of the course student will be able to

1. Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving.
2. Ability to reason logically.
3. Ability to understand relations, Diagraph and lattice..
4. Ability to understand use of functions, graphs and their use in programming applications.
5. Understand use of groups and codes in Encoding-Decoding
6. Apply discrete structures into other computing problems such as formal specification, verification, artificial intelligence, cryptography, Data Analysis and Data Mining etc.

**Prerequisite: Basic Mathematics**

Sr. No.	Module	Detailed Content	Hours
1	Set Theory	<ul style="list-style-type: none"> <li>• Sets, Venn diagrams, Operations on Sets</li> <li>• Laws of set theory, Power set and Products</li> <li>• Partitions of sets, The Principle of Inclusion and Exclusion</li> </ul>	4
2	Logic	<ul style="list-style-type: none"> <li>• Propositions and logical operations, Truth tables</li> <li>• Equivalence, Implications</li> <li>• Laws of logic, Normal Forms</li> <li>• Predicates and Quantifiers</li> <li>• Mathematical Induction</li> </ul>	8
3	Relations and Functions	<ul style="list-style-type: none"> <li>• Relations, Paths and Digraphs</li> <li>• Properties and types of binary relations</li> <li>• Operations on relations, Closures, Warshall's algorithm</li> <li>• Equivalence and partial ordered relations,</li> <li>• Poset, Hasse diagram and Lattice</li> <li>• Functions: Types of functions - Injective, Surjective and Bijective</li> </ul>	12



		<ul style="list-style-type: none"> <li>• Composition of functions , Identity and Inverse function</li> <li>• Pigeon-hole principle</li> </ul>	
4	Counting	<ul style="list-style-type: none"> <li>• Permutations , Combinations</li> <li>• Elements of Probability, Discrete Probability and Conditional Probability</li> <li>• Generating Functions and Recurrence Relations</li> <li>• Recursive Functions</li> <li>• Introduction to Functional Programming</li> </ul>	6
5	Graphs	<ul style="list-style-type: none"> <li>• Definitions, Paths and circuits: Eulerian and Hamiltonian</li> <li>• Types of graphs, Sub Graphs</li> <li>• Isomorphism of graphs</li> </ul>	6
6	Algebraic Structures and Coding Theory	<ul style="list-style-type: none"> <li>• Algebraic structures with one binary operation: semigroup, monoid and group, Abelian group</li> <li>• Isomorphism, Homomorphism and Automorphism</li> <li>• Cyclic groups, Normal subgroups,</li> <li>• Codes and group codes</li> </ul>	8

#### **Text Books:**

1. BernadKolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, “Discrete Mathematical Structures”, Pearson Education.
2. C.L.Liu, Elements of Discrete Mathematics, second edition 1985, McGraw-Hill BookCompany. Reprinted 2000.
3. K.H.Rosen, Discrete Mathematics and applications, fifth edition 2003, TataMcGraw Hill publishing Company.
4. D.E. Rydeheard University of Manchester , R.M. Burstall, University of Edinburgh “Computational Category Theory”.

#### **Reference Books:**

1. Y N Singh, “Discrete Mathematical Structures”, Wiley-India.
2. J .L.Mott, A.Kandel, T.P .Baker, Discrete Mathematics for Computer Scientists and Mathematicians, second edition 1986, Prentice Hall of India.
3. J. P. Trembley, R. Manohar “Discrete Mathematical Structures with Applications to Computer Science”, TataMcgraw-Hill.
4. Seymour Lipschutz , Marc Lars Lipson,“ Discrete Mathematics” Schaum’sOutline, McGraw Hill Education.

### **Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

### **Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

**\*\* Tutorial lecture can be conducted for each unit and min 10 problems on the covered unit can be given to the students for practice.**

Course Code	Course Name	Credits
CSC304	Electronic Circuits and Communication Fundamentals	4

**Course Objectives:**

1. To develop the knowledge of semiconductor devices and circuits, and explain their use in communication applications.
2. To inculcate circuit analysis capabilities in students.
3. To gain knowledge in electronic devices and circuits that is useful in real life applications.
4. To understand the fundamental concepts of electronic communication and their use in computer applications.

**Course Outcomes:** At the end of the course student should be able

1. To understand the use of semiconductor devices in circuits and analyze them.
2. To understand importance of oscillators and power amplifiers in communication system.
3. To understand basic concepts of operational amplifier and their applications.
4. To understand the fundamental concepts of electronic communication
5. To apply knowledge of electronic devices and circuits to communication applications.
6. To study basic concepts of information theory.

**Prerequisite: Basic electrical engineering**

Module	Detailed Content	Hours
1	<b>Electronic Circuits: Bipolar junction transistor.</b> Input and Output characteristics, Types of Biasing - Fixed bias, self-bias, voltage divider bias, DC load line and significance, CE amplifier using re model, (Analysis based Numericals)	08
2	<b>Power Amplifiers:</b> Introduction, Class A and Class C power amplifier. Oscillators: Introduction, Barkhausen criteria, Colpitts oscillator and Crystal oscillator	04
3	<b>Electronic Circuits : Operational Amplifier and its applications</b> Op-amp – block diagram, parameters and characteristics, applications- Inverting and Non inverting amplifier, Summing Amplifier(Numerical), Difference amplifier, Basic Integrator and Differentiator, Comparator, Zero Crossing Detector (only theory)	10

4	<p><b>Communication Fundamentals: Analog Communication</b></p> <p>Block diagram and elements of analog communication systems, Theory of amplitude modulation and types of AM (Numerical)</p> <p>Generation of DSB SC using diode based balanced modulator, Generation of SSB using phase shift method, Introduction of FM, and its mathematical representation, Statement of Carson's Rule Comparison of AM, FM, Block diagram of AM transmitter (HLM and LLM)</p> <p>Block diagram of AM Superheterodyne receiver.</p>	10
5	<p><b>Pulse Modulation and Multiplexing.</b></p> <p>Statement of Sampling Theorem, Generation and detection of PAM, PWM, PPM, PCM, DM and ADM.</p> <p>Principle of TDM using PCM and FDM</p>	10
6	<p><b>Communication Fundamentals: Information theory.</b></p> <p>Amount of information, average information, information rate, Statement of Shannon's theorem, channel capacity (Numericals)</p>	06

**Text Books:**

1. Robert Boylestad, 'Electronic Devices and circuit Theory', Prentice Hall.
2. D Roy Choudhury, ' Linear integrated Circuits' New Age International Ltd
3. G. Kennedy, B. Davis, S R M Prasanna, 'Electronic Communication Systems', McGraw Hill, 5th Edition.
4. Wayne Tomasi, 'Electronic Communication Systems (fundamentals through advanced)', Pearson Education, 4th Edition.
5. K. Sam Shanmugam, ' Digital and analog communication systems', Wiley.

**Reference Books:**

1. Donald Neamen, 'Electronic Circuit Analysis and Design', Tata McGraw Hill, 2nd Edition.
2. K. R. Botkar, 'Integrated Circuits', Khanna Publishers, 9th Edition
3. Simon Haykin, 'Digital Communication systems', Wiley.
4. David Bell, 'Electronic Devices and Circuits', Oxford, 5th Edition.
5. Ramakant A. Gayakwad, 'Op-amp and linear integrated circuits', PHI, 3rd edition.

### **Internal Assessment**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

### **Theory Examination:**

2. Question paper will comprise of 6 questions, each carrying 20 marks.
5. The students need to solve total 4 questions.
6. Question No.1 will be compulsory and based on entire syllabus.
7. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
<b>CSC305</b>	<b>Data Structures</b>	<b>4</b>

**Course Objectives:**

1. To teach various storage mechanisms of data.
2. To design and implement various data structures.
3. To introduce various techniques for representation of the data in the real world.
4. To teach different sorting techniques.
5. To teach different searching techniques.

**Course Outcomes:**

1. Students will be able to implement various linear and nonlinear data structures.
2. Students will be able to handle operations like insertion, deletion, searching and traversing on various data structures.
3. Students will be able to select appropriate sorting technique for given problem.
4. Students will be able to select appropriate searching technique for given problem.
5. Students will be able to apply the learned concepts in various domains like DBMS and Compiler Construction.
6. Students will be able to choose appropriate data structure for specified problem domain.

**Prerequisite:** C Programming

Module	Detailed Content	Hours
01	<b>Introduction to Data Structures</b>	03
	Introduction, Types of Data Structures – Linear and Nonlinear, Operations on Data Structures, Concept of ADT, Arrays.	
02	<b>Stack and Queues</b>	10
	Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack – Well form-ness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation, Recursion. ADT of Queue, Operations on Queue, Array Implementation of Queue, Circular Queue, Priority Queue, Double Ended Queue, Applications of Queue.	
03	<b>Linked List</b>	10
	Introduction, Representation of Linked List, Linked List v/s Array, Implementation of Linked List, Linked Implementation of Stack and Queue, Circular Linked List, Doubly Linked List, Application – Polynomial Representation and Addition.	
04	<b>Trees</b>	12
	Introduction, Tree Terminologies, Binary Tree, Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Implementation of Binary Search Tree, Applications – Expression Tree, Huffman Encoding. Search Trees – AVL, B Tree, B+ Tree, Splay Tree and Trie.	

05	<b>Graphs</b>	06
	Introduction, Graph Terminologies, Representation, Graph Traversals – Depth First Search (DFS) and Breadth First Search (BFS), Application – Topological Sorting	
06	<b>Sorting and Searching</b>	07
	Introduction, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort. Linear Search, Binary Search, Hashing – Concept, Hash Functions, Collision Handling Techniques.	

**Text Books:**

1. Data Structures using C, Reema Thareja, Oxford
2. Data Structures using C and C++, Rajesh K Shukla, Wiley - India
3. Data Structures Using C, Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, Pearson
4. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg & Behrouz A., Forouzan, Second Edition, CENGAGE Learning
5. Introduction to Data Structure and Its Applications, JeanPaul Tremblay, P. G. Sorenson

**Reference Books:**

1. C & Data Structures, Prof. P.S. Deshpande, Prof. O.G. Kakde, DreamTech press.
2. Data Structure Using C, Balagurusamy.
3. Data Structures Using C, ISRD Group, Second Edition, Tata McGraw-Hill.
4. Data Structures, Adapted by: GAV PAI, Schaum's Outlines.

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

- 1 Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules

Lab Code	Lab Name	Credits
CSL301	Digital System Lab	1

### Lab Outcome:

1. Understand the basics of various digital components.
2. Understand the principles of design of combinational logic and sequential logic circuits using basic components.
3. Recognize the importance of digital systems in computer architecture.
4. Design and simulate the basic digital circuit.

### Description

Experiments with Logic Building Blocks using SSI/MSI, Experiments on Design and/or use Minimization tools. Use of VHDL and simulation in Logic Design. Experiment on design using MSI and/or PLDs tools.

### Suggested List of Experiments:

Sr. No.	Title of Experiments
1	To study and verify the truth table of various logic gates using ICs and realize Boolean expressions using gates
2	To realize basic gates using universal gates
4	To realize binary to gray code and gray code to binary converter.
5	To realize parity generator and detector.
6	To realize arithmetic circuits i) Half adder ii) Full adder iii) Half subtractor iv) Full subtractor
7	To realize 2 bit magnitude comparator.
8	To Study multiplexer IC and realization of full adder using multiplexer IC
9	To Study decoder IC and realization of combinational logic using decoder IC
10	Study of flip-flops using IC's
11	To realize asynchronous 3 bit up counter.
12	To realize shift registers using flip flops
13	To realize basic gates using VHDL



14	To realize 4:1 multiplexer using VHDL
15	To realize 4 bit counter using VHDL

**Term Work:**

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

**Oral & Practical exam** will be based on the above and CSC302: Digital Logic Design and Analysis syllabus.

Lab Code	Lab Name	Credits
<b>CSL302</b>	<b>Basic Electronics Lab</b>	<b>1</b>

**Lab Outcome:**

1. Understand the basics of various semiconductor devices, electronic components and instruments.
2. Understand the working of electronic circuits using components
3. Recognize the importance of electronic circuits in electronic communications.
4. Study the fundamental concepts of various modulation methods.

**Description**

Experiments with semiconductor devices, ICs, electronic component and various measuring instruments. Study experiments on various modulation methods.

**Suggested List of Experiments:**

Sr. No.	List Experiments
1	Study of electronic components and measuring instruments.
2	Implementation of single stage BJT amplifier.
3	Implementation of oscillators.
4	Implementation of inverting, non inverting amplifier using IC741.
5	Implementation of adder and subtractor using IC 741.
6	Implementation of differentiator using IC741.
7	Implementation of integrator using IC741.
8	Modulation and Demodulation of AM.
9	Study of super heterodyne receiver
10	Modulation and Demodulation PAM.
11	Modulation and Demodulation PWM.
12	Modulation and Demodulation PPM.
13	Modulation and Demodulation PCM.
14	Study of TDM.

15	Study of FDM.
16	SPICE based simulation.

**Term Work:**

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

**Oral exam** will be based on the above mentioned experiment list and CSC304: Electronic circuits and communication fundamentals syllabus.

Lab Code	Lab Name	Credits
<b>CSL303</b>	<b>Data Structures Lab</b>	<b>1</b>

**Lab outcomes:**

1. Students will be able to implement various linear and nonlinear data structures.
2. Students will be able to handle operations like insertion, deletion, searching and traversing on various data structures.

**Description:** Experiments based on creating and manipulating various data structures.

**Suggested Experiments:**

Students are required to complete at least 12 experiments.

Star (\*) marked experiments are compulsory.

- \*1) Array Implementation of Stack.
- \*2) Conversion of Infix to Postfix.
- 3) Evaluation of Postfix Expression.
- 4) Check continuity of different types of parenthesis using stack.
- 5) Array Implementation of Queue.
- \*6) Array Implementation of Circular Queue.
- 7) Array Implementation of Priority Queue
- \*8) Implementation of Singly Linked List
- 9) Linked Implementation of Stack
- 10) Linked Implementation of Queue.
- 11) Implementation of Circular Linked List.
- 12) Implementation of Doubly Linked List.
- \*13) Implement Binary Search Tree.
- 14) Implementation of Bubble Sort.
- 15) Implementation of Insertion Sort.
- 16) Implementation of Merge Sort.
- \*17) Implementation of Quick Sort.
- \*18) Implementation of Binary Search.
- 19) Implementation of Hashing.
- 20) Implementation of Depth First Search and Breadth First Search.

**Term Work:**

1. Term work should consist of at least 10 experiments.
2. Journal must include at least 2 assignments.
3. A case study should be conducted using a Mini Project by taking a good problem definition and complete the following phases.
  - a. Decomposing the problem into modules
  - b. Identifying the best suited data structure for solving the sub problems with justification
  - c. Define algorithms for various identified functions
  - d. Implement the modules
4. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
5. Term Work:  
Total 25 Marks = (Experiments: 10 mark + Mini Project: 05 mark + Assignments: 05 mark)

**Practical and oral** examination will be based on the above syllabus.

Lab Code	Lab Name	Credits
CSL304	OOPM (JAVA) Lab	2

**Course Objective:**

1. To learn the object oriented programming concepts.
2. To study various java programming concept like multithreading, exception handling, packages etc.
3. To explain components of GUI based programming.

**Course Outcomes: At the end of the course Student should be able:**

1. To apply fundamental programming constructs.
2. To illustrate the concept of packages, classes and objects.
3. To elaborate the concept of strings, arrays and vectors.
4. To implement the concept of inheritance and interfaces.
5. To implement the notion of exception handling and multithreading.
6. To develop GUI based application.

**Prerequisite:** Structured Programming Approach

Sr. No.	Module	Detailed Content	Hours
1	Introduction to Object Oriented Programming	1.1 OOP Concepts: Object, Class, Encapsulation, Abstraction, Inheritance, Polymorphism. 1.2 Features of Java, JVM 1.3 Basic Constructs/Notions: Constants, variables and data types, Operators and Expressions, Revision of Branching and looping	02
2	Classes, Object and Packages	2.1 Class, Object, Method. 2.2 Constructor, Static members and methods 2.3 Passing and returning Objects 2.4 Method Overloading 2.5 Packages in java, creating user defined packages, access specifiers.	05
3	Array, String and Vector	3.1 Arrays, Strings, String Buffer 3.2 Wrapper classes, Vector	04
4	Inheritance and Interface	4.1 Types of Inheritance, super keyword, Method Overriding, abstract class and abstract method, final keyword, 4.2 Implementing interfaces, extending interfaces	03
5	Exception Handling and Multithreading	5.1 Error vs Exception, try, catch, finally, throw, throws, creating own exception 5.2 Thread lifecycle, Thread class methods, creating threads, Synchronization	04
6	GUI programming in JAVA	6.1 Applet: Applet life cycle, Creating applets, Graphics class methods, Font and Color class, parameter passing.	08

		6.2 Event Handling: Event classes and event listener 6.3 Introduction to AWT: Working with windows, Using AWT controls- push Buttons, Label, Text Fields, Text Area, Check Box, and Radio Buttons. 6.4 Programming using JDBC: Introduction to JDBC, JDBC Drivers & Architecture.	
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**Text books:**

1. Herbert Schildt, 'JAVA: The Complete Reference', Ninth Edition, Oracle Press.
2. Sachin Malhotra and Saurabh Chaudhary, "Programming in Java", Oxford University Press, 2010

**Reference Books:**

1. Ivor Horton, 'Beginning JAVA', Wiley India.
2. DietalandDietal, 'Java: How to Program', 8/e, PHI
3. 'JAVA Programming', Black Book, Dreamtech Press.
4. 'Learn to Master Java programming', Staredusolutions

**Digital Material:**

1. [www.nptelvideos.in](http://www.nptelvideos.in)
2. [www.w3schools.com](http://www.w3schools.com)
3. <http://spoken-tutorial.org>
4. [www.staredusolutions.org](http://www.staredusolutions.org)

**Suggested List of Programming Assignments/Laboratory Work:**

1.	Program on various ways to accept data through keyboard and unsigned right shift operator.
2.	Program on branching, looping, labelled break and labelled continue.
3.	Program to create class with members and methods, accept and display details for single object.
4.	Program on constructor and constructor overloading
5.	Program on method overloading
6.	Program on passing object as argument and returning object
7.	Program on creating user defined package
8.	Program on 1D array
9.	Program on 2D array

10.	Program on String
11.	Program on StringBuffer
12.	Program on Vector
13.	Program on single and multilevel inheritance (Use super keyword)
14.	Program on abstract class
15.	Program on interface demonstrating concept of multiple inheritance
16.	Program on dynamic method dispatch using base class and interface reference.
17.	Program to demonstrate try, catch, throw, throws and finally.
18.	Program to demonstrate user defined exception
19.	Program on multithreading
20.	Program on concept of synchronization
21.	Program on Applet to demonstrate Graphics, Font and Color class.
22.	Program on passing parameters to applets
23.	Program to create GUI application without event handling using AWT controls
24.	Program to create GUI application with event handling using AWT controls
25.	Mini Project based on content of the syllabus. (Group of 2-3 students)

**Term Work:**

Students will submit term work in the form of journal that will include:

1. At least 16-18 programs and mini project
2. Two assignments covering whole syllabus

**Term Work:** 50 Marks (Total Marks) = 20 marks (Experiments) +  
20 marks (Mini Project) +  
05 marks (Assignments) +  
05 marks (Attendance)

**Practical and oral** examination will be based on suggested practical list and entire syllabus.



Course Code	Course Name	Credits
<b>CSC401</b>	<b>Applied Mathematics-IV</b>	<b>5</b>

**Course Objectives:** The objectives of this course are to teach the students:

1. Matrix theory, and it's application to find the matrix function. Present methods of computing and using Eigen values and Eigen vectors.
2. Set up and directly evaluate contour integrals Cauchy's integral theorem and formula in basic and extended form. Present Taylor and Laurent's series to find singularities zero's and poles also presents residues theory
3. Theory of probability, Baye's Theorem, Expectation and Moments and it's application.
4. Probability distribution such as Binomial, Poisson and Normal distribution with their properties.
5. Sampling theory and it's application for small and large sample and Optimization techniques.

**Course Outcomes:**

1. Students in this course will be able to apply the method of solving complex integration, computing residues & evaluate various contour integrals.
2. Demonstrate ability to manipulate matrices and compute Eigen values and Eigen vectors.
3. Apply the concept of probability distribution to the engineering problems.
4. Apply the concept of sampling theory to the engineering problems.
5. Use matrix algebra with its specific rules to solve the system of linear equation, using concept of Eigen value and Eigen vector to the engineering problems.
6. Apply the concept of Linear & Non-Linear Programming Problem to the engineering problems.

Module No.	Unit No.	Topics	Hrs.
<b>1.0</b>		<b>Complex Integration</b>	<b>10</b>
	<b>1.1</b>	Complex Integration – Line Integral, Cauchy's Integral theorem for simply connected regions, Cauchy's Integral formula(without proof)	
	<b>1.2</b>	Taylor's and Laurent's series ( without proof)	
	<b>1.3</b>	Zeros, poles of f(z), Residues, Cauchy's Residue theorem.	
	<b>1.4</b>	Applications of Residue theorem to evaluate Integrals of the type $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta, \int_{-\infty}^{\infty} f(x)dx$	
<b>2.0</b>		<b>Matrices</b>	<b>10</b>
	<b>2.1</b>	Eigen values and Eigen vectors.	
	<b>2.2</b>	Cayley-Hamilton theorem(without proof)	
	<b>2.3</b>	Similar matrices, diagonalisable matrix.	
	<b>2.4</b>	Derogatory and non-derogatory matrices, Functions of square matrix.	

<b>3.0</b>		<b>Probability</b>	<b>10</b>
	<b>3.1</b>	Baye's Theorem	
	<b>3.2</b>	<b>Random Variables:</b> Discrete & continuous random variables, expectation, Variance, Probability Density Function & Cumulative Density Function.	
	<b>3.3</b>	Moments & Moment generating function.	
	<b>3.4</b>	<b>Probability distribution:</b> Binomial distribution, Poisson & Normal distribution. (For detail study)	
<b>4.0</b>		<b>Sampling Theory (Large Sample test)</b>	<b>06</b>
	<b>4.1</b>	Sampling Distribution, Test of Hypothesis, Level of significance, Critical region, One Tailed and Two Tailed test,	
	<b>4.2</b>	Test of significant for Large Samples:-Means of the samples and test of significant of means of two large samples.	
<b>5.0</b>		<b>Sampling Theory (Small Sample test)</b>	<b>06</b>
	<b>5.1</b>	Test of significant for small samples:- Students t- distribution for dependent and independent samples	
	<b>5.2</b>	Chi square test:- Test of goodness of fit and independence of attributes,Contingency table.	
<b>6.0</b>		<b>Mathematical Programming</b>	<b>10</b>
	<b>6.1</b>	Types of solution, Standard and Canonical form of LPP, Basic and feasible solutions, simplex method.	
	<b>6.2</b>	Artificial variables, Big –M method (method of penalty).	
	<b>6.3</b>	Duality and Dual simplex method.	
	<b>6.4</b>	Non Linear Programming Problems with equality constrains and inequality Constrains (two or three variables with one constrains) (No formulation, No Graphical method).	
		<b>Total</b>	<b>52</b>

**Text Books:**

1. Higher Engineering Mathematics by Grewal B. S. 38<sup>th</sup> edition, Khanna Publication 2005.
2. Operation Research by Hira & Gupta,S Chand.
3. A Text Book of Applied Mathematics Vol. I & II by P.N.Wartilar &
4. J.N.Wartikar, Pune, Vidyarthi Griha Prakashan., Pune.
5. Probability and Statistics for Engineering, Dr. J Ravichandran, Wiley-India.

**Reference Books:**

1. Probability & Statistics with reliability by Kishor s. Trivedi, Wiley India.
2. Advanced Engg. Mathematics by C. Ray Wylie & Louis Barrett.TMH International Edition.
3. Mathematical Methods of Science and Engineering by Kanti B. Datta, Cengage Learning.
4. Advanced Engineering Mathematics by Kreyszig E. 9<sup>th</sup> edition, John Wiley.
5. Operations Research by S.D. Sharma Kedar Nath, Ram Nath & Co. Meerat.
6. Engineering optimization (Theory and Practice) by Singiresu S.Rao, New Age International publication.

**Assessment:****Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

Course Code	Course Name	Credits
CSC402	Analysis of Algorithms	4

**Course Objectives:**

4. To provide mathematical approach for Analysis of Algorithms
5. To solve problems using various strategies
6. To analyse strategies for solving problems not solvable in polynomial time.

**Course Outcomes:** At the end of the course student will be able to

1. Analyze the running time and space complexity of algorithms.
2. Describe, apply and analyze the complexity of divide and conquer strategy.
3. Describe, apply and analyze the complexity of greedy strategy.
4. Describe, apply and analyze the complexity of dynamic programming strategy.
5. Explain and apply backtracking, branch and bound and string matching techniques to deal with some hard problems.
6. Describe the classes P, NP, and NP-Complete and be able to prove that a certain problem is NP-Complete.

**Prerequisites:** Students should be familiar with concepts of Data structure and discrete structures.

Module	Detailed Content	Hours
1	<p><b>Introduction to analysis of algorithm</b>  Performance analysis , space and time complexity  Growth of function – Big –Oh ,Omega , Theta notation  Mathematical background for algorithm analysis,  Analysis of selection sort , insertion sort.</p> <p><b>Recurrences:</b>  -The substitution method  -Recursion tree method  -Master method</p> <p><b>Divide and Conquer Approach:</b>  General method  Analysis of Merge sort, Analysis of Quick sort, Analysis of Binary search,  Finding minimum and maximum algorithm and analysis, Strassen’s matrix multiplication</p>	12
2	<p><b>Dynamic Programming Approach:</b>  General Method  Multistage graphs  single source shortest path  all pair shortest path  Assembly-line scheduling  0/1 knapsack  Travelling salesman problem  Longest common subsequence</p>	08
3	<p><b>Greedy Method Approach:</b></p>	06

	General Method Single source shortest path Knapsack problem Job sequencing with deadlines Minimum cost spanning trees-Kruskal and prim's algorithm Optimal storage on tapes	
4	<b>Backtracking and Branch-and-bound:</b> General Method 8 queen problem( N-queen problem) Sum of subsets Graph coloring 15 puzzle problem, Travelling salesman problem.	08
5	<b>String Matching Algorithms:</b> The naïve string matching Algorithms The Rabin Karp algorithm String matching with finite automata The knuth-Morris-Pratt algorithm	06
6	<b>Non-deterministic polynomial algorithms:</b> Polynomial time, Polynomial time verification NP Completeness and reducibility NP Completeness proofs Vertex Cover Problems Clique Problems	08

### Text Books:

1. T.H.coreman , C.E. Leiserson,R.L. Rivest, and C. Stein, "Introduction to algorithms", 2nd edition , PHI publication 2005.
2. Ellis horowitz , Sartaj Sahni , S. Rajsekar. "Fundamentals of computer algorithms" University Press

### Reference Books:

1. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw- Hill Edition.
2. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI.
3. John Kleinberg, Eva Tardos, "Algorithm Design", Pearson.
4. Michael T. Goodrich, Roberto Tamassia, "Algorithm Design", Wiley Publication.

## **Assessment:**

### **Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

### **End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules..

Course Code	Course Name	Credit
<b>CSC403</b>	<b>Computer Organization and Architecture</b>	<b>4</b>

**Course Objectives:**

1. To have a thorough understanding of the basic structure and operation of a digital computer.
2. To discuss in detail the operation of the arithmetic unit including the algorithms & implementation of fixed-point and floating-point addition, subtraction, multiplication & division.
3. To study the different ways of communicating with I/O devices and standard I/O interfaces.
4. To study the hierarchical memory system including cache memories and virtual memory.

**Course Outcomes:** At the end of the course student should be able-

1. To describe basic structure of the computer system.
2. To demonstrate the arithmetic algorithms for solving ALU operations.
3. To describe instruction level parallelism and hazards in typical processor pipelines.
4. To describe superscalar architectures, multi-core architecture and their advantages
5. To demonstrate the memory mapping techniques.
6. To Identify various types of buses, interrupts and I/O operations in a computer system

**Prerequisite:** Digital Logic Design and Application

Sr. No.	Module	Detailed Content	Hours
1	<u>Introduction</u>	<u>Overview of Computer Architecture &amp; Organization</u> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Basic organization of computer</li> <li>• Block level description of the functional units.</li> </ul> <u>Data Representation and Arithmetic Algorithms:</u> <ul style="list-style-type: none"> <li>• Integer Data computation: Addition, Subtraction. Multiplication: unsigned multiplication, Booth's algorithm.</li> <li>• Division of integers: Restoring and non restoring division</li> <li>• Floating point representation. IEEE 754 floating point number representation.</li> <li>• Floating point arithmetic: Addition, Subtraction, Multiplication, Division</li> </ul>	08
2	<u>Processor Organization and Architecture</u>	<ul style="list-style-type: none"> <li>• Von Neumann model, Harvard Architecture</li> <li>• Register Organization, Instruction formats, addressing modes, instruction cycle. Instruction interpretation and sequencing.</li> <li>• ALU and Shifters</li> <li>• Basic pipelined datapath and control, Data dependences, data hazards, Branch hazards, delayed branches, branch prediction</li> <li>• Performance measures – CPI, speedup, efficiency, throughput and Amdahl's law</li> </ul>	10

3	<u>Control Unit Design</u>	<ul style="list-style-type: none"> <li>• Hardwired control unit design methods: State table, delay element, sequence counter with examples like control unit for multiplication and division</li> <li>• Microprogrammed control Unit: Microinstruction sequencing and execution. Micro operations, Wilkie's microprogrammed Control Unit, Examples on microprograms</li> </ul>	08
4	<u>Memory Organization</u>	<ul style="list-style-type: none"> <li>• Classifications of primary and secondary memories. Types of RAM (SRAM, DRAM, SDRAM, DDR, SSD) and ROM, Characteristics of memory, Memory hierarchy: cost and performance measurement.</li> <li>• Virtual Memory: Concept, Segmentation and Paging, Address translation mechanism.</li> <li>• Interleaved and Associative memory.</li> <li>• Cache memory Concepts, Locality of reference, design problems based on mapping techniques. Cache Coherency, Write Policies</li> </ul>	12
5	<u>I/O Organization and Peripherals</u>	<ul style="list-style-type: none"> <li>• Common I/O device types and characteristics</li> <li>• Types of data transfer techniques: Programmed I/O, Interrupt driven I/O and DMA.</li> <li>• Introduction to buses, Bus arbitration and multiple bus hierarchy</li> <li>• Interrupt types, Interrupts handling</li> </ul>	06
6	<u>Advanced Processor Principles</u>	<ul style="list-style-type: none"> <li>• Introduction to parallel processing, Flynn's Classification</li> <li>• Concepts of superscalar architecture, out-of-order execution, speculative execution, multithreaded processor, VLIW, data flow computing.</li> <li>• Introduction to Multi-core processor architecture</li> </ul>	08

#### **Text Books:**

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Pearson Publication, 10<sup>th</sup> Edition, 2013
2. John P. Hayes, "Computer Architecture and Organization", McGraw-Hill, 1988
3. B. Govindarajulu, "Computer Architecture and Organization: Design Principles and Applications", Second Edition, McGraw-Hill (India),

#### **Reference Books:**

1. Andrew S. Tanenbaum "Structured Computer Organization", Pearson, Sixth Edition
2. Morris Mano. "Computer System Architecture" Pearson Publication, 3<sup>rd</sup> Edition, 2007
3. Kai Hwang, Fayé Alayé Briggs. "Computer architecture and parallel processing", McGraw-Hill
4. P. Pal Chaudhuri. "Computer Organization and Design" Prentice Hall India, 2004
5. Dr. M. Usha, T.S. Shrikant. "Computer System Architecture and Organization" Wiley India, 2014.



**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
<b>CSC404</b>	<b>Computer Graphics</b>	<b>4</b>

### Course Objectives

- 1 To equip students with the fundamental knowledge and basic technical competence in the field of computer graphics.
- 2 To emphasize on implementation aspect of Computer Graphics Algorithms.
- 3 To prepare the student for advance areas like Image Processing or Computer Vision or Virtual Reality and professional avenues in the field of Computer Graphics.

**Course Outcomes :** At the end of the course , the students should be able to

- 1 Understand the basic concepts of Computer Graphics.
- 2 Demonstrate various algorithms for scan conversion and filling of basic objects and their comparative analysis.
- 3 Apply geometric transformations, viewing and clipping on graphical objects.
- 4 Explore solid model representation techniques and projections.
- 5 Understand visible surface detection techniques and illumination models.

**Prerequisite:** Knowledge of C Programming, Basic Data Structures and Mathematics.

Module No	Detail Syllabus	Hours
1	<p><b>Introduction and Overview of Graphics System:</b></p> <ul style="list-style-type: none"> <li>• Definition and Representative uses of computer graphics, classification of application areas, Overview of coordinate systems ,definition of scan conversion, rasterization and rendering.</li> <li>• Raster scan &amp; random scan displays, Flat Panel displays like LCD and LED , architecture of raster graphics system with display processor, architecture of random scan systems.</li> </ul>	03
2	<p><b>Output Primitives :</b></p> <ul style="list-style-type: none"> <li>• Scan conversions of point,line, circle and ellipse : DDA algorithm and Bresenham algorithm for line drawing, midpoint algorithm for circle, midpoint algorithm for ellipse drawing ( Mathematical derivation for above algorithms is expected )</li> <li>• Aliasing , Antialiasing techniques like Pre and post filtering , super sampling , and pixel phasing ).</li> <li>• Filled Area Primitive: Scan line Polygon Fill algorithm, Inside outside tests, Boundary Fill and Flood fill algorithm.</li> </ul>	12
3	<p><b>Two Dimensional Geometric Transformations</b></p> <ul style="list-style-type: none"> <li>• Basic transformations : Translation , Scaling , Rotation</li> <li>• Matrix representation and Homogeneous Coordinates</li> <li>• Composite transformation</li> <li>• Other transformations : Reflection and Shear</li> <li>• Raster method for transformation.</li> </ul>	06

4	<b>Two Dimensional Viewing and Clipping</b> <ul style="list-style-type: none"> <li>Viewing transformation pipeline and Window to Viewport coordinate transformation</li> <li>Clipping operations – Point clipping , Line clipping algorithms : Cohen – Sutherland , Midpoint subdivision , Liang – Barsky , Polygon Clipping Algorithms : Sutherland – Hodgeman, Weiler – Atherton.</li> </ul>	08
5	<b>Three Dimensional Object Representations , Geometric Transformations and 3D Viewing</b> <ul style="list-style-type: none"> <li>Boundary Representation and Space partitioning representation: Polygon Surfaces , Bezier Curve , Bezier Surface , B-Spline Curve , Sweep Representation, Constructive Solid Geometry ,Octree, Fractal-Geometry : Fractal Dimension, Koch Curve.</li> <li>3D Transformations :Translation, Rotation , Scaling and Reflection.</li> <li>Composite transformations :Rotation about an arbitrary axis</li> <li>3D transformation pipeline</li> <li>Projections – Parallel , Perspective.( Matrix Representation )</li> <li>3D clipping.</li> </ul>	12
6	<b>Visible Surface Detection</b> <ul style="list-style-type: none"> <li>Classification of Visible Surface Detection algorithm</li> <li>Back Surface detection method</li> <li>Depth Buffer method</li> <li>Depth Sorting method</li> <li>Scan line method</li> <li>Area Subdivision method</li> </ul>	04
7	<b>Illumination Models and Surface Rendering</b> <ul style="list-style-type: none"> <li>Basic Illumination Models : Diffused reflection, Phong Specular reflection Model</li> <li>Halftone and Dithering techniques</li> <li>Polygon Rendering :Constant shading , Gouraud Shading , Phong Shading.</li> </ul>	03

**Text Books:**

1. “Computer Graphics” C version by Hearn & Baker, 2<sup>nd</sup> Edition, Pearson
2. “Computer Graphics Principles and Practice in C , 2nd Edition ,James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, Pearson .
3. “Computer Graphics”, by Rajesh K. Maurya, Wiley India Publication.
4. “Computer Graphics “ , by Samit Bhattacharya , Oxford Publication.

**Reference Books:**

1. “Procedural Elements for Computer Graphics “ by D. Rogers , Tata McGraw-Hill Publications.
2. “Computer Graphics” , by Zhigang Xiang , Roy Plastock , Schaum’s Outlines McGraw-Hill Education
3. “Computer Graphics using OpenGL” , by F.S.Hill , Jr. ,Third edition, Pearson Publications.

**Assessment:****Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC405	Operating System	4

**Course Objectives:**

1. To introduce basic concepts and functions of operating systems.
2. To understand the concept of process, thread and resource management.
3. To understand the concepts of process synchronization and deadlock.
4. To understand various Memory, I/O and File management techniques.

**Course Outcomes:** At the end of the course student should be able to

1. Understand role of Operating System in terms of process, memory, file and I/O management.
2. Apply and analyse the concept of a process, thread, mutual exclusion and deadlock.
3. Evaluate performance of process scheduling algorithms and IPC.
4. Apply and analyse the concepts of memory management techniques.
5. Evaluate the performance of memory allocation and replacement techniques.
6. Apply and analyze different techniques of file and I/O management.

**Prerequisite:** Computer Organization & Architecture

Sr No	Module	Detailed Content	Hours
1	<b>Operating System Overview</b>	Operating System Objectives and Functions, The Evolution of Operating Systems, OS Design Considerations for Multiprocessor and Multicore architectures, Operating system structures, System Calls, Linux Kernel and Shell.	8 hrs
2	<b>Process Concept and Scheduling</b>	<p><b>Process:</b> Concept of a Process, Process States, Process Description, Process Control Block, Operations on Processes.</p> <p><b>Threads:</b> Definition and Types, Concept of Multithreading, Multicore processors and threads.</p> <p><b>Scheduling:</b> Uniprocessor Scheduling - Types of Scheduling: Preemptive and, Non-preemptive, Scheduling Algorithms: FCFS, SJF, SRTN, Priority based, Round Robin, Multilevel Queue scheduling. Introduction to Thread Scheduling, Multiprocessor Scheduling and Linux Scheduling.</p>	8 hrs

3	<b>Synchronization and Deadlocks</b>	<p><b>Concurrency:</b> Principles of Concurrency, Inter-Process Communication, Process/Thread Synchronization.</p> <p><b>Mutual Exclusion:</b> Requirements, Hardware Support, Operating System Support (Semaphores and Mutex), Programming Language Support (Monitors), Classical synchronization problems: Readers/Writers Problem, Producer and Consumer problem.</p> <p><b>Principles of Deadlock:</b> Conditions and Resource Allocation Graphs, Deadlock Prevention, Deadlock Avoidance: Banker's Algorithm for Single &amp; Multiple Resources, Deadlock Detection and Recovery. Dining Philosophers Problem.</p>	12 hrs
4	<b>Memory Management</b>	<p><b>Memory Management:</b> Memory Management Requirements, Memory Partitioning: Fixed Partitioning, Dynamic Partitioning, Memory Allocation Strategies: Best-Fit, First Fit, Worst Fit, Next Fit, Buddy System, Relocation. Paging, Segmentation.</p> <p><b>Virtual Memory:</b> Hardware and Control Structures, Demand Paging, Structure of Page Tables, Copy on Write, Page Replacement Strategies: FIFO, Optimal, LRU, LFU, Approximation, Counting Based. Allocation of frames, Thrashing.</p>	8 hrs
5	<b>File Management</b>	<p><b>File Management:</b> Overview, File Organization and Access, File Directories, File Sharing, Secondary Storage Management, Linux Virtual File System.</p>	6 hrs
6	<b>Input /Output Management</b>	<p><b>I/O Management and Disk Scheduling:</b> I/O Devices, Organization of the I/O Function, Operating System Design Issues, I/O Buffering, Disk Scheduling algorithm: FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK. Disk Management, Disk Cache, Linux I/O.</p>	6 hrs

**Text Books:**

1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918 .
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons , Inc., 9th Edition, 2016, ISBN 978-81-265-5427-0
3. Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rd Edition.
4. D.M Dhamdhere, Operating Systems: A Concept Based Approach, Mc-Graw Hill

**Reference Books:**

1. Maurice J. Bach, “Design of UNIX Operating System”, PHI
2. Achyut Godbole and Atul Kahate, Operating Systems, Mc Graw Hill Education, 3rd Edition
3. The Linux Kernel Book, Remy Card, Eric Dumas, Frank Mevel, Wiley Publications.

**Assessment:****Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Lab Code	Lab Name	Credit
<b>CSL401</b>	<b>Analysis of Algorithms Lab</b>	<b>1</b>

**Lab outcomes:** At the end of the course student will be able to

1. Analyze the complexities of various problems in different domains.
2. Prove the correctness and analyze the running time of the basic algorithms for those classic problems in various domains.
3. Develop the efficient algorithms for the new problem with suitable designing techniques.
4. Implement the algorithms using different strategies.

**Prerequisites:** Students should be familiar with concepts of Data structure and Discrete structures.

**Description:**

Minimum 2 experiments should be implemented using any language on each algorithm design strategy (Divide and conquer, dynamic programming, Greedy method, backtracking and branch & bound, string matching).

**Suggested Laboratory Experiments:**

Sr. No.	Module Name	Suggested Experiment List
1	Introduction to analysis of algorithm Divide and Conquer Approach	Selection sort , insertion sort. Merge sort, Quick sort, Binary search.
2	Dynamic Programming Approach	Multistage graphs, single source shortest path, all pair shortest path, 0/1 knapsack, Travelling salesman problem, Longest common subsequence.
3	Greedy Method Approach	Single source shortest path, Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees-Kruskal and prim's algorithm, Optimal storage on tapes.
4	Backtracking and Branch-and-bound	8 queen problem ( N-queen problem), Sum of subsets, Graph coloring, 15 puzzle problem, Travelling salesman problem.



5	String Matching Algorithms	The naïve string matching Algorithms, The Rabin Karp algorithm, String matching with finite automata, The knuth-Morris-Pratt algorithm.
6	Any two Experiments	This will involve implementation of two algorithms for problems beyond the scope of syllabus. The exact set of algorithms to implement is to be decided by the course instructor.

**Text Books:**

1. T.H.Coreman , C.E. Leiserson,R.L. Rivest, and C. Stein, “Introduction to algorithms”, 2nd edition , PHI publication 2005.
2. Ellis horowitz , sartaj Sahni , s. Rajsekar. “Fundamentals of computer algorithms” University Press

**Reference Books:**

1. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, “Algorithms”, Tata McGraw- Hill Edition.
2. S. K. Basu, “Design Methods and Analysis of Algorithm”, PHI.
3. Dana Vrajittoru and William Knight, “Practical Analysis of Algorithms”, Springer 2014<sup>th</sup> Edition.

**Term Work:**

Laboratory work must contain implementation of minimum 10 experiments. The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing marks in term work. The 25 marks of the term work should be divided as below:

25 Marks (total marks) = 15 Marks Lab. Experiments + 05 Marks Assignments (based on theory syllabus) + 05 (Attendance: theory + practical)

**Oral & Practical Exam** will be based on the experiments implemented in the Laboratory.

Lab Code	Lab Title	Credit
<b>CSL402</b>	<b>Computer Graphics Lab</b>	<b>1</b>

### Lab Objectives

- 1 To emphasize on implementation aspect of Computer Graphics Algorithm.
- 2 To prepare students for advanced areas like Animation, image processing ,virtual reality etc

**Lab Outcomes :** At the end of the course , the students should be able to

- 1 Explore the working principle, utility of various input/ output devices and graphical tools.
- 2 Implement various output and filled area primitive algorithms using C/ OpenGL
- 3 Apply transformation and clipping algorithms on graphical objects.
- 4 Implementation of curve and fractal generation.
- 5 Develop a Graphical application based on learned concept.

### Content:

Scan conversions: lines, circles, ellipses. Filling algorithms, clipping algorithms. 2D and 3D transformation. Curves. Visible surface determination. Simple animations Application of these through exercises in C/C++/ Open GL

### List of Desirable Experiments:

1. Study and apply basic opengl functions to draw basic primitives. (\*)
2. Implement sierpinsky gasket using openGL.
3. Implement DDA Line Drawing algorithms and Bresenham algorithm(\*)
4. Implement midpoint Circle algorithm(\*)
5. Implement midpoint Ellipse algorithm
6. Implement Area Filling Algorithm: Boundary Fill, Flood Fill ,Scan line Polygon Fill (\*)
7. Implement Curve : Bezier for n control points , B Spline (Uniform ) ( atleast one)(\*)
8. Implement Fractal (Koch Curve)
9. Character Generation : Bit Map method and Stroke Method
10. Implement 2D Transformations: Translation, Scaling, Rotation, Reflection, Shear.(\*)
11. Implement Line Clipping Algorithm: Cohen Sutherland / Liang Barsky.(\*)
12. Implement polygon clipping algorithm(atleast one)
13. Program to represent a 3D object using polygon surfaces and then perform 3D transformation.
14. Program to perform projection of a 3D object on Projection Plane : Parallel and Perspective.(\*)

## Term Work

1. Term work should consist of at least 12 experiments. (\*)→ Practical to be covered necessarily
2. Journal must include at least 2 assignments.
3. Mini Project to perform using C / OpenGL.

Possible Ideas:

- a. Animation using multiple object
- b. Graphics editor with following features :

\*Draw basic geometrical entities; apply geometrical transformations, Area filling, Clipping against Clip window, displaying the text, displaying bar / line graphs , pie charts etc.

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

**Term Work:** 25 Marks (Total) = 10 Marks (Experiments)

+ 5 Marks (Mini Project)

+ 5 Marks (Assignments)

+ 5 Marks (Theory + Practical Attendance).

**Oral & Practical exam** will be based on the above content and CSC404: Computer Graphics.

Lab Code	Lab Name	Credit
<b>CSL403</b>	<b>Processor Architecture Lab</b>	<b>1</b>

**Lab Objectives:**

1. To implement the operation of the arithmetic unit including the algorithms & implementation of fixed-point and floating-point addition, subtraction, multiplication & division.
2. To study the different ways of communicating with I/O devices and standard I/O interfaces.
3. To design memory subsystem including cache memory
4. To have through understanding of various computer buses

**Lab Outcomes:** At the end of the course student should be

1. Assemble personal computer
2. Design the basic building blocks of a computer: arithmetic-logic unit, registers, central processing unit, and memory.
3. Implement various algorithms like Booth's algorithm for arithmetic operations
4. Describe various I/O buses with merits and demerits.

**Prerequisite:** Digital Logic Design and Applications

**Content:**

Sr. No.	Module	Detailed Content
1	Overview of Computer Architecture & Organization	<ul style="list-style-type: none"> <li>• Computer Anatomy- Memory, Ports, Motherboard and add-on cards</li> <li>• Dismantling and assembling PC</li> </ul>
2	Programs on Data Representation and Arithmetic	<ul style="list-style-type: none"> <li>• Ripple carry adder, Carry look-ahead adder, registers, Multiplication</li> <li>• Booths Algorithm, Restoring and Non restoring Division</li> </ul>
3	Processor Organization and Architecture	<ul style="list-style-type: none"> <li>• ALU Design, CPU Design</li> <li>• Case Study on multi-core Processors</li> </ul>
4	Memory Organization	<ul style="list-style-type: none"> <li>• Memory design, Cache Memory design</li> </ul>
5	I/O Organization and Interrupts	<ul style="list-style-type: none"> <li>• Case study on buses like ISA, PCI, USB etc</li> <li>• Interrupt handling using C/Java Programming</li> </ul>

**Digital Material:**

- **Manual to use the simulator for computer organization and architecture.** Developed by the Department of CSE, IIT kharagpur (<http://cse10-iitkgp.virtual-labs.ac.in/> )

**Books:**

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Pearson Publication, 10<sup>th</sup> Edition, 2013
2. B. Govindarajulu, "Computer Architecture and Organization: Design Principles and Applications", Second Edition, McGraw-Hill (India),
6. Andrew S. Tanenbaum "Structured Computer Organization", Pearson, Sixth Edition
7. Morris Mano. "Computer System Architecture" Pearson Publication, 3<sup>rd</sup> Edition, 2007
8. Kai Hwang, Fayé Alayé Briggs. "Computer architecture and parallel processing", McGraw-Hill
9. P. Pal Chaudhuri. "Computer Organization and Design" Prentice Hall India, 2004
10. Dr. M. Usha, T.S. Shrikant. "Computer System Architecture and Organization" Wiley India, 2014.

**Term Work**

Term work should consist of at least 10-12 experiments and 3-4 assignments based on above content and CSC403: Computer Organization and Architecture

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

**Term Work:** 25 Marks (Total) = 10 Marks (Experiments)  
+ 5 Marks (Mini Project)  
+ 5 Marks (Assignments)  
+ 5 Marks (Theory + Practical Attendance).

**Oral exam** will be based on the above content and CSC403: Computer Organization and Architecture.

Lab Code	Lab Name	Credit
<b>CSL404</b>	<b>Operating System Lab</b>	<b>1</b>

**Lab Outcome:**

1. Understand basic operating system commands.
2. Understand and explore various system calls.
3. Write shell scripts and shell commands using kernel APIs.
4. Implement and analyze different process scheduling algorithms
5. Implement and analyze different memory management algorithms.
6. Evaluate process management techniques and deadlock handling using simulator.

**Descriptions:**

Sr. No	Contents
1	Explore the internal commands of linux like ls, chdir, mkdir, chown, chmod, chgrp, ps etc
2	Write shell scripts to do the following: <ul style="list-style-type: none"> <li>➤ Display top 10 processes in descending order</li> <li>➤ Display processes with highest memory usage.</li> <li>➤ Display current logged in user and logname.</li> <li>➤ Display current shell, home directory, operating system type, current path setting, current working directory.</li> <li>➤ Display OS version, release number, kernel version.</li> <li>➤ Illustrate the use of sort, grep, awk, etc.</li> </ul>
3	a) Create a child process in Linux using the fork system call. From the child process obtain the process ID of both child and parent by using getpid and getppid system call. Explore wait and waitpid before termination of process. b) Explore the following system calls: open, read, write, close, getpid, setpid, getuid, getgid, getegid, geteuid.
4	Implement basic commands of linux like ls, cp, mv and others using kernel APIs.
5	Write a program to implement any two CPU scheduling algorithms like FCFS, SJF, Round Robin etc.
6	Write a program to implement dynamic partitioning placement algorithms i.e Best Fit, First-Fit, Worst-Fit etc
7	Write a program to implement various page replacement policies.
8	Using the <b>CPU-OS simulator</b> analyze and synthesize the following: <ol style="list-style-type: none"> <li>a. Process Scheduling algorithms.</li> <li>b. Thread creation and synchronization.</li> <li>c. Deadlock prevention and avoidance.</li> </ol>

**Digital Materials:**

1. Download the CPU-OS simulator along with related tutorials from <http://www.teach-sim.com>
2. <http://www.teach-sim.com>

**Books:**

1. Linux Kernel Book, by Remy Card, Eric Dumas, Frank Mevel, Wiley India
2. Unix Concepts and Applications, Sumitabha Das, McGraw Hill.

**Term Work:**

- Term work should consist of at least 12 experiments and 2-3 assignments on above content.
- The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
- Term Work: 25 Marks (Total) = 10 Marks (Experiments)  
+ 5 Marks (Mini Project)  
+ 5 Marks (Assignments)  
+ 5 Marks (Theory + Practical Attendance).

**Oral & Practical exam** will be based on the above content and CSC405: Operating system syllabus.

Lab Code	Lab Name	Credit
<b>CSL405</b>	<b>Open Source Technology Lab</b>	<b>2</b>

**Course Outcomes:**

1. To understand basic concepts in python and perl.
2. To explore contents of files, directories and text processing with python
3. To develop program for data structure using built in functions in python.
4. To explore django web framework for developing python based web application.
5. To understand file handling and database handling using perl.
6. To explore basics of two way communication between client and server using python and perl

**Prerequisites:** Knowledge of some programming language like C, Java

**Content:**

Sr. No	Module Name	Detailed Content
1	Python basics	Data types in python ,Operators in python, Input and Output, Control statement, Arrays in python, String and Character in python, Functions, List and Tuples, Dictionaries Exception, Introduction to OOP, Classes , Objects , Interfaces, Inheritance
2	Advanced Python	Files in Python, Directories, Building Modules, Packages, Text Processing, Regular expression in python.
3	Data Structure in Python	Link List, Stack, Queues, Dequeues
4	Python Integration Primer	Graphical User interface ,Networking in Python , Python database connectivity, Introduction to Django
5	Basics of Perl	Perl Overview, Variables, Control Statements, Subroutines, Objects, Packages and Modules
6	Perl advanced	Working with Files, Data manipulation, Database Systems, Networking

**Text Books**

1. Core Python Programming, Dr. R. Nageswara Rao, Dreamtech Press
2. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox publication
3. Perl: The Complete Reference. Second Edition. Martin C. Brown, McGraw-Hill
4. Introduction to computing and problem solving using python , E Balagurusamy, McGraw Hill Education



## Reference Book

1. Perl Black Book, 2nd Edition: Steven Holzner, Dreamtech Press
2. Learn Python the Hard Way: (3rd Edition) (Zed Shaw's Hard Way Series)
3. Python Projects , Laura Cassell, Alan Gauld, wrox publication

## Digital Material:

1. "The Python Tutorial", <http://docs.python.org/release/3.0.1/tutorial/>
2. Beginning Perl, <https://www.perl.org/books/beginning-perl/>
3. <http://spoken-tutorial.org>
4. [www.staredusolutions.org](http://www.staredusolutions.org)

## Suggested experiments using Python:

1. Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples) and control statements.
2. Creating functions, classes and objects using python. Demonstrate exception handling and inheritance.
3. Exploring Files and directories
  - a. Python program to append data to existing file and then display the entire file
  - b. Python program to count number of lines, words and characters in a file.
  - c. Python program to display file available in current directory
4. Creating GUI with python containing widgets such as labels, textbox, radio, checkboxes and custom dialog boxes.
5. Menu driven program for data structure using built in function for link list, stack and queues.
6. Program to demonstrate CRUD( **create, read, update and delete**) operations on database (SQLite/MySQL) using python.
7. Creation of simple socket for basic information exchange between server and client.
8. Creating web application using Django web framework to demonstrate functionality of user login and registration (also validating user detail using regular expression).

## Suggested experiments using Perl:

10. Exploring various data type , loops and conditional statement in perl. And Creating functions, packages and modules in perl.
11. Program to demonstrate use of objects and classes in perl.
12. Program to demonstrate file handling, data manipulation and use of regular expression for text processing in perl
13. Program to send email and read content of URL.

**Term Work:**

Students will submit term work in the form of journal that will include:

1. At least 12-14 programs.
2. One mini-project in a group 2-3 student.
3. Two assignments covering whole syllabus.

**Term Work (25)** = 15 marks (Experiments & Assignments)

+ 10 marks (Mini Project)

+ 05 marks (Attendance)

**Practical and oral examination will be based on suggested practical list and entire syllabus.**

AC – 5<sup>th</sup> May, 2018

Item No. – 4.51

# UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17

Under

## FACULTY OF TECHNOLOGY

### **Computer Engineering**

**Second Year** with Effect from **AY 2017-18**

**Third Year** with Effect from **AY 2018-19**

**Final Year** with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**

with effect from the AY 2016–17

**Co-ordinator, Faculty of Technology's Preamble:**

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

**Dr. S. K. Ukarande**

**Co-ordinator,**

**Faculty of Technology,**

**Member - Academic Council**

**University of Mumbai, Mumbai**

**Chairman's Preamble:**

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

As the Chairman, Board of Studies in Computer Engineering of the University of Mumbai, I am happy to state here that, the Program Educational Objectives for Undergraduate Program were finalized in a brainstorming session, which was attended by more than 85 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Computer Engineering. The Program Educational Objectives finalized for the undergraduate program in Computer Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals.
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems.
3. To equip the Learner with broad education necessary to understand the impact of Computer Science and Engineering in a global and social context.
4. To encourage, motivate and prepare the Learner's for Lifelong- learning.
5. To inculcate professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process.

In addition to Program Educational Objectives, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

**Dr. Subhash K. Shinde**  
**Chairman, Board of Studies in Computer Engineering,**  
**University of Mumbai, Mumbai.**

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2018-19**

**T. E. Computer Engineering (Semester-V)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC501	Microprocessor	4	-	-	4	-	-	4
CSC502	Database Management System	4	-	-	4	-	-	4
CSC503	Computer Network	4	-	-	4	-	-	4
CSC504	Theory of Computer Science	3+1@	-	-	4	-	-	4
CSDLO 501X	Department Level Optional Course -I	4	-	-	4	-	-	4
CSL501	Microprocessor Lab	-	2	-	-	1	-	1
CSL502	Computer Network Lab	-	2	-	-	1	-	1
CSL503	Database & Info. System Lab	-	2	-	-	1	-	1
CSL504	Web Design Lab	-	2+2*	-	-	2	-	2
CSL505	Business Comm. & Ethics	-	2+2*	-	-	2	-	2
	<b>Total</b>	<b>20</b>	<b>14</b>	<b>-</b>	<b>20</b>	<b>7</b>	<b>-</b>	<b>27</b>

@ 1 hour to be taken tutorial as class wise.

\*2 hours shown as Practical's to be taken class wise and other 2 hours to be taken as batch wise

Course Code	Course Name	Examination Scheme							Total
		Theory					TW	Oral & Pract	
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg.					
CSC501	Microprocessor	20	20	20	80	3	-	-	100
CSC502	Database Management System	20	20	20	80	3	-	-	100
CSC503	Computer Network	20	20	20	80	3	-	-	100
CSC504	Theory of Computer Science	20	20	20	80	3	-	-	100
CSDLO 501X	Department Level Optional Course -I	20	20	20	80	3	--	-	100
CSL501	Microprocessor Lab	-	-	-	-	-	25	25	50
CSL502	Computer Network Lab	-	-	-	-	-	25	25	50
CSL503	Database & Info. System Lab	-	-	-	-	-	25	25	50
CSL504	Web Design Lab	-	-	-	-	-	25	25	50
CSL505	Business Comm. & Ethics	-	-	-	-	-	50	-	50
	<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>400</b>	<b>-</b>	<b>150</b>	<b>100</b>	<b>750</b>

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2018-19**

**T. E. Computer Engineering (Semester-VI)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC601	Software Engineering	4	-	-	4	-	-	4
CSC602	System Programming & Compiler Construction	4	-	-	4	-	-	4
CSC603	Data Warehousing & Mining	4	-	-	4	-	-	4
CSC604	Cryptography & System Security	4	-	-	4	-	-	4
CSDLO 601X	Department Level Optional Course -II	4	-	-	4	-	-	4
CSL601	Software Engineering Lab	-	2	-	-	1	-	1
CSL602	System software Lab	-	2	-	-	1	-	1
CSL603	Data Warehousing & Mining Lab	-	2	-	-	1	-	1
CSL604	System Security Lab	-	2	-	-	1	-	1
CSP605	Mini-Project	-	4	-	-	2	-	2
	<b>Total</b>	<b>20</b>	<b>12</b>	<b>-</b>	<b>20</b>	<b>6</b>	<b>-</b>	<b>26</b>

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CSC601	Software Engineering	20	20	20	80	3	-	-	-	100
CSC602	System Programming & Compiler Construction	20	20	20	80	3	-	-	-	100
CSC603	Data Warehousing & Mining	20	20	20	80	3	-	-	-	100
CSC604	Cryptography & System Security	20	20	20	80	3	-	-	-	100
CSDLO 601X	Department Level Optional Course -II	20	20	20	80	3	-	-	-	100
CSL601	Software Engineering Lab	-	-	-	-	-	25	25	--	50
CSL602	System Software Lab	-	-	-	-	-	25	--	25	50
CSL603	Data Warehousing & Mining Lab	-	-	-	-	-	25	--	25	50
CSL604	System Security Lab	-	-	-	-	-	25	---	25	50
CSP605	Mini-Project	-	-	-	-	-	25	---	25	50
	<b>Total</b>	100	100	100	400	-	125	25	100	750

**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2019-20**  
**B. E. Computer Engineering (Semester-VII)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC701	Digital Signal & Image Processing	4	-	-	4	-	-	4
CSC702	Mobile Communication & Computing	4	-	-	4	-	-	4
CSC703	Artificial Intelligence & Soft Computing	4	-	-	4	-	-	4
CSDLO 701X	Department Level Optional Course -III	4	-	-	4	-	-	4
ILO701X	Institute Level Optional Course-I	3	-	-	3	-	-	3
CSL701	Digital Signal & Image Processing Lab	-	2	-	-	1	-	1
CSL702	Mobile App. Development. Tech. Lab	-	2	-	-	1	-	1
CSL703	Artificial Intelligence & Soft Computing Lab	-	2	-	-	1	-	1
CSL704	Computational Lab-I	-	2	-	-	1	-	1
CSP705	Major Project-I	-	6	-	-	3	-	3
	<b>Total</b>	<b>19</b>	<b>14</b>	<b>-</b>	<b>19</b>	<b>7</b>	<b>-</b>	<b>26</b>

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CSC701	Digital Signal & Image Processing	20	20	20	80	3	-	--	-	100
CSC702	Mobile Communication & Computing	20	20	20	80	3	-	--	-	100
CSC703	Artificial Intelligence & Soft Computing	20	20	20	80	3	-	--	-	100
CSDLO 701X	Department Level Optional Course -III	20	20	20	80	3	-	--	-	100
ILO701X	Institute Level Optional Course-I	20	20	20	80	3	--	--	-	100
CSL701	Digital Signal & Image Processing Lab	-	-	-	-	-	25	--	--	25
CSL702	Mobile App. Development. Tech. Lab	-	-	-	-	-	25	--	25	50
CSL703	Artificial Intelligence & Soft Computing Lab	--	-	-	-	--	25	25	--	50
CSL704	Computational Lab-I						25	--	25	50
CSP705	Major Project-I	-	-	-	-	-	50	-	25	75
	<b>Total</b>	100	100	100	400		150	25	75	750



**Program Structure B.E. Computer Engineering, (Rev. 2016) w.e.f. AY 2019-20**

**B. E. Computer Engineering (Semester-VIII)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/Pract	Tut	Total
CSC801	Human Machine Interaction	4	-	-	4	-	-	4
CSC802	Distributed Computing	4	-	-	4	-	-	4
CSDLO 801X	Department Level Optional Course -IV	4	-	-	4	-	-	4
ILO801X	Institute Level Optional Course-II	3	-	-	3	-	-	3
CSL801	Human Machine Interaction Lab	-	2	-	-	1	-	1
CSL802	Distributed Computing Lab	-	2	-	-	1	-	1
CSL803	Cloud Computing Lab	-	4	-	-	2	-	2
CSL804	Computational Lab-II	-	2	-	-	1	-	1
CSP805	Major Project-II	-	12	-	-	6	-	6
	<b>Total</b>	<b>15</b>	<b>22</b>	<b>-</b>	<b>15</b>	<b>11</b>	<b>-</b>	<b>26</b>

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration ( in				
		Test 1	Test 2	Avg.						
CSC801	Human Machine Interaction	20	20	20	80	3	-	-	-	100
CSC802	Distributed Computing	20	20	20	80	3	-	-	-	100
CSDLO 801X	Department Level Optional Course -IV	20	20	20	80	3	-	-	-	100
ILO801X	Institute Level Optional Course-II	20	20	20	80	3	-	-	-	100
CSC801	Human Machine Interaction Lab						25	25	-	50
CSL802	Distributed Computing Lab	-	-	-	-	-	25	25	-	50
CSL803	Cloud Computing Lab	-	-	-	-	-	50	--	25	75
CSL804	Computational Lab-II	-	-	-	-	-	50	--	25	75
CSP805	Major Project-II						50	--	50	100
	<b>Total</b>	80	80	80	320	--	200	50	100	750

Sem.	Department Level Optional Course (DLOC)	Institute Level Optional Course (ILOC)
V	<p>CSDLO5011: Multimedia System</p> <p>CSDLO5012: Advance Operating System</p> <p>CSDLO5013: Advance Algorithm</p>	-----
VI	<p>CSDLO6021: Machine Learning</p> <p>CSDLO6022: Advance Database System</p> <p>CSDLO6023: Enterprise Resource Planning</p> <p>CSDLO6024: Advance Computer Network</p>	-----
VII	<p>CSDLO7031: Advance System Security &amp; Digital Forensics</p> <p>CSDLO7032: Big Data &amp; Analytics</p> <p>CSDLO7033: Robotics</p>	<p>ILO7011. Product Lifecycle Management</p> <p>ILO7012. Reliability Engineering</p> <p>ILO7013. Management Information System</p> <p>ILO7014. Design of Experiments</p> <p>ILO7015. Operation Research</p> <p>ILO7016. Cyber Security and Laws</p> <p>ILO7017. Disaster Management &amp; Mitigation Measures</p> <p>ILO7018. Energy Audit and Management</p> <p>ILO7019. Development Engineering</p>
VIII	<p>DLO8011: High Performance Computing</p> <p>DLO8012: Natural Language Processing</p> <p>DLO8013: Adhoc Wireless Network</p>	<p>ILO8021. Project Management</p> <p>ILO8022. Finance Management</p> <p>ILO8023. Entrepreneurship Development and Management</p> <p>ILO8024. Human Resource Management</p> <p>ILO8025. Professional Ethics and CSR</p> <p>ILO8026. Research Methodology</p> <p>ILO8027. IPR and Patenting</p> <p>ILO8028. Digital Business Management</p> <p>ILO8029. Environmental Management</p>

Course Code	Course Name	Credits
CSC501	Microprocessor	4

**Course objectives:**

1. To equip students with the fundamental knowledge and basic technical competence in the field of Microprocessors.
2. To emphasize on instruction set and logic to build assembly language programs.
3. To prepare students for higher processor architectures and Embedded systems

**Course outcomes:** On successful completion of course learner will be able to:

1. Describe architecture of x86 processors.
2. Interpret the instructions of 8086 and write assembly and Mixed language programs.
3. Explain the concept of interrupts
4. Identify the specifications of peripheral chip
5. Design 8086 based system using memory and peripheral chips
6. Appraise the architecture of advanced processors

**Prerequisite:** Digital Electronics and Logic Design

Module No.	Unit No.	Topics	Hrs.
1.0		<b>The Intel Microprocessors 8086/8088 Architecture</b>	10
	1.1	<ul style="list-style-type: none"> <li>• 8086/8088 CPU Architecture, Programmer's Model</li> <li>• Functional Pin Diagram</li> <li>• Memory Segmentation</li> <li>• Banking in 8086</li> <li>• Demultiplexing of Address/Data bus</li> <li>• Study of 8284 Clock Generator</li> <li>• Study of 8288 Bus Controller</li> <li>• Functioning of 8086 in Minimum mode and Maximum mode</li> <li>• Timing diagrams for Read and Write operations in minimum and maximum mode</li> </ul>	
2.0		<b>Instruction Set and Programming</b>	12
	2.1	<ul style="list-style-type: none"> <li>• Addressing Modes</li> <li>• Instruction set – Data Transfer Instructions, String Instructions, Logical Instructions, Arithmetic Instructions, Transfer of Control Instructions, Processor Control Instructions</li> <li>• Assembler Directives and Assembly Language Programming, Macros, Procedures</li> <li>• Mixed Language Programming with C Language and Assembly Language.</li> <li>• Programming based on DOS and BIOS Interrupts (INT 21H, INT 10H)</li> </ul>	
3.0		<b>8086 Interrupts</b>	6
	3.1	<ul style="list-style-type: none"> <li>• Types of interrupts</li> <li>• Interrupt Service Routine</li> <li>• Interrupt Vector Table</li> <li>• Servicing of Interrupts by 8086 microprocessor</li> <li>• Programmable Interrupt Controller 8259 – Block Diagram, Interfacing the 8259 in single and cascaded mode, Operating modes, programs for 8259 using ICWs and OCWs</li> </ul>	

<b>4.0</b>		<b>Peripherals and their interfacing with 8086</b>	<b>12</b>
	<b>4.1</b>	Memory Interfacing - RAM and ROM Decoding Techniques – Partial and Absolute	
	<b>4.2</b>	8255-PPI – Block diagram, Functional PIN Diagram, CWR, operating modes, interfacing with 8086.	
	<b>4.3</b>	8253 PIT - Block diagram, Functional PIN Diagram, CWR, operating modes, interfacing with 8086.	
	<b>4.4</b>	8257-DMAC – Block diagram, Functional PIN Diagram, Register organization, DMA operations and transfer modes	
<b>5.0</b>		<b>Intel 80386DX Processor</b>	<b>6</b>
	<b>5.1</b>	<ul style="list-style-type: none"> <li>• Architecture of 80386 microprocessor</li> <li>• 80386 registers – General purpose Registers, EFLAGS and Control registers</li> <li>• Real mode, Protected mode, virtual 8086 mode</li> <li>• 80386 memory management in Protected Mode – Descriptors and selectors, descriptor tables, the memory paging mechanism</li> </ul>	
<b>6.0</b>		<b>Pentium Processor</b>	<b>6</b>
	<b>6.1</b>	Pentium Architecture Superscalar Operation, Integer & Floating Point Pipeline Stages, Branch Prediction Logic, Cache Organisation and MESI Model	
		<b>Total</b>	<b>52</b>

### Assessment:

#### **Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

#### **End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
1. The students need to solve total 4 questions.
2. Question No.1 will be compulsory and based on entire syllabus.
3. Remaining question (Q.2 to Q.6) will be selected from all the modules.

#### **Text Books:**

1. 8086/8088 family: Design Programming and Interfacing: John Uffenbeck , PHI.
2. Advanced Microprocessors and Peripherals: K M Bhurchandani, A k Ray McGraw Hill
3. The 80386DX Microprocessor: hardware, Software and Interfacing, Walter A Triebel, Prentice Hall
4. Pentium Processor System Architecture: Tom Shanley & Don Anderson, Addison-Wesley.

#### **Reference Books:**

1. Intel Microprocessors: Barry B. Brey, 8<sup>th</sup> Edition, Pearson Education India
2. Microprocessor and Interfacing: Douglas Hall, Tata McGraw Hill.
3. Advanced MS DOS Programming – Ray Duncan BPB
4. Intel 80386 Datasheets
5. IBM PC Assembly language and Programming: Peter Abel, 5<sup>th</sup> edition, PHI
6. The Pentium Microprocessor, James Antonakons, Pearson Education

Course Code	Course Name	Credits
CSC502	Database Management System	4

**Course objectives:**

1. Learn and practice data modelling using the entity-relationship and developing database designs.
2. Understand the use of Structured Query Language (SQL) and learn SQL syntax.
3. Apply normalization techniques to normalize the database
4. Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access.

**Course outcomes:** On successful completion of course learner will be able to:

1. Understand the fundamentals of a database systems
2. Design and draw ER and EER diagram for the real life problem.
3. Convert conceptual model to relational model and formulate relational algebra queries.
4. Design and querying database using SQL.
5. Analyze and apply concepts of normalization to relational database design.
6. Understand the concept of transaction, concurrency and recovery.

**Prerequisite:**

Basic knowledge of Data structure.

Module No.	Unit No.	Topics	Hrs.
1.0		<b>Introduction Database Concepts:</b>	4
	1.1	<ul style="list-style-type: none"> <li>● Introduction, Characteristics of databases</li> <li>● File system v/s Database system</li> <li>● Users of Database system</li> </ul>	
	1.2	<ul style="list-style-type: none"> <li>● Data Independence</li> <li>● DBMS system architecture</li> <li>● Database Administrator</li> </ul>	
2.0		<b>Entity–Relationship Data Model</b>	8
	2.1	<ul style="list-style-type: none"> <li>● The Entity-Relationship (ER) Model: Entity types : Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints : Cardinality and Participation, Extended Entity-Relationship (EER) Model : Generalization, Specialization and Aggregation</li> </ul>	
3.0		<b>Relational Model and relational Algebra</b>	8
	3.1	<ul style="list-style-type: none"> <li>● Introduction to the Relational Model, relational schema and concept of keys.</li> <li>● Mapping the ER and EER Model to the Relational Model</li> </ul>	
	3.2	<ul style="list-style-type: none"> <li>● Relational Algebra – unary and set operations, Relational Algebra Queries.</li> </ul>	
4.0		<b>Structured Query Language (SQL)</b>	12
	4.1	<ul style="list-style-type: none"> <li>● Overview of SQL</li> </ul>	

		<ul style="list-style-type: none"> <li>Data Definition Commands, Data Manipulation commands, Data Control commands, Transaction Control Commands.</li> </ul>	
	4.2	<ul style="list-style-type: none"> <li>Set and string operations, aggregate function - group by, having.</li> <li>Views in SQL, joins , Nested and complex queries, Integrity constraints :- key constraints, Domain Constraints, Referential integrity , check constraints</li> </ul>	
	4.3	<ul style="list-style-type: none"> <li>Triggers</li> </ul>	
5.0		<b>Relational–Database Design</b>	8
	5.1	<ul style="list-style-type: none"> <li>Pitfalls in Relational-Database designs , Concept of normalization</li> <li>Function Dependencies , First Normal Form, 2nd , 3rd , BCNF, multi valued dependencies , 4NF.</li> </ul>	
6.0		<b>Transactions Management and Concurrency</b>	12
	6.1	<ul style="list-style-type: none"> <li>Transaction concept, Transaction states, ACID properties</li> <li>Concurrent Executions, Serializability – Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols.</li> </ul>	
	6.2	<ul style="list-style-type: none"> <li>Recovery System: Failure Classification, Log based recovery, ARIES, Checkpoint, Shadow paging.</li> <li>Deadlock handling</li> </ul>	
		<b>Total</b>	<b>52</b>

### Assessment:

#### **Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

#### **End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

#### **Text Books:**

1. G. K. Gupta “Database Management Systems”, McGraw – Hill.
2. Korth, Silberchatz, Sudarshan, “Database System Concepts”, 6th Edition, McGraw – Hill
3. Elmasri and Navathe, “Fundamentals of Database Systems”, 5th Edition, Pearson education.
4. Peter Rob and Carlos Coronel, “Database Systems Design, Implementation and Management”, Thomson Learning, 5th Edition.

#### **Reference Books:**

1. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
2. Gillenson, Paulraj Ponniah, “Introduction to Database Management”, Wiley Publication.
3. Sharaman Shah, “Oracle for Professional”, SPD.
4. Raghu Ramkrishnan and Johannes Gehrke, “ Database Management Systems ”, TMH.

Course Code	Course Name	Credits
CSC 503	Computer Network	4

**Course objective:**

1. To introduce concepts and fundamentals of data communication and computer networks.
2. To explore the inter-working of various layers of OSI.
3. To explore the issues and challenges of protocols design while delving into TCP/IP protocol suite.
4. To assess the strengths and weaknesses of various routing algorithms.
5. To understand the transport layer and various application layer protocols.

**Course Outcomes:**

On successful completion of course learner will be able to:

1. Demonstrate the concepts of data communication at physical layer and compare ISO - OSI model with TCP/IP model.
2. Demonstrate the knowledge of networking protocols at data link layer.
3. Design the network using IP addressing and subnetting / supernetting schemes.
4. Analyze various routing algorithms and protocols at network layer.
5. Analyze transport layer protocols and congestion control algorithms.
6. Explore protocols at application layer .

**Prerequisite:** Digital Communication Fundamentals

Module No.	Unit No.	Topics	Hrs.
1	<b>Introduction to Networking</b>		06
	1.1	Introduction to computer network, network application, network software and hardware components (Interconnection networking devices), Network topology, protocol hierarchies, design issues for the layers, connection oriented and connectionless services	
	1.2	Reference models: Layer details of OSI, TCP/IP models. Communication between layer.	
2	<b>Physical Layer</b>		06
	2.1	Introduction to Communication System, digital Communication, Electromagnetic Spectrum	
	2.2	<b>Guided Transmission Media:</b> Twisted pair, Coaxial, Fiber optics. Unguided media (Wireless Transmission): Radio Waves, Microwave, Bluetooth, Infrared, Circuit and Packet Switching	

<b>3</b>	<b>Data Link Layer</b>		10
	<b>3.1</b>	DLL Design Issues (Services, Framing, Error Control, Flow Control), Error Detection and Correction(Hamming Code, CRC, Checksum) , Elementary Data Link protocols , Stop and Wait, Sliding Window(Go Back N, Selective Repeat), HDLC	
	<b>3.2</b>	<b>Medium Access Control sublayer</b> Channel Allocation problem, Multiple access Protocol( Aloha, Carrier Sense Multiple Access (CSMA/CD), Local Area Networks - Ethernet (802.3)	
<b>4</b>	<b>Network layer</b>		14
	<b>4.1</b>	4.1 Network Layer design issues, Communication Primitives: Unicast, Multicast, Broadcast. IPv4 Addressing (classfull and classless), Subnetting, Supernetting design problems ,IPv4 Protocol, Network Address Translation (NAT)	
	<b>4.2</b>	<b>Routing algorithms</b> : Shortest Path (Dijkstra's), Link state routing, Distance Vector Routing	
	<b>4.3</b>	<b>Protocols</b> - ARP,RARP, ICMP, IGMP	
	<b>4.4</b>	<b>Congestion control algorithms:</b> Open loop congestion control, Closed loop congestion control, QoS parameters, Token & Leaky bucket algorithms	
<b>5</b>	<b>Transport Layer</b>		10
	<b>5.1</b>	<b>The Transport Service:</b> Transport service primitives, Berkeley Sockets, Connection management (Handshake), UDP, TCP, TCP state transition, TCP timers	
	5.2	TCP Flow control (sliding Window), TCP Congestion Control: Slow Start	
<b>6</b>	<b>Application Layer</b>		06
	<b>6.1</b>	DNS: Name Space, Resource Record and Types of Name Server. HTTP, SMTP, Telnet, FTP, DHCP	

**Assessment:**

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.



**End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions (Q.2 to Q.6) will be selected from all the modules.

**Textbooks:**

1. A.S. Tanenbaum, "Computer Networks", Pearson Education, (4e)
2. B.A. Forouzan, "Data Communications and Networking", TMH (5e)
3. James F. Kurose, Keith W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", Addison Wesley, (6e)

**References:**

1. S.Keshav: An Engineering Approach To Computer Networking, Pearson
2. Natalia Olifer& Victor Olifer,"Computer Networks:Principles, Technologies & Protocols for Network Design", Wiley India, 2011.
3. Larry L.Peterson, Bruce S.Davie, Computer Networks: A Systems Approach, Second Edition (The Morgan Kaufmann Series in Networking).

Course Code	Course Name	Credits
CSC504	Theory of Computer Science	4

**Course Objectives:**

1. Acquire conceptual understanding of fundamentals of grammars and languages.
2. Build concepts of theoretical design of deterministic and non-deterministic finite automata and push down automata.
3. Develop understanding of different types of Turing machines and applications.
4. Understand the concept of Undecidability.

**Course Outcomes:** On successful completion of course learner will be able to:

1. Identify the central concepts in theory of computation and differentiate between deterministic and nondeterministic automata, also obtain equivalence of NFA and DFA.
2. Infer the equivalence of languages described by finite automata and regular expressions.
3. Devise regular, context free grammars while recognizing the strings and tokens.
4. Design pushdown automata to recognize the language.
5. Develop an understanding of computation through Turing Machine.
6. Acquire fundamental understanding of decidability and undecidability.

**Prerequisite:** Discrete Mathematics

Module No.	Unit No.	Topics	Theory Hrs.	Tutorial Hrs.
1.0		<b>Basic Concepts and Finite Automata</b>	09	03
	1.1	<ul style="list-style-type: none"> <li>Alphabets, Strings, Languages, Closure properties.</li> <li>Finite Automata (FA) and Finite State machine (FSM).</li> </ul>		
	1.2	<ul style="list-style-type: none"> <li>Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA): Definitions, transition diagrams and Language recognizers</li> <li>NFA to DFA Conversion</li> <li>Equivalence between NFA with and without <math>\epsilon</math>- transitions</li> <li>Minimization of DFA</li> <li>FSM with output: Moore and Mealy machines, Equivalence</li> <li>Applications and limitations of FA</li> </ul>		
2.0		<b>Regular Expressions and Languages</b>	06	02
	2.1	<ul style="list-style-type: none"> <li>Regular Expression (RE)</li> <li>Equivalence of RE and FA, Arden's Theorem</li> <li>RE Applications</li> </ul>		
	2.2	<ul style="list-style-type: none"> <li>Regular Language (RL)</li> <li>Closure properties of RLs</li> <li>Decision properties of RLs</li> <li>Pumping lemma for RLs</li> </ul>		
3.0		<b>Grammars</b>	08	03
	3.1	<ul style="list-style-type: none"> <li>Grammars and Chomsky hierarchy</li> </ul>		
	3.2	<ul style="list-style-type: none"> <li>Regular Grammar (RG)</li> </ul>		

		<ul style="list-style-type: none"> <li>• Equivalence of Left and Right linear grammar</li> <li>• Equivalence of RG and FA</li> </ul>		
	<b>3.3</b>	<b>Context Free Grammars (CFG)</b> <ul style="list-style-type: none"> <li>• Definition, Sentential forms, Leftmost and Rightmost derivations, Parse tree, Ambiguity.</li> <li>• Simplification and Applications.</li> <li>• Normal Forms: Chomsky Normal Forms (CNF) and Greibach Normal Forms (GNF).</li> <li>• CFLs - Pumping lemma, Closure properties</li> </ul>		
<b>4.0</b>		<b>Pushdown Automata(PDA)</b>	<b>04</b>	<b>01</b>
	<b>4.1</b>	<ul style="list-style-type: none"> <li>• Definition, Transitions ,Language of PDA</li> <li>• Language acceptance by final state and empty stack</li> <li>• PDA as generator, decider and acceptor of CFG.</li> <li>• Deterministic PDA , Non-Deterministic PDA</li> <li>• Application of PDA.</li> </ul>		
<b>5.0</b>		<b>Turing Machine (TM)</b>	<b>09</b>	<b>03</b>
	<b>5.1</b>	<ul style="list-style-type: none"> <li>• Definition, Transitions</li> <li>• Design of TM as generator, decider and acceptor.</li> <li>• Variants of TM: Multitrack, Multitape</li> <li>• Universal TM.</li> <li>• Equivalence of Single and Multi Tape TMs.</li> <li>• Applications, Power and Limitations of TMs.</li> <li>• Context Sensitivity and Linear Bound Automata.</li> </ul>		
<b>6.0</b>		<b>Undecidability</b>	<b>03</b>	<b>01</b>
	<b>6.1</b>	<ul style="list-style-type: none"> <li>• Decidability and Undecidability,</li> <li>• Recursive and Recursively Enumerable Languages.</li> <li>• Halting Problem,</li> <li>• Rice's Theorem,</li> <li>• Post Correspondence Problem,</li> </ul>		
		<b>Total</b>	<b>39</b>	<b>13</b>

### Assessment:

#### **Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

#### **End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

**Text Books:**

1. John E. Hopcroft, Rajeev Motwani, Jeffery D. Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education.
2. Michael Sipser, "Theory of Computation", Cengage learning.
3. Vivek Kulkarni, "Theory of Computation", Oxford University Press, India.

**Reference Books:**

1. J. C. Martin, "Introduction to Languages and the Theory of Computation", Tata McGraw Hill.
2. Kavi Mahesh, "Theory of Computation: A Problem Solving Approach", Wiley-India.

Course Code	Course Name	Credits
<b>CSDLO5011</b>	<b>Multimedia System</b>	<b>4</b>

**Course objectives:**

1. To introduce students about basic fundamentals and key aspects of Multimedia system.
2. To provide knowledge of compression techniques of different multimedia components
3. To help students to understand multimedia communication standards along with technology environment
4. To provide an opportunity to gain hands-on experience in building multimedia applications.

**Course outcomes:** Learner will be able to

1. To identify basics of multimedia and multimedia system architecture.
2. To understand different multimedia components.
3. To explain file formats for different multimedia components.
4. To analyze the different compression algorithms.
5. To describe various multimedia communication techniques.
6. To apply different security techniques in multimedia environment.

**Prerequisite:** Computer Fundamentals and Graphics.

Module No.	Unit No.	Topics	Hrs.
1	<b>Introduction to Multimedia</b>		8
	1.1	Overview	
	1.2	Objects and Elements of Multimedia	
	1.3	Applications of Multimedia	
	1.4	Multimedia Systems Architecture – IMA, Workstation, Network	
	1.5	Types of Medium (Perception, Representation-..)	
	1.6	Interaction Techniques	
	1.7	I/O devices - Salient features (Electronic Pen , Scanner, Digital Camera, Printers, plotters), Storage Media (Jukebox, DVD), Multimedia Databases	
2	<b>Text &amp; Digital Image</b>		10
	<b>Text</b>		
	2.1	Visual Representation, Digital Representation.	
	2.2	File Formats: RTF, TIFF.	
	2.3	Compression Techniques : Huffman Coding, RLE, CCITT group 3 1D	

	<b>Digital Image</b>		
	2.4	Digital Image Representation (2D format, resolution) Types of Images (monochrome, gray, color), examples of images (X-Ray, fractal, synthetic, acoustic).	
	2.5	File formats: BMP, JPG	
	2.6	Compression Techniques: fundamentals (coding, interpixel and psychovisual redundancies),Types – lossless and lossy, Lossless Compression Algorithms– Shannon-Fano, CCITT group 4 2D, Lossy Compression Algorithm – JPEG	
3	<b>Digital Audio</b>		8
	3.1	Basic Sound Concepts: computer representation of sound,	
	3.2	File Formats – WAV, MPEG Audio	
	3.3	Compression: PCM, DM, DPCM	
4	<b>Digital Video</b>		8
	4.1	Digitization of Video, types of video signals ( component, composite and S-video),	
	4.2	File Formats: MPEG Video, H.261	
	4.3	Compression: MPEG	
5	<b>Multimedia Network Communication and Representation</b>		10
	5.1	Quality of Service	
	5.2	Multimedia over IP ( RTP, RTSP, RTCP,RSVP)	
	5.3	Representation- Authoring systems and user interface	
6	<b>Multimedia Security</b>		8
	6.1	Requirements and properties	
	6.2	Mechanisms – Digital Signatures, Steganographic methods	
	6.3	Sample applications – unidirectional distributed systems, information systems and conference systems	
		<b>Total</b>	<b>52</b>

**Text Books:**

1. Multimedia System Design, Prabhat K. Andleigh& Kiran Thakrar, PHI.
2. Multimedia Communication Systems: Techniques, Standards & Networks, K. R. Rao, Zoran S. Bojkovic&Dragorad A. Milovanovic, TMH.
3. Multimedia Systems, K. Buford, PHI.
4. Fundamentals of Multimedia, Ze-Nian Li & Mark S. Drew, PHI.

**Reference Books:**

1. Multimedia Computing Communications & Applications, Ralf Steinmetz & Klara Nahrstedt, Pearson.
2. Digital Image processing, Rafael C. Gonzalez, Richard E. Woods, Pearson.
3. Multimedia Applications, Ralf Steinmetz & Klara Nahrstedt, Springer International Edition

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

**Suggested List of Experiments:**

1. Create a new file format to store a multimedia data.
2. Implement a compression technique and check the efficiency on different inputs.
3. To develop a theme based multimedia presentation
4. To add a digital signature onto a document
5. To perform steganography of text onto an image and check the efficiency with different inputs.

\*\* Perform laboratory work of this course in 'CSL504: Web Design Lab' as experiments or mini project.

Course Code	Course Name	Credits
<b>CSDL05012</b>	<b>Advanced Operating Systems</b>	4

**Course Objectives:**

1. To understand design issues of Advanced Operating systems.
2. To understand the architecture, kernel and file management of Unix operating system.
3. To understand basic concepts and need of Distributed operating systems.
4. To understand concepts and working of different advanced Operating systems like Multiprocessor OS, Real time OS, Mobile OS.

**Course Outcomes:** On successful completion of the course student should be able to

1. Demonstrate understanding of design issues of Advanced operating systems and compare different types of operating systems.
2. Analyse design aspects and data structures used for file subsystem, memory subsystem and process subsystem of Unix OS.
3. Demonstrate understanding of different architectures used in Multiprocessor OS and analyse the design and data structures used in Multiprocessor operating systems.
4. Differentiate between threads and processes and compare different processor scheduling algorithms used in Multiprocessor OS
5. Classify Real Time OS and analyse various real time scheduling algorithms.
6. Explore architectures and design issues of Mobile OS, Virtual OS, Cloud OS.

**Prerequisite:** Operating Systems

Module	Unit	Detailed Content	Hrs
1		Introduction	04
		Functions of operating systems, Design approaches: layered, kernel based and virtual machine approach, types of advanced operating systems (NOS, DOS, Multiprocessor OS, Mobile OS, RTOS, Cloud OS)	
2		Unix Kernel and File Management	14
	2.1	System Structure, User Perspective, Architecture of Unix Operating System	
	2.2	Buffer cache: Header, Buffer Pool, Retrieving, Reading and Writing Buffer	
	2.3	File Representation: inodes: Structure of file Directories, Path conversion to inode, superblock, inode assignment, allocation of disk blocks	
3		Unix Process and Memory management	12
	3.1	Detailed design of Process Structure: Kernel Data structures for process, Structure of Uarea and Process table, Process states and Transitions	
	3.2	Context of a Process: Static and Dynamic area of context, Saving the Context Layout of System Memory, Regions, Mapping regions	



		with Process, page table and mapping virtual address to physical address.	
4		Distributed Operating system concepts	06
		Goals, Distributed Computing Models, Hardware Concepts, Software Concepts, Architecture of DOS. Design Issues: Transparency, Flexibility, Scalability, Reliability, Performance, fault tolerance	
5		Multiprocessor Operating System	08
	5.1	Introduction, Basic multiprocessor system architectures, design issues, Threads, Process synchronization: the test and set instruction, the swap instruction, implementation of the process wait	
	5.2	Processor scheduling: Issues, Co-scheduling, Smart scheduling, Affinity Based scheduling	
6		Real Time Operating Systems and Mobile OS	08
	6.1	Characteristics of Real Time operating Systems, Classification of Real Time Operating Systems, Scheduling in RTOS: Clock driven: cyclic, Event driven: EDF and rate monotonic scheduling.	
	6.2	Mobile OS: Architecture, Android OS, iOS, Virtual OS, Cloud OS and their design issues	

### **Assessment:**

#### **Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

#### **End Semester Theory Examination:**

- Question paper will comprise of 6 questions, each carrying 20 marks.
- The students need to solve total 4 questions.
- Question No.1 will be compulsory and based on entire syllabus.
- Remaining question (Q.2 to Q.6) will be selected from all the modules.

#### **Text Books:**

1. The Design of the UNIX Operating System, PHI, by Maurice J. Bach.
2. Distributed Computing 2<sup>nd</sup> Edition, Mahajan and Seema Shah, Oxford.
3. Advanced Concepts in Operating Systems, Mukesh Singhal, Niranjana G Shivaratri.
4. Mobile Computing by Rajkamal, 1<sup>st</sup> edition, Oxford.
5. Real Time Operating System, Jane W.S. Liu, Pearson.

#### **Reference Books:**

1. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms, 2nd edition, Pearson Education.
2. "Real-Time Systems: Theory and Practice", Rajib Mall, Pearson Education India, 2006.

Course Code	Course Name	Credit
<b>CSDLO5013</b>	<b>Advanced Algorithm</b>	<b>4</b>

**Course Objectives:**

1. To provide mathematical approach for Analysis of Algorithms.
2. To teach advanced data structures.
3. To solve complex problems in real life applications.

**Course Outcomes:** At the end of the course student will be able to

1. Describe analysis techniques for algorithms.
2. Identify appropriate data structure and design techniques for different problems
3. Identify appropriate algorithm to be applied for the various application like geometric modeling, robotics, networking, etc.
4. Appreciate the role of probability and randomization in the analysis of algorithm
5. Analyze various algorithms.
6. Differentiate polynomial and non deterministic polynomial algorithms.

**Prerequisites:** Data structures, Discrete mathematics and Analysis of Algorithm

Sr. No.	Module	Detailed Content	Hours
1	<b>Fundamental of Algorithms</b>	<b>Introduction- Complexity-</b> complexity of recursive algorithms, finding complexity by tree method, master method, proving technique (contradiction, mathematical induction). <b>Amortized analysis-</b> aggregate analysis, accounting analysis, potential analysis dynamic tables	08
2	<b>Probabilistic Analysis and Randomized Algorithm</b>	The hiring problem Indicator random variables Randomized algorithms Probabilistic analysis and further uses of indicator random variable	08
3	<b>Advanced Data Structure</b>	<b>Introduction to trees and heap</b> <b>Red-Black Trees:</b> properties of red-black trees , Operations on Red-black trees <b>Binomial Heaps:</b> Binomial trees and binomial heaps, Operation on Binomial heaps <b>Analysis of all above operations</b>	12
4	<b>Maximum Flow</b>	Flow networks , the ford Fulkerson method ,max bipartite matching , push Relabel Algorithm , The relabel to front algorithm	08

<b>5</b>	<b>Computational Geometry</b>	Line Segment properties, Determining whether any pair of segment intersects, finding the convex hull, Finding the closest pair of points.	08
<b>6</b>	<b>NP-Completeness And Approximation Algorithms</b>	NP-Completeness: NP-Completeness and reducibility, NP-Completeness proofs, NP-Complete problems-The vertex-cover problem, The travelling salesman problem	08

**Text Books:**

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, PHI, India Second Edition.
2. Horowitz, Sahani and Rajsekar, “Fundamentals of Computer Algorithms”, Galgotia.
3. Harsh Bhasin, “Algorithms – Design and Analysis”, Oxford, 2015.

**Reference Books:**

1. Rajeev Motwani, Prabhakar Raghavan, “ Randomized Algorithm”, Cambridge University
2. S. K. Basu, “Design Methods and Analysis of Algorithm”, PHI
3. Vijay V. Vajirani, “Approximation Algorithms”, Springer.

**Internal Assessment:**

Assessment consists of two tests out of which; one (T1) should be compulsory class test (on at least 02 Modules) and the other (T2) is either a class test or assignments on live problems or course project

**Theory Examination:**

1. Question paper will comprise of total six questions.
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

Lab Code	Lab Name	Credits
<b>CSL501</b>	<b>Microprocessor Lab</b>	<b>1</b>

**Lab Objective:**

1. To emphasize on use of Assembly language program.
2. To prepare students for advanced subjects like embedded system and IOT.

**Lab Outcome:**

1. Use appropriate instructions to program microprocessor to perform various task
2. Develop the program in assembly/ mixed language for Intel 8086 processor
3. Demonstrate the execution and debugging of assembly/ mixed language program

**Description:**

A microprocessor is the most important unit within a computer system. It is responsible for processing the unique set of instructions and processes. It is a controlling unit of a computer, capable of performing Arithmetic Logical Unit (ALU) operations and communicating with the other devices connected to it. Typical microprocessor operations include adding, subtracting, comparing two numbers, and fetching numbers from one area to another. These operations are the result of a set of instructions that are part of the microprocessor design. When computer is turned on, the microprocessor gets the first instruction from the basic input/output system that comes with the computer as part of its memory. After that, either the BIOS, or the operating system that BIOS loads into computer memory, or an application program provides instructions to perform.

**Suggested List of Experiments:**

Sr. No.	Title of Experiments
1	Use of programming tools (Debug/TASM/MASM/8086kit) to perform basic arithmetic operations on 8bit/16 bit data
2	Code conversion (Hex to BCD, BCD to Hex, ASCII to BCD, BCD to ASCII)
3	Assembly programming for 16-bit addition, subtraction, multiplication and division (menu based)
4	Assembly program based on string instructions ( overlapping/ non-overlapping block transfer/ string search/ string length)
5	Assembly program to display the contents of the flag register.
6	Mixed Language program to shift a number for given number of times
7	Assembly program to find the GCD/ LCM of two numbers
8	Assembly program to sort numbers in ascending/ descending order

9	Mixed Language program to increment, decrement the size of the cursor and also to disable it.
10	Assembly program to find minimum/ maximum no. from a given array.
11	Program for device driver (printer/mouse/keyboard)
12	Program based on 32 bit architecture (e.g. Switching from real mode to protected mode using DPMS driver, 32bit multiplication)
13	Assembly program to find factorial of number using procedure
14	Program and interfacing using 8255/ 8253
15	Program and interfacing of ADC/ DAC/ Stepper motor

**Term Work:**

Term should consist of at least 10 experiments.

Journal must include –

- At least one experiment with use of macros/ procedures
- At least five experiments with use of DOS, BIOS interrupts
- At least two assignments

At least one experiment on hardware interfacing is desirable

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum marks in term work.

**Term Work:** 25 marks (Total) = 15 Marks (Experiments) + 5 Marks (Assignments) + 5 Marks (Theory + Practical Attendance)

**Oral & Practical exam** will be based on the CSL501 and CSC501 syllabus.

Lab Code	Lab Name	Credits
<b>CSL 502</b>	<b>Computer Network Lab</b>	<b>1</b>

**Lab Objective:**

To practically explore OSI layers and understand the usage of simulation tools.

**Lab Outcomes:**

On successful completion of course learner will be able to

1. Design and setup networking environment in Linux.
2. Use Network tools and simulators such as NS2, Wireshark etc. to explore networking algorithms and protocols.
3. Implement programs using core programming APIs for understanding networking concepts.

**Description**

The experiments are expected to be performed in Linux environment.

**Suggested List of Experiments**

Sr. No	Title of Experiments
1.	Setup a network and configure IP addressing, subnetting, masking. (Eg. CISCO Packet Tracer, Student Ed.)
2.	Use basic networking commands in Linux (ping, tracert, nslookup, netstat, ARP, RARP, ip, ifconfig, dig, route )
3.	Build a simple network topology and configure it for static routing protocol using packet tracer.
4.	Perform network discovery using discovery tools (eg. mrtg)
5.	Use Wireshark to understand the operation of TCP/IP layers : <ul style="list-style-type: none"> <li>● Ethernet Layer : Frame header, Frame size etc.</li> <li>● Data Link Layer : MAC address, ARP (IP and MAC address binding)</li> <li>● Network Layer : IP Packet (header, fragmentation), ICMP (Query and Echo)</li> <li>● Transport Layer: TCP Ports, TCP handshake segments etc.</li> <li>● Application Layer: DHCP, FTP, HTTP header formats</li> </ul>
6.	CRC/ Hamming code implementation.
7.	Stop and wait protocol/ sliding window (selective repeat / Go back N )
8.	Use simulator (Eg. NS2) to understand functioning of ALOHA, CSMA/CD.
9.	<ol style="list-style-type: none"> <li>a. Set up multiple IP addresses on a single LAN.</li> <li>b. Using nestat and route commands of Linux, do the following:</li> </ol>

	<ul style="list-style-type: none"> <li>● View current routing table</li> <li>● Add and delete routes</li> <li>● Change default gateway</li> </ul> <p>c. Perform packet filtering by enabling IP forwarding using IPtables in Linux.</p>
10.	Implementation of DVR/ LSR in NS2/(any other simulator)
11.	Socket programming using TCP or UDP
12.	Simulate congestion control ( leaky bucket / token bucket).
13.	Perform File Transfer and Access using FTP
14.	Perform Remote login using Telnet server

**Term Work:**

Laboratory work should be based on above syllabus of suggested list having minimum 10 experiments, covering all layers.

Experiments ----- (15) Marks  
Assignments ----- (05) Marks  
Attendance (Theory + Practical) ----- (05) Marks  
**Total ----- (25) Marks**

**Oral & Practical exam** will be based on the **above and CSC 503 : Computer Network.**

Lab Code	Lab Name	Credits
<b>CSL503</b>	<b>Database &amp; Information System Lab</b>	<b>1</b>

**Lab Outcome:** On successful completion of course learner will be able to:

1. Design and draw ER and EER diagram for the real life problem with software tool.
2. Create and update database and tables with different DDL and DML statements.
3. Apply /Add integrity constraints and able to provide security to data.
4. Implement and execute Complex queries.
5. Apply triggers and procedures for specific module/task
6. Handle concurrent transactions and able to access data through front end (using JDBC ODBC connectivity.)

**Description:**

- The below suggested experiments needs to be performed by a group of **3/4 students**.
- Select any database management system and conduct all experiments based on the same topic.

**Suggested List of Experiments:**

Sr. No.	Title of Experiments
1	Identify the case study and detail statement of problem. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model.
2	Mapping ER/EER to Relational schema model.
3	Create and populate database using Data Definition Language (DDL) and DML Commands for you're the specified System.
4	Apply Integrity Constraints for the specified system.
5	Perform Simple queries, string manipulation operations.
6	Nested queries and Complex queries
7	Perform Join operations
8	Views and Triggers
9	Functions , cursor and procedure.
10	Transaction and Concurrency control
11	Mini project- Creating a Two-tier client-server database applications using JDBC

**Assignment:** Perform Normalization -1NF, 2NF, 3NF

**Term Work:**

Laboratory work will be based on DBMS syllabus with minimum 10 experiments to be incorporated.

Experiments should be completed by students on the given time duration

Experiments -----	(10) Marks
Mini Project-----	(10) Marks
Attendance (Theory + Practical) -----	(05) Marks
<b>Total -----</b>	<b>(25) Marks</b>



### **Practical and Oral :**

Practical and oral Exam should be conducted for the Lab, on Database Management System subject for given list of experiments .

Implementation -----(15) Marks  
Oral -----(10) Marks  
**Total -----(25) Marks**

**\*\*Oral & Practical exam** will be based on the above and CSC502: ‘DBMS’ syllabus

### **Text Books:**

1. G. K. Gupta :”Database Management Systems”, McGraw – Hill.
2. Korth, Slberchatz,Sudarshan, :”Database System Concepts”, 6th Edition, McGraw – Hill
3. Elmasri and Navathe, “ Fundamentals of Database Systems”, 5thEdition, PEARSON
4. Peter Rob and Carlos Coronel, “ Database Systems Design, Implementation and Management”, Thomson Learning, 5th Edition.

### **Reference Books :**

1. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g,Black Book, Dreamtech Press
2. PaulrajPonniah, “ Introduction to Database Management”,Wiley publication
3. Raghu Ramkrishnan and Johannes Gehrke, “ Database Management Systems”,TMH
4. Debabrata Sahoo “Database Management Systems” Tata McGraw Hill, Schaum’s Outline

Course Code	Course Name	Credits
<b>CSL504</b>	<b>Web Design Lab</b>	<b>2</b>

**Course objectives:**

1. To design and create web pages using HTML5 and CSS3.
2. To Create web pages and provide client side validation.
3. To create dynamic web pages using server side scripting.
4. To use MVC framework for web application development.

**Course outcomes:** On completion of course learner will be able to:

1. Understand the core concepts and features of Web Technology
2. Design static web pages using HTML5 and CSS3
3. Apply the concept of client side validation and design dynamic web pages using JavaScript and JQuery.
4. Evaluate client and server side technologies and create Interactive web pages using PHP , AJAX with database connectivity using MySQL.
5. Understand the basics of XML, DTD and XSL and develop web pages using XML / XSLT.
6. Analyze end user requirements and Create web application using appropriate web technologies and web development framework

**Prerequisite:** Data Structures, Basics of Programming Languages

Module No.	Unit No.	Topics	Hrs.
1.0		<b>INTRODUCTION TO WWW</b>	2
	1.1	Internet Standards – Introduction to WWW – WWW Architecture – SMTP – POP3 – File Transfer Protocol	
	1.2	Overview of HTTP, HTTP request – response — Generation of dynamic web pages- W3C Validator, How web works - Setting up the environment (LAMP/XAMP/WAMP server)	
2.0		<b>CLIENT SIDE PROGRAMMING</b>	6
	2.1	<b>Markup Language (HTML):</b> Introduction to HTML and HTML5 - Formatting and Fonts –Commenting Code – Anchors – Backgrounds – Images – Hyperlinks	
	2.2	Lists – Tables – Frames - HTML Forms and controls.	
	2.3	<b>Cascading Style Sheet (CSS):</b> The need for CSS, Introduction to CSS 3 – Basic syntax and structure ,CSS Properties-Inline Styles – Embedding Style Sheets	
2.4	Linking External Style Sheets – Backgrounds –Box Model( Introduction , Border Properties, Padding Properties, Margin Properties), Manipulating text - Margins and Padding - Positioning using CSS., Creating page Layout and Site Designs		
3.0		<b>INTRODUCTION TO JAVASCRIPT</b>	6
	3.1	Introduction - Core features - Data types and Variables - Operators, Expressions, and Statements, Functions - Objects - Array, Date and Math related Objects	
	3.2	Document Object Model - Event Handling Controlling Windows &	

		Frames and Documents Form handling and validations.	
	<b>3.3</b>	<b>Advanced JavaScript</b> - Browser Management and Media Management – Classes – Constructors – Object-Oriented Techniques in JavaScript	
	<b>3.4</b>	Object constructor and Prototyping - Sub classes and Super classes – JSON - jQuery and AJAX., Rich Internet Application with AJAX, JQuery Framework	
		<b>SERVER SIDE PROGRAMMING</b>	
<b>4.0</b>	<b>4.1</b>	Introduction - Programming basics - Print/echo - Variables and constants – Strings and Arrays	<b>8</b>
	<b>4.2</b>	Operators, Control structures and looping structures – Functions – Reading Data in Web Pages	
	<b>4.3</b>	Embedding PHP within HTML - Establishing connectivity with MySQL database, cookies, sessions and Authentication	
	<b>4.4</b>	AJAX with PHP - AJAX with Databases	
		<b>XML</b>	
<b>5.0</b>	<b>5.1</b>	Dynamic page generation (adding interactivity, styles, using HTML, DHTML, XHTML, CSS, Java Script), XML –DTD(Document Type Definition) - XML Schema	<b>4</b>
	<b>5.2</b>	XML –DTD(Document Type Definition) - XML Schema - Document Object Model - Presenting XML - Using XML Parsers: DOM and SAX,XSL-eXtensible Style sheet Language	
<b>6.0</b>		<b>WEB DEVELOPMENT FRAMEWORK</b>	<b>2</b>
	<b>6.1</b>	Introduction to Composer - MVC Architecture	
	<b>6.2</b>	Web Application Development using web development framework :-Introduction to Laravel, Development of Web pages using Laravel., Example web applications – Interactive websites, web based information systems , blogs, social networking sites etc.	
		<b>Total</b>	<b>28</b>

#### Text Books:

1. Ralph Moseley , M.T. Savliya ,” Developing Web Applications”, Willy India, Second Edition, ISBN: 978-81-265-3867-6
2. “Web Technology Black Book”, Dremtech Press, First Ediction, 978-7722-997
3. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition, O'REILLY,2014.  
([http://www.ebooksbucket.com/uploads/itprogramming/javascript/Learning\\_PHP\\_MySQL\\_Javascrpt\\_CSS\\_HTML5\\_Robin\\_Nixon\\_3e.pdf](http://www.ebooksbucket.com/uploads/itprogramming/javascript/Learning_PHP_MySQL_Javascrpt_CSS_HTML5_Robin_Nixon_3e.pdf))
4. Professional Rich Internet Applications: AJAX and Beyond, Dana Moore, Raymond Budd, Edward Benson, Wiley publications.  
<https://ebooks-it.org/0470082801-ebook.htm>

#### Reference Books:

1. Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, “Internet and World Wide Web - How To Program”, Fifth Edition, Pearson Education, 2011.
2. Achyut S Godbole and AtulKahate, “Web Technologies”, Second Edition, Tata McGraw Hill, 2012.
3. Thomas A Powell, Fritz Schneider, “JavaScript: The Complete Reference”, Third Edition, Tata McGraw Hill, 2013.

4. David Flanagan, “JavaScript: The Definitive Guide, Sixth Edition”, O'Reilly Media, 2011
5. Steven Holzner, “The Complete Reference - PHP”, Tata McGraw Hill, 2008
6. Mike Mcgrath, “PHP & MySQL in easy Steps”, Tata McGraw Hill, 2012.

**Digital Material:**

1. [www.nptelvideos.in](http://www.nptelvideos.in)
2. [www.w3schools.com](http://www.w3schools.com)
3. <http://spoken-tutorial.org>

**Term work Assessment:**

Term work will consist of lab experiments testing all the technologies included in syllabus and a **Mini project** solving an appropriate problem using the above technology.

Module	Detailed Contents	Lab Sessions
1	Installation and Setting of LAMP / WAMP / XAMP	1
2	Create Simple web page using HTML5	1
3	Design and Implement web page using CSS3 and HTML5	1
4	Form Design and Client Side Validation using : a. Javascript and HTML5 b. Javascript and JQuery	2
5	Develop simple web page using PHP	1
6	Develop interactive web pages using PHP with database connectivity MYSQL	2
7	Develop XML web page using DTD, XSL	1
8	Implement a webpage using Ajax and PHP	1
9	Hosting the website with Domain Registration Process.	1
10	Design a Web application using Laravel Framework	3

**\*\*Setting up /buying the web host management system for hosting of mini project is recommended.**

**Term Work:** The distribution of marks for term work shall be as follows:

- Lab Assignments : 10 Marks
- Mini Project : 10 Marks
- Attendance : 05 Marks

**Practical & Oral Examination:**

Practical & Oral examination is to be conducted by pair of internal and external examiners based on the above syllabus.

Course Code	Course Name	Credits
<b>CSL505</b>	<b>Business Communication &amp; Ethics</b>	<b>02</b>

**Course Objectives:**

1. To inculcate professional and ethical attitude at the work place
2. To enhance effective communication and interpersonal skills
3. To build multidisciplinary approach towards all life tasks
4. To hone analytical and logical skills for problem-solving.

**Course Outcomes:** Learner will be able to...

1. Design a technical document using precise language, suitable vocabulary and apt style.
2. Develop the life skills/interpersonal skills to progress professionally by building stronger relationships.
3. Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities.
4. Apply the traits of a suitable candidate for a job/higher education , upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP.
5. Deliver formal presentations effectively implementing the verbal and non-verbal skills

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Report Writing</b>	<b>05</b>
1.1	Objectives of Report Writing	
1.2	Language and Style in a report	
1.3	Types: Informative and Interpretative (Analytical, Survey and Feasibility) and Formats of reports(Memo, Letter, Short and Long Report)	
<b>02</b>	<b>Technical Writing</b>	<b>03</b>
2.1	Technical Paper Writing(IEEE Format)	
2.2	Proposal Writing	
<b>03</b>	<b>Introduction to Interpersonal Skills</b>	<b>09</b>
3.1	Emotional Intelligence	
3.2	Leadership and Motivation	
3.3	Team Building	
3.4	Assertiveness	
3.5	Conflict Resolution and Negotiation Skills	
3.6	Time Management	
3.7	Decision Making	
<b>04</b>	<b>Meetings and Documentation</b>	<b>02</b>
4.1	Strategies for conducting effective meetings	
4.2	Notice, Agenda and Minutes of a meeting	
4.3	Business meeting etiquettes	
<b>05</b>	<b>Introduction to Corporate Ethics</b>	<b>02</b>
5.1	Professional and work ethics (responsible use of social media Facebook, WA, Twitter etc.)	
5.2	Introduction to Intellectual Property Rights	
5.4	Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response and making ethical decisions)	

<b>06</b>	<b>Employment Skills</b>	<b>07</b>
6.1	Group Discussion	
6.2	Resume Writing	
6.3	Interview Skills	
6.4	Presentation Skills	
6.5	Statement of Purpose	
		28

### Assessment:

#### List of Assignments

1. Report Writing(Theory)
2. Technical Proposal
3. Technical Paper Writing(Paraphrasing a published IEEE Technical Paper)
4. Interpersonal Skills(Group activities and Role plays)
5. Interpersonal Skills(Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation(Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics(Case studies, Role plays)
8. Writing Resume and Statement of Purpose

#### Term Work

Term work shall consist of all assignments from the list. The distribution of marks for term work shall be as follows:

Book Report	<b>10 marks</b>
Assignments:	<b>10 marks</b>
Project Report Presentation:	<b>15 marks</b>
Group Discussion:	<b>10 marks</b>
Attendance:	<b>05 marks</b>

#### References:

1. Fred Luthans, "Organizational Behavior", Mc GrawHill,
2. Lesiker and Petit, "Report Writing for Business ", McGrawHill
3. R. Subramaniam, "Professional Ethics" Oxford University Press
4. Huckin and Olsen, "Technical Writing and Professional Communication ", McGraw
5. Raman and Sharma, Fundamentals of Technical Communication, Oxford University Press
6. Hill Wallace and Masters, "Personal Development for Life and Work", Thomson Learning.
7. Heta Murphy, "Effective Business Communication ", McGraw Hill, edition
8. R.C Sharma and Krishna Mohan, "Business Correspondence and Report Writing",
9. Raman Sharma, "Communication Skills", Oxford University Press
10. B N Ghosh, "Managing Soft Skills for Personality Development", Tata McGraw Hill
11. Dufrene, Sinha, "BCOM", Cengage Learning, 2nd edition
12. Bell. Smith, "Management Communication" Wiley India Edition, 3rd edition.
13. Dr. K. Alex, "Soft Skills", S Chand and Company
14. Robbins Stephens P., "Organizational Behavior", Pearson Education
15. <https://grad.ucla.edu/asis/agep/advvsopstem.pdf>

Course Code	Course Name	Credits
CSC601	Software Engineering	4

### Course objectives:

The main objective of the course is to introduce to the students about the product that is to be engineered and the processes that provides a framework for the engineering methodologies and practices.

1. To provide the knowledge of software engineering discipline.
2. To apply analysis, design and testing principles to software project development.
3. To demonstrate and evaluate real time projects with respect to software engineering principles.

### Course outcomes:

On successful completion of course, learners will be able to:

1. Understand and demonstrate basic knowledge in software engineering.
2. Identify requirements, analyze and prepare models.
3. Plan, schedule and track the progress of the projects.
4. Design & develop the software projects.
5. Identify risks, manage the change to assure quality in software projects.
6. Apply testing principles on software project and understand the maintenance concepts.

### Prerequisite:

1. Concepts of Object Oriented Programming & Methodology
2. Knowledge of developing applications with front end & back end connectivity.

### Course syllabus:

Module No.	Unit No.	Topics	Hrs.
1.0		<b>Introduction To Software Engineering and Process Models</b>	08
	1.1	Nature of Software, Software Engineering, Software Process, Capability Maturity Model (CMM)	
	1.2	Generic Process Model, <b>Prescriptive Process Models:</b> The Waterfall Model, V-model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, Agile process, Agility Principles, Extreme Programming (XP), Scrum, Kanban model	
2.0		<b>Requirements Analysis and Modelling</b>	08
	2.1	Requirement Elicitation, Software requirement specification (SRS), Developing Use Cases (UML)	
	2.2	Requirement Model – Scenario-based model, Class-based model, Behavioural model.	
3.0		<b>Project Scheduling and Tracking</b>	08
	3.1	Management Spectrum, 3Ps (people, product and process)	
	3.2	Process and Project metrics	

	<b>3.3</b>	<b>Software Project Estimation:</b> LOC, FP, Empirical Estimation Models - COCOMO II Model, Specialized Estimation Techniques	
	<b>3.4</b>	<b>Project scheduling:</b> Defining a Task Set for the Software Project, Timeline charts, Tracking the Schedule, Earned Value Analysis	
<b>4.0</b>		<b>Software Design</b>	<b>10</b>
	<b>4.1</b>	Design Principles, Design Concepts, Effective Modular Design – Cohesion and Coupling	
	<b>4.2</b>	Architectural Design	
	<b>4.3</b>	Component-level design	
	<b>4.4</b>	User Interface Design	
<b>5.0</b>		<b>Software Risk, Configuration Management &amp; Quality Assurance</b>	<b>08</b>
	<b>5.1</b>	Risk Identification, Risk Assessment, Risk Projection, RMMM	
	<b>5.2</b>	Software Configuration management, SCM repositories, SCM process	
	<b>5.3</b>	Software Quality Assurance Task and Plan, Metrics, Software Reliability, Formal Technical Review (FTR), Walkthrough	
<b>6.0</b>		<b>Software Testing and Maintenance</b>	<b>10</b>
	<b>6.1</b>	Strategic Approach to Software Testing, Unit testing, Integration testing Verification, Validation Testing, System Testing	
	<b>6.2</b>	Software Testing Fundamentals, White-Box Testing , Basis Path Testing, Control Structure Testing, Black-Box Testing,	
	<b>6.3</b>	Software maintenance and its types, Software Re-engineering, Reverse Engineering	
		<b>Total</b>	<b>52</b>

#### **Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

#### **End Semester Theory Examination:**

1. Question paper will comprise of 06 questions, each carrying 20 marks.
2. The students need to solve total 04 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions (Q.2 to Q.6) will be selected from all the modules.

#### **Text Books:**

1. Roger Pressman, "Software Engineering: A Practitioner's Approach", McGraw-Hill Publications
2. Ian Sommerville, "Software Engineering", Pearson Education (9th edition)
3. Ali Behfroz and Fredeick J.Hudson, "Software Engineering Fundamentals", Oxford University Press

#### **Reference Books:**

1. Ugrasen Suman, "Software Engineering – Concepts and Practices", Cengage Learning
2. Pankaj Jalote, "An integrated approach to Software Engineering", Springer/Narosa
3. Jibitesh Mishra and Ashok Mohanty, "Software Engineering", Pearson
4. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India



Course Code	Course Name	Credits
<b>CSC602</b>	<b>System Programming And Compiler Construction</b>	<b>4</b>

**Course objectives:**

1. To understand the role and functioning of various system programs over application program.
2. To understand basic concepts and designing of assembler, Macro processor and role of static and dynamic loaders and linkers.
3. To understand the need to follow the syntax in writing an application program and to learn the how the analysis phase of compiler is designed to understand the programmer's requirements without ambiguity.
4. To synthesize the analysis phase outcomes to produce the object code that is efficient in terms of space and execution time.

**Course outcomes:** On successful completion of course learner will be able to:

1. Identify the relevance of different system programs.
2. Describe the various data structures and passes of assembler design.
3. Identify the need for different features and designing of macros.
4. Distinguish different loaders and linkers and their contribution in developing efficient user applications.
5. Construct different parsers for given context free grammars.
6. Justify the need synthesis phase to produce object code optimized in terms of high execution speed and less memory usage

**Prerequisite:** Data Structures, Theoretical computer science, Operating system. Computer Organization and Architecture, Microprocessor

Module No.	Unit No.	Topics	Hrs.
<b>1</b>	<b>Introduction to System Software</b>	Concept of System Software, Goals of system softwares, system program and system programming,  Introduction to various system programs such as Assembler, Macro processor, Loader, Linker, Compiler, Interpreter, Device Drivers, Operating system, Editors, Debuggers.	<b>2</b>
<b>2</b>	<b>Assemblers</b>	Elements of Assembly Language programming, Assembly scheme, pass structure of assembler,  Assembler Design: Two pass assembler Design and single pass Assembler Design for Hypothetical / X86 family processor, data structures used.	<b>10</b>
<b>3</b>	<b>Macros and Macro Processor</b>	Introduction, Macro definition and call, Features of Macro facility: Simple, parameterized, conditional and nested. Design of single pass macro processor, data structures used.	<b>8</b>
<b>4</b>	<b>Loaders and Linkers</b>	Introduction, functions of loaders, Relocation and Linking concept, Different loading schemes: Relocating loader, Direct Linking Loader, Dynamic linking and loading.	<b>8</b>

5	<b>Compilers: Analysis Phase</b>	<p>Introduction to compilers, Phases of compilers:</p> <p>Lexical Analysis- Role of Finite State Automata in Lexical Analysis, Design of Lexical analyser, data structures used .</p> <p>Syntax Analysis- Role of Context Free Grammar in Syntax analysis, Types of Parsers: Top down parser- LL(1), Bottom up parser- Operator precedence parser, SLR</p> <p>Semantic Analysis, Syntax directed definitions.</p>	12
6	<b>Compilers: Synthesis phase</b>	<p>Intermediate Code Generation: Types of Intermediate codes: Syntax tree, Postfix notation, Three address codes: Triples and Quadruples.</p> <p>Code Optimization: Need and sources of optimization, Code optimization techniques: Machine Dependent and Machine Independent.</p> <p>Code Generation: Issues in the design of code generator, code generation algorithm. Basic block and flow graph.</p>	12

**Text Books:**

1. D. M Dhamdhare: Systems programming, Tata McGraw Hill
2. A. V. Aho, R. Shethi, Monica Lam , J.D. Ulman : Compilers Principles, Techniques and Tools , Pearson Education , Second Edition.
3. J. J. Donovan: Systems Programming Tata McGraw Hill Publishing Company

**Reference Books:**

1. Lex &yacc, 2nd Edition by John R. Levine, Tony Mason & Doug Brown O'Reilly
2. Compiler construction D,M.Dhamdhare second edition MACMILLAM.
3. Compiler construction : principles and practices , Kenneth C.Louden ,CENGAGE Learning
4. System software : An introduction to system programming , Leland L. Beck, Pearson

**Assessment:**

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC603	Data Warehousing and Mining	4

**Course objectives:**

1. To identify the scope and essentiality of Data Warehousing and Mining.
2. To analyze data, choose relevant models and algorithms for respective applications.
3. To study spatial and web data mining.
4. To develop research interest towards advances in data mining.

**Course outcomes:** On successful completion of course learner will be able to:

1. Understand Data Warehouse fundamentals, Data Mining Principles
2. Design data warehouse with dimensional modelling and apply OLAP operations.
3. Identify appropriate data mining algorithms to solve real world problems
4. Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining
5. Describe complex data types with respect to spatial and web mining.
6. Benefit the user experiences towards research and innovation.

**Prerequisite:** Basic database concepts, Concepts of algorithm design and analysis.

Module No.	Topics	Hrs.
1.0	<b>Introduction to Data Warehouse and Dimensional modelling:</b> Introduction to Strategic Information, Need for Strategic Information, Features of Data Warehouse, Data warehouses versus Data Marts, Top-down versus Bottom-up approach. Data warehouse architecture, metadata, E-R modelling versus Dimensional Modelling, Information Package Diagram, STAR schema, STAR schema keys, Snowflake Schema, Fact Constellation Schema, Factless Fact tables, Update to the dimension tables, Aggregate fact tables.	8
2.0	<b>ETL Process and OLAP:</b> Major steps in ETL process, Data extraction: Techniques, Data transformation: Basic tasks, Major transformation types, Data Loading: Applying Data, OLTP Vs OLAP, OLAP definition, Dimensional Analysis, Hypercubes, OLAP operations: Drill down, Roll up, Slice, Dice and Rotation, OLAP models : MOLAP, ROLAP.	8
3.0	<b>Introduction to Data Mining, Data Exploration and Preprocessing:</b> Data Mining Task Primitives, Architecture, Techniques, KDD process, Issues in Data Mining, Applications of Data Mining, Data Exploration :Types of Attributes, Statistical Description of Data, Data Visualization, Data Preprocessing: Cleaning, Integration, Reduction: Attribute subset selection, Histograms, Clustering and Sampling, Data Transformation & Data Discretization: Normalization, Binning, Concept hierarchy generation, Concept Description: Attribute oriented Induction for Data Characterization.	10

<b>4.0</b>	<b>Classification, Prediction and Clustering:</b> Basic Concepts, Decision Tree using Information Gain, Induction: Attribute Selection Measures, Tree pruning, Bayesian Classification: Naive Bayes, Classifier Rule - Based Classification: Using IF-THEN Rules for classification, Prediction: Simple linear regression, Multiple linear regression Model Evaluation & Selection: Accuracy and Error measures, Holdout, Random Sampling, Cross Validation, Bootstrap, Clustering: Distance Measures, Partitioning Methods ( <i>k</i> -Means, <i>k</i> -Medoids), Hierarchical Methods(Agglomerative, Divisive)	<b>12</b>
<b>5.0</b>	<b>Mining Frequent Patterns and Association Rules:</b> Market Basket Analysis, Frequent Item sets, Closed Item sets, and Association Rule, Frequent Pattern Mining, Efficient and Scalable Frequent Item set Mining Methods: Apriori Algorithm, Association Rule Generation, Improving the Efficiency of Apriori, FP growth, Mining frequent Itemsets using Vertical Data Format, Introduction to Mining Multilevel Association Rules and Multidimensional Association Rules	<b>8</b>
<b>6.0</b>	<b>Spatial and Web Mining:</b> Spatial Data, Spatial Vs. Classical Data Mining, Spatial Data Structures, Mining Spatial Association and Co-location Patterns, Spatial Clustering Techniques: CLARANS Extension, Web Mining: Web Content Mining, Web Structure Mining, Web Usage mining, Applications of Web Mining	<b>6</b>
<b>Total</b>		<b>52</b>

**Text Books:**

1. PaulrajPonniah, "Data Warehousing: Fundamentals for IT Professionals", Wiley India.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3rd edition.
3. ReemaTheraja "Data warehousing", Oxford University Press.
4. M.H. Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education.

**Reference Books:**

1. Ian H. Witten, Eibe Frank and Mark A. Hall " Data Mining ", 3rd Edition Morgan kaufmann publisher.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining", Person Publisher.
3. R. Chattamvelli, "Data Mining Methods" 2nd Edition NarosaPublishing House.

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC604	Cryptography and System Security	4

**Course Objectives:**

1. To introduce classical encryption techniques and concepts of modular arithmetic and number theory.
2. To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms
3. To explore the design issues and working principles of various authentication protocols, PKI standards and various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.
4. To develop the ability to use existing cryptographic utilities to build programs for secure communication.

**Course Outcomes:** At the end of the course learner will able to

1. Understand system security goals and concepts, classical encryption techniques and acquire fundamental knowledge on the concepts of modular arithmetic and number theory.
2. Understand, compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication
3. Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes.
4. Apply different digital signature algorithms to achieve authentication and design secure applications
5. Understand network security basics, analyze different attacks on networks and evaluate the performance of firewalls and security protocols like SSL, IPSec, and PGP.
6. Analyze and apply system security concept to recognize malicious code.

**Detailed Syllabus:**

Module No	Unit No	Detailed Content	Hrs
1	<b>Introduction &amp; Number Theory</b>		10
	1.1	Security Goals, Services, Mechanisms and attacks, The OSI security architecture, Network security model, Classical Encryption techniques, Symmetric cipher model, mono-alphabetic and poly-alphabetic substitution techniques: Vigenere cipher, playfair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers, steganography.	
	1.2	Modular Arithmetic and Number Theory:- Euclid's algorithm--Prime numbers-Fermat's and Euler's theorem- Testing for primality -The Chinese remainder theorem, Discrete logarithms.	
2	<b>Symmetric and Asymmetric key Cryptography and key Management</b>		12

	2.1	Block cipher principles, block cipher modes of operation, DES, Double DES, Triple DES, Advanced Encryption Standard (AES), Stream Ciphers: RC5 algorithm.	
	2.2	Public key cryptography: Principles of public key cryptosystems-The RSA algorithm, The knapsack algorithm, ElGamal Algorithm.	
	2.3	Key management techniques: using symmetric and asymmetric algorithms and trusted third party. Diffie Hellman Key exchange algorithm.	
	<b>Hashes, Message Digests and Digital Certificates</b>		06
3	3.1	Cryptographic hash functions, Properties of secure hash function, MD5, SHA-1, MAC, HMAC, CMAC.	
	3.2	Digital Certificate: X.509, PKI	
	<b>Authentication Protocols &amp; Digital signature schemes</b>		08
4	4.1	User Authentication and Entity Authentication, One-way and mutual authentication schemes, Needham Schroeder Authentication protocol, Kerberos Authentication protocol.	
	4.2	Digital Signature Schemes – RSA, ElGamal and Schnorr signature schemes.	
	<b>Network Security and Applications</b>		10
	5.1	Network security basics: TCP/IP vulnerabilities (Layer wise), Packet Sniffing, ARP spoofing, port scanning, IP spoofing, TCP syn flood, DNS Spoofing.	
5	5.2	Denial of Service: Classic DOS attacks, Source Address spoofing, ICMP flood, SYN flood, UDP flood, Distributed Denial of Service, Defenses against Denial of Service Attacks.	
	5.3	Internet Security Protocols: SSL, IPSEC, Secure Email: PGP, Firewalls, IDS and types, Honey pots	
	<b>System Security</b>		06
6	6.1	Software Vulnerabilities: Buffer Overflow, Format string, cross-site scripting, SQL injection, Malware: Viruses, Worms, Trojans, Logic Bomb, Bots, Rootkits.	

### Text Books:

1. William Stallings, Cryptography and Network Security, Principles and Practice, 6<sup>th</sup> Edition, Pearson Education, March 2013
2. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill
3. Bernard Menezes, "Cryptography & Network Security", Cengage Learning.
4. Network Security Bible, Eric Cole, Second Edition, Wiley.

**Reference Books:**

1. Applied Cryptography, Protocols Algorithms and Source Code in C, Bruce Schneier, Wiley.
2. Cryptography and Network Security, Atul Kahate, Tata Mc Graw Hill.

**Assessment:****Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**Theory Examination:**

1. Question paper will comprise of total six questions.
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

**In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

Course Code	Course Name	Credits
<b>CSDLO6021</b>	<b>Machine Learning</b>	<b>04</b>

**Course Objectives:**

- 1 To introduce students to the basic concepts and techniques of Machine Learning.
- 2 To become familiar with regression methods, classification methods, clustering methods.
- 3 To become familiar with Dimensionality reduction Techniques.

**Course Outcomes:** Students will be able to-

1. Gain knowledge about basic concepts of Machine Learning
2. Identify machine learning techniques suitable for a given problem
3. Solve the problems using various machine learning techniques
4. Apply Dimensionality reduction techniques.
5. Design application using machine learning techniques

**Pre-requisites:** Data Structures, Basic Probability and Statistics, Algorithms

Module No.	Unit No.	Topics	Hrs.
1		<b>Introduction to Machine Learning</b> Machine Learning, Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps in developing a Machine Learning Application.	6
2		<b>Introduction to Neural Network</b> Introduction – Fundamental concept – Evolution of Neural Networks – Biological Neuron, Artificial Neural Networks, NN architecture, Activation functions, McCulloch-Pitts Model.	8
3		<b>Introduction to Optimization Techniques:</b> Derivative based optimization- Steepest Descent, Newton method. Derivative free optimization- Random Search, Down Hill Simplex	6
4		<b>Learning with Regression and trees:</b> Learning with Regression : Linear Regression, Logistic Regression. Learning with Trees: Decision Trees, Constructing Decision Trees using Gini Index, Classification and Regression Trees (CART).	10
5		<b>Learning with Classification and clustering:</b>	14
	5.1	<b>Classification:</b> Rule based classification, classification by Bayesian Belief networks, Hidden Markov Models. <b>Support Vector Machine:</b> Maximum Margin Linear Separators, Quadratic Programming solution to finding maximum margin separators, Kernels for learning non-linear functions.	
	5.2	<b>Clustering:</b> Expectation Maximization Algorithm, Supervised learning	



		after clustering, Radial Basis functions.	
<b>6</b>		<b>Dimensionality Reduction:</b> Dimensionality Reduction Techniques, Principal Component Analysis, Independent Component Analysis, Single value decomposition	<b>8</b>
		<b>Total</b>	<b>52</b>

**Text Books:**

1. Peter Harrington “Machine Learning In Action”, DreamTech Press
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press
3. Tom M.Mitchell “Machine Learning” McGraw Hill
4. Stephen Marsland, “Machine Learning An Algorithmic Perspective” CRC Press
5. J.-S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.
6. Samir Roy and Chakraborty, “Introduction to soft computing”, Pearson Edition.
7. Kevin P. Murphy , Machine Learning “ A Probabilistic Perspective”

**Reference Books:**

1. Han Kamber, “Data Mining Concepts and Techniques”, Morgann Kaufmann Publishers
2. Margaret.H.Dunham, “Data Mining Introductory and Advanced Topics”, Pearson Education

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

- Question paper will comprise of 6 questions, each carrying 20 marks.
- The students need to solve total 4 questions.
- Question No.1 will be compulsory and based on entire syllabus.
- Remaining question (Q.2 to Q.6) will be selected from all the modules.

**Suggested Experiment work :**

1. To implement Linear Regression.
2. To implement Logistic Regression.
3. To implement SVM.
4. To implement PCA.
5. To implement Steepest Descent
6. To implement Random search
7. To implement Naïve Baysian algorithm.
8. To implement Single layer Perceptron Learning algorithm
9. To implement Radialbasis functions.
10. Case study based on any ML technique

**\*\* Laboratory work based on above syllabus is incorporate as mini project in CSM605: Mini-Project.**

Course Code	Course Name	Credits
CSDLO6022	Advanced Database Management System	4

**Course objectives:**

1. To provide overview of indexing and hashing techniques
2. To impart knowledge of query processing and optimization
3. To provide an overview of distributed database systems.
4. To introduce the concept of document oriented database.
5. To create awareness about potential security threats to a database and mechanisms to handle it.
6. Understand the usage of advanced data models for real life application.

**Course outcomes:** On successful completion of course learner will be able to:

1. Build indexing mechanisms for efficient retrieval of information from databases.
2. Measure query cost and optimize query execution
3. Design distributed database for better resource management
4. Demonstrate the understanding of the concepts of document oriented databases.
5. Apply appropriate security techniques database systems.
6. Implement advanced data models for real life applications.

**Prerequisite:** Basic knowledge of Database management System.

Module No.	Unit No.	Topics	Hrs.
1.0		<b>Indexing and Hashing Techniques</b>	8
	1.1	<b>Indexing and Hashing:</b> <ul style="list-style-type: none"> <li>• Operation on Files</li> <li>• Hashing Techniques; Static and dynamic</li> <li>• Types of Single-Level Ordered Indexes; Multilevel Indexes; Dynamic Multilevel Indexes Using B-Trees and B+-Trees; Indexes on Multiple Keys,</li> </ul>	
2.0		<b>Query processing and Optimization</b>	12
		<b>Query Processing :</b> <ul style="list-style-type: none"> <li>• Overview</li> <li>• Measures of Query cost</li> <li>• Selection operation</li> <li>• Sorting</li> <li>• Join Operations, and other Operations</li> </ul> Evaluation of Expression <b>Query Optimization :</b> <ul style="list-style-type: none"> <li>• Translations of SQL Queries into relational algebra</li> <li>• Heuristic approach &amp; cost based optimization</li> </ul>	

<b>3.0</b>		<b>Distributed Databases</b>	12
	<b>3.1</b>	<ul style="list-style-type: none"> <li>Types of Distributed Database Systems; Distributed Database Architectures; Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design</li> </ul>	
	<b>3.2</b>	<ul style="list-style-type: none"> <li>Distributed Query Processing (Semi join)</li> <li>distributed Transaction Management in Distributed Databases</li> <li>distributed Concurrency Control (locking) , Recovery in Distributed Databases {2PC/3PC} and deadlock management.</li> </ul>	
<b>4</b>		<b>Document oriented database</b>	
		<ul style="list-style-type: none"> <li>Need of object oriented database.</li> <li>Impedance matching problem between OO languages and Relational database, Case study db4O</li> <li>Need of Document Oriented database, difference between Document Oriented Database and Traditional database. Types of encoding XML, JSON, BSON, Representation XML, Json Objects. Case study on doc oriented based such a Mariadb</li> </ul>	8
<b>5</b>		<b>Advanced data models</b>	6
	<b>5.1</b>	<ul style="list-style-type: none"> <li>Temporal data models :- Aspects of valid time , Bi-temporal time and bi-temporal time with examples of each.</li> <li>Spatial model :- Types of spatial data models - Raster, Vector and Image</li> <li>Mobile databases</li> </ul>	
	<b>5.2</b>	<ul style="list-style-type: none"> <li>Multimedia databases</li> </ul>	
<b>6</b>		<b>Data Security</b>	<b>6</b>
	<b>6.1</b>	<ul style="list-style-type: none"> <li>Introduction to Database Security Issues; authorization , Discretionary Access Control Based on Granting and Revoking Privileges</li> <li>Mandatory Access Control and Role-Based</li> </ul>	

	<b>6.2</b>	Access Control for Multilevel Security <ul style="list-style-type: none"> <li>● SQL Injection</li> <li>● Introduction to Statistical Database Security</li> <li>Introduction to Flow Control</li> </ul>	
		<b>Total</b>	<b>52</b>

**Text Books:**

1. Elmasri&Navathe“ fundamentals of Database Systems” IV edition. PEARSON Education.
2. Korth, Silberschatzsudarshan “Database systems, concepts” 5th edition McGraw Hill
3. Raghu Ramkrishnan& Johannes Gehrke “Database Management System” Tata McGraw Hill. III edition.
4. Ruosell J.T. Dyer, Learning MySQL and Mariadb.

**Reference Books:**

1. Chhanda Ray , “Distributed Database System”, Pearson Education India.
2. Hector Garcia-Molina, Jeffery D. Ullman, Jennifer Widom , “ Database system Implementation”
3. Thomas M.Connolly Carolyn Begg, Database Systems : A practical Approach to Design , Implementation and Management, 4/e.

**Suggested mini. Project / Experiment work:**

1. Given problem statement 2/3 student to perform-
  - a. Design EER model and perform sorting, join operations for the specified problem statement.
  - b. Perform the various fragmentation (Horizontal, Vertical, Derived) and check its correctness criteria.
  - c. Perform two phase commit protocol (2PC)
2. Mini Project / Case study on document oriented database such a Mariadb
3. Mini Project Case study Development of an application based on any one advance data model (temporal, Spatial Multimedia )

**\*\* Perform Laboratory (Experiments) work in the in CSM605:Mini-Project**

**Assessment:**

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

- 1 Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
<b>CSDLO6023</b>	<b>Enterprise Resource Planning(ERP)</b>	<b>4</b>

**Course Objectives:**

1. To understand the technical aspects and life cycle of ERP systems.
2. To understand the steps and activities in ERP.
3. To identify and describe different types of ERP system.
4. To understand tools and methodology used for designing ERP for an Enterprise.

**Course Outcomes: After completion of this course, students will be able ..**

1. To understand the basic structure of ERP.
2. To identify implementation strategy used for ERP.
3. To apply design principles for various business modules in ERP.
4. To apply different emerging technologies for implementation of ERP.
5. To analyze security issues in ERP.
6. To acquire ERP concepts for real world applications.

**Pre-requisites:** Web Engineering, Computer Network, Database Systems

Module No.	Unit No.	Topics	Hrs.
<b>1.0</b>		<b>Introduction to Enterprise Resource Planning (ERP )</b> Information System and Its Components, Value Chain Framework, Organizational Functional Units, Evolution of ERP Systems, Role of ERP in Organization, Three-Tier Architecture of ERP system.	<b>8</b>
<b>2.0</b>		<b>ERP and Implementation</b> ERP implementation and strategy, Implementation Life cycle, Pre-implementation task, requirement definition, implementation Methodology.	<b>8</b>
<b>3.0</b>		<b>ERP Business Modules</b>	<b>8</b>
	<b>3.1</b>	Finance, manufacturing, human resources, quality management, material management, marketing, Sales distribution and service.	
	<b>3.2</b>	Case study on Supply Chain management (SCM), Customer relationship Management (CRM)	
<b>4.0</b>		<b>Introduction to ERP related Technologies</b>	<b>10</b>
	<b>4.1</b>	Business Process Re-engineering (BPR) ,Data warehousing ,Data Mining, On- line Analytical Processing(OLAP), Product Life Cycle Management (PLM)	
	<b>4.2</b>	Geographical Information Management ,RFID, QR Code ,Bar	

		Coding, E-commerce and their application in Enterprise planning	
5.0		Extended ERP and security issues	8
	5.1	Enterprise application Integration (EAI), open source ERP, cloud ERP	
	5.2	Managing ERP Securities: Types of ERP security Issues, System Access security, Data Security and related technology for managing data security	
6.0		Cases of ERP for Enterprises.	10
	6.1	Cases of ERP like MySAP for Business suite implementation at ITC, ERP for Nestle GLOBE Project, Oracle ERP Implementation at Maruti Suzuki.	
	6.2	Need of ERP for Small and Medium size enterprises.(Zaveri)	
		<b>Total</b>	<b>52</b>

### Text Books:

1. Alexis Leon, ERP Demystified: II Edition, Tata McGraw Hill.
2. Rajesh Ray, Enterprise Resource Planning, Text and cases, Tata McGraw Hill.
3. Sandeep Desai, Abhishek Srivastava, ERP to E<sup>2</sup> ERP: A Case study approach, PHI.
4. Jyotindra Zaveri, Enterprise Resource Planning, Himalaya Publishing House, 2012.

### Reference Books:

1. V.K. Garg & N.K. Venkatakrishnan, Enterprise Resource Planning: concepts & practices, by ; PHI.
2. Supply Chain Management Theories & Practices: R. P. Mohanty, S. G. Deshmukh, - Dreamtech Press.
3. Enterprise wide resource planning: Theory & practice: by Rahul Altekar, PHI
4. Customer Relationship Management, Concepts and cases, Second Edition.

### Mini Project / Laboratory Work:

1. Give case study 2/3 student of any organization. Make a report before-after situation at organization (Domain).
2. Make a list of Resource of the Selected Domain.
3. Categorized the Resource as per the function level process and Identify module of the domain.
4. Explain process of each module of the domain.
5. Perform Business process re-engineering (BPR) on selected Module.
6. Implement new system based on BPR.
7. Perform Impact analysis of the new system as the BPR.
  - a. Prepare study on JD Edward Tool.

- b. Prepare study on Microsoft Dynamics.
8. Download any open source ERP Tool and prepare Installation Guideline and information about the Tool.
9. Make Data Entry in the Software in all modules & generate report.

**\*\* Perform Laboratory (Experiments) work in the in CSM605:Mini-Project.**

**Assessment:**

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

- 1 Question paper will comprise of 6 questions, each carrying 20 marks.
  - The students need to solve total 4 questions.
  - Question No.1 will be compulsory and based on entire syllabus.
  - Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
<b>CSDLO6024</b>	<b>Advanced Computer Network</b>	<b>4</b>

**Course Objective:**

1. To make learners aware about advances in computer networking technologies.
2. To give overview of advance internet, QoS based and management protocols.
3. To introduce issues related to traffic engineering and capacity planning.

**Course Outcomes:** On successful completion of course learner will be able to

1. Demonstrate the understanding of advance data communication technologies.
2. Demonstrate the understanding of WAN Technology typically ATM .
3. Demonstrate the understanding of packet switching protocols such as X.25, X.75.
4. Explore the issues of advance internet routing protocols and also QoS based protocols.
5. Analyze issues of traffic requirements and perform capacity planning.
6. Demonstrate the understanding of protocol used for management of network.

**Prerequisite:** Computer Networks, ISO OSI Layered Protocols, TCP/IP protocol suite.

Module No.	Unit No.	Topics	Hrs.
1	<b>Data Communications:</b>		<b>06</b>
	1.1	Defining Data Communication needs, Transmission Hierarchy	
	1.2	<b>Optical Networks:</b> SONET/SDH standard, Architecture, Format, Hardware, Configuration, advantages	
2	<b>WAN Technology:</b>		<b>10</b>
	2.1	Introducing ATM Technology, Need and Benefit, Concept, Faces of ATM	
	2.2	Why ATM, BISDN Reference Model, ATM Layer, ATM Adaptation Layer, ATM Signaling	
3	<b>Protocols and Interfaces:</b>		<b>10</b>
	3.1	<b>Introduction to TCP/IP:</b> Issues in IPV4, IPV6 protocol	
	3.2	<b>Mature Packet Switching Protocols:</b> ITU Recommendation X.25, User Connectivity, Theory of Operations, Network Layer Functions, X.75 Internetworking Protocol, Advantages and Drawbacks	



	<b>Advance Routing Protocols:</b>	<b>14</b>
<b>4</b>	<b>4.1</b>	<b>Internet Routing Protocols :</b> OSPF, RIP, BGP <b>Multicast Routing:</b> Reverse Path Broadcasting, Internet Group Management Protocol, Reverse Path Multicasting, Discrete Vector Multicasting protocol
	<b>4.2</b>	IP forwarding Architectures <b>Overlay Model:</b> Classical IP over ATM and LANE
	<b>4.3</b>	<b>Multiprotocol Label Switching MPLS :</b> Fundamentals of Labels, Label Stack, VC Merging, Label Distribution Protocol, Explicit routing for Traffic Engineering
	<b>4.4</b>	Integrated services, RSVP, Differentiated Services
	<b>4.5</b>	<b>MultiMedia Over Internet:</b> RTP, Session Control Protocol H.323
	<b>Traffic Engineering :</b>	<b>08</b>
<b>5</b>	<b>5.1</b>	<b>Requirement Definition:</b> User requirement Traffic Sizing , Traffic Characteristics, Protocols, Time and Delay Considerations
	<b>5.2</b>	<b>Traffic Engineering and Capacity planning:</b> Throughput calculation, Traffic Engineering basics, Traditional traffic Engineering and Queued data and Packet Switched packet modeling, Queuing Disciplines (M/M/1), Design parameters for Peak: delay or latency, availability and reliability.
<b>6</b>	<b>Network management</b>	
	<b>6.1</b>	<b>Network Management :</b> SNMP Concept and format, Management Components: SMI, MIB
		<b>04</b>

**Text Books:**

1. M. A. Gallo and W. M. Hancock, Computer Communications and Networking Technologies, Cengage Learning, (1e).
2. Leon-Garcia, Communication Networks, Tata McGraw-Hill.
3. Darren L. Spohn, Data Network Design, Tata McGraw-Hill.
4. BehrouzForouzan, TCP/IP Protocol Suite ,McGraw-Hill, (5e).
5. William Stallings, High-Speed Networks and Internets, Pearson Education, (2e).

**Reference Books:**

1. Andrew Tanenbaum“ Computer Networks”, Prentice Hall, (5e).
2. Cisco Certified Network Analyst study guide, Wiley Publishing House.(7e).
3. Douglas E. Comer, Internetworking with TCP/IP Volume One, (6e).
4. James F. Kurose, Keith W. Ross, “Computer Networking, A Top-Down Approach Featuring the Internet”,Addison Wesley, (5e).

**Assessment:****Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Lab Code	Lab Name	Credits
<b>CSL601</b>	<b>Software Engineering Lab</b>	<b>1</b>

**Lab Outcome:**

On successful completion of laboratory sessions, learners will be able to

1. Identify requirements and apply process model to selected case study.
2. Analyze and design models for the selected case study using UML modeling.
3. Use various software engineering tools.

**Description:**

The Software Engineering Lab has been developed by keeping in mind the following objectives:

- Select case studies to solve real life problems by applying software engineering principles.
- To impart state-of-the-art knowledge on Software Engineering and UML.

**List of Experiments:**

Laboratory work will be based on course syllabus with minimum 10 experiments to be incorporated.

Assign case study to a group of two/three students and each group to perform the following experiments on their case study.

Sr. No.	Title of Experiments
1	Prepare detailed statement of problem for the selected / allotted mini project and identify suitable process model for the same with justification.
2	Develop Software Requirement Specification (SRS) document in IEEE format for the project.
3	Use project management tool to prepare schedule for the project.
4	Prepare RMMM plan for the project.
5	Identify scenarios & develop UML Use case and Class Diagram for the project.
6	Draw DFD (upto 2 levels) and prepare Data Dictionary for the project.
7	Develop Activity / State Transition diagram for the project.
8	Develop Sequence and Collaboration diagram for the project.
9	Change specification and make different versions using any SCM Tool.
10	Develop test cases for the project using white box testing.

**Digital Material:**

Practical can be conducted using any open source software tools like Dia, Star UML, etc.

**Term Work:**

Term work (25 Marks) shall consist of

- Laboratory work ..... 15 marks
- Two assignments ... 05 marks
- Attendance (theory and practical) ..... 05 marks

**Oral exam** will be based on CSC601 and CSL601 syllabus.

Lab Code	Lab Name	Credits
<b>CSL602</b>	<b>System Software Lab</b>	<b>1</b>

**Outcome:** At the end of the course learner will be able to

1. Generate machine code by using various databases generated in pass one of two pass assembler.
2. Construct different databases of single pass macro processor.
3. Identify and validate different tokens for given high level language code.
4. Parse the given input string by constructing Top down /Bottom up parser.
5. Implement synthesis phase of compiler with code optimization techniques.
6. Explore various tools like LEX and YACC.

**Description:** The current System Software is highly complex with huge built in functionality offered to the programmer to develop complex applications with ease. This laboratory course aims to make a student understand-

- The need for modular design
- The need for well-defined data structures and their storage management
- The increase in the complexity of translators as we move from assembly level to high level programming
- The need to produce an efficient machine code that is optimized for both execution speed and memory requirement
- The efficient programming constructs that make them a good coder

**Suggested List of Experiments:**

Sr. No.	Title of Experiments
1	Implementations of two pass Assembler.
2	Implementation of single pass Macro Processor.
4	Implementation of Lexical Analyzer.
5	Implementation of Parser (Any one).
6	Implementation of Intermediate code generation phase of compiler.
7	Implementation of code generation phase of compiler.
8	Study and implement experiments on LEX, YACC, Grey Box Probing.

**Reference Books:**

1. Modern Compiler. Implementation in Java, Second. Edition. Andrew W. Appel Princeton University. Jens Palsberg Purdue University. CAMBRIDGE.
2. Crafting a compiler with C, Charles N. Fischer, Ron K. Cytron, Richard J. LeBlanc .

**Term Work:**

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/case studies): .....(15) Marks.
- Assignment: ..... (05) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

**Oral & Practical exam** will be based on the above and **CSC602** syllabus.

Lab Code	Lab Name	Credits
<b>CSL603</b>	<b>Data Warehousing and Mining Lab</b>	<b>1</b>

**Lab Outcome:**

1. Design data warehouse and perform various OLAP operations.
2. Implement classification, prediction, clustering and association rule mining algorithms.
3. Demonstrate classifications, prediction, clustering and association rule mining algorithms on a given set of data sample using data mining tools.
4. Implement spatial and web mining algorithms.

**Description:**

An operational database undergoes frequent changes on a daily basis on account of the transactions that take place. A data warehouses provides us generalized and consolidated data in multidimensional view. Data mining functions such as classification, prediction, clustering, and association rule mining can be integrated with OLAP operations to enhance the interactive mining of knowledge at multiple level of abstraction. Data mining supports knowledge discovery by finding hidden patterns and associations, constructing analytical models, performing classification and prediction, these mining results can be demonstrated using the data mining tools.

**Suggested List of Experiments:**

Sr. No.	Title of Experiments
1	Build Data Warehouse/Data Mart for a given problem statement i) Identifying the source tables and populating sample data ii) Design dimensional data model i.e. Star schema, Snowflake schema and Fact Constellation schema (if applicable)
2	To perform various OLAP operations such as slice, dice, drilldown, rollup, pivot
3	Implementation of Classification algorithm( Decision Tree/ Bayesian)
4	Implementation of Linear Regression.
5	Implementation of Clustering algorithm( K-means/ Agglomerative).
6	Implementation of Association Rule Mining algorithm(Apriori).

7	Perform data Pre-processing task and Demonstrate performing Classification, Clustering, Association algorithm on data sets using data mining tool (WEKA,R tool, XL Miner, etc.)
8	Implementation of page rank algorithm.
9	Implementation of HITS algorithm.
10	Implementation of Spatial Clustering Algorithm- CLARANS Extensions

**Term Work:**

Laboratory work will be based on above syllabus with minimum 08 experiments to be incorporated.

Experiments ----- (15) Marks  
Assignment----- (05) Marks  
Attendance (Theory + Practical) ----- (05) Marks  
**Total ----- (25) Marks**

**Oral & Practical exam** will be based on the above and CSC603:“Data Warehousing and Mining” syllabus.



Lab Code	Lab Name	Credit
<b>CSL604</b>	<b>System Security Lab</b>	<b>01</b>

### Lab Outcome:

Learner will able to

1. To be able to apply the knowledge of symmetric cryptography to implement simple ciphers.
2. To be able to analyze and implement public key algorithms like RSA and El Gamal.
3. To analyze and evaluate performance of hashing algorithms.
4. To explore the different network reconnaissance tools to gather information about networks.
5. To explore and use tools like sniffers, port scanners and other related tools for analysing packets in a network.
6. To be able to set up firewalls and intrusion detection systems using open source technologies and to explore email security.
7. To be able to explore various attacks like buffer-overflow, and web-application attacks.

### Suggested Experiment List: (Any 10)

Sr. No	Description
1	Design and Implementation of a product cipher using Substitution and Transposition ciphers
2	Implementation and analysis of RSA cryptosystem and Digital signature scheme using RSA/El Gamal.
3	Implementation of Diffie Hellman Key exchange algorithm
4	For varying message sizes, test integrity of message using MD-5, SHA-1, and analyse the performance of the two protocols. Use crypt APIs
5	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.
6	Study of packet sniffer tools : wireshark, : 1. Download and install wireshark and capture icmp, tcp, and http packets in promiscuous mode. 2. Explore how the packets can be traced based on different filters.
7	Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, xmas scan etc.
8	Detect ARP spoofing using nmap and/or open source tool ARPWATCH and wireshark. Use arping tool to generate gratuitous arps and monitor using wireshark
9	Simulate DOS attack using Hping, hping3 and other tools.
10	Simulate buffer overflow attack using Ollydbg, Splint, Cppcheck etc

11	a. Set up IPSEC under LINUX. b. Set up Snort and study the logs.
12	Setting up personal Firewall using iptables
13	Explore the GPG tool of linux to implement email security
14	SQL injection attack, Cross-Cite Scripting attack simulation

**Reference Books:**

1. Build your own Security Lab, Michael Gregg, Wiley India
2. CCNA Security, Study Guide, TIm Boyles, Sybex.
3. Network Security Bible, Eric Cole, Wiley India.
4. Web Application Hacker’s Handbook, Dafydd Stuttard, Marcus Pinto, Wiley India.

**Term Work:**

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Experiments -----	(15) Marks
Assignment-----	(05) Marks
Attendance (Theory + Practical) -----	(05) Marks
<b>Total -----</b>	<b>(25) Marks</b>

**Oral & practical examination** will be based on the above and Cryptography and System Security (CSC604) syllabus.

Lab Code	Lab Name	Credit
<b>CSM605</b>	<b>Mini-Project</b>	<b>2</b>

**Lab Outcome:** After successful completion of this Lab student will be able to

1. Acquire practical knowledge within the chosen area of technology for project development.
2. Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach
3. Contribute as an individual or in a team in development of technical projects
4. Develop effective communication skills for presentation of project related activities

**Description:**

Mini project may be carried out in one or more form of following:

Product preparations, prototype development model, fabrication of set-ups, laboratory experiment development, process modification/development, simulation, software development, integration of software and hardware, statistical data analysis, creating awareness in society, etc.

**Guidelines:**

- A project to be developed based on one or more of the following fields- Advance Database Management System, Enterprise Resource Planning, Advance Operating System, Advance Computer Network, etc.
- Mini project may be carried out a group of 2 /3 students. The student is required to submit a report based on the work. The evaluation of the project shall be on continuous basis.

**Term Work (TW):**

Distribution of marks for term work shall be as follows:

- |                                  |          |
|----------------------------------|----------|
| 1. Attendance                    | 05 Marks |
| 2. Mini project work             | 10 Marks |
| 3. Project Report (Spiral Bound) | 10 Marks |

The final certification and acceptance of TW ensures the satisfactory performance on the above three aspects.

**Oral & Practical Examination** should be conducted by internal and external examiners appointed by University of Mumbai. Students have to give presentation and demonstration on the Mini-Project.

Course Code	Course Name	Credits
CSC701	Digital Signal & Image Processing	4

**Course objectives:**

1. To understand the fundamental concepts of digital signal processing and Image processing.
2. To explore DFT for 1-D and 2-D signal and FFT for 1-D signal
3. To apply processing techniques on 1-D and Image signals.
4. To apply digital image processing techniques for edge detection.

**Course outcomes:** On successful completion of the course learner will be able to:

1. Apply the concept of DT Signal and DT Systems.
2. Classify and analyze discrete time signals and systems
3. Implement Digital Signal Transform techniques DFT and FFT.
4. Use the enhancement techniques for digital Image Processing
5. Differentiate between the advantages and disadvantages of different edge detection techniques
6. Develop small projects of 1-D and 2-D Digital Signal Processing.

**Prerequisite:** Applied Mathematics

Module No.	Unit No.	Topic details	Hrs.
1.0		<b>Discrete-Time Signal and Discrete-Time System</b>	14
	1.1	Introduction to Digital Signal Processing, Sampling and Reconstruction, Standard DT Signals, Concept of Digital Frequency, Representation of DT signal using Standard DT Signals, Signal Manipulations(shifting, reversal, scaling, addition, multiplication).	
	1.2	Classification of Discrete-Time Signals, Classification of Discrete-Systems	
	1.3	Linear Convolution formulation for 1-D and 2-D signal (without mathematical proof), Circular Convolution (without mathematical proof), Linear convolution using Circular Convolution. Auto and Cross Correlation formula evaluation, LTI system, Concept of Impulse Response and Step Response, Output of DT system using Time Domain Linear Convolution.	
2.0		<b>Discrete Fourier Transform</b>	08
	2.1	Introduction to DTFT, DFT, Relation between DFT and DTFT, IDFT	
	2.2	Properties of DFT without mathematical proof (Scaling and Linearity, Periodicity, Time Shift and Frequency Shift, Time Reversal, Convolution Property and Parsevals' Energy Theorem). DFT computation using DFT properties.	
	2.3	Transfer function of DT System in frequency domain using DFT. Linear and Circular Convolution using DFT, Convolution of long sequences, Introduction to 2-D DFT	
3.0		<b>Fast Fourier Transform</b>	06
	3.1	Need of FFT, Radix-2 DIT-FFT algorithm,	

Module No.	Unit No.	Topic details	Hrs.
	3.2	DIT-FFT Flow graph for N=4 and 8, Inverse FFT algorithm.	
	3.3	Spectral Analysis using FFT	
4.0		<b>Digital Image Fundamentals</b>	<b>08</b>
	4.1	Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization	
	4.2	Representation of Digital Image, Connectivity	
	4.3	Image File Formats: BMP, TIFF and JPEG.	
5.0		<b>Image Enhancement in Spatial domain</b>	<b>10</b>
	5.1	Gray Level Transformations, Zero Memory Point Operations,	
	5.2	Histogram Processing, Histogram equalization.	
	5.3	Neighborhood Processing, Spatial Filtering, Smoothing and Sharpening Filters, Median Filter.	
6.0		<b>Image Segmentation</b>	<b>06</b>
	6.1	Segmentation based on Discontinuities (point, Line, Edge),	
	6.2	Image Edge detection using Robert, Sobel, Prewitt masks, Image Edge detection using Laplacian Mask.	
		<b>Total</b>	<b>52</b>

#### Text Books:

1. John G. Proakis, Dimitris and G.Manolakis, 'Digital Signal Processing: Principles, Algorithms, and Applications' 4<sup>th</sup> Edition 2007, Pearson Education.
2. A. Anand Kumar, 'Digital Signal Processing', PHI Learning Pvt. Ltd. 2013.
3. Rafel C. Gonzalez and Richard E. Woods, 'Digital Image Processing', Pearson Education Asia, 3<sup>rd</sup> Edition, 2009,
4. S. Sridhar, 'Digital Image Processing', Oxford University Press, Second Edition, 2012.

#### Reference Books:

1. Sanjit Mitra, 'Digital Signal Processing: A Computer Based Approach', TataMcGraw Hill, 3<sup>rd</sup> Edition.
2. S. Salivahanan, A. Vallavaraj, and C. Gnanapriya, 'Digital Signal Processing' Tata McGraw Hill Publication 1<sup>st</sup> Edition (2010).
3. S. Jayaraman, E. Esakkirajan and T. Veerkumar, 'Digital Image Processing' TataMcGraw Hill Education Private Ltd, 2009.
4. Anil K. Jain, 'Fundamentals and Digital Image Processing', Prentice Hall of India Private Ltd, 3<sup>rd</sup> Edition.

#### Assessment:

##### Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 50% syllabus is completed. Duration of each test shall be one hour.

##### End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSC702	Mobile Communication & Computing	4

**Course objectives:**

1. To introduce the basic concepts and principles in mobile computing. This includes major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications.
2. To explore both theoretical and practical issues of mobile computing.
3. To provide an opportunity for students to understand the key components and technologies involved and to gain hands-on experiences in building mobile applications.

**Course outcomes:** On successful completion of course learner will be able:

1. To identify basic concepts and principles in mobile communication & computing, cellular architecture.
2. To describe the components and functioning of mobile networking.
3. To classify variety of security techniques in mobile network.
4. To apply the concepts of WLAN for local as well as remote applications.
5. To describe and apply the concepts of mobility management
6. To describe Long Term Evolution (LTE) architecture and its interfaces.

**Prerequisite: Computer Networks**

Module No.	Unit No.	Topics	Hrs
1.0	1.1	Introduction to Mobile Computing, Telecommunication Generations, Cellular systems,	06
	1.2	Electromagnetic Spectrum, Antenna ,Signal Propagation, Signal Characteristics, , Multiplexing, Spread Spectrum: DSSS & FHSS	
2.0	2.1	GSM Mobile services, System Architecture, Radio interface, Protocols , Localization and Calling, Handover, security (A3,A5 & A8)	10
	2.2	GPRS system and protocol architecture	
	2.2	UTRAN , UMTS core network ; Improvements on Core Network,	
3.0	3.1	<b>Mobile Networking</b> : Medium Access Protocol, Internet Protocol and Transport layer	12
	3.2	Medium Access Control: Motivation for specialized MAC, , Introduction to multiple Access techniques (MACA)	

	<b>3.3</b>	Mobile IP: IP Packet Delivery, Agent Advertisement and Discovery, Registration, Tunneling and Encapsulation, Reverse Tunneling, Routing (DSDV,DSR)	
	3.4	Mobile TCP : Traditional TCP, Classical TCP Improvements like Indirect TCP, Snooping TCP & Mobile TCP, Fast Retransmit/ Fast Recovery, Transmission/Timeout Freezing, Selective Retransmission	
<b>4.0</b>	<b>4.1</b>	<b>Wireless Local Area Networks</b> : Introduction, Infrastructure and ad-hoc network	<b>08</b>
	<b>4.2</b>	<b>IEEE 802.11</b> :System architecture , Protocol architecture , Physical layer, Medium access control layer, MAC management, 802.11a, 802.11b	
	<b>4.3</b>	Wi-Fi security : WEP ,WPA, Wireless LAN Threats , Securing Wireless Networks	
	<b>4.4</b>	HiperLAN 1 & HiperLAN 2	
	<b>4.5</b>	Bluetooth: Introduction, User Scenario, Architecture, protocol stack	
<b>5.0</b>	<b>5.1</b>	<b>Mobility Management</b> : Introduction, IP Mobility, Optimization, IPv6	<b>06</b>
	<b>5.2</b>	Macro Mobility : MIPv6, FMIPv6,	
	<b>5.3</b>	Micro Mobility: CellularIP, HAWAII, HMIPv6,	
<b>6.0</b>	<b>6.1</b>	<b>Long-Term Evolution (LTE) of 3GPP</b> : LTE System Overview, Evolution from UMTS to LTE	<b>10</b>
	<b>6.2</b>	LTE/SAE Requirements, SAE Architecture	
	<b>6.3</b>	EPS: Evolved Packet System, E-UTRAN, Voice over LTE (VoLTE), Introduction to LTE-Advanced,	
	<b>6.4</b>	System Aspects, LTE Higher Protocol Layers, LTE MAC layer, LTE PHY Layer,	
	6.5	Self Organizing Network (SON-LTE),SON for Heterogeneous Networks (HetNet), Introduction to 5G	
		<b>Total</b>	<b>52</b>

### Assessment:

#### **Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

**Text Books:**

- 1 Jochen Schiller, "Mobile Communication", Addison Wesley, Pearson Education
- 2 "Wireless Communications & Networks," By William Stallings, Second Edition, Pearson Education
- 3 Raj Kamal, Mobile Computing, 2/e, Oxford University Press-New Delhi

**Reference Books:**

- 1 LTE Self-Organizing Networks (SON): Network Management Automation for Operational Efficiency, [Seppo Hamalainen](#), [Henning Sanneck](#), [Cinzia Sartori](#), Wiley publications
- 2 Christopher Cox, "An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications," Wiley publications
- 3 Mobility Protocols and Handover Optimization: Design, Evaluation and Application By Ashutosh Dutta, Henning Schulzrinne, IEEE Press, Wiley Publication
- 4 Michael Gregg, "Build your own security lab," Wiley India edition
- 5 Emerging Wireless Technologies and the Future Mobile Internet, Dipankar Raychaudhuri, Mario Gerla, Cambridge.
- 6 Andreas F. Molisch, "Wireless Communications," Second Edition, Wiley Publications.



Course Code	Course Name	Credits
<b>CSC703</b>	<b>Artificial Intelligence &amp; Soft Computing</b>	<b>4</b>

**Course Objectives (CO):**

- 1 To conceptualize the basic ideas and techniques of AI and SC.
- 2 To distinguish various search techniques and to make student understand knowledge representation and planning.
- 3 To become familiar with basics of Neural Networks and Fuzzy Logic.
- 4 To familiarize with Hybrid systems and to build expert system.

**Course Outcomes:** Students should be able to -

- 1 Identify the various characteristics of Artificial Intelligence and Soft Computing techniques.
- 2 Choose an appropriate problem solving method for an agent to find a sequence of actions to reach the goal state.
- 3 Analyse the strength and weakness of AI approaches to knowledge representation, reasoning and planning.
- 4 Construct supervised and unsupervised ANN for real world applications.
- 5 Design fuzzy controller system.
- 6 Apply Hybrid approach for expert system design.

**Pre-requisites:** Basic Mathematics, Algorithms

Module No.	Unit No.	Topics	Hrs.
1.0		<b>Introduction to Artificial Intelligence(AI) and Soft Computing</b>	4
	1.1	Introduction and Definition of Artificial Intelligence.	
	1.2	Intelligent Agents : Agents and Environments ,Rationality, Nature of Environment, Structure of Agent, types of Agent	
	1.3	Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques.	
2.0		<b>Problem Solving</b>	10
	2.1	Problem Solving Agent, Formulating Problems, Example Problems	
	2.2	Uninformed Search Methods: Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Method: A* Search	
	2.3	Optimization Problems: Hill climbing Search, Simulated annealing, Genetic algorithm	
3.0		<b>Knowledge, Reasoning and Planning</b>	10
	3.1	Knowledge based agents	
	3.2	First order logic: syntax and Semantic, Knowledge Engineering in FOL Inference in FOL : Unification, Forward Chaining, Backward Chaining and Resolution	
	3.3	Planning Agent, Types of Planning: Partial Order, Hierarchical Order, Conditional Order	
4.0		<b>Fuzzy Logic</b>	12

	4.1	Introduction to Fuzzy Set: Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, membership functions,	
	4.2	Fuzzy Logic: Fuzzy Logic basics, Fuzzy Rules and Fuzzy Reasoning	
	4.3	Fuzzy inference systems: Fuzzification of input variables, defuzzification and fuzzy controllers.	
5.0		<b>Artificial Neural Network</b>	12
	5.1	Introduction – Fundamental concept– Basic Models of Artificial Neural Networks – Important Terminologies of ANNs – McCulloch-Pitts Neuron	
	5.2	Neural Network Architecture: Perceptron, Single layer Feed Forward ANN, Multilayer Feed Forward ANN, Activation functions, Supervised Learning: Delta learning rule, Back Propagation algorithm.	
	5.3	Un-Supervised Learning algorithm: Self Organizing Maps	
6.		<b>Expert System</b>	4
	6.1	Hybrid Approach - Fuzzy Neural Systems	
	6.2	Expert system : Introduction, Characteristics, Architecture, Stages in the development of expert system,	
		Total	52

#### Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach "Second Edition" Pearson Education.
2. Samir Roy and Chakraborty, "Introduction to soft computing", Pearson Edition.
3. S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
4. S.Rajasekaran and G.A.VijayalakshmiPai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.
5. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press.

#### Reference Books:

1. Elaine Rich and Kevin Knight "Artificial Intelligence" Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
2. Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.
3. Zimmermann H.S "Fuzzy Set Theory and its Applications"Kluwer Academic Publishers.
4. Hagan, Demuth, Beale,"Neural Network Design" CENGAGE Learning, India Edition.
5. J.-S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.
6. JacekM.Zurada "Introduction to Artificial Neural Sytems" Jaico Publishing House.

#### Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

#### End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
CSDLO7031	Advanced System Security and Digital Forensics	4

**Course Objectives:**

1. To understand cyber attacks and defence strategies.
2. To understand underlying principles of access control mechanisms.
3. To explore software vulnerabilities, attacks and protection mechanisms of wireless networks and protocols, mobile devices and web applications.
4. To develop and mitigate security management and policies.
5. To understand and explore techniques used in digital forensics.

**Course Outcomes:** At the end of the course learner will able to

1. Understand cyber attacks and apply access control policies and control mechanisms.
2. Identify malicious code and targeted malicious code.
3. Detect and counter threats to web applications.
4. Understand the vulnerabilities of Wi-Fi networks and explore different measures to secure wireless protocols, WLAN and VPN networks.
5. Understand the ethical and legal issues associated with cyber crimes and be able to mitigate impact of crimes with suitable policies.
6. Use different forensic tools to acquire and duplicate data from compromised systems and analyse the same.

**Prerequisite:** Cryptography and System Security

Module No.	Unit No.	Detailed Content	Hrs
1	<b>Introduction &amp; Access Control</b>		08
	1.1	Cyber-attacks, Vulnerabilities, Defence Strategies and Techniques, Authentication Methods and Protocols, Defence in Depth Strategies.	
	1.2	Access Control Policies: DAC, MAC, Multi-level Security Models: Biba Model, Bell La Padula Model, Single Sign on, Federated Identity Management.	
2	<b>Program &amp; OS Security</b>		08
	2.1	Malicious and Non-Malicious programming errors, Targeted Malicious codes: Salami Attack, Linearization Attack, Covert Channel, Control against Program threats.	
	2.2	Operating System Security: Memory and Address protection, File Protection Mechanism, User Authentication.	
	2.3	Linux and Windows: Vulnerabilities, File System Security.	
3	<b>Web Application Security</b>		12
		OWASP, Web Security Considerations, User Authentication and Session	

		Management, Cookies, SSL, HTTPS, SSH, Privacy on Web, Web Browser Attacks, Account Harvesting, Web Bugs, Clickjacking, Cross-Site Request Forgery, Session Hijacking and Management, Phishing and Pharming Techniques, Web Service Security, OAuth 2.0	
4	<b>Wireless Security</b>		08
		Wi-Fi Security, WEP, WPA, WPA-2, Mobile Device Security- Security Threats, Device Security, GSM and UMTS Security, IEEE 802.11/802.11i Wireless LAN Security, VPN Security.	
5	<b>Legal and Ethical issues</b>		06
	5.1	Cybercrime and its types, Intellectual property, Privacy, Ethical issues.	
	5.2	Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, case studies of ethics.	
6	<b>Digital Forensics</b>		10
		Introduction to Digital Forensics, Acquiring Volatile Data from Windows and Unix systems, Forensic Duplication Techniques, Analysis of forensic images using open source tools like Autopsy and SIFT, Investigating logs from Unix and windows systems, Investigating Windows Registry.	

**Text Books:**

1. Computer Security Principles and Practice, William Stallings, Sixth Edition, Pearson Education
2. Security in Computing, Charles P. Pfleeger, Fifth Edition, Pearson Education
3. Network Security and Cryptography, Bernard Menezes, Cengage Learning
4. Network Security Bible, Eric Cole, Second Edition, Wiley

**Reference Books:**

1. Computer Security, Dieter Gollman, Third Edition, Wiley
2. Digital Forensics by Nilakshi Jain & Kalbande, Wiley.
3. Incident Response & Computer Forensics by Kevin Mandia, Chris Prorise, Wiley.
4. Cyber Security. Nina Godbole, Sunit Belapure, Wiley.

**Digital references:**

1. [https://www.owasp.org/index.php/Category:OWASP\\_Top\\_Ten\\_Project](https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project)

**Assessment:**

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

### **Theory Examination:**

1. Question paper will comprise of total six question.
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

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### **Laboratory/ Experimental Work**

**# The Experiments for this course are required to be performed and to be evaluated in CSL704: Computational Lab-1.**

#### **Lab Outcome:**

Learner will able to

1. Analyze static code and program vulnerabilities using open source tools.
2. Explore and analyze network vulnerabilities using open source tools.
3. Explore and analyze different security tools to detect web application and browser vulnerabilities.
4. Explore and analyze different tools to secure wireless networks and routers, and mobile devices and perform penetration testing, and analyze its impact.
5. Understand and implement AAA using RADIUS and TACACS.
6. Explore various forensics tools in Kali Linux and use them to acquire, duplicate and analyze data and recover deleted data.

<b>Sr. No</b>	<b>Description</b>
1	Static code analysis using open source tools like RATS, Flawfinder etc.
3	Vulnerability scanning using Nessus, Nikto (Kali Linux)
4	Explore web-application vulnerabilities using open source tools like Wapiti, browser exploitation framework (BeEf), etc.
5	Detect SQL injection vulnerabilities in a website database using SQLMap
6	Performing a penetration testing using Metasploit (Kali Linux)
7	Exploring Router and VLAN security, setting up access lists using Cisco Packet tracer(student edition)
8	Exploring VPN security using Cisco Packet tracer(student edition)
9	Exploring Authentication and access control using RADIUS, TACACS and TACACS+
10	Install and use a security app on an Android mobile (e.g. Droidcrypt)
11	Explore forensics tools in Kali Linux for acquiring, analyzing and duplicating data: dd, dcfldd, foremost, scalpel, debugfs, wireshark, tcptrace, tcpflow
12	Analysis of forensic images using open source tools like Autopsy, SIFT, FKT Imager
13	Use of steganographic tools like OpenStego, to detect data hiding or unauthorized file copying

14.	Use Password cracking using tools like John the Ripper/Cain and Abel/ Ophcrack to detect weak passwords.
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**Reference Books:**

1. Build your own Security Lab, Michael Gregg, Wiley India
2. CCNA Security, Study Guide, Tim Boyles, Sybex.
3. Web Application Hacker's Handbook, Dafydd Stuttard, Marcus Pinto, Wiley India
4. Network Infrastructure Security, Randy Waver, Dawn Weaver, Cengage Learning.
5. Incident Response & Computer Forensics by Kevin Mandia, Chris Prorise, Wiley.

**Digital References:**

<http://www.opentechinfo.com/learn-use-kali-linux/>

Course Code	Course/Subject Name	Credits
CSDLO7032	Big Data Analytics	4

**Course Objectives:**

1. To provide an overview of an exciting growing field of big data analytics.
2. To introduce programming skills to build simple solutions using big data technologies such as MapReduce and scripting for NoSQL, and the ability to write parallel algorithms for multiprocessor execution.
3. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
4. To enable students to have skills that will help them to solve complex real-world problems in for decision support.
5. To provide an indication of the current research approaches that is likely to provide a basis for tomorrow's solutions.

**Course Outcomes: Learner will be able to...**

1. Understand the key issues in big data management and its associated applications for business decisions and strategy.
1. Develop problem solving and critical thinking skills in fundamental enabling techniques like Hadoop, Mapreduce and NoSQL in big data analytics.
2. Collect, manage, store, query and analyze various forms of Big Data.
3. Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.
4. Adapt adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.
5. Solve Complex real world problems in various applications like recommender systems, social media applications, health and medical systems, etc.

**Prerequisite:**

Some prior knowledge about Java programming, Basics of SQL, Data mining and machine learning methods would be beneficial.

Module	Detailed Contents	Hrs.
01	<p><b>Introduction to Big Data and Hadoop</b></p> <p>1.1 Introduction to Big Data,  1.2 Big Data characteristics, types of Big Data,  1.3 Traditional vs. Big Data business approach,  1.4 Case Study of Big Data Solutions.  1.5 Concept of Hadoop  1.6 Core Hadoop Components; Hadoop Ecosystem</p>	06

02	<p><b>Hadoop HDFS and MapReduce</b></p> <p>2.1 Distributed File Systems: Physical Organization of Compute Nodes, Large-Scale File-System Organization.</p> <p>2.2 MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures.</p> <p>2.3 Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce</p> <p>2.4 Hadoop Limitations</p>	10
03	<p><b>NoSQL</b></p> <p>3.1 Introduction to NoSQL, NoSQL Business Drivers,</p> <p>3.2 NoSQL Data Architecture Patterns: Key-value stores, Graph stores, Column family (Bigtable)stores, Document stores, Variations of NoSQL architectural patterns, NoSQL Case Study</p> <p>3.3 NoSQL solution for big data, Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; NoSQL systems to handle big data problems.</p>	06
04	<p><b>Mining Data Streams:</b></p> <p>4.1 The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing.</p> <p>4.2 Sampling Data techniques in a Stream</p> <p>4.3 Filtering Streams: Bloom Filter with Analysis.</p> <p>4.4 Counting Distinct Elements in a Stream, Count-Distinct Problem, Flajolet-Martin Algorithm, Combining Estimates, Space Requirements</p> <p>4.5 Counting Frequent Items in a Stream, Sampling Methods for Streams, Frequent Itemsets in Decaying Windows.</p> <p>4.6 Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm, Decaying Windows.</p>	12
05	<p><b>Finding Similar Items and Clustering</b></p> <p>5.1 Distance Measures: Definition of a Distance Measure, Euclidean Distances, Jaccard Distance, Cosine Distance, Edit Distance, Hamming Distance.</p> <p>5.2 CURE Algorithm, Stream-Computing , A Stream-Clustering Algorithm, Initializing &amp; Merging Buckets, Answering Queries</p>	08
	<p><b>Real-Time Big Data Models</b></p> <p>6.1 PageRank Overview, Efficient computation of</p>	



06	PageRank: PageRank Iteration Using MapReduce, Use of Combiners to Consolidate the Result Vector. 6.2 A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering. 6.3 Social Networks as Graphs, Clustering of Social-Network Graphs, Direct Discovery of Communities in a social graph.	10
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**Text Books:**

1. CreAnand Rajaraman and Jeff Ullman “Mining of Massive Datasets”, Cambridge University Press,
2. Alex Holmes “Hadoop in Practice”, Manning Press, Dreamtech Press.
3. Dan Mcary and Ann Kelly “Making Sense of NoSQL” – A guide for managers and the rest of us, Manning Press.

**References books:**

1. Bill Franks , “Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics”, Wiley
2. Chuck Lam, “Hadoop in Action”, Dreamtech Press
3. Jared Dean, “Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners”, Wiley India Private Limited, 2014.
4. Jiawei Han and Micheline Kamber, “Data Mining: Concepts and Techniques”, Morgan Kaufmann Publishers, 3rd ed, 2010.
5. Lior Rokach and Oded Maimon, “Data Mining and Knowledge Discovery Handbook”, Springer, 2<sup>nd</sup> edition, 2010.
6. Ronen Feldman and James Sanger, “The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data”, Cambridge University Press, 2006.
7. Vojislav Kecman, “Learning and Soft Computing”, MIT Press, 2010.

**Term Work:**

Assign a case study for group of 3/4 students and each group to perform the following experiments on their case-study; Each group should perform the exercises on a large dataset created by them.

The distribution of marks for term work shall be as follows:

- Programming Exercises: ..... (10) Marks.
- Mini project: ..... (10) Marks.
- Attendance (Theory & Practical) ..... (05) Marks.
- TOTAL:** ..... **(25) Marks.**

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

### End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions (Q.2 to Q.6) will be selected from all the modules.

### Oral examination:

An oral exam will be held based on the above syllabus.

### Suggested Practical List:

1. Hadoop HDFS Practical:
  - HDFS Basics, Hadoop Ecosystem Tools Overview.
  - Installing Hadoop.
  - Copying File to Hadoop.
  - Copy from Hadoop File system and deleting file.
  - Moving and displaying files in HDFS.
  - Programming exercises on Hadoop.
2. Use of Sqoop tool to transfer data between Hadoop and relational database servers.
  - a. Sqoop - Installation.
  - b. To execute basic commands of Hadoop eco system component Sqoop.
3. To install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL commands.
4. Experiment on Hadoop Map-Reduce / PySpark:
2. -Implementing simple algorithms in Map-Reduce: Matrix multiplication, Aggregates, Joins, Sorting, Searching, etc.
5. Create HIVE Database and Descriptive analytics-basic statistics, visualization using Hive/PIG/R.
6. Write a program to implement word count program using MapReduce.
7. Implementing DGIM algorithm using any Programming Language/ Implement Bloom Filter using any programming language.
8. Implementing any one Clustering algorithm (*K*-Means/CURE) using Map-Reduce.
9. Streaming data analysis – use flume for data capture, HIVE/PYSpark for analysis of twitter data, chat data, weblog analysis etc.
10. Implement PageRank using Map-Reduce.
11. Implement predictive Analytics techniques (regression / time series, etc.) using R/ Scilab/ Tableau/ Rapid miner.
12. **Mini Project:** One real life large data application to be implemented (Use standard Datasets available on the web).

**# The Experiments for this course are required to be performed and to be evaluated  
in CSL704: Computational Lab-1.**

Course Code	Course Name	Credits
CSDLO7033	Robotics	4

**Course objectives:**

- 1 To know basics of a typical robot and its characteristics.
- 2 To analyse mathematically kinematic modelling of a typical robot manipulator.
- 3 To identify actuators, sensors and control of a robot for different applications.
- 4 To apply task planning and vision algorithms.

**Course outcomes:** On successful completion of course learner will be able to:

1. Describe typical robot and its characteristics.
2. Analyse kinematics parameters of robotic manipulator.
3. Identify actuators, sensors and control of a robot for different applications.
4. Design task plan and motion for a robot.
5. Apply Robotics to solve day to day problems using vision algorithms.
6. Use robot programming languages and acquire skills to program robots.

**Prerequisite:** Mathematical concepts of Geometry, Matrices Algebra, knowledge of Basic Electronics.

Module No.	Unit No.	Topics	Hrs.
1.0		<b>Introduction and Fundamentals of Robotics</b>	08
	1.1	Types of automation, Introduction, definition of a Robot, Classification of Robots, Robotics, History of Robotics, Advantages and Disadvantages of Robots, Robot Applications	
	1.2	Tasks involved in Robotics, Robot Components, Robot characteristics and classification, Degrees of Freedom, Robot joints, Robot Coordinates, Robot Reference frames, Programming Modes, Robot Workspace, Work Envelop.	
2.0		<b>Direct and Inverse Kinematics</b>	08
	2.1	<b>Direct (Forward) Kinematics:</b> Homogeneous coordinates, Link coordinates, Coordinate frame, coordinate transform, Arm equations, An example – Four Axis SCARA.	
	2.2	<b>Inverse Kinematics:</b> Inverse kinematics problem, Tool Configuration, An example – Four Axis SCARA.	
		<b>Sensors, Actuators and Drive Systems</b>	08

<b>3.0</b>	<b>3.1</b>	<b>Sensors:</b> Characteristics, Utilization, Types - Position, Velocity, Acceleration, Force and Pressure, Torque, Visible Light and Infrared, Touch and Tactile, Proximity, Range Finders sensors.	
	<b>3.2</b>	<b>Actuators and Drive System:</b> Characteristics, Hydraulic Actuators, Pneumatic Devices, Electric Motors	
<b>4.0</b>		<b>Robot Task and Motion Planning</b>	<b>10</b>
	<b>4.1</b>	Reactive Paradigms: Overview, Attributes of reactive paradigm	
	<b>4.2</b>	Task level programming, Uncertainty, Configuration Space, Gross motion planning, Fine-motion planning, Simulation of Planner motion, Source and goal scene, Task planner Simulation.	
	<b>4.3</b>	Robot Motion Planning: Concept of motion planning, BUG 1, BUG 2 and Tangent Bug Algorithms	
<b>5.0</b>		<b>Robot Vision</b>	<b>10</b>
	<b>5.1</b>	Image Representation, Template Matching, Polyhedral Objects	
	<b>5.2</b>	Shape Analysis, Iterative Processing	
	<b>5.3</b>	Perspective Transformations, Structured Illumination , Camera Calibration	
<b>6.0</b>		<b>Expert Systems, Robot Language and Fuzzy Logic</b>	<b>12</b>
	<b>6.1</b>	Introduction to Expert Systems, Expert system Characteristics, Robot as a Expert System, Robot Languages: Classification of Robot Languages, Computer Control and Robot Software, VAL System, and Language.	
	<b>6.2</b>	Introduction, Fuzzy set, Fuzzification, Fuzzy Inference Rule Base, Defuzzification, Applications of Fuzzy Logic in Robotics.	
		<b>Total</b>	<b>52</b>

**Text Books:**

1. Introduction Robotics - Analysis, Control, Applications by Saeed B. Niku, Second Edition, Wiley India.
2. Fundamentals of Robotics – Analysis and Control by Robert J. Schilling, Pearson
3. Introduction to AI robotics by Robin Murphy, PHI.  
University of Mumbai, B. E. (Computer Engineering), Rev. 2016

4. Robotics Technology and Flexible Automation by S. R. Deb, TMH.
5. Artificial Intelligence by Rich, Knight and Nair, TMH.
6. Introduction to Fuzzy Sets by M Ganesh PHI

**Reference Books:**

1. Robotics – Control, Sensing, Vision, and Intelligence by K. S. Fu, R. C. Gonzalez, C. S. G. Lee, Tata McGraw Hill
2. Principles of Robot Motion – Theory, Algorithms and Implementation by Howie Choset, Lynch, PHI
3. Introduction to Fuzzy Logic using Matlab, By: S.N.Sivanandam, S.N. Deepa, P Sumathi , Springer Publications

**Assessment:**

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

**Term Work :**

The distribution of marks for term work shall be as follows:

• Programming Exercises:	.....	(10) Marks.
• Mini project:	.....	(10) Marks.
• Attendance (Theory & Practical)	.....	(05) Marks.
<b>TOTAL:</b>	.....	<b>(25) Marks.</b>

**Suggested List of Experiments:**

1. Representation of Various Robots and their all Specifications (Study Experiment)
2. Co-ordinate Transform of a Robot
3. Fundamental Rotation
4. Composite Rotation
5. BFS and DFS
6. Homogeneous Rotation
7. Run Length Encoding
8. Shrink and swell Operator
9. BUG1 Algorithm

- 10 Bug2 Algorithm
- 11 Tangent Bug Algorithm
- 12 Edge detection algorithm
- 13 Case Study of CNC Machine
- 14 Designing a Robot Manipulator for Pre defined Task

Students can perform experiments based on Theory Syllabus or any 12 experiments from above list of experiments or experiments framed by teachers.

**# The Experiments for this course are required to be performed and to be evaluated in CSL704: Computational Lab-1.**

Course Code	Course Name	Credits
<b>ILO 7011</b>	<b>Product Life Cycle Management</b>	<b>03</b>

**Objectives:**

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

**Outcomes:** Learner will be able to...

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Sr. No.	Detailed Contents	Hrs
<b>01</b>	<b>Introduction to Product Lifecycle Management (PLM):</b> Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications <b>PLM Strategies:</b> Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
<b>02</b>	<b>Product Design:</b> Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
<b>03</b>	<b>Product Data Management (PDM):</b> Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
<b>04</b>	<b>Virtual Product Development Tools:</b> For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
<b>05</b>	<b>Integration of Environmental Aspects in Product Design:</b> Sustainable Development,	05

	Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	
<b>06</b>	<b>Life Cycle Assessment and Life Cycle Cost Analysis:</b> Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

### Assessment:

#### **Internal Assessment for 20 marks:**

##### Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### **End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

### **REFERENCES:**

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265



<b>Course Code</b>	<b>Course Name</b>	<b>Credits</b>
<b>ILO 7012</b>	<b>Reliability Engineering</b>	<b>03</b>

**Objectives:**

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

**Outcomes:** Learner will be able to...

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

<b>Sr. No</b>	<b>Detailed Contents</b>	<b>Hrs</b>
<b>01</b>	<b>Probability theory:</b> Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. <b>Probability Distributions:</b> Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. <b>Measures of Dispersion:</b> Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
<b>02</b>	<b>Reliability Concepts:</b> Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. <b>Failure Data Analysis:</b> Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. <b>Reliability Hazard Models:</b> Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
<b>03</b>	<b>System Reliability:</b> System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
<b>04</b>	<b>Reliability Improvement:</b> Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
<b>05</b>	<b>Maintainability and Availability:</b> System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
<b>06</b>	<b>Failure Mode, Effects and Criticality Analysis:</b> Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis	05

## **Assessment:**

### **Internal Assessment for 20 marks:**

#### **Consisting Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

### **End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

## **REFERENCES:**

1. L.S. Srinath, "Reliability Engineering", Affiliated East-West Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillon, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Connor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
ILO 7013	Management Information System	03

**Objectives:**

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

**Outcomes:** Learner will be able to...

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Sr. No.	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

## **Assessment:**

### **Internal Assessment for 20 marks:**

#### **Consisting Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

### **End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

## **REFERENCES:**

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10<sup>th</sup> Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Credits
ILO 7014	Design of Experiments	03

**Objectives:**

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

**Outcomes:** Learner will be able to...

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Sr. No	Detailed Contents	Hrs
01	<b>Introduction</b> 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	<b>Fitting Regression Models</b> 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
03	<b>Two-Level Factorial Designs</b> 3.1 The $2^2$ Design 3.2 The $2^3$ Design 3.3 The General $2^k$ Design 3.4 A Single Replicate of the $2^k$ Design 3.5 The Addition of Center Points to the $2^k$ Design, 3.6 Blocking in the $2^k$ Factorial Design 3.7 Split-Plot Designs	07
04	<b>Two-Level Fractional Factorial Designs</b> 4.1 The One-Half Fraction of the $2^k$ Design 4.2 The One-Quarter Fraction of the $2^k$ Design 4.3 The General $2^{k-p}$ Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07
05	<b>Response Surface Methods and Designs</b> 5.1 Introduction to Response Surface Methodology	07

	5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	
<b>06</b>	<b>Taguchi Approach</b> 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

**REFERENCES:**

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3<sup>rd</sup> edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2<sup>nd</sup> Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

<b>Course Code</b>	<b>Course Name</b>	<b>Credits</b>
<b>ILO 7015</b>	<b>Operations Research</b>	<b>03</b>

**Objectives:**

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

**Outcomes:** Learner will be able to...

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

<b>Sr. No.</b>	<b>Detailed Contents</b>	<b>Hrs</b>
<b>01</b>	<p><b>Introduction to Operations Research:</b> Introduction, , Structure of the Mathematical Model, Limitations of Operations Research</p> <p><b>Linear Programming:</b> Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, <b>Duality</b>, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis</p> <p><b>Transportation Problem:</b> Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.</p> <p><b>Assignment Problem:</b> Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem</p> <p><b>Integer Programming Problem:</b> Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.</p>	14
<b>02</b>	<p><b>Queuing models:</b> queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population</p>	05
<b>03</b>	<p><b>Simulation:</b> Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation</p>	05

<b>04</b>	<b>Dynamic programming.</b> Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
<b>05</b>	<b>Game Theory.</b> Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
<b>06</b>	<b>Inventory Models:</b> Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

### **Assessment:**

#### **Internal Assessment for 20 marks:**

##### **Consisting Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### **End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

### **REFERENCES:**

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons



Course Code	Course Name	Credits
ILO 7016	Cyber Security and Laws	03

**Objectives:**

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

**Outcomes:** Learner will be able to...

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Sr. No.	Detailed Contents	Hrs
01	<b>Introduction to Cybercrime:</b> Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	<b>Cyber offenses &amp; Cybercrime:</b> How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	<b>Tools and Methods Used in Cyberline</b> Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	<b>The Concept of Cyberspace</b> E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	<b>Indian IT Act.</b> Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	<b>Information Security Standard compliances</b> SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

## Assessment:

### **Internal Assessment for 20 marks:**

#### **Consisting Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

### **End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

## **REFERENCES:**

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kenneth J. Knapp, *Cyber Security & Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : <https://www.tifrh.res.in>
9. Website for more information , A Compliance Primer for IT professional : <https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538>

Course Code	Course Name	Credits
ILO 7017	Disaster Management and Mitigation Measures	03

**Objectives:**

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

**Outcomes: Learner will be able to...**

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Sr. No.	Detailed Contents	Hrs
01	Introduction 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion 2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	Disaster Management, Policy and Administration 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
05	Financing Relief Measures:	09

	5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	
06	Preventive and Mitigation Measures: 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

### **Assessment:**

#### **Internal Assessment for 20 marks:**

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First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### **End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

### **REFERENCES:**

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

<b>Course Code</b>	<b>Course Name</b>	<b>Credits</b>
<b>ILO 7018</b>	<b>Energy Audit and Management</b>	<b>03</b>

**Objectives:**

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

**Outcomes: Learner will be able to...**

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

<b>Sr. No</b>	<b>Detailed Contents</b>	<b>Hrs</b>
<b>01</b>	<b>Energy Scenario:</b> Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
<b>02</b>	<b>Energy Audit Principles:</b> Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
<b>03</b>	<b>Energy Management and Energy Conservation in Electrical System:</b> Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. <b>Energy efficiency measures in lighting system, Lighting control:</b> Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
<b>04</b>	<b>Energy Management and Energy Conservation in Thermal Systems:</b> Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity,	10

	factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	
<b>05</b>	<b>Energy Performance Assessment:</b> On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
<b>06</b>	<b>Energy conservation in Buildings:</b> Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

### **Assessment:**

#### **Internal Assessment for 20 marks:**

Consisting Two Compulsory Class Tests

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#### **End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

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3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

### **REFERENCES:**

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. [www.energymanagertraining.com](http://www.energymanagertraining.com)
9. [www.bee-india.nic.in](http://www.bee-india.nic.in)

Course Code	Course Name	Credits
<b>ILO7019</b>	<b>Development Engineering</b>	<b>03</b>

**Objectives:**

1. To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development.
2. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a ‘good’ human being, a ‘good’ professional, a ‘good’ society and a ‘good life’ in the context of work life and the personal life of modern Indian professionals
4. To understand the Nature and Type of Human Values relevant to Planning Institutions

**Outcomes:** Learner will be able to...

1. Apply knowledge for Rural Development.
2. Apply knowledge for Management Issues.
3. Apply knowledge for Initiatives and Strategies
4. Develop acumen for higher education and research.
5. Master the art of working in group of different nature.
6. Develop confidence to take up rural project activities independently

Sr. No.	Module Contents	Hrs
<b>01</b>	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	<b>08</b>
<b>02</b>	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people’s participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development	<b>04</b>
<b>03</b>	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	<b>06</b>
<b>04</b>	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	<b>04</b>
<b>05</b>	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education.	<b>10</b>

	Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	
<b>06</b>	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	<b>04</b>

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

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**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
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3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved

**References:**

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory andPractice, Vol. 4, No.4, pp.395 – 407



Lab Code	Lab Name	Credits
<b>CSL701</b>	<b>Digital Signal and Image Processing Lab</b>	<b>1</b>

**Lab Outcome:** The learner will be able to

1. Sample and reconstruct the signal.
2. Implement and apply operations like Convolution, Correlation, DFT and FFT on DT signals
3. Implement spatial domain Image enhancement techniques.
4. Implement Edge detection techniques using first order derivative filters.

**Description:**

Implementation of programs can be in C or C++ or any computational software. A List of ten experiments is given below, are needed to be performed covering all syllabus modules. Additional experiments within the scope of the syllabus can be added.

**Suggested List of Experiments:**

1. Sampling and Reconstruction
2. To perform Discrete Correlation
3. To perform Discrete Convolution
4. To perform Discrete Fourier Transform
5. To perform Fast Fourier Transform
6. Implementation of Image negative, Gray level Slicing and Thresholding
7. Implementation of Contrast Stretching ,Dynamic range compression & Bit plane Slicing
8. Implementation of Histogram Processing
9. Implementation of Image smoothing/ Image sharpening
10. Implementation of Edge detection using Sobel and Previtt masks

**Term Work:**

- Laboratory work will be based on above syllabus of CSC701 - ‘Digital Signal and Image Processing’ with minimum 10 experiments to be incorporated.
- The distribution of marks for term work shall be as follows:

Lab Performance	15 Marks
Assignments	05 Marks
Attendance (Theory & practical)	05 Marks

Lab Code	Lab Name	Credits
CSL702	Mobile Application Development Lab	1

### Lab Outcome:

1. To develop and demonstrate mobile applications using various tools
2. Students will articulate the knowledge of GSM, CDMA & Bluetooth technologies and demonstrate it.
3. Students will be able to carry out simulation of frequency reuse, hidden terminal problem
4. To develop security algorithms for mobile communication network
5. To demonstrate simulation and compare the performance of Wireless LAN
6. To implement and demonstrate mobile node discovery and route maintains.

**Description:** The softwares like Android Studio, J2ME, NS2, NS3 and any other software which is suitable are recommended for performing the practicals.

### Suggested List of Experiments:

Sr. No.	Title of Experiments
01	To understand the cellular frequency reuse concept to find the co-channel cells for a particular cell. Design a game based application on the above concept.
02	To understand the cellular frequency reuse concept to find the cell clusters within certain geographic area. Design a game based application on the above concept.
03	Implementation a Bluetooth network with application as transfer of a file from one device to another.
04	To implement a basic function of Code Division Multiple Access (CDMA) to test the orthogonality and autocorrelation of a code to be used for CDMA operation. Write an application based on the above concept.
05	To implement Mobile node discovery
06	Implementation of GSM security algorithms (A3/A5/A8)
07	<p><u>Illustration of Hidden Terminal Problem (NS-2)</u> Consider two Wifi base stations (STA) and an access point (AP) located along the x-axis. All the nodes are fixed. The AP is situated at the middle of the two STA, the distance of separation being 150 m. [variable]. Node #0 and node #1 are the hidden terminals. Both are transmitting some data to the AP (almost at same rate) at the same time. The loss across the wireless link between each STA and the AP is fixed at 50 dB <u>irrespective of the distance of separation.</u></p> <p>To study how RTS/CTS helps in wireless networks,</p> <ol style="list-style-type: none"> <li>1. No RTS/CTS is being sent.</li> <li>2. Nodes do exchange RTS/CTS packets.</li> </ol> <p><b>Compare the no. of packet retransmissions required in both the cases (as obtained in the output) and compare the results.</b></p>

08	To setup & configuration of Wireless Access Point (AP) using NS3. Analyze the Wi-Fi communication range in the presence of the access point (AP) and the base station (BS). Consider BS and AP are static. Find out the maximum distance to which two way communications is possible. Try multiple iterations by adjusting its distance in the code and test it.
09	Develop an application that writes data to the SD card.
10	Develop an application that uses GUI components.
11	Write an application that draws basic graphical primitives on the screen.
12	Develop an application that makes use of database.
13	Develop a native application that uses GPS location information.
14	Implement an application that creates an alert upon receiving a message.
15	Implementation of income tax/loan EMI calculator and deploy the same on real devices.

#### Digital Material (if Any):

1. <http://www.isi.edu/nsnam/ns/> : NS-2 software download
2. [https://nsnam.isi.edu/nsnam/index.php/NS\\_manual](https://nsnam.isi.edu/nsnam/index.php/NS_manual)
3. <https://www.nsnam.org/> : Ns-3 Software Download
4. <http://vlssit.iitkgp.ernet.in/ant/ant/>

#### Text Books:

1. Jochen Schiller, "Mobile Communication", Addison Wesley, Pearson Education
2. "Wireless Communications & Networks," By William Stallings, Second Edition, Pearson Education
3. Ekram Hossain and Teerawat Issariyakul, "Introduction to Network Simulator NS-2," Springer, Second Edition.
4. Michael Burton, "Android Application Development for Dummies," A Wiley brand
5. Marko Gargenta & Masumi Nakamura, "Learning Android," O'Reilly publications
6. James Keogh, "The complete reference J2ME," McGraw-Hill.

#### Term Work:

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Laboratory work (experiments): ..... (15) Marks.

Assignments: ..... (05) Marks.

Attendance (Theory + Practical)..... (05) Marks

**TOTAL: ..... (25) Marks.**

**Oral & Practical exam** will be based on the above and CSC702: Mobile Communication & Computing syllabus.

Lab Code	Lab Name	Credits
CSL703	Artificial Intelligence & Soft Computing Lab	1

**Lab Outcomes: Learner will be able to**

- 1 To realize the basic techniques to build intelligent systems
- 2 To create knowledge base and apply appropriate search techniques used in problem solving.
- 3 Apply the supervised/unsupervised learning algorithm.
- 4 Designfuzzy controller system.

**Description:** The current applications from almost all domains, like games, robots, expert system, optimization or even the search engines are becoming smarter. We have moved to the era of knowledge processing from data and information processing. Therefore learning these technologies practically is very essential for a student to gain the proficiency. They will also learn and be able to appreciate the use of fusion of basic techniques.

LAB	Topic / Activity	Explanation of Activity
Lab 1	<ul style="list-style-type: none"> <li>• Identify the problem</li> <li>• PEAS Description</li> <li>• Problem formulation</li> </ul>	Select a problem statement relevant to AI
Lab 2	Introduce AI programming Language	Introduce PROLOG programming.
Lab 3	<ul style="list-style-type: none"> <li>• Start Implementation</li> <li>• Knowledge Representation and Create Knowledge Base</li> </ul>	Use AI programming languages  Or C/JAVA
Lab 4	Implement search algorithms to reach goal state	Identify and analyse Algorithm to solve the problem
Lab 5	To implement Mc-Culloch Pitts Model for a problem	Apply to solve AND / OR/ XOR, etc.
Lab 6	To implement Fuzzy Controller system	Design an automobile or washing machine controller, etc. and implement
Lab 7	To implement Basic Supervised / Unsupervised Neural Network learning rules for a problem.	Design a NN using a learning method to generate knowledge for classification.
Lab 8	Case study on Hybrid Systems	Study the designing of Neuro Fuzzy systems
Lab 9	Case study of an Application	Printed Character Recognition, Face Recognition, etc.

**Term Work:**

1. Labs 1-4 are to design and implement an intelligent system using AI techniques.
2. Labs 5-7 are to design and implement an Intelligent System using SC techniques.
3. Perform any one from Lab 8 and lab 9.

**The distribution of marks for term work shall be as follows:**

Lab Performance (Experiments /case studies):	15
Assignment	05
Attendance (Theory & Practical)	05

**Oral examination** will be based on the above and **CSC703: 'AI and SC'** Syllabus.

Lab Code	Lab Name	Credits
<b>CSL703</b>	<b>Computational Lab-I</b>	<b>1</b>

**Lab Outcome:** After successful completion of this course student will be able to:

1. Acquire practical knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

**Description:**

Design and implementation of any case study/ applications /experiments / mini project based on departmental level optional courses using modern tools.

**Term work:**

The distribution of marks for **term work** shall be as follows:

Lab/ Experimental Work	:	15
Report/ Documentation	:	05
Attendance (Theory & Practical)	:	05

**Practical & Oral** examination is to be conducted based on respective departmental level optional courses by pair of internal and external examiners appointed by the University of Mumbai.

Course Code	Title	Credit
<b>CSP705</b>	<b>Major Project- I</b>	<b>3</b>

**Objective:** The Project work enables students to develop further skills and knowledge gained during the programme by applying them to the analysis of a specific problem or issue, via a substantial piece of work carried out over an extended period. For students to demonstrate proficiency in the design of a research project, application of appropriate research methods, collection and analysis of data and presentation of results.

**Guidelines:**

**1. Project Topic:**

- To proceed with the project work it is very important to select a right topic. Project can be undertaken on any subject addressing IT programme. Research and development projects on problems of practical and theoretical interest should be encouraged.
- Project work must be carried out by the group of at least two students and maximum three and must be original.
- Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements.
- The project work can be undertaken in a research institute or organization/company/any business establishment.
- Student must consult internal guide along with external guide (if any) in selection of topic.
- Head of department and senior staff in the department will take decision regarding selection of projects.
- Student has to submit weekly progress report to the internal guide and where as internal guide has to keep track on the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.
- In case of industry projects, visit by internal guide will be preferred.

**2. Project Report Format:**

At the end of semester a project report should preferably contain at least following details:-

- Abstract
- Introduction
- Literature Survey
  - Survey Existing system
  - Limitation Existing system or research gap
  - Problem Statement and Objective
  - Scope
- Proposed System
  - Analysis/Framework/ Algorithm
  - Details of Hardware & Software
  - Design details
  - Methodology (your approach to solve the problem)

- Implementation Plan for next semester
- Conclusion
- References

3. **Term Work:**

Distribution of marks for term work shall be as follows:

- a. Weekly Attendance on Project Day
- b. Project work contribute
- c. Project Report (Spiral Bound)
- d. Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

4. **Oral & Practical :**

Oral & Practical examination of Project-I should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project-I.



Course Code	Course Name	Credits
<b>CSC801</b>	<b>Human Machine Interaction</b>	<b>4</b>

**Course Objectives:** At the end of the course, students will be able to –

1. Learn the foundation of human machine interaction.
2. Understand the importance of human psychology in designing good interfaces.
3. Be aware of mobile interaction design and its usage in day – to – day activities.
4. Understand various design technologies to meet user requirements.
5. Encourage to indulge into research in Machine Interaction Design.

**Course Outcomes:** At the end of the course, the students will be able to -

1. Identify User Interface (UI) design principles.
2. Analysis of effective user friendly interfaces.
3. Apply Interactive Design process in real world applications.
4. Evaluate UI design and justify.
5. Create application for social and technical task.

**Pre-requisites:** Web Technologies; Software Engineering; Experience in designing interfaces for applications and web sites. Basic knowledge of designing tools and languages like HTML, Java, etc

Module No.	Topics	Hrs.
<b>1.0</b>	<b>FOUNDATIONS OF HMI:</b> The Human: History of User Interface Designing, I/O channels, Hardware, Software and Operating environments, The Psychopathology of everyday Things, Psychology of everyday actions, Reasoning and problem solving . The computer: Devices, Memory, processing and networks. Interaction: Models, frameworks, Ergonomics, styles, elements, interactivity, Paradigms.	8
<b>2.0</b>	<b>DESIGN &amp; SOFTWARE PROCESS:</b> Mistakes performed while designing a computer system, Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds .Interactive Design basics, process, scenarios, navigation, Iteration and prototyping. HMI in software process: software life cycle, usability engineering, Prototyping in practice, design rationale. Design rules: principles, standards, guidelines, rules. Recognize the goals, Goal directed design process. Evaluation Techniques: Universal Design.	10
<b>3.0</b>	<b>GRAPHICAL USER INTERFACE:</b> The graphical User Interface: Popularity of graphics, the concept of direct manipulation, graphical systems, Characteristics. Web user Interface: Interface popularity, characteristics. The merging of graphical Business systems and the Web. Principles of user interface design.	8

<b>4.0</b>	<b>SCREEN DESIGNING:</b> Design goals , Screen planning and purpose, organizing screen elements, ordering of screen data and content , screen navigation and flow, Visually pleasing composition, amount of information, focus and emphasis, presentation information simply and meaningfully, information retrieval on web, statistical graphics, Technological consideration in interface design.	10
<b>5.0</b>	<b>INTERFACE DESIGN FOR MOBILE DEVICES:</b> Mobile Ecosystem: Platforms, Application frameworks: Types of Mobile Applications: Widgets, Applications, Games, Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.	8
<b>6.0</b>	<b>INTERACTION STYLES AND COMMUNICATION:</b> Windows:Characteristics, Components, Presentation styles, Types of Windows, Management, operations. Text messages: Words, Sentences, messages and text words, Text for web pages. Icons, Multimedia and colors	<b>8</b>
	<b>Total</b>	<b>52</b>

**Text Books:**

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, 3rdEdition, Pearson Education, 2004.
2. Wilbert O. Galitz, “The Essential Guide to User Interface Design”, Wiley publication.
3. Alan Cooper, Robert Reimann, David Cronin, “About Face3: Essentials of Interaction design”, Wiley publication.
4. Jeff Johnson, “Designing with the mind in mind”, Morgan Kaufmann Publication.
5. Donald A. Normann, “ Design of everyday things”,Basic Books; Reprint edition 2002.
6. Brian Fling, “Mobile Design and Development”, First Edition , O’Reilly Media Inc., 2009.

**Reference Books:**

1. Rogers Sharp Preece, ”Interaction Design:Beyond Human Computer Interaction”,,Wiley.
2. Guy A. Boy “The Handbook of Human Machine Interaction”, Ashgate publishing Ltd.
3. Kalbande, Kanade, Iyer, “Galitz’s Human Machine Interaction”, Wiley Publications.

**Assessment:**

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Course Code	Course Name	Credits
<b>CSC802</b>	<b>Distributed Computing</b>	<b>04</b>

**Course objectives:**

1. To provide students with contemporary knowledge in distributed systems
2. To equip students with skills to analyze and design distributed applications.
3. To provide master skills to measure the performance of distributed synchronization algorithms

**Course outcomes:** On successful completion of course learner will be able to:

1. Demonstrate knowledge of the basic elements and concepts related to distributed system technologies;
2. Illustrate the middleware technologies that support distributed applications such as RPC, RMI and Object based middleware.
3. Analyze the various techniques used for clock synchronization and mutual exclusion
4. Demonstrate the concepts of Resource and Process management and synchronization algorithms
5. Demonstrate the concepts of Consistency and Replication Management
6. Apply the knowledge of Distributed File System to analyze various file systems like NFS, AFS and the experience in building large-scale distributed applications.

**Prerequisite: Java Programming, Operating Systems, Computer Networks**

Module No.	Unit No.	Topics	Hrs.
<b>1.0</b>	<b>Introduction to Distributed Systems</b>		<b>06</b>
	<b>1.1</b>	Characterization of Distributed Systems: Issues, Goals, and Types of distributed systems, Distributed System Models, Hardware concepts, Software Concept.	
	<b>1.2</b>	Middleware: Models of Middleware, Services offered by middleware, Client Server model.	
<b>2.0</b>	<b>Communication</b>		<b>10</b>
	<b>2.1</b>	Layered Protocols, Interprocess communication (IPC): MPI, Remote Procedure Call (RPC), Remote Object Invocation, Remote Method Invocation (RMI)	
	<b>2.2</b>	Message Oriented Communication, Stream Oriented Communication, Group Communication	
<b>3.0</b>	<b>Synchronization</b>		<b>10</b>
	<b>3.1</b>	Clock Synchronization, Logical Clocks, Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm, Requirements of Mutual Exclusion Algorithms, Performance measure.	
	<b>3.2</b>	Non Token based Algorithms: Lamport Algorithm, Ricart–Agrawala’s Algorithm, Maekawa’s Algorithm	
	<b>3.3</b>	Token Based Algorithms: Suzuki-Kasami’s Broadcast Algorithms, Singhal’s Heuristic Algorithm, Raymond’s Tree based Algorithm, Comparative Performance Analysis.	
<b>4.0</b>	<b>Resource and Process Management</b>		<b>06</b>
	<b>4.1</b>	Desirable Features of global Scheduling algorithm, Task assignment approach, Load balancing approach, load sharing approach	
	<b>4.2</b>	Introduction to process management, process migration, Threads,	

		Virtualization, Clients, Servers, Code Migration	
<b>5.0</b>	<b>Consistency, Replication and Fault Tolerance</b>		<b>08</b>
	<b>5.1</b>	Introduction to replication and consistency, Data-Centric and Client-Centric Consistency Models, Replica Management	
	<b>5.2</b>	Fault Tolerance: Introduction, Process resilience, Reliable client-server and group communication, Recovery	
<b>6.0</b>	<b>Distributed File Systems and Name Services</b>		<b>12</b>
	<b>6.1</b>	Introduction and features of DFS, File models, File Accessing models, File-Caching Schemes, File Replication, Case Study: Distributed File Systems (DSF), Network File System (NFS), Andrew File System (AFS)	
	<b>6.2</b>	Introduction to Name services and Domain Name System, Directory Services, Case Study: The Global Name Service, The X.500 Directory Service	
	<b>6.3</b>	Designing Distributed Systems: Google Case Study	
		<b>Total</b>	<b>52</b>

### Assessment:

#### **Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

#### **End Semester Theory Examination:**

- a. Question paper will comprise of 6 questions, each carrying 20 marks.
- b. The students need to solve total 4 questions.
- c. Question No.1 will be compulsory and based on entire syllabus.
- d. Remaining question (Q.2 to Q.6) will be selected from all the modules.

#### **Text Books:**

1. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms, 2nd edition, Pearson Education.
2. George Coulouris, Jean Dollimore, Tim Kindberg, , "Distributed Systems: Concepts and Design", 4th Edition, Pearson Education, 2005.

#### **Reference Books:**

1. A. S. Tanenbaum and M. V. Steen, "Distributed Systems: Principles and Paradigms", Second Edition, Prentice Hall, 2006.
2. M. L. Liu, "Distributed Computing Principles and Applications", Pearson Addison Wesley, 2004.

Course Code	Course Name	Credit
<b>DLO8011</b>	<b>High Performance Computing</b>	04

**Course Objectives:**

1. To learn concepts of parallel processing as it pertains to high-performance computing.
2. To design, develop and analyze parallel programs on high performance computing resources using parallel programming paradigms.

**Course Outcomes:** Learner will be able to-

1. Memorize parallel processing approaches
2. Describe different parallel processing platforms involved in achieving High Performance Computing.
3. Discuss different design issues in parallel programming
4. Develop efficient and high performance parallel programming
5. Learn parallel programming using message passing paradigm using open source APIs.

**Prerequisite:** Computer Organization

Sr.No.	Module	Detailed Content	Hours
1	Introduction	<b>Introduction to Parallel Computing:</b> Motivating Parallelism, Scope of Parallel Computing, Levels of parallelism (instruction, transaction, task, thread, memory, function) <b>Classification Models:</b> Architectural Schemes (Flynn's, Shore's, Feng's, Handler's) and Memory access (Shared Memory, Distributed Memory, Hybrid Distributed Shared Memory) <b>Parallel Architectures:</b> Pipeline Architecture, Array Processor, Multiprocessor Architecture, Systolic Architecture, Data Flow Architecture	6
2	Pipeline Processing	Introduction, Pipeline Performance, Arithmetic Pipelines, Pipeline instruction processing, Pipeline stage design, Hazards, Dynamic instruction scheduling	8
3	Parallel Programming Platforms	Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor & Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines	10
4	Parallel Algorithm Design	Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models	12

5	Performance Measures	Performance Measures : Speedup, execution time, efficiency, cost, scalability, Effect of granularity on performance, Scalability of Parallel Systems, Amdahl's Law, Gustavson's Law, Performance Bottlenecks	6
6	HPC Programming	Programming Using the Message-Passing Paradigm: Principles of Message Passing Programming, The Building Blocks: Send and Receive Operations  <b>MPI:</b> the Message Passing Interface, Topology and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Introduction to OpenMP	10

### **Text Books:**

1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar , "Introduction to Parallel Computing", Pearson Education, Second Edition, 2007.
2. M. R. Bhujade, "Parallel Computing", 2nd edition, New Age International Publishers, 2009.
3. Kai Hwang, Naresh Jotwani, "Advanced Computer Architecture: Parallelism, Scalability, Programmability", McGraw Hill, Second Edition, 2010.
4. Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall / CRC Computational Science series, 2011.

### **Reference Books:**

1. Michael J. Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw-Hill International Editions, Computer Science Series, 2008.
2. Kai Hwang, Zhiwei Xu, "Scalable Parallel Computing: Technology, Architecture, Programming", McGraw Hill, 1998.
3. Laurence T. Yang, MinyiGuo, "High- Performance Computing: Paradigm and Infrastructure" Wiley, 2006.

**Internal Assessment:** Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

### **Theory Examination:**

1. Question paper will comprise of total six questions.
2. All question carry equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four question need to be solved.

**In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

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**Laboratory Work:**

**Description:** The Laboratory Work (Experiments) for this course is required to be performed and to be evaluated in CSL803: Computational Lab-II

**Suggested Experiment List:**

<b>Sr. No.</b>	<b>Detailed Content</b>
1	Execution of Simple Hello world program on MPI platform
2	a. Program to send data and receive data to/from processors using MPI b. Program illustrating Broadcast of data using MPI
3	Implement a parallel program to demonstrate the cube of N number within a set range.
4	Write a parallel program for area of a circle/triangle
5	Implement a program to demonstrate balancing of workload on MPI platform
6	Using directives of MPI/OpenMP implement parallel programming for calculator application (add, sub, multiplication and division)
7	<b>Mini Project</b> Evaluate performance enhancement of HPC for any of the following: One-Dimensional Matrix-Vector Multiplication/ Single-Source Shortest-Path/ Sample Sort/Two-Dimensional Matrix-Vector Multiplication

Course Code	Course Name	Credits
<b>DLO8012</b>	<b>Natural Language Processing</b>	<b>4</b>

**Course objectives:**

1. To understand natural language processing and to learn how to apply basic algorithms in this field.
2. To get acquainted with the basic concepts and algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.
3. To design and implement applications based on natural language processing
4. To implement various language Models.
5. To design systems that uses NLP techniques

**Course outcomes:** On successful completion of course learner should:

1. Have a broad understanding of the field of natural language processing.
2. Have a sense of the capabilities and limitations of current natural language technologies,
3. Be able to model linguistic phenomena with formal grammars.
4. Be able to Design, implement and test algorithms for NLP problems
5. Understand the mathematical and linguistic foundations underlying approaches to the various areas in NLP
6. Be able to apply NLP techniques to design real world NLP applications such as machine translation, text categorization, text summarization, information extraction...etc.

**Prerequisite:** Data structure & Algorithms, Theory of computer science, Probability Theory.

Module No.	Unit No.	Topics	Hrs.
1	<b>Introduction</b>	History of NLP, Generic NLP system, levels of NLP , Knowledge in language processing , Ambiguity in Natural language , stages in NLP, challenges of NLP ,Applications of NLP	4
2	<b>Word Level Analysis</b>	Morphology analysis –survey of English Morphology, Inflectional morphology & Derivational morphology, Lemmatization, Regular expression, finite automata, finite state transducers (FST) ,Morphological parsing with FST , Lexicon free FST Porter stemmer. N –Grams- N-gram language model, N-gram for spelling correction.	10
3	<b>Syntax analysis</b>	Part-Of-Speech tagging( POS)- Tag set for English ( Penn Treebank ) , Rule based POS tagging, Stochastic POS tagging, Issues –Multiple tags & words, Unknown words. Introduction to CFG, Sequence labeling: Hidden Markov Model (HMM), Maximum Entropy, and Conditional Random Field (CRF).	10
4	<b>Semantic Analysis</b>	Lexical Semantics, Attachment for fragment of English- sentences, noun phrases, Verb phrases, prepositional phrases, Relations among lexemes & their senses –Homonymy, Polysemy, Synonymy, Hyponymy, WordNet, Robust Word Sense Disambiguation (WSD) ,Dictionary based approach	10



5	<b>Pragmatics</b>	Discourse –reference resolution, reference phenomenon , syntactic & semantic constraints on co reference	8
6	<b>Applications ( preferably for Indian regional languages)</b>	Machine translation, Information retrieval, Question answers system, categorization, summarization, sentiment analysis, Named Entity Recognition.	10

**Text Books:**

1. Daniel Jurafsky, James H. Martin “Speech and Language Processing” Second Edition, Prentice Hall, 2008.
2. Christopher D.Manning and Hinrich Schutze, “ Foundations of Statistical Natural Language Processing “, MIT Press, 1999.

**Reference Books:**

1. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press (2008).
2. Daniel M Bikel and Imed Zitouni “ Multilingual natural language processing applications” Pearson, 2013
3. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor) “ The Handbook of Computational Linguistics and Natural Language Processing “ ISBN: 978-1-118-
4. Steven Bird, Ewan Klein, Natural Language Processing with Python, O’Reilly
5. Brian Neil Levine, An Introduction to R Programming
6. Niel J le Roux, Sugnet Lubbe, A step by step tutorial : An introduction into R application and programming

**Assessment:**

**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

- 1 Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

## **Laboratory Work/Case study/Experiments:**

**Description:** The Laboratory Work (Experiments) for this course is required to be performed and to be evaluated in CSL803: Computational Lab-II

The objective of Natural Language Processing lab is to introduce the students with the basics of NLP which will empower them for developing advanced NLP tools and solving practical problems in this field.

Reference for Experiments: <http://cse24-iiith.virtual-labs.ac.in/#>

Reference for NPTEL: <http://www.cse.iitb.ac.in/~cs626-449>

**Sample Experiments:** possible tools / language: R tool/ Python programming Language

Note: Although it is not mandatory, the experiments can be conducted with reference to any Indian regional language.

1. Preprocessing of text (Tokenization, Filtration, Script Validation, Stop Word Removal, Stemming)
2. Morphological Analysis
3. N-gram model
4. POS tagging
5. Chunking
6. Named Entity Recognition
7. Case Study/ Mini Project based on Application mentioned in Module 6.

Course Code	Course Name	Credits
DLO8013	Adhoc Wireless Networks	4

**Course objectives:**

1. To Identify the major issues associated with ad-hoc networks
2. To identify the requirements for protocols for wireless ad-hoc networks as compared to the protocols existing for wired network.
3. To explore current ad-hoc technologies by researching key areas such as algorithms, protocols, hardware, and applications.
4. To Provide hands-on experience through real-world programming projects
5. To provide advanced in–depth networking materials to graduate students in networking research.

**Course outcomes:** On successful completion of course learner will be able to:

1. Identify the characteristics and features of Adhoc Networks.
2. Understand the concepts & be able to design MAC protocols for Ad Hoc networks
3. Implement protocols / Carry out simulation of routing protocols of Adhoc Networks
4. Interpret the flow control in transport layer of Ad Hoc Networks
5. Analyze security principles for routing of Ad Hoc Networks
6. Utilize the concepts of Adhoc Networks in VANETs

**Prerequisite: Computer Network, Wireless Networking**

Module No.	Unit No.	Topics	Hrs.
1.0		<b>Introduction</b>	04
	1.1	Introduction to wireless Networks. Characteristics of Wireless channel,	
	1.2	Issues in Ad hoc wireless networks, Adhoc Mobility Models:- Indoor and outdoor models,	
	1.3	Introduction to Adhoc networks – definition, characteristics features, applications.	
2.0		<b>MAC protocols for Wireless Ad-Hoc Networks</b>	12
	2.1	Introduction	
	2.2	Issues in designing MAC for Wireless Ad-Hoc Networks	
	2.3	Design Goals and classification of MAC for Wireless Ad-Hoc Networks	
	2.4	Contention based MAC protocols for Wireless Ad-Hoc Networks, with reservation mechanisms, scheduling Mechanisms	
	2.5	MAC protocols using directional antennas, Other MAC Protocols	
	2.6	IEEE standards MAC Protocols: 802.15.1(WPAN based on Bluetooth), 802.15.4 (WSN/Zigbee), 802.15.6 (WBAN).	
3.0		<b>Routing Protocols for Wireless Ad-Hoc Networks</b>	10
	3.1	Introduction, Issues in designing a routing protocol for Wireless Ad-Hoc Networks	
	3.2	Classification of routing protocols, Table driven routing protocols like DSDV, WRP,	

		On- demand routing protocols like ABR, DSR, TORA, AODV, etc.	
	<b>3.3</b>	Hybrid Routing Protocols : ZRP, Routing Protocols with efficient flooding mechanism, Hierarchical Routing Protocols, Power aware routing protocols	
<b>4.0</b>		<b>Transport Layer</b>	<b>10</b>
	<b>4.1</b>	Transport layer protocols for Ad hoc wireless Networks: Introduction,	
	<b>4.2</b>	Issues in designing a transport layer protocol for Ad hoc wireless Networks,	
	<b>4.3</b>	Design goals of a transport layer protocol for Ad hoc wireless Networks,	
	<b>4.4</b>	Classification of transport layer solutions: Split Approach , End-to-End approach :TCP-F,TCP-ELFN, Ad-Hoc TCP, TCP Buffering capability and Sequencing information	
	<b>4.5</b>	End-to-End Quality of Service	
<b>5.0</b>		<b>Security</b>	<b>08</b>
	<b>5.1</b>	Security attacks in wireless Ad hoc wireless Networks, Network security requirements,	
	<b>5.2</b>	Issues & challenges in security provisioning,	
	<b>5.3</b>	Link Layer security attacks: 802.11 MAC , WPA and variations	
	<b>5.4</b>	Network Security Attacks: Routing Protocol Attacks: attacks using falsifying route errors and broadcasting falsifying routes, spoofing attacks, Rushing attacks, Secure routing in Ad hoc wireless Networks	
<b>6.0</b>		<b>Vehicular Ad-Hoc Network (VANET)</b>	<b>08</b>
	<b>6.1</b>	Introduction: Challenges and Requirements, , Layered architecture for VANETs, DSRC /WAVE standard (IEEE 802.11p )	
	<b>6.2</b>	IEEE 802.11p protocol Stack (PHY & MAC) , A Survey on Proposed MAC Approaches for VANETs like TDMA, SDMA and CDMA based approaches, DSRC MAC & LLC	
	<b>6.3</b>	Georouting: CBF, Flooding with broadcast suppression	
	<b>6.4</b>	Delay Tolerant Network, Introduction to Opportunistic Networking in Delay Tolerant Vehicular Ad Hoc Networks	
		<b>Total</b>	<b>52</b>

### **Assessment:**

#### **Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

#### **End Semester Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

**Text Books:**

1. Siva Ram Murthy and B.S. Manoj , “Ad hoc Wireless Networks Architectures and protocols”, 2nd edition, Pearson Education, 2007 (T1)
2. C. K. Toh, “Adhoc Mobile Wireless Networks”, Pearson Education, 2002 (T2)
3. Charles E. Perkins, “Adhoc Networking”, Addison – Wesley, 2000 (T3)
4. Dipankar Raychaudhuri, Mario Gerla, “Emerging Wireless Technologies and the Future Mobile Internet, D, Cambridge. (T4)

**Reference Books:**

1. Subir Kumar Sarkar, “Ad-Hoc Mobile Wireless Networks: principles, protocols and applications” CRC Press (R1)
2. Prasant Mohapatra and Sriramamurthy, “Ad Hoc Networks: Technologies and Protocols”, Springer International Edition, 2009, (R2)
3. Stefano Basangi, Marco Conti, Silvia Giordano, Ivan Stojmenovic, “Mobile Ad-Hoc Networking, “ John-Wiley and Sons Publications, 2004,(R3)
4. [Hannes Hartenstein](#), [Kenneth Laberteaux](#), “VANET Applications and Interworking Technologies,” Wiley Publications (R4)
5. [Christoph Sommer](#) , [Falko Dressler](#), “Vehicular Networking,” Cambridge University Press, 2014 (R5)

**Laboratory Work****Lab Outcome:**

1. Explore the knowledge of NS2 and NS3 by installing it and make it ready
2. Shall synthesize a simulation and evaluate the performance of WLAN 802.11 and Bluetooth
3. Students will able to analyze and implement MAC & Network layer protocols using open source and synthesis as well as evaluate its performance
4. Implement Transport layer protocols / Carry out simulation of routing protocols of Adhoc Networks
5. Describe and interpret the use security routines and evaluate its performance
6. Explore and understand the capability of SUMO and MOVE as well as Nessi by installing it and analyze it by applying on various scenarios

**Description:** It is recommended that Network simulation Softwares like NS-2, NS-3, SUMO (Simulation software for Urban MObility) with MOVE. Software like Nessi is also recommended for the event based security attacks simulation and measure.

The Laboratory Work (Experiments) for this course is required to be performed and to be evaluated in CSL803: Computational Lab-II

**Suggested List of Experiments:**

Sr. No.	Title of Experiments
1	Installation of NS2 & NS3 in Fedora 19 (32 bit) OS Linux.
2	Simulating IEEE 802.11 wireless LAN in Ad-Hoc Mode using NS2
3	Implementation a Bluetooth network in NS3 with application as transfer of a file from one device to another
4	To implement and compare MAC layer protocols, MACAW, MACA-BI and MACA with piggybacked Reservation using NS-3

5	Develop sample wireless network in which a. implement AODV and AOMDV protocol b. Calculate the time to receive reply from the receiver using NS2. c. Generate graphs which show the transmission time for packet. Implement wireless network. Capture data frame and identify fields using NS2.
6	Communicate between two different networks (NS-3) which has following specifications: a. One network has Class A network with “TORA protocol” b. Second has Class B network “AODV protocol”
7	To calculate and compare average throughput for various TCP variants like TCP-F (Feedback) and Ad-Hoc TCP using NS-3
8	Explore and use security tools like WEP & WPA and evaluate its performance on mobile terminals
9	Simulation of Urban Mobility (SUMO) along with MOVE is software that helps in simulating the VANETs. Install it on Fedora 19 (32 bit) OS Linux
10	Create a simulation for road traffic with 6 junctions. There are various vehicles going on and your own car also. Select a shortest route for your car. Demonstrate with simulation software SUMO and MOVE.
11	A car acts as a malicious node and can be analyzed for the packet loss before and after malicious activity. Using SUMO and MOVE.
12	Create an Ad-hoc Network using nessi Simulation software and include events incorporate dropped packets, infected flows, compromised machines, unavailable services etc, and check its performance

Digital Material (if Any):

1. <http://www.isi.edu/nsnam/ns/> : NS-2 software download (D1)
2. [https://nsnam.isi.edu/nsnam/index.php/NS\\_manual](https://nsnam.isi.edu/nsnam/index.php/NS_manual) (D2)
3. <https://www.nsnam.org/> : Ns-3 Software Download (D3)
4. <http://www.nsnam.com/2013/11/vanet-simulator-in-fedora-19-32-bit.html> (D4)
5. [http://www.sumo.dlr.de/userdoc/Tutorials/Quick\\_Start.html](http://www.sumo.dlr.de/userdoc/Tutorials/Quick_Start.html) (D5)
6. <http://veins.car2x.org/> (D6)
7. <http://www.nessi2.de/> (D7)

**Text Books:**

1. Ekram Hossain and Teerawat Issariyakul, “Introduction to Network Simulator NS-2,” Springer , Second Edition. (T1)
2. Jack L. Burbank, “Introduction to Network Simulator 3,” Wiley Publications(T2)
3. Siva Ram Murthy and B.S. Manoj , “Ad hoc Wireless Networks Architectures and protocols”, 2nd edition, Pearson Education, 2007 (T3)
4. Michael Gregg, “Build your own security lab,” Wiley India edition (T4)

<b>Course Code</b>	<b>Course Name</b>	<b>Credits</b>
<b>ILO 8021</b>	<b>Project Management</b>	<b>03</b>

**Objectives:**

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

**Outcomes:** Learner will be able to...

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

<b>Module</b>	<b>Detailed Contents</b>	<b>Hrs</b>
<b>01</b>	<b>Project Management Foundation:</b> Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)	5
<b>02</b>	<b>Initiating Projects:</b> How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
<b>03</b>	<b>Project Planning and Scheduling:</b> Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	8
<b>04</b>	<b>Planning Projects:</b> Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
<b>05</b>	<b>5.1 Executing Projects:</b> Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings <b>5.2 Monitoring and Controlling Projects:</b> Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit	8

	<b>5.3 Project Contracting</b> Project procurement management, contracting and outsourcing,	
<b>06</b>	<b>6.1 Project Leadership and Ethics:</b> Introduction to project leadership, ethics in projects, Multicultural and virtual projects <b>6.2 Closing the Project:</b> Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	<b>6</b>

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

**REFERENCES:**

1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7<sup>th</sup> Edition, Wiley India
2. A Guide to the Project Management Body of Knowledge (PMBOK<sup>®</sup> Guide), 5<sup>th</sup> Ed, Project Management Institute PA, USA
3. Project Management, Gido Clements, Cengage Learning
4. Project Management, Gopalan, Wiley India
5. Project Management, Dennis Lock, 9<sup>th</sup> Edition, Gower Publishing England



<b>Course Code</b>	<b>Course Name</b>	<b>Credits</b>
<b>ILO 8022</b>	<b>Finance Management</b>	<b>03</b>

**Objectives:**

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

**Outcomes:** Learner will be able to...

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

<b>Module</b>	<b>Detailed Contents</b>	<b>Hrs</b>
<b>01</b>	<p><b>Overview of Indian Financial System:</b> Characteristics, Components and Functions of Financial System.</p> <p><b>Financial Instruments:</b> Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills.</p> <p><b>Financial Markets:</b> Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market</p> <p><b>Financial Institutions:</b> Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges</p>	06
<b>02</b>	<p><b>Concepts of Returns and Risks:</b> Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio.</p> <p><b>Time Value of Money:</b> Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.</p>	06
<b>03</b>	<p><b>Overview of Corporate Finance:</b> Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision.</p> <p><b>Financial Ratio Analysis:</b> Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.</p>	09
<b>04</b>	<p><b>Capital Budgeting:</b> Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)</p> <p><b>Working Capital Management:</b> Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.</p>	10
<b>05</b>	<p><b>Sources of Finance:</b> Long Term Sources—Equity, Debt, and Hybrids; Mezzanine</p>	05

	Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. <b>Capital Structure:</b> Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	
<b>06</b>	<b>Dividend Policy:</b> Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches— Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

**REFERENCES:**

1. Fundamentals of Financial Management, 13<sup>th</sup> Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10<sup>th</sup> Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9<sup>th</sup> Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11<sup>th</sup> Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

<b>Course Code</b>	<b>Course Name</b>	<b>Credits</b>
<b>ILO8023</b>	<b>Entrepreneurship Development and Management</b>	<b>03</b>

**Objectives:**

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

**Outcomes:** Learner will be able to...

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

<b>Module</b>	<b>Detailed Contents</b>	<b>Hrs</b>
<b>01</b>	<b>Overview Of Entrepreneurship:</b> Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
<b>02</b>	<b>Business Plans And Importance Of Capital To Entrepreneurship:</b> Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur <b>Entrepreneurship And Business Development:</b> Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
<b>03</b>	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
<b>04</b>	<b>Indian Environment for Entrepreneurship:</b> key regulations and legal aspects , MSME Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
<b>05</b>	<b>Effective Management of Business:</b> Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
<b>06</b>	<b>Achieving Success In The Small Business:</b> Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

## **Assessment:**

### **Internal Assessment for 20 marks:**

#### **Consisting Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

### **End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

## **REFERENCES:**

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. [www.msme.gov.in](http://www.msme.gov.in)
12. [www.dcmesme.gov.in](http://www.dcmesme.gov.in)
13. [www.msmetraining.gov.in](http://www.msmetraining.gov.in)

Course Code	Course Name	Credits
ILO8024	Human Resource Management	03

**Objectives:**

1. To introduce the students with basic concepts, techniques and practices of the human resource management
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations
3. To familiarize the students about the latest developments, trends & different aspects of HRM
4. To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers

**Outcomes:** Learner will be able to...

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioural skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	<p><b>Introduction to HR</b></p> <ul style="list-style-type: none"> <li>• Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions</li> <li>• Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues</li> </ul>	5
02	<p><b>Organizational Behaviour (OB)</b></p> <ul style="list-style-type: none"> <li>• Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues</li> <li>• Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness</li> <li>• Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour</li> <li>• Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor);</li> <li>• Group Behaviour and Group Dynamics: Work groups formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team.</li> <li>• Case study</li> </ul>	7
03	<p><b>Organizational Structure &amp; Design</b></p> <ul style="list-style-type: none"> <li>• Structure, size, technology, Environment of organization; Organizational Roles &amp; conflicts: Concept of roles; role dynamics; role conflicts and stress.</li> <li>• Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.</li> <li>• Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.</li> </ul>	6

<b>04</b>	<p><b>Human resource Planning</b></p> <ul style="list-style-type: none"> <li>• Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale</li> <li>• Performance Appraisal Systems: Traditional &amp; modern methods, Performance Counselling, Career Planning</li> <li>• Training &amp; Development: Identification of Training Needs, Training Methods</li> </ul>	5
<b>05</b>	<p><b>Emerging Trends in HR</b></p> <ul style="list-style-type: none"> <li>• Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes &amp; transformation in HR. Organizational Change, Culture, Environment</li> <li>• Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation</li> </ul>	6
<b>06</b>	<p><b>HR &amp; MIS:</b> Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&amp;D, Public Transport, Hospitals, Hotels and service industries)</p> <p><b>Strategic HRM:</b> Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals</p> <p><b>Labor Laws &amp; Industrial Relations:</b> Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act</p>	10

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

**REFERENCES:**

1. Stephen Robbins, Organizational Behavior, 16<sup>th</sup> Ed, 2013
2. V S P Rao, Human Resource Management, 3<sup>rd</sup> Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6<sup>th</sup> edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15<sup>th</sup> Ed, 2015, Himalaya Publishing, 15<sup>th</sup>edition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5<sup>th</sup> Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Course Code	Course Name	Credits
ILO8025	Professional Ethics and Corporate Social Responsibility (CSR)	03

**Objectives:**

1. To understand professional ethics in business
2. To recognized corporate social responsibility

**Outcomes:** Learner will be able to...

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	<b>Professional Ethics and Business:</b> The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	<b>Professional Ethics in the Marketplace:</b> Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy <b>Professional Ethics and the Environment:</b> Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	<b>Professional Ethics of Consumer Protection:</b> Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy <b>Professional Ethics of Job Discrimination:</b> Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	<b>Introduction to Corporate Social Responsibility:</b> Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	<b>Corporate Social Responsibility:</b> Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	<b>Corporate Social Responsibility in Globalizing India:</b> Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

## **Assessment:**

### **Internal Assessment for 20 marks:**

#### **Consisting Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

### **End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

## **REFERENCES:**

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.



<b>Course Code</b>	<b>Course Name</b>	<b>Credits</b>
<b>ILO8026</b>	<b>Research Methodology</b>	<b>03</b>

**Objectives:**

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

**Outcomes:** Learner will be able to...

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

<b>Module</b>	<b>Detailed Contents</b>	<b>Hrs</b>
<b>01</b>	<b>Introduction and Basic Research Concepts</b> <b>1.1</b> Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology <b>1.2</b> Need of Research in Business and Social Sciences <b>1.3</b> Objectives of Research <b>1.4</b> Issues and Problems in Research <b>1.5</b> Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	<b>09</b>
<b>02</b>	<b>Types of Research</b> <b>2.1.</b> Basic Research <b>2.2.</b> Applied Research <b>2.3.</b> Descriptive Research <b>2.4.</b> Analytical Research <b>2.5.</b> Empirical Research <b>2.6</b> Qualitative and Quantitative Approaches	<b>07</b>
<b>03</b>	<b>Research Design and Sample Design</b> <b>3.1</b> Research Design – Meaning, Types and Significance <b>3.2</b> Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	<b>07</b>
<b>04</b>	<b>Research Methodology</b> <b>4.1</b> Meaning of Research Methodology <b>4.2.</b> Stages in Scientific Research Process: <b>a.</b> Identification and Selection of Research Problem <b>b.</b> Formulation of Research Problem <b>c.</b> Review of Literature <b>d.</b> Formulation of Hypothesis <b>e.</b> Formulation of research Design <b>f.</b> Sample Design <b>g.</b> Data Collection <b>h.</b> Data Analysis <b>i.</b> Hypothesis testing and Interpretation of Data <b>j.</b> Preparation of Research Report	<b>08</b>

<b>05</b>	<b>Formulating Research Problem</b> 5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	<b>04</b>
<b>06</b>	<b>Outcome of Research</b> 6.1 Preparation of the report on conclusion reached 6.2 Validity Testing & Ethical Issues 6.3 Suggestions and Recommendation	<b>04</b>

**Assessment:**

**Internal Assessment for 20 marks:**

**Consisting Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

**REFERENCES:**

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2<sup>nd</sup>ed), Singapore, Pearson Education

<b>Course Code</b>	<b>Course Name</b>	<b>Credits</b>
<b>ILO8027</b>	<b>IPR and Patenting</b>	<b>03</b>

**Objectives:**

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

**Outcomes:** Learner will be able to...

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

<b>Module</b>	<b>Detailed Contents</b>	<b>Hr</b>
<b>01</b>	<b>Introduction to Intellectual Property Rights (IPR):</b> Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. <b>Importance of IPR in Modern Global Economic Environment:</b> Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
<b>02</b>	<b>Enforcement of Intellectual Property Rights:</b> Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement <b>Indian Scenario of IPR:</b> Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
<b>03</b>	<b>Emerging Issues in IPR:</b> Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
<b>04</b>	<b>Basics of Patents:</b> Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
<b>05</b>	<b>Patent Rules:</b> Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
<b>06</b>	<b>Procedure for Filing a Patent (National and International):</b> Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement <b>Patent databases:</b> Important websites, Searching international databases	07

## **Assessment:**

### **Internal Assessment for 20 marks:**

#### **Consisting Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

### **End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

### **REFERENCE BOOKS:**

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7<sup>th</sup> Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellectual Property Rights: A Case Book, 3<sup>rd</sup> Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press.

Course Code	Course Name	Credits
<b>ILO 8028</b>	<b>Digital Business Management</b>	<b>03</b>

**Objectives:**

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

**Outcomes:** The learner will be able to .....

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	<b>Introduction to Digital Business-</b> Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, <b>Drivers of digital business-</b> Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) <b>Opportunities and Challenges in Digital Business,</b>	09
2	<b>Overview of E-Commerce</b> <b>E-Commerce-</b> Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	<b>Digital Business Support services:</b> ERP as e –business backbone, knowledge Tople Apps, Information and referral system <b>Application Development:</b> Building Digital business Applications and Infrastructure	06
4	<b>Managing E-Business-</b> Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	<b>E-Business Strategy-</b> E-business Strategic formulation- Analysis of Company’s Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	<b>Materializing e-business: From Idea to Realization-</b> Business plan preparation <b>Case Studies and presentations</b>	08

## **Assessment:**

### **Internal Assessment for 20 marks:**

#### **Consisting Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

### **End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

### **References:**

1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6<sup>th</sup> Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2<sup>nd</sup> Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2<sup>nd</sup> International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective- DoI:10.1787/9789264221796-enOECD Publishing

Course Code	Course Name	Credits
ILO8029	Environmental Management	03

**Objectives:**

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

**Outcomes:** Learner will be able to...

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

**REFERENCES:**

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management V Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press Environment and Ecology, Majid Hussain, 3<sup>rd</sup> Ed. Access Publishing, 2015



Lab Code	Lab Name	Credits
CSL801	Human Machine Interactions Lab	1

**Lab Outcome:**

- 1: To design user centric interfaces.
- 2: To design innovative and user friendly interfaces.
- 3: To apply HMI in their day-to-day activities.
- 4: To criticize existing interface designs, and improve them.
- 5: To Design application for social Task.
- 6: To Design application for Technical Tasks

**Description:**

Human Machine Interaction provides the study of user interface and benefit of good design. The design process gives an idea about how people interact with computer and the problems that they fall, so understanding the human characteristics is important as this lays the base for a good interface. It enables the students to apply his/her design skills to develop an appropriate Mobile App or Website. Students also learn the different types of icon, color and its representation with social and ethical concerns. Students can also learn the different software tools used to assemble and build user interface along with the different types of interaction devices and finally try to measure the usability of the application by learning HMI principles.

**Suggested List of Experiments:**

Sr. No.	Title of Experiments
1	Problem representation for Designing User Interface
2	Design a Mobile app/ Website that can teach mathematics to children of 4-5 years age in schools in Rural /Urban Sector
3	Design a Mobile App/Website that can help people to sell their handmade products in metro cities
4	ATM machine/KIOSK screen design for rural people.
5	Design a Mobile App/Website to get an experience for passengers whose flight /train is delayed.
6	Design an UI application for Institute event management.
7	Design of User interface for the system using various interaction styles.
8	Statistical Graphics and its use in visualization
9	Design appropriate icons pertaining to a given domain .(Eg. Greeting cards)

10	Design a personal website for an Artisan
11	Design a interface for Home appliances
12	Design an interactive data access using Graphics (QR, BAR Code, Image etc) and generating a print form
13	Redesign of a user interface (Suggest and implement changes in Existing User Interface)
14	Design a navigator for a student new in your Institute.
15	Design a navigator for a person new in tourist city/ village
16	Design UI for Motor paralysis for disabled people.
17	KIOSK design for hospital/school/educational campus/National Institute.
18	To calculate screen complexity of existing Graphical User Interface and redesign the interface to minimize the screen complexity.

**Guidelines:**

1. Students are expected to use advanced tools and Technologies towards execution of lab work.
2. Students can work individually or only 2-3 Students can form a team if they wish to work in Group.
3. Case Study and assignments may be linked with CSC801 Syllabus.

**Term Work:**

Laboratory work will be based on above syllabus with minimum 10(Ten) experiments in line with the above Lab outcomes to be incorporated with 13(Thirteen) lab session of 2 (two) hours each. The problem statement can be decided by the instructor in line with the above list of experiments

**The distribution of 25 marks for term work shall be as follows:**

Lab Performance	15
Mini Project	05
Attendance (Theory & Practical)	05

**Oral exam** will be based on the above and CSC801:‘HMI Theory’ Syllabus.

Lab Code	Lab Name	Credits
CSL802	Distributed Computing Lab	01

**Lab Outcome:**

1. Develop, test and debug RPC/RMI based client-server programs.
2. Implement the main underlying components of distributed systems (such as IPC, name resolution, file systems etc.)
3. Implement various techniques of synchronization.
4. Design and implement application programs on distributed systems.

**Suggested List of Experiments:**

Sr. No.	Title of Experiments
1	Client/server using RPC/RMI.
2	Implementation of multi tread application
3	Inter-process communication
4	Group Communication
5	Load Balancing Algorithm.
6	Name Resolution protocol.
7	Election Algorithm.
8	Clock Synchronization algorithms.
9	Mutual Exclusion Algorithm.
10	Deadlock management in Distributed systems
11	Distributed File System
12	CORBA

**Term Work:**

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Laboratory work (experiments): ..... (15) Marks.  
 Assignments: ..... (05) Marks.  
 Attendance (Theory + Practical)..... (05) Marks  
**TOTAL: ..... (25) Marks.**

**Oral exam** will be based on the above and CSC802 syllabus.

Lab Code	Course Name	Credits
<b>CSL803</b>	<b>Cloud Computing Lab</b>	<b>2</b>

**Lab Objectives:** The course will help the learners to get familiar with

1. Key concepts of virtualization.
2. Various deployment models such as private, public, hybrid and community.
3. Various service models such as IaaS and PaaS.
4. Security and Privacy issues in cloud.

**Lab Outcomes:** On completion of the course learners will be able to

1. Adapt different types of virtualization and increase resource utilization.
2. Build a private cloud using open source technologies.
3. Analyze security issues on cloud.
4. Develop real world web applications and deploy on commercial cloud.
5. Demonstrate various service models.

Module	Detailed Contents	Hours
01	<b>Title:</b> Study of NIST model of cloud computing. <b>Objective:</b> Understand deployment models, service models, advantages of cloud computing.	2
02	<b>Title:</b> Virtualization. <b>Objective:</b> Understand different types of virtualizations, Host and bare metal hypervisors and implement horizontal scalability. <b>Technology:</b> XEN/ Vmwares EXSi	2
03	<b>Title:</b> Infrastructure as a Service. <b>Objective:</b> Implement IaaS using your resources. <b>Technology:</b> Open Stack / Eucalyptus	2
04	<b>Title:</b> Identity Management in Cloud <b>Concept:</b> Simulate identity management in your private cloud. <b>Technology:</b> Open Stack	2
05	<b>Title:</b> Storage as a Service <b>Objective:</b> Explore Storage as a Service for remote file access using web interface. <b>Technology:</b> ownCloud	2
06	<b>Title:</b> Cloud Security <b>Objective:</b> Understand security of web server and data directory. <b>Technology:</b> ownCloud	2
07	<b>Title:</b> Platform as a Service <b>Objective:</b> Deploy web applications on commercial cloud. <b>Technology:</b> Google appEngine/ Windows Azure	2
08	<b>Title:</b> Amazon Web Service <b>Objective:</b> To create and access VM instances and demonstrate various	2

	components such as EC2, S3, Simple DB, DynamoDB. <b>Technology:</b> AWS	
09	<b>Title:</b> Software as a Service <b>Objective:</b> Understand on demand application delivery and Virtual desktop infrastructure. <b>Technology:</b> Ulteo	2
10	<b>Title: Case Study on Fog Computing</b> <b>Objective:</b> To have a basic understanding of implementation/applications of fog computing.	2
11	<b>Title:</b> Mini Project <b>Objective:</b> Using the concepts studied throughout the semester students shall be able to <ol style="list-style-type: none"> <li>1. Create their private cloud for the institute using the available resources.</li> <li>2. Apply security concepts to secure a private cloud.</li> <li>3. Implement efficient load balancing.</li> <li>4. Compare various virtualization technologies with given resource.</li> <li>5. Create cloud applications such as messenger, photo editing website, your own social media etc.</li> </ol> <b>Note:</b> Evaluators must check if students have used appropriate cloud computing tools for their projects.	6

### Digital Material

[www.openstack.org](http://www.openstack.org)

### Text Books:

1. Enterprise Cloud Computing by Gautam Shroff, Cambridge,2010
2. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley - India, 2010 ,
3. Getting Started with OwnCloud by Aditya Patawar , Packt Publishing Ltd, 2013

### Term Work:

- Term work should consist of at least 6 experiments and a mini project.
- Journal must include at least 2 assignments.
- The final certification and acceptance of term work indicates that performance in laboratory work is satisfactory and minimum passing marks may be given in term work.
- The distribution of marks for term work shall be as follows:
- Laboratory work (experiments): ..... (15) Marks.
- Mini project..... (15) Marks.
- Mini Project Presentation & Report..... (10) Marks
- Assignments..... (05) Marks
- Attendance .....(05) Marks
- **TOTAL: .....(50) Marks.**

**Practical and Oral** examination will be based on Laboratory work, mini project and above syllabus.

Lab Code	Course Name	Credits
<b>CSL804</b>	<b>Computational Lab II</b>	<b>1</b>

**Lab Outcome:** After successful completion of this course student will be able to:

1. Acquire practical knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

**Description:**

Design and implementation of any case study/ applications /experiments / mini project based on departmental level optional courses using modern tools.

**Term work:**

The distribution of marks for **term work** shall be as follows:

Lab Experimental Work & mini project	:	25
Report/ Documentation/Presentation	:	20
Attendance (Theory & Practical)	:	05

**Practical & Oral** examination is to be conducted based on departmental level optional courses by pair of internal and external examiners appointed by the University of Mumbai.

Course Code	Title	Credit
<b>CSP805</b>	<b>Major Project- II</b>	<b>6</b>

**Objective:** The primary objective is to meet the milestones formed in the overall project plan decided in Project - I. The idea presented in Project -I should be implemented in Project -II with results, conclusion and future work. The project will culminate in the production of a thesis by each individual student.

**Guidelines:**

**Project Report Format:**

At the end of semester a student need to prepare a project report should be prepared as per the guidelines issued by the University of Mumbai. Along with project report a CD containing: project documentation, Implementation code, required utilities, Software's and user Manuals need to be attached.

**Term Work:**

Student has to submit weekly progress report to the internal guide and where as internal guide has to keep track on the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks. In case of industry projects, visit by internal guide will be preferred to get the status of project.

Distribution of marks for term work shall be as follows:

- a) Weekly Attendance on Project Day
- b) Project work contributions as per objective
- c) Project Report (Hard Bound)
- d) Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

**Oral & Practical :**

Oral & Practical examination of Project- II should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project- II.

**Program Structure for B.E. Computer Engineering**  
**Third Year (Computer)**  
**( Semester V)**  
**(REV 2012)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
CPC501	Microprocessor	4	2	-	4	1	-	5
CPC502	Operating Systems	4	2	-	4	1	-	5
CPC503	Structured and Object Oriented Analysis and Design	4	2	-	4	1	-	5
CPC504	Computer Networks	4	2	-	4	1	-	5
CPL501	Web Technologies Laboratory	-	4	-	-	2	-	2
CPL502	Business Communication and Ethics*	-	2	2	-	2	-	2
	<b>Total</b>	<b>18</b>	<b>12</b>	<b>2</b>	<b>16</b>	<b>8</b>	<b>-</b>	<b>24</b>

\* 2 hours shown as Practicals to be taken class wise and 2 hours for tutorials to be taken as batch wise

Course Code	Course Name	Examination Scheme									
		Internal Assesment					End Sem Exam	Exam Duration (in Hrs)	TW	Oral / Pract	Total
		Internal Assesment			Avg	Exam					
		Test 1	Test 2	Avg							
CPC501	Microprocessor	20	20	20	80	03	25	25 prac	125		
CPC502	Operating Systems	20	20	20	80	03	25	25 (prac	150		
CPC503	Structured and Object Oriented Analysis and Design	20	20	20	80	03	25	25 (oral)	150		
CPC504	Computer Networks	20	20	20	80	03	25	25 prac	150		
CPL501	Web Technologies Laboratory	-	-	-	-	-	25	50 (oral)	75		
CPL502	Business Communication and Ethics	-	-	-	-	-	50	-	50		
	<b>Total</b>	<b>-</b>	<b>-</b>	<b>80</b>	<b>320</b>		<b>175</b>	<b>150</b>	<b>725</b>		



**Program Structure for B.E. Computer Engineering**

**Third Year (Computer) ( Semester VI)**

**(REV 2012)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
CPC601	System Programming and Compiler Construction	4	2	-	4	1	-	5
CPC602	Software Engineering	4	2	-	4	1	-	5
CPC603	Distributed Databases	4	2	-	4	1	-	5
CPC604	Mobile Communication and Computing	4	2	-	4	1	-	5
CPE6011	Elective-I	3	-	-	-	2	-	2
CPL601	Network Programming Laboratory	-	4	-	-	2	-	2
	<b>Total</b>	<b>19</b>	<b>12</b>	<b>-</b>	<b>16</b>	<b>8</b>	<b>-</b>	<b>24</b>

Course Code	Course Name	Examination Scheme								
		Internal Assesment						TW	oral / pract	Tot
		Internal Assesment			End Sem Exam	Exam Duration ( in Hrs)				
		Test 1	Test 2	Avg						
CPC601	System Programming and Compiler Construction	20	20	20	80	03	25	25 (pract)	150	
CPC602	Software Engineering	20	20	20	80	03	25	25 (oral)	150	
CPC603	Distributed Databases	20	20	20	80	03	25	25 (oral)	150	
CPC604	Mobile Communication and Computing	20	20	20	80	03	25	25 (pract)	150	
CPE601X	Elective-I	-	-	-	-	-	50	-	50	
CPL601	Network Programming Laboratory	-	-	-	-	-	25	50 (oral)	75	
	<b>Total</b>	<b>-</b>	<b>-</b>	<b>80</b>	<b>320</b>	<b>-</b>	<b>175</b>	<b>150</b>	<b>725</b>	

**Program Structure B.E. Computer Engineering**  
**Fourth Year (Computer) ( Semester VII)**  
**( REV 2012)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
CPC701	Digital Signal Processing	4	2	-	4	1	-	5
CPC702	Cryptography and System Security	4	2	-	4	1	-	5
CPC703	Artificial Intelligence	4	2	-	4	1	-	5
CPE7042X	Elective-II	4	2	-	4	1	-	5
CPP701	Project I	-	-	-	-	3	-	3
CPL701	Network Threats and Attacks Laboratory	-	4	-	-	2	-	2
	<b>Total</b>	<b>16</b>	<b>12</b>	<b>-</b>	<b>16</b>	<b>09</b>	<b>-</b>	<b>25</b>

Course Code	Course Name	Examination Scheme									
		Internal Assesment					End Sem Exam	Exam Duration ( in Hrs)	TW	oral	Tot
		Internal Assesment			Avg	Exam					
		Test 1	Test 2	Avg							
CPC701	Digital Signal Processing	20	20	20	80	03	25	-	125		
CPC702	Cryptography and System Security	20	20	20	80	03	25	25 (prac	150		
CPC703	Artificial Intelligence	20	20	20	80	03	25	25	150		
CPE7042X	Elective-II	20	20	20	80	03	25	25	150		
CPP701	Project I	-	-	-	-	-	50	50	100		
CPL701	Network Threats and Attacks Laboratory	-	-	-	-	-	25	50	50		
	<b>Total</b>	<b>-</b>	<b>-</b>	<b>80</b>	<b>320</b>	<b>-</b>	<b>200</b>	<b>175</b>	<b>775</b>		

**Program Structure for B.E. Computer Engineering**

**Second Year (Computer) ( Semester VIII)**

**(REV 201)**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
CPC801	Data Warehouse and Mining	4	2	-	4	1	-	5
CPC802	Human Machine Interaction	4	2	-	4	1	-	5
CPC803	Parallel and distributed Systems	4	2	-	4	1	-	5
CPE803X	Elective-III	4	2	-	4	1	-	5
CPP802	Project II	-	-	-	-	6	-	6
CPL801	Cloud Computing Laboratory	-	2	-	-	1	-	1
	<b>Total</b>	<b>16</b>	<b>10</b>	<b>-</b>	<b>16</b>	<b>11</b>	<b>-</b>	<b>27</b>

Course Code	Course Name	Examination Scheme										
		Internal Assesment					End Sem Exam	Exam Duration ( in Hrs)	TW	oral	Tot	
		Internal Assesment			Test 1	Test 2						Avg
		Test 1	Test 2	Avg								
CPC801	Data Warehouse and Mining	20	20	20	20	20	20	80	03	25	25	150
CPC802	Human Machine Interaction	20	20	20	20	20	20	80	03	25	25	150
CPC803	Parallel and distributed Systems	20	20	20	20	20	20	80	03	25	25	150
CPE803X	Elective-III	20	20	20	20	20	20	80	03	25	25	150
CPP802	Project II	-	-	-	-	-	-	-	-	50	50	100
CPL801	Cloud Computing Laboratory	-	-	-	-	-	-	-	-	25	-	-
	<b>Total</b>				80	80	80	320		175	150	725

**Elective I Sem 6****CPE6011 Operation Research****CPE6012 Project Management****CPE6013 Foreign Language – German****CPE6014 Foreign Language – French****Elective II Sem 7**

<b>System Group</b>	<b>CPE7021</b>	Advance Algorithms
	<b>CPE7022</b>	Computer Simulation and Modeling
<b>Electronics Group</b>	<b>CPE7023</b>	Image Processing
<b>Software Group</b>	<b>CPE7024</b>	Software Architecture
	<b>CPE7025</b>	Soft Computing
<b>DB Group</b>	<b>CPE7026</b>	ERP and Supply Chain Management

**Elective III - Sem 8**

<b>Electronics Group</b>	<b>CPE8031</b>	Machine Learning
<b>Digital Group</b>	<b>CPE8032</b>	Embedded Systems
<b>Network Group</b>	<b>CPE8033</b>	Adhoc wireless networks
	<b>CPE8034</b>	Digital Forensic
<b>DB Group</b>	<b>CPE8035</b>	Big data Analytics

Course Code	Course/Subject Name	Credits
CPC501	<b>Microprocessor</b>	<b>5</b>

**Objectives:**

1. To understand basic architecture of 16 bit and 32 bit microprocessors.
2. To understand interfacing of 16 bit microprocessor with memory and peripheral chips involving system design.
3. To understand techniques for faster execution of instructions and improve speed of operation and performance of microprocessors.
4. To understand RISC and CISC based microprocessors.
5. To understand concept of multi core processors.

**Outcomes:** Learner will be able to...

1. Write programs to run on 8086 microprocessor based systems.
2. Design system using memory chips and peripheral chips for 16 bit 8086 microprocessor.
3. Understand and devise techniques for faster execution of instructions, improve speed of operations and enhance performance of microprocessors.
4. Distinguish between RISC and CISC processors.
5. Understand multi core processor and its advantages.

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Intel 8086/8088 Architecture</b> 1.1 8086/8088 Microprocessor Architecture, Pin Configuration, Programming Model, Memory Segmentation, Study of 8284 Clock Generator, Operating Modes, Study of 8288 Bus Controller, Timing diagrams for Read and Write operations, Interrupts.	10
<b>02</b>	<b>Instruction Set and Programming</b> 2.1 Instruction Set of 8086, Addressing Modes, Assembly Language Programming, Mixed Language Programming with C Language and Assembly Language.	08
<b>03</b>	<b>System designing with 8086</b> 3.1 Memory Interfacing: SRAM, ROM and DRAM (using DRAM Controller-Intel 8203). 3.2 Applications of the Peripheral Controllers namely 8255-PPI, 8253-PIT, 8259-PIC and 8237-DMAC. Interfacing of the above Peripheral Controllers with 8086 microprocessor. 3.3 Introduction to 8087 Math Coprocessor and 8089 I/O Processor.	12
<b>04</b>	<b>Intel 80386DX Processor</b> 4.1 Study of Block Diagram, Signal Interfaces, Bus Cycles, Programming Model, Operating Modes, Address Translation Mechanism in Protected Mode, Memory Management, Protection Mechanism.	06

<b>05</b>	<b>Pentium Processor</b> 5.1 Block Diagram, Superscalar Operation, Integer & Floating Point Pipeline Stages, Branch Prediction, Cache Organization. 5.2 Comparison of Pentium 2, Pentium 3 and Pentium 4 Processors. Comparative study of Multi core Processors i3, i5 and i7.	08
<b>06</b>	<b>SuperSPARC Architecture</b> 6.1 SuperSPARC Processor, Data Formats, Registers, Memory model. Study of SuperSPARC Architecture.	04

### Term Work:

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/practical & case studies):..... (15) Marks.
- Assignments..... (05) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

### Practical/Experiments:

1. Total eight experiments / practical must be performed out of which five practical must be performed on assemblers for 8086 and three experiments must be performed on interfacing of 8086 with peripheral chips like 8255 PPI, 8253 PIT, 8259 PIC and 8237 DMAC.
2. In addition to eight experiments/practical, two case studies are mandatory, one case study on RISC processor and second case study on CISC processor.

**Practical examination will be conducted based on the above syllabus.**

### Text Books:

1. Microprocessor and Interfacing: Douglas Hall, Tata McGraw Hill.
2. Microcomputer Systems: 8086/8088 family Architecture, Programming and Design: Liu & Gibson, PHI Publication.
3. Pentium Processor System Architecture: Tom Shanley & Don Anderson, Addison-Wesley.
4. Advanced Microprocessor: Daniel Tabak, Tata McGraw Hill.
5. The 80386DX Microprocessor: Hardware, Software and Interfacing: Walter A Triebel, Prentice Hall.

### Reference Books:

1. 8086/8088 family: Design Programming and Interfacing: John Uffenbeck , PHI.
2. Intel Microprocessors: Barry B. Brey, 8<sup>th</sup> Edition, Pearson Education India.

3. Processor Architecture and Interfacing: Swati Joshi, Atul Joshi, Hemlata Jadhav, Wiley.
4. The X86 Microprocessors: Architecture and Programming (8086 to Pentium): Das Lyla B, Pearson Education India.
5. The SPARC Architecture Manual
6. I Intel Manuals
7. Programmer's Reference Manual for IBM Personal Computers: Steven Armbrust, Ted Forgeron, McGraw Hill
8. IBM PC Assembly Language and Programming: Peter Abel, 5<sup>th</sup> Edition, Prentice Hall of India

Course Code	Course/Subject Name	Credits
CPC502	<b>Operating Systems</b>	<b>5</b>

**Objectives:**

1. To introduce students with basic concepts of Operating System, its functions and services.
2. To familiarize the students with various views and management policies adopted by O.S. as pertaining with processes , Deadlock , memory , File and I/O operations.
3. To brief the students about functionality of various OS like Unix , Linux and Windows XP as pertaining to resource management.
4. To provide the knowledge of basic concepts towards process synchronization and related issues.

**Outcomes:** Learner will be able to...

1. Appreciate the role of operating system as System software.
2. Compare the various algorithms and comment about performance of various algorithms used for management of memory , CPU scheduling, File handling and I/O operations.
3. Apply various concept related with Deadlock to solve problems related with Resources allocation, after checking system in Safe state or not.
4. To appreciate role of Process synchronization towards increasing throughput of system.
5. Describe the various Data Structures and algorithms used by Different Oss like Windows XP , Linux and Unix pertaining with Process , File , I/O management.
6. To control the behavior of OS by writing Shell scripts.

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Introduction</b> 1.1 Introduction to Operating System, Objectives and Functions of O.S., OS Services, Special purpose systems, Types Of OS, System Calls, types of system calls, Operating system structure ,System Boot.	04
<b>02</b>	<b>Process Management</b> 2.1 <b>Process concept</b> , operations on process Process scheduling: basic concepts , scheduling criteria , scheduling algorithms, Preemptive, Non-preemptive, FCFS ,SJF ,SRTN ,Priority based, Round Robin ,Multilevel Queue scheduling,Operating System Examples. 2.2 <b>Synchronization:</b> Background , the critical section problem , Peterson’s Solution, Synchronization Hardware Semaphores, classic problems of Synchronization: The Producer Consumer Problem:Readers writers problem, Semaphores, Dining Philosopher Problem	10



<b>03</b>	<b>Deadlock</b> 3.1 Deadlock Problem, Deadlock Characterization, Deadlock Prevention. Deadlock avoidance Banker's algorithm for single & multiple resources , Deadlock recovery , Deadlock Detection,	04
<b>04</b>	<b>Memory Management</b> 4.1 <b>Memory management strategies:</b> background , swapping ,contiguous memory allocation, paging , structure of page tables , segmentation 4.2 <b>Virtual memory management:</b> Demand paging , copy-on write,Page replacement, FIFO, Optimal, LRU, LRU Approximation,Counting Based, , Allocation of frames , Thrashing	05
<b>05</b>	<b>File Management</b> 5.1 Files-System Structure, File System implementation, Directory implementation , Allocation Methods contiguous allocation, linked list allocation, indexed allocations, Free space management. 5.2 <b>Secondary storage</b> : structures: Disks Scheduling Algorithm: FCFS, SSTF, SCAN, CSCAN, LOOK, Disk Management	06
<b>06</b>	<b>Input Output Management</b> 6.1 Overview , I/O Hardware , Application I/O Interface	02
<b>07</b>	<b>Case Study of UNIX</b> 7.1 History of UNIX, Overview of UNIX ,UNIX File System, Data structures for process/memory management ,Process states and State Transitions, Using the System(Booting and login ),Process scheduling , Memory management , Shell programming	08
<b>08</b>	<b>Case Study of Linux</b> 8.1 History , Design Principles , Kernel Modules , Process management , Scheduling , Memory management , File Systems , Input and Output , Inter process communication , Network structure , Security	05
<b>09</b>	<b>Case study: Windows 7</b> 9.1 History, Design Principles , System components , environmental subsystems , File System, Networking, Programmer Interface	04

### Term Work:

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments+mini project ): ..... (15)
- Assignments:..... (05)
- Attendance ..... (05)
- TOTAL: ..... (25)**

## **Practical/Experiments:**

Laboratory work shall consist of minimum **05** experiments and mini project, 2 assignments based on above theory syllabus.

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

**Practical exam will be based on the above syllabus.**

## **Text Books:**

1. Silberschatz A., Galvin P., Gagne G. "Operating Systems Principles", Willey Eight edition
2. Achyut S. Godbole , Atul Kahate "Operating Systems" McGraw Hill Third Edition
3. "Operating System-Internal & Design Principles", William Stallings, Pearson
4. Andrew S. Tanenbaum, "Modern Operating System", Prentice Hall.

## **Reference Books:**

1. "Linux Command Line & Shell Scripting", Richard Blum and Christine Bresnahan, 2nd edition, Wiley.
2. "The Design of Unix Operating System", Maurice J. Bach, Prentice Hall.
3. Unix and Shell Programming by B. M. Harwani Oxford
4. Unix Concept and Application 4th Edition by Sumitabha Das 'Mc Graw Hill'
5. Thomas Rebecca : Yates A user guide to the Unix system.

## **Syllabus for Practical:**

Suggested topics for experiment but not limited to:

1. Exploring basic commands for handling File system under Unix/Linux using shell scripts.  
( creating groups , chown , chmod , directory name, tty , diff, umask )
2. Pattern matching utilities like awk, grep , nroff , troff , sort etc.
3. Exploring the boot process of Unix/Linux and implementing practical on it (for ex. MBR, passing different parameter to kernel, do different activity while booting and power-off ).
4. Basic Process management algorithms ( Any from FCFS , SJF , SRTN, RR , multilevel Queue scheduling )
5. Process synchronization algorithms like producer consumer problem , dining philosopher problem
6. Implementing Various page replacement policies: FIFO, Optimal, LRU, LFU
7. Implementation of Disk scheduling algorithms like FCFS,SSTF,SCAN ,CSCAN,LOOK.
8. Implementing Various file allocation methods : Index Allocation , Contiguous allocation.
9. Simulating Paging and Segmentation
10. Implementation of System calls like printing a file, display file using Unix/Linux internals.
11. Study booting process of Windows XP, Linux , and Unix.

Course Code	Course/Subject Name	Credits
CPC503	<b>Structured and Object Oriented Analysis and Design</b>	<b>5</b>

**Outcomes:** Learner will be able to...

1. Understand and apply techniques to get the system requirements and present it in standard format.
2. Apply key modeling concepts to both the traditional structured approach and the object-oriented approach.
3. Construct the candidate system following design methodology.

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Introduction</b> 1.1 System overview, Types of Systems , 1.2 Key Differences Between Structured and Object-Oriented Analysis and Design 1.3 Role of the System Analyst 1.4 Systems Development Life Cycle	06
<b>02</b>	<b>System Analysis</b> 2.1 Business process Reengineering and the Zachman Framework, System Requirement, Stakeholders, Techniques for information gathering, Validating the requirements.	06
<b>03</b>	<b>Feasibility Analysis</b> 3.1 Feasibility Analysis, Tests for feasibility, Cost-Benefit Analysis, Feasibility analysis of candidate system. 3.2 The system Proposal.	06
<b>04</b>	<b>Modeling System Requirements</b> 4.1 Traditional Approach to Requirement: Data Flow Diagrams, Documentation of DFD Components. Information Engineering Models, 4.2 Object-Oriented Approach to Requirement: Object-Oriented Requirements, The System Activities, Identifying Input and Outputs, Identifying Object Behavior, Integrating Object-Oriented Models. 4.3 Evaluating Alternatives for requirements, Environment and Implementation	12
<b>05</b>	<b>System Design</b> 5.1 Moving To Design 5.2 The traditional Approach to design 5.3 The Object-Oriented Approach to design: Use Case REalization 5.4 Designing Database, Designing the User Interface, Designing System Interfaces, Controls and security	12
<b>06</b>	<b>Application Architecture</b> 6.1 IT Architecture, Application Architecture Strategies, Modeling Application Architecture for Information System. 6.2 Deployment using UML diagrams, Component and deployment diagram for various architectures.	06

## List of Assignment:

Assignments can be based on following topics

1. Feasibility analysis
2. Design patterns.

## Term Work:

The distribution of marks for term work shall be as follows:

- Laboratory work: ..... (10) Marks.
- Mini Project presentation:..... (10) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

**Oral exam will be based on the above syllabus and tLaboratory work.**

## Suggested Practical List:

1. Develop Requirement specification document of the selected / allotted project.
2. Develop DFD model (level-0, level-1 DFD and Data dictionary) of tselected / allotted project.
3. Develop UML Use case model for selected / allotted project. .
4. Develop sequence diagram selected / allotted project. .
5. Develop Class diagram selected / allotted project.
6. Develop prototype of your project selected / allotted project.
7. Draw system architecture diagram selected / allotted project.

## Text Books:

1. System Analysis & Design by Satzinger, Jackson and Burd, Cengage Learning, 2007
2. System Analysis and Design Methods by Jeffery I. Whitten, Lonnie D Bentley, McGraw Hill, 7<sup>th</sup> edition.
3. System Analysis and Design by Alan Dennis, Barbara H. Wixom, Roberta M. Roth, Wiley India 4<sup>th</sup> edition

## Reference Books:

1. Systems Analysis and Design by Kendall & Kendall, PHI Publication, 7<sup>th</sup> Edition.
2. Analysis and Design of Information Systems by James a. Senn, 2<sup>nd</sup> Edition, McGrawHill.
3. Object-Oriented Modeling and Design with UML by Michael Blaha, James Rumbaugh, Pearson Education Publication, 2<sup>nd</sup> Edition.
4. The Unified Modeling Language - User Guide by Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Education Publication.
5. Modern Systems Analysis and Design by Jeffrey A. Hoffer, Joey F. George, Joseph S. Valacich, Prabin K. Panigrahi, Pearson Education Publication, 4<sup>th</sup> Edition.
6. UML Distilled by Martin Fowler, Pearson Edition, 3<sup>rd</sup> Edition.

7. Object Oriented Systems Development Using the Modified Modeling Language by Ali Bahrami, Tata McGraw Hill Publication.
8. Applying UML and Patterns by Craig Larman, Pearson Education, 2<sup>nd</sup> Edition.

Course Code	Course/Subject Name	Credits
CPC504	<b>Computer Networks</b>	<b>4+1</b>

**Objectives:**

1. To provide students with an overview of the concepts and fundamentals of data communication and computer networks
2. To familiarize with the basic taxonomy and terminology of computer networking area.
3. To experience the designing and managing of communication protocols while getting a good exposure to the TCP/IP protocol suite.

**Outcomes:**

**After completion of this course learner will be able to:**

1. Conceptualize all the OSI Layers
2. Use appropriate network tools to build network topologies
3. Install and configure an open source tool NS2
4. Test simple protocols in a laboratory scenario

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Introduction</b> 1.1 History and development of computer network, network application, network software and hardware components, topology, protocol hierarchies, design issues for the layers, connection oriented and connectionless services, reference models: layer details of OSI, TCP/IP models. Communication between layers.	06
<b>02</b>	<b>Physical Layer</b> 2.1 Guided Transmission Media: Twisted pair, Coaxial, Fiber optics. 2.2 Unguided media (Wireless Transmission): Radio Waves, Bluetooth, Infrared, Virtual LAN.	06
<b>03</b>	<b>3.1 Data Link Layer</b> DDL Design Issues, Functionalities of DLL, Flow control algorithms - Sliding Window, Error Detection & Correction techniques, SDLC, PPP, Framing. <b>3.2 MAC Layer</b> Aloha protocols, Control Access Protocol, Carrier Sense Multiple Access(CSMA), Ethernet, Local Area Networks - Ethernet, Token ring, FDDI.	09
<b>04</b>	<b>Network layer</b> 4.1 Communication Primitives: Unicast, Multicast, Broadcast. IP Addressing, Subnetting, IPv4, IPv6, Routing algorithms : Link state routing, Distance Vector Routing, ARP, RARP, ICMP, Routing protocols - RIP, OSPF, BGP, IGRP, Congestion control algorithms: Open Loop congestion control, Closed Loop congestion control.	08

<b>05</b>	<b>Transport Layer</b> 5.1 The Transport Service: Transport service primitives, Berkeley Sockets, Connection management, UDP, TCP, Socket Programming (TCP & UDP), Socket Programming examples, TCP Flow control, TCP Congestion Control, Multiplexing.	08
<b>06</b>	<b>Application Layer</b> 6.1 DNS, HTTP, E-mail, SMTP, Telnet, FTP, Security-PGP-SSH.	06
<b>07</b>	<b>Network Management</b> 7.1 SNMP Concept, Management Components, SMI, MIB, SNMP Format, Messages.	04

### Term Work:

Term work shall consist of minimum **12** experiments.

Journal must include at least 2 assignments.

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

The distribution of marks for term work shall be as follows:

- Experiments: ..... (15) Marks.
- Assignments:..... (05) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

**Practical exam will be based on the above syllabus.**

### Suggested Practicals:

1. Study of LAN Topology.
2. Study of various Network devices.
3. Building of any topology using Network tool.
4. Installation & Configuration of NS2 in Linux environment.
5. Basic wired & wireless topology in NS2.
6. Build class A & Class B Network using router in Network tool.
7. Implement subnetting concept using Network tool.
8. Write a program to implement find out class of a given IP address, subnet mask & first & last IP address of that block.
9. Write a program to build client-server model on different computers.
10. Congestion Control: Stop & Wait, Sliding Window & Selective Repeat, Go Back n.
11. Datalink Layer : Error Detection and correction, Flow Control, Framing
12. Network Layer : IP Addressing, Routing
13. Transport Layer : Socket Programming, Network Management/ Monitoring Tools.

**Text Books:**

1. A.S. Tanenbaum, "Computer Networks", Pearson Education, Fourth Edition.
2. B.A. Forouzan, "Data Communications and Networking", TMH, Fourth Edition.

**Reference Books:**

1. M. A. Gallo and W. M. Hancock, Computer Communications and Networking Technologies, Cengage Learning (Indian Edition), First Edition.
2. Natalia Olifer & Victor Olifer, "Computer Networks : Principles, Technologies & Protocols for Network Design", Wiley India, 2011.
3. Computer Networks: A Systems Approach, Second Edition (The Morgan Kaufmann Series in Networking) Larry L.Peterson(Author),Bruce S.Davie(Author)
4. Computer Networking, 6e,James F. Kurose , Keith W. Ross.
5. An Engineering Approach To Computer Networking: Atm Networks, The Internet ...By Keshav



Course Code	Course/Subject Name	Credits
CPL502	<b>Business Communication &amp; Ethics</b>	<b>2</b>

**Objectives:**

1. To inculcate in students professional and ethical attitude, effective communication skills, teamwork, skills, multidisciplinary approach and an ability to understand engineer's social responsibilities.
2. To provide students with an academic environment where they will be aware of the excellence, leadership and lifelong learning needed for a successful professional career.
3. To inculcate professional ethics and codes of professional practice
4. To prepare students for successful careers that meets the global Industrial and Corporate requirement' provide an environment for students to work on Multidisciplinary projects as part of different teams to enhance their team building capabilities like leadership, motivation, teamwork etc.

**Outcomes:** A learner will be able to .....

1. communicate effectively in both verbal and written form and demonstrate knowledge of professional and ethical responsibilities
2. Participate and succeed in Campus placements and competitive examinations like GATE, CET.
3. Possess entrepreneurial approach and ability for life-long learning.
4. Have education necessary for understanding the impact of engineering solutions on Society and demonstrate awareness of contemporary issues.

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Report Writing</b> 1.1 Objectives of report writing 1.2 Language and Style in a report 1.3 Types of reports 1.4 Formats of reports: Memo, letter, project and survey based	08
<b>02</b>	<b>Technical Proposals</b> 2.1 Objective of technical proposals 2.2 Parts of proposal	02
<b>03</b>	<b>Introduction to Interpersonal Skills</b> 3.1 Emotional Intelligence 3.2 Leadership 3.3 Team Building 3.4 Assertiveness 3.5 Conflict Resolution 3.6 Negotiation Skills 3.7 Motivation 3.8 Time Management	08
<b>04</b>	<b>Meetings and Documentation</b> 4.1 Strategies for conducting effective meetings 4.2 Notice	02

	4.3 Agenda 4.4 Minutes of the meeting	
<b>05</b>	<b>Introduction to Corporate Ethics and etiquettes</b> 5.1 Business Meeting etiquettes, Interview etiquettes, Professional and work etiquettes, Social skills 5.2 Greetings and Art of Conversation 5.3 Dressing and Grooming 5.4 Dinning etiquette 5.5 Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response, the process of making ethical decisions)	02
<b>06</b>	<b>Employment Skills</b> 6.1 Cover letter 6.2 Resume 6.3 Group Discussion 6.4 Presentation Skills 6.5 Interview Skills	06

### List of Assignment:

1. Report Writing (Synopsis or the first draft of the Report)
2. Technical Proposal (Group activity, document of the proposal)
3. Interpersonal Skills (Group activity and Role play)
4. Interpersonal Skills ( Documentation in the form of soft copy or hard copy)
5. Meetings and Documentation ( Notice, Agenda, Minutes of Mock Meetings)
6. Corporate ethics and etiquettes (Case study, Role play)
7. Cover Letter and Resume
8. Printout of the PowerPoint presentation

### Term Work:

Term work shall consist of all assignments from the list. The distribution of marks for term work shall be as follows:

- Assignments: ..... (20) Marks.
  - Project Report Presentation..... (15) Marks.
  - Group Discussion..... (10) Marks.
  - Attendance .....(05) Marks
- TOTAL: ..... (50) Marks.**

The final certification and acceptance of term work ensures the satisfactory performance of work assigned and minimum passing in the term work.

## References:

1. Fred Luthans, "*Organisational Behavior*", Mc Graw Hill, edition
2. Lesiker and Petit, "*Report Writing for Business*", Mc Graw Hill, edition
3. Huckin and Olsen, "*Technical Writing and Professional Communication*", Mc Graw Hill
4. Wallace and Masters, "*Personal Development for Life and Work*", Thomson Learning, 12<sup>th</sup> edition
5. Heta Murphy, "*Effective Business Communication*", Mc Graw Hill, edition
6. R.C Sharma and Krishna Mohan, "*Business Correspondence and Report Writing*",
7. B N Ghosh, "*Managing Soft Skills for Personality Development*", Tata McGraw Hill. Lehman, Dufrene, Sinha, "*BCOM*", Cengage Learning, 2<sup>nd</sup> edition
8. Bell . Smith, "Management Communication" Wiley India Edition, 3<sup>rd</sup> edition. Dr.K.Alex, "Soft Skills", S Chand and Company
9. Dr.K Alex, "Soft Skills", S Chand and Company

Course Code	Course/Subject Name	Credits
CPL501	<b>Web Technologies Laboratory</b>	2

Module	Detailed Contents	Lab Sessions
01	<p><b>Title:</b> Create HTML Forms. Use of various HTML Tag on Web Forms.</p> <p><b>Concept:</b> Designing of effective web site, Introduction of different Web Technologies : HTML, and Different HTML Tag.</p> <p><b>Objective:</b> objective of this module is to provide students an overview of the concepts Web Technologies, and HTML.</p> <p><b>Scope:</b> Designing static client side web page using various HTML tags.</p> <p><b>Technology:</b> HTML</p>	01
02	<p><b>Title:</b> Use of CSS on HTML Form.</p> <p><b>Concept:</b> Cascaded Style Sheets</p> <p><b>Objective:</b> In this module student will learn, defining a CSS and unstaring its purpose different syntax and types of CSS.</p> <p><b>Scope:</b> Creating web pages and use CSS to control the layout pages.</p> <p><b>Technology:</b> HTML with Cascade Style Sheet</p>	01
03	<p><b>Title:</b> Use of Java Script functions on Web Forms and Use of Dynamic HTML Page.</p> <p><b>Concept:</b> Scripting Languages, Dynamic web pages</p> <p><b>Objective:</b> in this lab student will learn how to define client side scripting and understand its advantages and disadvantages. Embedding JavaScript code into HTML document using script tag, and will understand dynamic HTML.</p> <p><b>Scope:</b> Create animation using JavaScript.</p> <p><b>Technology:</b> HTML with JavaScript.</p>	02
04	<p><b>Title:</b> Creation of Web page with the help of Quanta Plus /Aptana /Kompozer.</p> <p><b>Concept:</b> Web development Environment</p> <p><b>Objective:</b> This module students will learn how will introduce editors for development of web pages.</p> <p><b>Scope:</b> Development of web pages using any web tool.</p> <p><b>Technology:</b> Quanta Plus /Aptana /Kompozer</p>	03

<b>05</b>	<p><b>Title:</b> Write an XML file marksheet.xml representing your semester mark sheet.</p> <p><b>Concept:</b> Extensible Mark up Language (XML)</p> <p><b>Objective:</b> is to learn about basics of XML and how it can be used to store information away from the mechanism of processing or formatting of such data. Will also learn how to build simple XML files and be able to manipulate and refer to them.</p> <p><b>Scope:</b> is to creating an XML file in that it must include basic syntax of an XML doc and DTD for the same.</p>	03
<b>06</b>	<p><b>Title:</b> server side scripting. Use HTML form to accept the two numbers N1 and N2 and using PHP program display only prime numbers in between N1 and N2.</p> <p><b>Concept:</b> Server side scripting, introduction to PHP</p> <p><b>Objective:</b> this lab gives a basic introduction of to PHP and dynamic programming on the server side.</p> <p><b>Scope:</b> creating a server side script using PHP, decisions, looping</p> <p><b>Technology:</b> PHP, HTML</p>	03

### Term work Assessment:

Term work will consist of small assignments testing all the technologies included in syllabus and a Mini project solving an appropriate problem using the above technology

The distribution of marks for term work shall be as follows:

- Assignments: ..... (20) Marks.
- Project Report Presentation..... (15) Marks.
- Group Discussion..... (10) Marks.
- Attendance .....(05) Marks
- TOTAL: ..... (50) Marks.**

### End Semester Examination:

**Oral examination is to be conducted by pair of internal and external examiners based on the mini projects undertaken by student groups.**

### Text Books:

1. Ralph Moseley ,M.T. Savaliya “Developing Web Applications “, Willy India,Second Edition , ISBN:978-81-265-3867-6
2. “Web Technology Black Book ”,Dreamtech Press, First Edition, ISBN 978-7722-997

Course Code	Course/Subject Name	Credits
CPC601	<b>System Programming Compiler Construction</b>	05

**Objectives:**

1. To help students appreciate the role and functioning of various system programs over application program
2. To initiate an understanding of compilers in general and brief about phases of compiler.
3. To provide a theoretical framework for optimizing the code.
4. To familiarize and encourage the students to use various software tools for Developing System programs.

**Outcomes:** Learner will be able to...

1. Identify different system software
2. Use Lex tool used for generating lexical analyser.
3. Write macros as and when required to increase readability and productivity
4. Design hand written lexical analyzer
5. Design new language structures with the help of grammars
6. Appreciate the role of Operating System functions such as memory management as pertaining to run time storage management
7. Appreciate role of Intermediate Code Generation in connection with language designing
8. Apply optimization principles on given code
9. Implement various parser types and use YACC.

Module	Detailed Contents	Hours
<b>01</b>	<b>System Software</b> 1.1 Concept, introduction to various system programs such as assemblers, loaders , linkers ,macro processors, compilers, interpreters, operating systems, device drivers	01
<b>02</b>	<b>Assemblers</b> 2.1 General Design Procedure , Design of Assembler (Single Pass – Assembler IBM PC , multi pass Assembler - IBM 360/370 Processor), Statement of Problem , Data Structure , format of Databases , Algorithm , Look for modularity	06
<b>03</b>	<b>Macros &amp; Macro processors</b> 3.1 Macro instructions, Features of Macro facility, Design of 2 pass macroprocessor	04
<b>04</b>	<b>Loaders and Linkers</b> 4.1 loader schemes, Design of Absolute loader , Design of Direct linking loader	04
<b>05</b>	<b>Software Tools</b> 5.1 Software Tools for Program development, Editors: Types of Editors , Design of Editor ,Debug Monitors	02

<b>06</b>	<b>Compilers</b> 5.1 Introduction to Compilers, Phases of a compiler, comparison of compilers and interpreters.	02
<b>07</b>	<b>Lexical Analysis</b> 5.1 Role of a Lexical analyzer, input buffering, specification and recognition of tokens, Designing a lexical analyzer generator, Pattern matching based on NFA's.	02
<b>08</b>	<b>Syntax Analysis</b> 5.1 Role of Parser, Top-down parsing, Recursive descent and predictive parsers (LL), Bottom-Up parsing, Operator precedence parsing, LR, SLR and LALR parsers.	08
<b>09</b>	<b>Syntax Directed Translation</b> 9.1 Syntax directed definitions, Inherited and Synthesized attributes, Evaluation order for SDDs , S attributed Definitions , L attributed Definitions	3
<b>10</b>	<b>Intermediate Code Generation</b> 10.1 Intermediate languages: declarations, Assignment statements, Boolean expression, case statements, back patching , procedure calls.	04
<b>11</b>	<b>Code Generation</b> 11.1 Issues in the design of Code Generator , Basic Blocks and Flow graphs, code generation algorithm , DAG representation of Basic Block	04
<b>12</b>	<b>Code Optimization</b> 12.1 Principal sources of Optimization, Optimization of Basic Blocks , Loops in Flow graph ,Peephole Optimization	03
<b>13</b>	<b>Run Time storage</b> 11.1 Storage Organization , storage allocation strategies, parameter passing , Symbol table , introduction to garbage collection and compaction	04
<b>14</b>	<b>Compiler-compilers</b> 11.1 JAVA compiler environment, YACC compiler-compiler	01

### Term Work:

Journal should include at least 10 experiments (out of which at least 7 from suggested list below) and at least 2 assignments.

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments): ..... (15) Marks.
- Assignment:..... (05) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

### **Practical/Oral examination:**

Practical examination will be conducted based on above syllabus

### **Theory Examination:**

**In question paper, weight age of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

1. Question paper will comprise of total 6 questions, each of 20 Marks.
2. Only 4 questions need to be solved.
3. Question 1 will be compulsory and based on maximum part of the syllabus.
4. Remaining questions will be mixed in nature (for example suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)

### **Text Books:**

1. J. J Donovan: Systems Programming Tata McGraw Hill Publishing Company
2. A. V. Aho, R. Shethi and J.D. Ulman; Compilers - Principles, Techniques and Tools, *Pearson Education*
3. A. V. Aho, R. Shethi, Monica Lam , J.D. Ulman : Compilers - Principles, Techniques and Tools , Pearson Education , Second Edition.
4. D. M Dhamdhere: Systems programming, *Tata McGraw Hill*

### **Reference Books:**

1. lex & yacc, 2nd Edition by John R. Levine, Tony Mason & Doug Brown O'Reilly
2. D.M. Dhamdhere : Systems programming ,*Tata McGraw Hill*



## **Syllabus for LAB**

Experiments can be conducted based on the suggested topics below:

**However list is not limited to mentioned topics.**

**Use of Open source tools is suggested.**

1. Lexical analyzer tool : flex
2. Parser generator tool : Yacc.
3. Find first() , follow() set of given grammer
4. removing left recursion direct as well as indirect given the set of production rule
5. Assemblers : 2 pass Assembler .
6. Macroprocessor : 2 pass Macro processor.
7. Syntax Analysis : ( any 1 of LL(1) , LR(0) , LR(1) , LALR(1) , operator precedence parser. )
8. Create your library in Linux environment and using it.
9. Code Generation algorithm.
10. Code Optimization techniques.
11. Study ld command in Unix/Linux.

Course Code	Course/Subject Name	Credits
CPC602	<b>Software Engineering</b>	05

**Objectives:**

The main objective is to introduce to the students about the product that is to be engineered and the process that provides a framework for the engineering technology.

1. To provide knowledge of software engineering discipline.
2. To analyze risk in software design and quality.
3. To introduce the concept of advance software methodology.

**Outcomes:** Learner will be able to...

1. Students will demonstrate basic knowledge in software engineering.
2. Students will be able to plan, design, develop and validate the software project.
3. Students will be apply advance software methodology to create high quality WebApps.
4. Students will have an understanding of impact of sound engineering principles.

Module	Detailed Contents	Hrs
<b>01</b>	<b>Introduction</b> 1.1 Software Engineering Process Paradigms 1.2 Process Models – Incremental and Evolutionary models, 1.3 Typical Application for each model, 1.4 Agile methodology 1.5 Process and Project Metrics.	06
<b>02</b>	<b>Software project scheduling, Control &amp; Monitoring</b> 2.1 Software estimation – Empirical estimation models – Cost/Effort estimation 2.2 Planning – Work breakdown Structure, Gantt Chart. Discuss schedule and cost slippage.	04
<b>03</b>	<b>Risk Management</b> 3.1 Risk Identification, Risk Assessment, Risk Projection, RMMM	04
<b>04</b>	<b>Software Configuration Management</b> 4.1 Software Configuration items, SCM process, Identification of objects in software configuration, version and change control, configuration audit , status reporting, SCM standards and SCM issues.	04
<b>05</b>	<b>Software Design Specification</b> 5.1 Software Design – Abstraction , Modularity 5.2 Software Architecture – Effective modular design, Cohesion and Coupling, Example of code for cohesion and coupling.	08

	5.3 User Interface Design – Human Factors, Interface standards, Design Issues – User Interface Design Process.	
<b>06</b>	<b>Software Quality</b> 6.1 Software Quality Assurance – Software standards , Quality metrics Software Reliability ,Quality Measurement and Metrics	04
<b>07</b>	<b>Software Testing</b> 7.1 Basic concept and terminology, Verification & validation, White Box Testing- Path Testing, Control Structures Testing , DEF-USE testing, 7.2 Black Box Testing –BVA Integration, Validation and system testing. 7.3 OO testing methods-Class Testing, Interclass testing, testing architecture, Behavioral testing. 7.4 Software Maintenance – Reverse Engineering.	12
<b>08</b>	<b>Web Engineering</b> 8.1 For web based applications – attributes, analysis and design, testing. 8.2 Security Engineering, 8.3 Service-Oriented Software Engineering. 8.4 Test Driven Development 8.5 Software engineering with aspects	06

### **Term Work:**

Term work shall consist of at least 10 Laboratory assignments and two written tests.

The final certification and acceptance of Term Work ensures the satisfactory performance of laboratory Work and Minimum Passing in the term work.

### **Practical/Oral examination:**

Oral examination will be conducted based on above syllabus.

### **Suggested List of Experiments:**

1. SRS in IEEE format for any case study.
2. Use project management tool to schedule project plan.
3. RMMM plan for case study.
4. Develop test cases for white box testing.
5. Assignment / code for stubs and drivers.
6. Change specifications and make different versions using any SCM tool.
7. For one scenario- Implement TDD

## **Text Books:**

1. Roger Pressman, Software Engineering: A Practitioners Approach, (6th Edition), McGraw Hill, 2010
2. Ian Somerville, Software Engineering, 9th edition, Addison Wesley, 2011

## **Reference Books:**

1. Eric J. Braude and Micheal E. Bernstein, Software Engineering Modern Approach, 2<sup>nd</sup> edition, Wiley, 2011.
2. Ali Behforooz Fredrick Hudson, Software Engineering Fundamentals, Oxford University Press, 2006.
3. James F. Peters and Witold Pedrycz, “ Software Engineering – An Engineering Approach”, Wiley.
4. Mouratidis and Giorgini. “Integrating Security and Software Engineering – Advances and Future”, IGP. ISBN – 1-59904-148-0

Course Code	Course/Subject Name	Credits
CPC603	<b>Distributed Databases</b>	05

**Objectives:**

1. To introduce principles and foundations of distributed databases, including architecture, design issues, integrity control, query processing and optimization, transactions, and concurrency control.
2. To enable students to understand the difference between different database system and integrate the.

**Outcomes:** Learner will be able to...

1. Design and implement distributed database for enterprise application.
2. Provides solutions for heterogeneous database
3. Use XML for schema integration.

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Concept and Overview Distributed Database system</b> 1.1 What is Distributed Database System (DDBS), Features of DDBS, promises of DDBS, Design issue in DDBS, Distributed DBMS architecture: Client/server System, Peer-to-Peer, Mutli-Database system.	08
<b>02</b>	<b>Distributed Database Design</b> 2.1 Distributed database design concept, objective of Data Distribution, Data Fragmentation, The allocation of fragment , Transparencies in Distributed Database Design	08
<b>03</b>	<b>Distributed Transaction and concurrency control</b> 3.1 Basic concept of Transaction management, objective Distributed transaction management, Model for Transaction management 3.2 Distributed Concurrency control: Objective, concurrency control anomalies, Distributed Serializability, Locking based algorithm, Timestamp based algorithm.	08
<b>04</b>	<b>Distributed Deadlock and Recovery</b> 4.1 Introduction to Deadlock, Distributed Deadlock prevention, avoidance, detection and recovery, Two-Phase and Three-Phase Commit Protocol.	06
<b>05</b>	<b>Distributed query processing and optimization</b> 5.1 Concept, objective, and phases of distributed query processing; join strategies in fragment relation , Global query optimization	04
<b>06</b>	<b>Heterogeneous Database</b> 6.1 Architecture of Heterogeneous Database, Database Integration: Schema Translation and schema Integration, Query processing issues in Heterogeneous database.	06

<b>07</b>	<b>XML</b> 7.1 XML for data integration, structure of XML, XML document schema, Querying and Transformation, storage of XML data, XML application.	<b>08</b>
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**Term Work:**

Assign a case study for group of 2/3 students and each group to perform the following experiments on their case-study:

- Creation of centralized database (Global Schema).
- Perform Fragmentation (PHF, DHF, VF, and HF) and allocation in DDBS design.
- Implementation of concurrency control.
- Implementations of two phase or three phases commit protocol.
- Implementations of three deadlock detection.
- Simulation of distributed query processor.
- Implementation of query optimization.
- Implementation any two experiment on XML

The distribution of marks for term work shall be as follows:

- |  |             |               |
|--|-------------|---------------|
| • Laboratory work (experiments/assignments): ..... | (10)        | Marks.        |
| • Course project:.....                             | (10)        | Marks.        |
| • Attendance .....                                 | (05)        | Marks         |
| <b>TOTAL: .....</b>                                | <b>(25)</b> | <b>Marks.</b> |

**Practical/Oral examination:**

An oral exam will be held based on the above syllabus.

**Text Books:**

1. Chhanda Ray , “Distributed Database System”, Pearson Education India.
2. A. Siberschatz, H. Korth, “Database System”, Six Edition, Mc-Graw Hill.
3. Seed K. Rahimi and Frank S. Haug, “Distributed Database Management System”, Wiley India.

## **Reference Books:**

1. M. Tamer Ozsu , Patrick Valduriez, “Principles of Distributed Database”, Pearson Education India.
2. Elmasri and Navathe, “Fundamentals of Database Systems”, 6<sup>th</sup> Edition, Pearson Education India.

Course Code	Course/Subject Name	Credits
CPC604	<b>Mobile Communication and Computing</b>	05

**Objectives:**

1. To introduce the basic concepts and principles in mobile computing. This includes the major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications.
2. To explore both theoretical and practical issues of mobile computing.
3. To provide an opportunity for students to understand the key components and technologies involved and to gain hands-on experiences in building mobile applications.

**Outcomes:** Learner will be able to...

1. Understand GSM and CDMA Cellular architecture.
2. Setup and configure wireless access points.
3. Use Network Simulator tool to simulate mobile network.
4. Implement small android based applications.

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Introduction to Mobile Computing</b> 1.1 Wireless Communication, Applications, Cellular Systems, Antennas, satellite system, GEO, LEO, MEO, GPRS:-Architecture, Network nodes, GPRS support nodes.	05
<b>02</b>	<b>GSM cellular telephony-architecture and system aspects</b> 2.1 Introduction, Basic GSM architecture, Basic radio transmission parameters of the GSM system, Logical channel description, GSM time hierarchy, GSM burst structures, Description of the call set-up procedure, Handover, Ensuring privacy and authentication of a user, Modifications and derivatives of GSM	08
<b>03</b>	<b>Mobile Network</b> 3.1 Mobile IP, IP Packet Delivery, Agent Advertisement and Discovery, Registration, Tunneling and Encapsulation, Optimization, Reverse Tunneling, Mobile TCP, Fast Retransmit/ Fast Recovery, Transmission/Timeout Freezing, Selective Retransmission.	06
<b>04</b>	<b>Third and Fourth Generation Systems</b> 4.1 W-CDMA, CDMA 2000; Improvements on Core Networks; Quality of Services in 3G ; Wireless Local Loop; Wireless Local Loop Architecture; Deployment Issues; TR-45 Service Description; Wireless Local Loop technologies. TETRA, UMTS and IMT-2000;UMTS Basic Architecture, UTRA FDD mode, UTRA TDD mode, 4G Architecture, Comparison between 3G and 4G.	06



<b>05</b>	<b>Mobility Management</b> 5.1 Co- channel Interference, Mobility: Types of Handoffs; Location Management, HLR-VLR scheme, Hierarchical scheme, Predictive Location management schemes, cellular IP, PSTN.	04
<b>06</b>	<b>Wireless Local Area Networks</b> 6.1 Introduction, Types of WLANs, Hidden station problem, HIPERLAN Type 1: HIPERLAN/1 MAC sublayer, HIPERLAN/1 CAC layer, HIPERLAN/1 physical layer. IEEE 802.11 WLAN standards: IEEE 802.11 physical layer, IEEE 802.11 MAC sublayer. IEEE 802.11 and HIPERLAN standards for 5 GHz band: HIPERLAN/2 physical layer, HIPERLAN /2 data link control layer. Bluetooth: Introduction, User Scenario, Architecture, protocol.	08
<b>07</b>	<b>Introduction to Android</b> 7.1 Layers, android components, mapping application to process. Android development basics. Hardware tools, Software tools, Android SDK features	05
<b>08</b>	<b>Security Issues In Mobile Computing</b> 8.1 Security Issues, Authentication, Encryption, Cryptographic Tools: Hash, Message Authentication Code (MAC), Digital Signature, Certificate. Secure Socket Layer (SSL). Characteristics of SIM, Equipment Identification.	06

### Term Work:

Term work shall consist of minimum assignments and course project. The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/assignments): ..... (20) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

### Practical/Oral examination:

Practical exam will be held based on the above syllabus.

### Suggested Laboratory Exercises of Mobile Computing:

1. Setup & Configuration of Wireless Access Point (AP)
2. Implementation of WLAN : Ad Hoc & Infrastructure Mode
3. Implementation of Bluetooth Protocol and Applications
4. GSM modem study (Android based mobile) and SMS client-server application
5. Implementation of Mobile Network using Network Simulator (NS2)
6. Mobile Internet and WML
7. J2ME Program for Mobile Node Discovery

8. Mobile protocol study using GNS3.
9. Design and Program Income Tax and Loan EMI Calculator for Mobile Phones.
10. Wireless Network Security: kismet and Netstumbler

### **Text Books:**

1. Jochen Schilller ,”Mobile Communication “, Addison wisely,Pearson Education
2. Krzysztof Wesolowski, “Mobile Communication Systems”, Wiley publication
3. W. Frank Ableson,Robi sen, Chris King, “ Android IN ACTION “, Third Edition, Dreamtech Press
4. Mobile Computing By Rajkamal (Oxford).

### **Reference Book:**

1. Uwe Hansmann, Lothar Merk, Martin S. Nicklous, Thomas Stober, “Principles of Mobile Computing”, Springer
2. Rappaort, “Wireless Communications Principles and Practices”
3. Yi Bang Lin, “Wireless and Mobile Network Architecture”, John Wiley
4. P. Nicopolitidis, “Wireless Networks”, John Wiley
5. K. Pahlavan, P.Krishnamurthy, “Principles of Wireless Networks”
6. Introduction to Wireless Telecommunication System and Networks by Mullet (Cengage Learning).
7. Beginning for Android 4 Application Development By Wei- Meng Lee, Wiley –India Edition.

Course Code	Course/Subject Name	Credits
<b>CPE6011</b>	<b>Operations Research</b>	<b>02</b>

**Outcomes:** Learner will be able to

1. model and solve problem using linear programming techniques
2. Implement algebraic solution using simplex method
3. Define transportation model and apply transportation algorithm in a known situation.
4. Use montecarlo simulation technique.
5. Use the spreadsheet as a tool effectively for OR topics

Module	Detailed Contents	Hrs.
<b>01</b>	<b>What is Operations Research</b> 1.1 Introduction.	02
<b>02</b>	<b>Modeling with Linear Programming</b> 2.1 Two-Variable LP Model 2.2 Graphical LP Solution 2.2.1 Solution of a Maximization Model 2.2.2 Solution of a Minimization Model 2.3 Computer Solution with Solver and AMPL 2.3.1 LP solution with Excel Solver 2.3.2 LP Solution with AMPL 2.4 Linear Programming Applications 2.4.1 Investment 2.4.2 Product Planning and Inventory Control 2.4.3 Manpower Planning 2.4.4 Urban Development Planning 2.4.5 Blending and Refining 2.4.6 Additional LP Applications	07

03	<p><b>The Simplex Method and Sensitivity Analysis</b></p> <ul style="list-style-type: none"> <li>3.1 LP Model in Equation Form</li> <li>3.2 Transition from Graphical to Algebraic Solution</li> <li>3.3 The Simplex Method <ul style="list-style-type: none"> <li>3.3.1 Iterative Nature of the Simplex Method</li> <li>3.3.2 Computational details of the Simplex algorithm</li> <li>3.3.3 Summary of the Simplex Method</li> </ul> </li> <li>3.4 Artificial Starting Solution <ul style="list-style-type: none"> <li>3.4.1 M-Method</li> <li>3.4.2 Two-Phase Method</li> </ul> </li> <li>3.5 Special Cases in the Simplex Method <ul style="list-style-type: none"> <li>3.5.1 Degeneracy</li> <li>3.5.2 Alternative Optima</li> <li>3.5.3 Unbounded Solution</li> <li>3.5.4 Infeasible Solution</li> </ul> </li> <li>3.6 Sensitivity Analysis <ul style="list-style-type: none"> <li>3.6.1 Graphical Sensitivity Analysis</li> <li>3.6.2 Algebraic Sensitivity Analysis – Changes in the Right-hand side</li> <li>3.6.3 Algebraic Sensitivity Analysis – Objective function</li> <li>3.6.4 Sensitivity Analysis with Tora, Solver, and Ampl</li> </ul> </li> <li>3.7 Computational issues in Linear Programming</li> </ul>	06
04	<p><b>Duality and Post-Optimal Analysis</b></p> <ul style="list-style-type: none"> <li>4.1 Definition of the Dual Problem</li> <li>4.2 Primal-Dual Relationships <ul style="list-style-type: none"> <li>4.2.1 Review of Simplex Matrix Operations</li> <li>4.2.2 Simplex Tableau Layout</li> <li>4.2.3 Optimal Dual Solution</li> <li>4.2.4 Simplex Tableau Computations</li> </ul> </li> <li>4.3 Economic Interpretation of Duality <ul style="list-style-type: none"> <li>4.3.1 Economic Interpretation of Dual Variables</li> <li>4.3.2 Economic Interpretation of Dual Constraints</li> </ul> </li> <li>4.4 Additional Simplex Algorithms <ul style="list-style-type: none"> <li>4.4.1 Dual Simplex Algorithm</li> <li>4.4.2 Generalized Simplex Algorithm</li> </ul> </li> </ul>	05
05	<p><b>Transportation Model and Its Variants</b></p> <ul style="list-style-type: none"> <li>5.1 Definition of the Transportation Model</li> <li>5.2 Nontraditional Transportation Models</li> <li>5.3 The Transportation Algorithm <ul style="list-style-type: none"> <li>5.3.1 Determination of the Starting Solution</li> <li>5.3.2 Iterative Computations of the Transportation Algorithm</li> <li>5.3.3 Simplex Method Explanation of the Method of Multipliers</li> </ul> </li> <li>5.4 The Assignment Model</li> </ul>	05

	5.4.1 The Hungarian Method 5.4.2 Simplex Explanation of the Hungarian Method	
<b>06</b>	<b>Decision Analysis</b> 6.1 Decision Making under Certainty – Analytic Hierarchy Process (AHP) 6.2 Decision Making under Risk 6.2.1 Decision Tree-Based Expected Value Criterion 6.2.2 Variants of the Expected Value Criterion 6.3 Decision under Uncertainty	03
<b>07</b>	<b>Stimulation Modeling</b> 7.1 Monte Carlo Simulation 7.2 Types of Simulation 7.3 Elements of Discrete Event Simulation 7.3.1 Generic Definition of Events 7.3.2 Sampling from Probability Distributions	02
<b>08</b>	<b>Nonlinear Programming Algorithms</b> 8.1 Unconstrained Algorithms 8.1.1 Direct Search Method 8.1.2 Gradient Method 8.2 Constrained Algorithms 8.2.1 Separable Programming 8.2.2 Quadratic Programming	03
<b>09</b>	<b>Introduction to spreadsheet model</b>	02

### List of Assignment:

Atleast **15** assignments based on the above syllabus; Assignments to also include progams wherever applicable.

### Term Work:

The distribution of marks for term work shall be as follows:

- Laboratory work (assignments): ..... (25) Marks.
- Case Study Presentations (to be done during semester):... (15) Marks.
- Attendance ..... (10) Marks
- TOTAL: ..... (50) Marks.**

The final certification and acceptance of term work ensures the satisfactory performance of work assigned and minimum passing in the term work.

### References:

1. Taha, Hamdy A. “Operations Research” Pearson, 2011.
2. N.D. Vhora “Quantitative Techniques in Management” TMH , 3<sup>rd</sup> edition

Course Code	Course/Subject Name	Credits
<b>CPE6012</b>	<b>Software Project Management</b>	<b>02</b>

**Outcomes:** Learner will be able to...

1. Learner will be able to define characteristics of a project,
2. Learner will be able to appreciate project management principles, risk in environment and the management challenges for effective project management.
3. Learner will be able to apply the project management principles across all phases of a project.
4. Learner will be able to demonstrate use of tools and techniques for the management of a project plan, monitor and controlling a project schedule and budget, tracking project progress.

<b>Module</b>	<b>Detailed Contents</b>	<b>Hrs.</b>
<b>01</b>	<b>An overview of IT Project Management</b> 1.1 Introduction, the state of IT project management, context of project management, need of project management, project goals, project life cycle and IT development, extreme project management, PMBOK.	02
<b>02</b>	<b>Conceptualizing and Initializing the IT Project</b> 2.1 An information technology project methodology (ITPM), project feasibility, request for proposal (RFP), the business case, project selection and approval, project contracting, IT governance and the project office.	04
<b>03</b>	<b>The Human Side of Project Management</b> 3.1 Introduction, organization and project planning, the project team, the project environment.	02
<b>04</b>	<b>Developing the Project Charter and Project Plan</b> 4.1 Introduction, project management process, project integration management, the project charter, project planning framework, the contents of a project plan, the planning process. 4.2 The Work Breakdown Structure (WBS), the linear responsibility chart, multidisciplinary teams.	04
<b>05</b>	<b>The Scope Management Plan</b> 5.1 Introduction, scope planning, project scope definition, project scope verification, scope change control.	04
<b>06</b>	<b>The Project is Schedule, Budget and Risk Management</b> 6.1 Introduction, developing the project schedule, project management	08

	software tools, methods of budgeting, developing the project budget, improving cost estimates, finalizing the project schedule and budget. 6.2 IT project risk management planning process, identifying IT project risks, risk analysis and assessment, risk strategies, risk monitoring, and control, risk responses and evaluation.	
<b>07</b>	<b>Allocating Resources to the Project</b> 7.1 Resource loading, resource leveling, allocating scarce resources to projects and several projects, Goldratt's critical chain.	03
<b>08</b>	<b>The Project Communication Plan</b> 8.1 Introduction, monitoring and controlling the project, the project communications plan, project metric, project control, designing the control system, the plan-monitor-control cycle, data collection and reporting, reporting performance and progress, information distribution.	02
<b>09</b>	<b>Managing Change, Resistance and Conflicts</b>	02
<b>10</b>	<b>Managing Project Procurement and Outsourcing</b> 10.1 Introduction, project procurement management, outsourcing.	02
<b>11</b>	<b>Project Leadership and Ethics</b> 11.1 Introduction, project leadership, ethics in projects, multicultural projects.	01
<b>12</b>	<b>The Implementation Plan and Project Closure</b> 12.1 Introduction, project implementation, administrative closure, project evaluation, project audit.	02

### Term Work:

Term work shall consist of at least **10** assignments covering all topics and course project by using appropriate tool. The distribution of marks for term work shall be as follows:

1. Assignments: ..... (25) Marks.
  2. Case study presentations (**to be done during semester**):..... (15)
  3. Attendance:..... (10)
- TOTAL: ..... (50)Marks.**

The final certification and acceptance of TW ensures the satisfactory Performance of laboratory Work and Minimum Passing in the term work.

## **Suggested Assignment List**

In practical, a group of maximum three students should be formed. Each group is supposed to complete all lab experiments on the case study given by the subject teacher. In lab experiments students can use the tools like MsWord to prepare document whereas MsProject to preparing WBS, N/w diagram, PERT, CPM, Variance analysis etc.

1. Project and System's Management
2. Feasibility study document
3. Project Proposal
4. Project Planning
5. Activity Planning
6. Analyzing the project network diagram
7. Cost estimation and budgeting
8. Risk management
9. Performance analysis of project
10. Project evaluation and closure

### **Text Book:**

1. "Information Technology Project Management", Jack T. Marchewka, 3<sup>rd</sup> edition, Wiley India, 2009.

### **Reference Books:**

1. S. J. Mantel, J. R. Meredith and etl.. "Project Management" 1<sup>st</sup> edition, Wiley India, 2009.
2. John M. Nicholas, "Project Management for Business and Technology", 2<sup>nd</sup> edition, Pearson Education.
3. Joel Henry, "Software Project Management, A real-world guide to success", Pearson Education, 2008.
4. Gido and Clements, "Successful Project Management", 2<sup>nd</sup> edition, Thomson Learning.
5. Hughes and Cornell, "Software Project Management", 3<sup>rd</sup> edition, Tata McGraw Hill
6. Joseph Phillips, "IT Project Management", 2<sup>nd</sup> edition, Tata McGraw Hill
7. Robert K. Wyzocki and Rudd McGary, "Effective Project Management", 3<sup>rd</sup> edition, Wiley
8. Brown, K.A. Project Management, McGraw Hill, 2002.
9. E-Book – Project Management Body of Knowledge.
10. Dinsmore, P. C. (Ed.). (1993) The AMA Handbook of Project Management. AMACOM



Course Code	Course/Subject Name	Credits
CPE6013	<b>Elective – Foreign Language – German</b>	02

Course Code	Course/Subject Name	Credits
CPE6014	<b>Elective – Foreign Language – French</b>	02

**Objectives:**

1. To introduce German language in a holistic manner. The texts and exercises are aimed at developing the students' skills of reading, writing, listening and speaking. The course is divided into units with a thematic and grammatical progression. Scenarios from everyday life and formulated in a manner suitable and especially interesting for beginners. However since most of the students would want to do this course for professional advancement this course scenarios from the professional life are introduced in simple but engaging manner.

**Outcomes:** Learner will be able to...

1. read and understand simple German / French text
2. Describe basic family structure , culture and work culture
3. Draft e-mails and create simple presentations

Module	Detailed Contents	Hrs.
<b>01</b>	Basic Grammar, pronunciation and basic expression	08
<b>02</b>	<b>Communication</b> 2.1 Greetings , begining of conversation, Introduction of oneself , numbers , counting and dates	08
<b>03</b>	Reading , Comprehension and writing - ( Type of Text) Dialogs, Monologs , Biodata,	05
<b>04</b>	Family Structures Culture Computer and Multimedia Work culture	10
<b>05</b>	<b>Corporate communication</b> 5.1 Emails , Technical Reports , Making presentations	05

## **Term Work:**

Term work shall consist of minimum **10** assignments of different difficulty level based on above syllabus.  
The distribution of marks for term work shall be as follows:

- Laboratory work (assignments): ..... (25) Marks.
- Presentation:.....(15) Marks.
- Attendance ..... (10) Marks
- TOTAL: ..... (50) Marks.**

## **References:**

### **For German**

1. German Conversation Demystified with Two Audio CDs / Edition by Ed Swick
1. German Conversational: Learn to Speak and Understand French with Pimsleur Language Programs Audio CD – Audiobook by Pimsleur

### **For French**

2. French Conversational: Learn to Speak and Understand French with Pimsleur Language Programs Audio CD – Audiobook by Pimsleur

Subject Code	Subject Name	Credits
CPL605	<b>Network Programming Laboratory</b>	02

Laboratory Course Outcomes:

Learner will be able to :

1. Configure Linux Network
2. View and edit routing tables
3. Configure Linux Router
4. Configure Linux FTP server
5. Install and Configure DNS server
6. Install and configure web server

Module	Detailed content	Hours
1	Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.	2
2	Linux Network Configuration. <ol style="list-style-type: none"> <li>i. Configuring NIC's IP Address.</li> <li>ii. Determining IP Address and MAC Address using if-config command.</li> <li>iii. Changing IP Address using ifconfig.</li> <li>iv. Static IP Address and Configuration by Editing.</li> <li>v. Determining IP Address using DHCP.</li> <li>vi. Configuring Hostname in /etc/hosts file.</li> </ol>	4
3	Setting up multiple IP Addresses on a single LAN.	2
4	Using netstat and route commands to do the following. <ol style="list-style-type: none"> <li>i. View current routing table.</li> <li>ii. Add and delete routes.</li> <li>iii. Change default gateway.</li> </ol>	2
5	Using GUI configuration Tools to add /configure Ethernet Card.	2
6	Configuring Linux as a router by enabling IP Forwarding.	2
7	Configuring remote login Services, telnet & ssh.	2

	<ul style="list-style-type: none"> <li>i. To install and configure TELNET server.</li> <li>ii. To set up SSH and connect to remote machine.</li> </ul>	
8	To configure Linux FTP server using VSFTPD. <ul style="list-style-type: none"> <li>i. Set up anonymous access of FTP server.</li> <li>ii. Enable individual logins and add FTP users with Read-only access.</li> <li>iii. Transfer Files.</li> </ul>	2
9	To install and configure DNS server.	2
10	To install and configure Web server.	2
11	Design TCP iterative Client and Server application to reverse the given input sentence.	2
12	Design TCP concurrent Client and Server application to reverse the given input sentence.	2
13	Design TCP Client and Server application to transfer file.	2
14	Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call “select”.	2
15	Design a TCP concurrent Server to echo given set of sentences using Poll functions.	2
16	Design UDP Client and Server application to reverse the given input sentence.	2
17	Design UDP Client Server to transfer a file.	2
18	Design using Poll Client Server application to multiplex TCP and UDP requests for 60converting a given text into upper case.	2
19	Design a RPC application to add and subtract a given pair of integers.	2
20	Program to determine the host ByteOrder	2
21	Program to set and get socket options	2

**Format of Laboratory Course:**

The format for the Laboratory Course is

1. Atleast 8 small experiments based on above syllabus
2. One group Miniproject

A group of 3 students ; 4 Batches per class.

The scope of the miniproject should be such that it completes in 15 hours of actual working.

**Termwork Assessment:**

Laboratory Experiment: 10

Mini Project presentation : 10

Attendance : 05

**End Semester Examination:**

Oral examination is to be conducted by pair of internal and external examiners

Course Code	Course/Subject Name	Credits
CPC701	<b>Digital Signal Processing</b>	5

**Objectives:**

1. To learn the fundamental concepts of Digital Signal Processing.
2. To explore the properties of DFT in mathematical problem solving.
3. To illustrate FFT calculations mathematically and develop FFT based DSP algorithms.
4. To introduce DSP processor for real time signal processing application

**Outcomes:** Learner will be able to...

1. To understand the concept of DT Signal and perform signal manipulation
2. To perform analysis of DT system in time domain
3. To develop FFT flow-graph and Fast DSP Algorithms.
4. To design DSP system for Real Time Signal Processing.

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Discrete Time Signal</b> 1.1 Introduction to Digital Signal Processing, Discrete Time Signals, Sampling and Reconstruction, Standard DT Signals, Concept of Digital Frequency, Representation of DT signal using Standard DT Signals, Signal Manipulations(shifting, addition, subtraction, multiplication), Classification of Signals, Linear Convolution formulation(without mathematical proof), Circular Convolution formulation(without mathematical proof), Matrix Representation of Circular Convolution, Linear by Circular Convolution. Auto and Cross Correlation formula evaluation,	12
<b>02</b>	<b>Discrete Time System</b> 2.1 Introduction to Discrete Time System, Classification of DT Systems (Linear/Non Linear, Causal/Non Causal, Time Invariant/Time Variant Systems, Stable/ Unstable), BIBO Time Domain Stability Criteria. LTI system, Concept of Impulse Response and Step Response. 2.2 Concept of IIR System and FIR System, Output of IIR and FIR DT system using Time Domain Linear Convolution formula Method.	08
<b>03</b>	<b>Discrete Fourier Transform</b> 3.1 Introduction to DTFT, DFT, Relation between DFT and DTFT, Properties of DFT without mathematical proof (Scaling and Linearity, Periodicity, Time Shift and Frequency Shift, Time Reversal, Convolution Property and Parsevals' Energy Theorem). DFT computation using DFT properties. 3.2 Transfer function of DT System in frequency domain using DFT. Linear and Circular Convolution using DFT. Response of FIR system calculation in frequency domain using DFT.	08
<b>04</b>	<b>Fast Fourier Transform</b> 4.1 Radix-2 DIT-FFT algorithm, DIT-FFT Flowgraph for N=4, 6 & 8, Inverse	06

	FFT algorithm. Spectral Analysis using FFT, Comparison of complex and real, multiplication and additions of DFT and FFT.	
<b>05</b>	<b>DSP Algorithms</b> 5.1 Carls' Correlation Coefficient Algorithm, Fast Circular Convolution Algorithm, Fast Linear Convolution Algorithm, Linear FIR filtering using Fast Overlap Add Algorithm and Fast Overlap Save Algorithm,	08
<b>06</b>	<b>DSP Processors and Application of DSP</b> 6.1 Need for Special architecture of DSP processor, Difference between DSP processor & microprocessor, A general DSP processor TMS320C54XX series, Case study of Real Time DSP applications to Speech Signal Processing and Biomedical Signal Processing.	06

### List of Experiments:

Implementation of programs must be either in C or C++ only. Application can be developed using open source simulation software such as Scilab. A List of compulsory eight experiments is given below. Additional experiments within the scope of the syllabus can be added.

#### 1. Sampling and Reconstruction

##### Aim:

To study sampling and reconstruction of signal

##### Objective:

Develop a program to sample a continuous time signal and convert it to Discrete Time Signal.

##### Problem Definition:

1. Sample the input signal and display first 50 samples. Calculate data rate and bit rate.
2. Reconstruct the original signal and display the original and reconstructed signals.
3. Vary the sampling frequency and observe the change in the quality of reconstructed signal.

#### 2. To perform Discrete Correlation

##### Aim:

To study mathematical operation Correlation and measure degree of similarity between two signals

##### Objective:

1. Write a function to find correlation operation.
2. Calculate correlation of a DT signals and verify the results using mathematical formulation.
3. Measure the degree of similarity using Carl's Correlation Coefficient formula in time domain.

### Input Specifications:

1. Length of first Signal L and signal values.
2. Length of second Signal M and signal values.

**Problem Definition:**

1. Find auto correlation of input signal. What is the significance of value of output signal value at  $n=0$ ?
  2. Find auto correlation of delayed input signal.
  3. Find cross correlation of input signal and delayed input signal,
  4. Find cross correlation of input signal and scaled delayed input signal.
  5. Compare the resultant signals. Give your conclusion.
  6. Take two input finite length DT signals and develop a function to find Carl's Correlation Coefficient value. Determine the degree of similarity of two signals from the calculated Carl's Correlation Coefficient value.
- 

**3. To perform Discrete Convolution**

**Aim:**

The aim of this experiment is to study mathematical operation such as Linear convolution, Circular convolution, Linear convolution using circular convolution.

**Objective:**

1. Develop a function to find Linear Convolution and Circular Convolution
2. Calculate Linear Convolution, Circular Convolution, Linear Convolution using Circular Convolution and verify the results using mathematical formulation.
3. Conclude on aliasing effect in Circular convolution

**Input Specifications:**

1. Length of first Signal L and signal values.
2. Length of second Signal M and signal values.

**Problem Definition:**

1. Find Linear Convolution and Circular Convolution of L point sequence  $x[n]$  and M point sequence  $h[n]$ .
  2. Find Linear Convolution of L point sequence  $x[n]$  and M point sequence  $h[n]$  using Circular convolution.
  3. Give your conclusion about No of values in linearly convolved signal, and Aliasing effect in Circular Convolution.
-

#### 4. To perform Discrete Fourier Transform

**Aim:**

The aim of this experiment is to study magnitude spectrum of the DT signal.

**Objective:**

1. Develop a function to perform DFT of N point signal
2. Calculate DFT of a DT signal and Plot spectrum of the signal.
3. Conclude the effect of zero padding on magnitude spectrum.
4. Calculate the number of real multiplications and real additions required to find DFT.

**Input Specifications:**

1. Length of Signal N
2. Signal values

**Problem Definition:**

1. Take any four-point sequence  $x[n]$ .
    - Find DFT  $X[k]$ .
    - Compute number of real multiplications and real additions required to find  $X[k]$ .
    - Plot Magnitude Spectrum of the signal.
  2. Append the input sequence by four zeros. Find DFT and plot magnitude spectrum. Repeat the same by appending the sequence by eight zeros. Observe and compare the magnitude spectrum. Give your conclusion.
- 

#### 5. To perform Fast Fourier Transform

**Aim:**

To implement computationally fast algorithms.

**Objective:**

1. Develop a program to perform FFT of N point signal.
2. Calculate FFT of a given DT signal and verify the results using mathematical formulation.
3. Illustrate the computational efficiency of FFT.

**Input Specifications:**

- Length of Signal N
- Signal values

**Problem Definition:**

Take any eight-point sequence  $x[n]$ .



- Find FFT  $X[k]$ .
  - Write number of real multiplications and real additions involved in finding  $X[k]$ .
- 

## **6. Filtering of long Data Sequence**

### **Aim:**

To perform filtering of Long Data Sequence using Overlap Add Method and Overlap Save Method.

### **Objective:**

Develop a function to implement Fast Overlap Add and Fast Overlap Save Algorithm using FFT.

### **Input Specifications:**

1. Length of long data sequence and signal values.
2. Length of impulse response  $M$  and coefficient values of  $h[n]$ .

### **Problem Definition:**

Find the output of a Discrete Time system using Fast Overlap Add Method OR Fast Overlap Save Method.

---

## **7. Real Time Signal Processing**

### **Aim:**

To perform real time signal processing using TMS320 Processor.

### **Objective:**

Study real time signal processing.

### **Input Specifications:**

1. Real Time Speech Signal

### **Problem Definition:**

- 1) Capture the real time audio signal.
  - 2) Filter it by convolving input signal with the impulse response of FIR filter using Fast Overlap Add filtering Algorithm OR Fast Overlap Save Filtering Algorithm.
  - 3) Observe the quality of output signal.
- 

## **8. Application of Digital Signal Processing**

### **Aim:**

To implement any Signal Processing operation on one dimensional signal.

**Objective:**

To develop application of signal processing.

**Input Specifications:**

One dimensional signal.

**Rules:**

1. Number of students in one Group : min - 2 max -3
2. Decide one DSP application of your choice. Collect the information related to the application from the published granted patents. Download the related published papers from the standard refereed journals and conferences.
3. Develop a block diagram of the proposed system and flowchart of proposed system algorithm, implement it using Scilab/C, C++ language and obtain the appropriate results.
4. Prepare the three to four pages report on the mini project in IEEE paper format. Report should include Abstract, Introduction, Related Theory, Proposed System Design/Algorithm, Experimentation & Result Analysis, Conclusion, and References.
- 5.

**Term Work:**

- Term work shall consist of minimum **08** assignments and course project.
- Journal must include at least 1 assignment on each module and two quiz.
- The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

The distribution of marks for term work shall be as follows:

- |  |             |               |
|--|-------------|---------------|
| • Laboratory work (experiments): ..... | (15)        | Marks.        |
| • Assignment:.....                     | (05)        | Marks.        |
| • Attendance (Theory+ Practical).....  | (05)        | Marks         |
| <b>TOTAL: .....</b>                    | <b>(25)</b> | <b>Marks.</b> |

**Text Books :**

1. Ashok Ambardar, 'Digital Signal Processing', Cengage Learning, 2007, ISBN : 978-81-315-0179-5.

2. Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal Processing: A Practical Approach", Pearson Education ISBN 0-201-59619- 9
3. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, 'Digital Signal Processing' TataMcgraw Hill Publication First edition (2010). ISBN 978-0-07-066924-6.
4. Avtar Signh, S.Srinivasan,"Digital Signal Processing', Thomson Brooks/Cole, ISBN : 981-243-254-4

### **Reference Books :**

1. B. Venkatramani, M. Bhaskar ,"Digital Signal Processor', TataMcGraw Hill, Second Edition, (2001). ISBN : 978-0-07-070256-1.
2. Sanjit Mitra, 'Digital Signal Processing : A Computer Based Approach' , TataMcGraw Hill, Third Edition
3. Dr, Shaila Apte, "Digital Signal Processing," , Wiley India, Second Edition,2013 ISBN : 978-81-2652142-5
4. Proakis Manolakis, 'Digital Signal Processing : Principles, Algorithms and Applications' Fourth 2007, Pearson Education, ISBN 81-317-1000-9.
5. Monson H. Hayes, "Schaums Outline of Digital Signal Processing' McGraw Hill International second edition. ISBN : 978-00-7163509-7

Course Code	Course/Subject Name	Credits
CPC702	<b>Cryptography and System Security</b>	5

**Objectives:**

1. To provide students with contemporary knowledge in Cryptography and Security.
2. To understand how crypto can be used as an effective tools in providing assurance concerning privacy and integrity of information.
3. To provide skills to design security protocols for recognize security problems.

**Outcomes:** Learner will be able to...

1. Understand the principles and practices of cryptographic techniques.
2. Understand a variety of generic security threats and vulnerabilities, and identify & analyze particular security problems for given application.
3. Appreciate the application of security techniques and technologies in solving real-life security problems in practical systems.
4. Apply appropriate security techniques to solve security problem
5. Design security protocols and methods to solve the specific security problems.
6. Familiar with current research issues and directions of security.

Module	Detailed Contents	Hrs
<b>01</b>	<b>Introduction</b> 1.1 Security Attacks, Security Goals, Computer criminals, Methods of defense, Security Services, Security Mechanisms	06
<b>02</b>	<b>Basics of Cryptography</b> 2.1 Symmetric Cipher Model, Substitution Techniques, Transportation Techniques, Other Cipher Properties- Confusion, Diffusion, Block and Stream Ciphers.	06
<b>03</b>	<b>Secret Key Cryptography</b> 3.1 Data Encryption Standard(DES), Strength of DES, Block Cipher Design Principles and Modes of Operations, Triple DES, International Data Encryption algorithm, Blowfish, CAST-128.	06
<b>04</b>	<b>Public Key Cryptography</b> 4.1 Principles of Public Key Cryptosystems, RSA Algorithm, Diffie-Hellman Key Exchange	04
<b>05</b>	<b>Cryptographic Hash Functions</b> 5.1 Applications of Cryptographic Hash Functions, Secure Hash Algorithm, Message Authentication Codes – Message Authentication Requirements and Functions, HMAC, Digital signatures, Digital Signature Schemes, Authentication Protocols, Digital Signature Standards.	06
<b>06</b>	<b>Authentication Applications</b> 6.1 Kerberos, Key Management and Distribution, X.509 Directory Authentication service, Public Key Infrastructure, Electronic Mail Security: Pretty Good Privacy, S/MIME.	06

<b>07</b>	<p><b>7.1 Program Security</b> Secure programs, Nonmalicious Program Errors, Malicious Software – Types, Viruses, Virus Countermeasures, Worms, Targeted Malicious Code, Controls against Program Threats.</p> <p><b>7.2 Operating System Security</b> Memory and Address protection, File Protection Mechanism, User Authentication.</p> <p><b>7.3 Database Security</b> Security Requirement, Reliability and Integrity, Sensitive data, Inference, Multilevel Databases</p> <p><b>7.4 IDS and Firewalls</b> Intruders, Intrusion Detection, Password Management, Firewalls-Characteristics, Types of Firewalls, Placement of Firewalls, Firewall Configuration, Trusted systems.</p>	08
<b>08</b>	<p><b>8.1 IP Security</b> Overview, Architecture, Authentication Header, Encapsulating Security Payload, Combining security Associations, Internet Key Exchange, Web Security: Web Security Considerations, Secure Sockets Layer and Transport Layer Security, Electronic Payment.</p> <p><b>8.2 Non-cryptographic protocol Vulnerabilities</b> DoS, DDoS, Session Hijacking and Spoofing, Software Vulnerabilities-Phishing, Buffer Overflow, Format String Attacks, SQL Injection.</p>	06

### Term Work:

Term work should consist of at least 10 experiments, 2 assignments based on above theory syllabus.

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments): ..... (15) Marks.
- Assignment:..... (05) Marks.
- Attendance (Theory+ Practical)..... (05) Marks
- TOTAL: ..... (25) Marks.**

### Practical/Oral examination:

Practical Exam will be based on above syllabus.

#### Syllabus for Practical

Suggested topics for experiment but not limited to:

1. RSA and MD5 algorithms.
2. Packet Analyzer.

3. IPSec
4. Spoofing
5. PGP(Pretty Good Privacy)
6. Port Scanning
7. Vulnerability scanner
8. Buffer Overflow
9. Intrusion Detection System
10. Password cracking
11. Firewall
12. SSL

### **Theory Examination:**

1. Question paper will comprise of total 6 questions, each of 20 Marks.
2. Only 4 questions need to be solved.
3. Question 1 will be compulsory and based on maximum part of the syllabus.
4. Remaining questions will be mixed in nature (for example suppose Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.**

### **Text Books:**

1. Cryptography and Network Security: Principles and Practice 5th edition, William Stallings, Pearson.
2. Network Security and Cryptography 2nd edition, Bernard Menezes, Cengage Learning.
3. Cryptography and Network, 2nd edition, Behrouz A Fourouzan, Debdeep Mukhopadhyay, TMH.

### **Reference Books:**

1. Cryptography and Network Security by Behrouz A. Forouzan, TMH
2. Security in Computing by Charles P. Pfleeger, Pearson Education.
3. Computer Security Art and Science by Matt Bishop, Addison-Wesley.

Course Code	Course/Subject Name	Credits
CPC703	<b>Artificial Intelligence</b>	5

**Objectives:**

1. To conceptualize the basic ideas and techniques underlying the design of intelligent systems.
2. To make students understand and Explore the mechanism of mind that enable intelligent thought and action.
3. To make students understand advanced representation formalism and search techniques.
4. To make students understand how to deal with uncertain and incomplete information.

**Outcomes:** Learner will be able to

1. Ability to develop a basic understanding of AI building blocks presented in intelligent agents.
2. Ability to choose an appropriate problem solving method and knowledge representation technique.
3. Ability to analyze the strength and weaknesses of AI approaches to knowledge– intensive problem solving.
4. Ability to design models for reasoning with uncertainty as well as the use of unreliable information.
5. Ability to design and develop the AI applications in real world scenario.

Module	Detailed Contents	Hrs
<b>01</b>	<b>Introduction to Artificial Intelligence</b> 1.1 Introduction , History of Artificial Intelligence, Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Sub-areas of AI, Applications of AI, Current trends in AI.	04
<b>02</b>	<b>Intelligent Agents</b> 2.1 Agents and Environments, The concept of rationality, The nature of environment, The structure of Agents, Types of Agents, Learning Agent.	04
<b>03</b>	<b>Problem solving</b> 3.1 Solving problem by Searching : Problem Solving Agent, Formulating Problems, Example Problems. 3.2 Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS) , Depth Limited Search, Depth First Iterative Deepening(DFID), Informed Search Methods: Greedy best first Search ,A* Search , Memory bounded heuristic Search. 3.3 Local Search Algorithms and Optimization Problems: Hill-climbing search Simulated annealing, Local beam search,	14

	Genetic algorithms. 3.4 Adversarial Search: Games, Optimal strategies, The minimax algorithm , Alpha-Beta Pruning.	
<b>04</b>	<b>Knowledge and Reasoning</b> 4.1 Knowledge based Agents, The Wumpus World, The Propositional logic, First Order Logic: Syntax and Semantic, Inference in FOL, Forward chaining, backward Chaining. 4.2 Knowledge Engineering in First-Order Logic, Unification, Resolution, Introduction to logic programming (PROLOG). 4.3 <b>Uncertain Knowledge and Reasoning:</b> Uncertainty, Representing knowledge in an uncertain domain, The semantics of belief network, Inference in belief network.	12
<b>05</b>	<b>Planning and Learning</b> 5.1 The planning problem, Planning with state space search, Partial order planning, Hierarchical planning, Conditional Planning. 5.2 Learning: Forms of Learning, Inductive Learning, Learning Decision Tree. 5.3 Expert System: Introduction, Phases in building Expert Systems, ES Architecture, ES vs Traditional System.	10
<b>06</b>	<b>Applications</b> 6.1 Natural Language Processing(NLP), Expert Systems.	04

### Term Work:

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/case studies): ..... (15) Marks.
- Assignment:..... (05) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

There will be at least two assignments covering the above syllabus.

### Practical/Oral examination:

Practical examination based on the above syllabus will be conducted.

### List of AI Practical / Experiments

**All the programs should be implemented in C/C++/Java/Prolog under Windows or Linux environment. Experiments can also be conducted using available open source tools.**



1. One case study on NLP/Expert system based papers published in IEEE/ACM/Springer or any prominent journal.
2. Program on uninformed and informed search methods.
3. Program on Local Search Algorithm.
4. Program on Optimization problem.
5. Program on adversarial search.
6. Program on Wumpus world.
7. Program on unification.
8. Program on Decision Tree.

Any other practical covering the syllabus topics and subtopics can be conducted.

### **Reference Books (Practicals):**

1. Ivan Bratko "PROLOG Programming for Artificial Intelligence", Pearson Education, Third Edition.
2. Elaine Rich and Kevin Knight "Artificial Intelligence "Third Edition
3. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
4. Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers.

### **Text Books:**

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach "Second Edition" Pearson Education.
2. Saroj Kaushik "Artificial Intelligence" , Cengage Learning.
3. George F Luger "Artificial Intelligence" Low Price Edition , Pearson Education., Fourth edition.

### **Reference Books:**

1. Ivan Bratko "PROLOG Programming for Artificial Intelligence", Pearson Education, Third Edition.
2. Elaine Rich and Kevin Knight "Artificial Intelligence" Third Edition
3. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
4. Hagan, Demuth, Beale, "Neural Network Design" CENGAGE Learning, India Edition.
5. Patrick Henry Winston , "Artificial Intelligence", Addison-Wesley, Third Edition.
6. Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers.
7. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press.

Course Code	Course/Subject Name	Credits
CPE7021	<b>Advanced Algorithms</b>	5

**Objectives:**

1. To teach fundamentals of analysis of algorithm at depth
2. To provide in depth study of advanced data structures and its uses
3. To teach analysis of problems from different domains

**Outcomes:** Learner will be able to...

1. Identify and use suitable data structures for given problem from different domains
2. Appreciate the role of Graph algorithms in solving variety of problems
3. Appreciate the role of Optimization by using linear programming
4. Analyze the various algorithms from different domains

Module	Detailed Contents	Hrs
01	<b>Introduction</b> 1.1 Asymptotic notations Big O, Big $\Theta$ , Big $\Omega$ , $\omega$ notations, Proofs of master theorem, applying theorem to solve problems	03
02	<b>Advanced Data Structures</b> 2.1 Red-Black Trees: properties of red-black trees, Insertions, Deletions 2.2 B-Trees and its operations 2.3 Binomial Heaps: Binomial trees and binomial heaps, Operation on Binomial heaps	09
03	<b>Dynamic Programming</b> 3.1 matrix chain multiplication, cutting rod problem and its analysis	06
04	<b>Graph algorithms</b> 4.1 Bellman ford algorithm, Dijkstra algorithm, Johnson's All pair shortest path algorithm for sparse graphs	06
05	<b>Maximum Flow</b> 5.1 Flow networks, the ford Fulkerson method, max bipartite matching, push Relabel Algorithm, The relabel to front algorithm	08
06	<b>Linear Programming</b> 6.1 Standard and slack forms, Formulating problems as linear programs, simplex algorithm, Duality, Initial basic feasible solution	08
07	<b>Computational Geometry</b> 7.1 Line Segment properties, Determining whether any pair of segment intersects, finding the convex hull, Finding the closest pair of points.	08

## **Term Work:**

Term work should consist of at least 6 experiments, 2 assignments based on above theory syllabus.

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

The distribution of marks for term work shall be as follows:

• Laboratory work (experiments): .....	(15)	Marks.
• Assignment:.....	(05)	Marks.
• Attendance (Theory+ Practical).....	(05)	Marks
<b>TOTAL: .....</b>	<b>(25)</b>	<b>Marks.</b>

## **Practical/Oral examination:**

Oral examination based on above syllabus will be conducted

### **Syllabus for Practical**

Suggested topics for experiment but not limited to:

1. Red – black trees and its various operations
2. Binomial Heaps and its various operations
3. Dynamic programming: matrix chain multiplication , cutting rod example
4. Bellman ford , Johnson’s algorithm for sparse graphs
5. Ford Fulkerson algorithm , push relabel to front methods
6. Finding closest pair of points, Determining the convex hull
7. Implementation of Simplex algorithm

## **Text Books:**

1. T.H. Cormen , C.E. Leiserson, R.L. Rivest, and C. Stein, “Introduction to algorithms”,2nd edition , PHI publication 2005
2. Ellis Horowitz , Sartaj Sahni , S. Rajsekar. “Fundamentals of computer algorithms” University press

Course Code	Course/Subject Name	Credits
CPE7023	<b>Image Processing</b>	5

**Objectives:**

1. To learn the fundamental concepts of Digital Image Processing and Video Processing .
2. To understand basic image enhancement and segmentation techniques.
3. To illustrate Image Transform calculations mathematically and develop fast transform algorithm
4. To learn Image Compression and Decompression Techniques

**Outcomes:** Learner will be able to...

1. Understand the concept of Digital Image and Video Image.
2. Explain image enhancement and Segmentation technique.
3. Develop fast image transform flowgraph
4. Solve Image compression and decompression techniques
5. Perform Binary Image Processing Operations

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Digital Image and Video Fundamentals</b> 1.1 Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization, Representation of Digital Image, Connectivity, Image File Formats : BMP, TIFF and JPEG. Colour Models (RGB, HSI, YUV) Introduction to Digital Video, Chroma Sub-sampling, CCIR standards for Digital Video	06
<b>02</b>	<b>Image Enhancement</b> 2.1 Gray Level Transformations, Zero Memory Point Operations, Histogram Processing, Neighbourhood Processing, Spatial Filtering, Smoothing and Sharpening Filters. Homomorphic Filtering	09
<b>03</b>	<b>Image Segmentation and Representation</b> 3.1 Detection of Discontinuities, Edge Linking using Hough Transform, Thresholding, Region based Segmentation, Split and Merge Technique, Image Representation and Description, Chain Code, Polygonal Representation, Shape Number, Moments.	09
<b>04</b>	<b>Image Transform</b> 4.1 Introduction to Unitary Transform, Discrete Fourier Transform(DFT), Properties of DFT, Fast Fourier Transform(FFT), Discrete Hadamard Transform(DHT), Fast Hadamard Transform(FHT), Discrete Cosine Transform(DCT), Discrete Wavelet Transform(DWT),	09
<b>05</b>	<b>Image Compression</b> 5.1 Introduction, Redundancy, Fidelity Criteria, 5.2 Lossless Compression Techniques : Run Length Coding, Arithmetic Coding, Huffman Coding, Differential PCM,	09

	5.3 Lossy Compression Techniques: Improved Gray Scale Quantization, Vector Quantization, JPEG, MPEG-1.	
<b>06</b>	<b>Binary Image Processing</b> 6.1 Binary Morphological Operators, Hit-or-Miss Transformation, Boundary Extraction, Region Filling, Thinning and Thickening, Connected Component Labeling, Iterative Algorithm and Classical Algorithm	06

### Term Work:

Term work should consist of at least 08 experiments.

Journal must include at least 1 assignment on each module and two quiz.

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments): ..... (15) Marks.
- Assignment:..... (05) Marks.
- Attendance (Theory+ Practical)..... (05) Marks
- TOTAL: ..... (25) Marks.**

### Practical/Oral examination:

Oral exam will be based on the above syllabus

### Practicals

Implementation of programs must be either in C or C++ only. A List of experiments is given below. Input can be Monochrome OR Colour Image. Additional experiments within the scope of the syllabus can be added.

1. Image Enhancement [ Any two techniques ]
  - (1) using Zero Memory Point Operations.
  - (2) using Histogram Processing Technique
  - (3) using Spatial Filtering [ Smoothing Filters/ Sharpening Filters]
  - (4) using Homomorphic Filtering
  
2. Image Segmentation [ Any two techniques ]
  - (1) Horizontal and Vertical Line Detection
  - (2) Edge Detection
  - (3) Split and Merge Technique
  - (4) Edge Linking using Hough Transform

3. Image Compression and De-compression [ Any two techniques ]
  - (1) Arithmetic Coding and Decoding
  - (2) Huffman Coding and Decoding
  - (3) IGS Quantization/ Vector Quantization based Compression and De-compression
  - (4) Transform based Image Compression and De-compression [FFT/ FHT/DCT/ DWT]
  
4. Binary Image Processing [ Any two techniques ]
  - (1) Opening followed by Closing
  - (2) Hit or Miss Transform
  - (3) Thinning/Thickening/ Region Filling / Boundary Extraction
  - (4) Connected Component Algorithm

### **Text Books :**

1. Rafel C. Gonzalez and Richard E. Woods, 'Digital Image Processing', Pearson Education Asia, Third Edition, 2009,
2. S. Jayaraman, E.Esakkirajan and T.Veerakumar, "Digital Image Processing" TataMcGraw Hill Education Private Ltd, 2009,
3. Anil K. Jain, "Fundamentals and Digital Image Processing", Prentice Hall of India Private Ltd, Third Edition
  4. S. Sridhar, "Digital Image Processing", Oxford University Press, Second Edition, 2012.
  5. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison Wesley, 1993.

### **Reference Books:**

1. Dwayne Phillips, "Image Processing in C", BPB Publication, 2006
2. B. Chandra and D.Dutta Majumder, "Digital Image Processing and Analysis", Prentice Hall of India Private Ltd, 2011
3. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", Prentice Hall of India Private Ltd, Third Edition
4. Fred Halshall, "Multimedia Communications: Applications, Networks Protocols and Standards,", Pearson Education 2001
5. David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", Pearson Education, Limited, 2011

Course Code	Course/Subject Name	Credits
CPE7024	<b>Software Architecture</b>	5

**Outcomes:**

Software architecture is foundational to the development of large, practical software-intensive applications.

After successful completion of this course learner will be able to:

- Visualize the architectural concepts in development of large, practical software-intensive applications.
- Rather than focusing on one method, notation, tool, or process, this new course widely surveys software architecture techniques, enabling us to choose the right tool for the job at hand.

Module	Detailed Contents	Hrs.
01	<b>Basic Concepts</b> 1.1 Concepts of Software Architecture 1.2 Models. 1.3 Processes. 1.4 Stakeholders	03
02	<b>Designing Architectures</b> 2.1 The Design Process. 2.2 Architectural Conception. 2.3 Refined Experience in Action: Styles and Architectural Patterns. 2.4 Architectural Conception in Absence of Experience.	02
03	<b>Connectors</b> 3.1 Connectors in Action: A Motivating Example. 3.2 Connector Foundations. 3.3 Connector Roles. 3.4 Connector Types and Their Variation Dimensions. 3.5 Example Connectors.	06
04	<b>Modeling</b> 4.1 Modeling Concepts. 4.2 Ambiguity, Accuracy, and Precision. 4.3 Complex Modeling: Mixed Content and Multiple Views. 4.4 Evaluating Modeling Techniques. 4.5 Specific Modeling Techniques.	04
05	<b>Analysis</b> 5.1 Analysis Goals. 5.2 Scope of Analysis. 5.3 Architectural Concern being Analyzed. 5.4 Level of Formality of Architectural Models.	08

	5.5 Type of Analysis. 5.6 Analysis Techniques.	
<b>06</b>	<b>Implementation and Deployment</b> 6.1 Concepts. 6.2 Existing Frameworks. 6.3 Software Architecture and Deployment. 6.4 Software Architecture and Mobility.	04
<b>07</b>	<b>Conventional Architectural styles</b> 7.1 Pipes and Filters 7.2 Event- based, Implicit Invocation 7.3 Layered systems 7.4 Repositories 7.5 Interpreters 7.6 Process control	05
<b>08</b>	<b>Applied Architectures and Styles</b> 8.1 Distributed and Networked Architectures. 8.2 Architectures for Network-Based Applications. 8.3 Decentralized Architectures. 8.4 Service-Oriented Architectures and Web Services.	08
<b>09</b>	<b>Designing for Non-Functional Properties</b> 9.1 Efficiency. 9.2 Complexity. 9.3 Scalability and Heterogeneity. 9.4 Adaptability. 9.5 Dependability.	04
<b>10</b>	<b>Domain-Specific Software Engineering</b> 10.1 Domain-Specific Software Engineering in a Nutshell. 10.2 Domain-Specific Software Architecture. 10.3 DSSAs, Product Lines, and Architectural Styles.	04

### Term Work:

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments):..... (20) Marks.
- Attendance:..... (05) Marks.
- TOTAL: ..... (25) Marks.**

### Practical/Oral examination:

An Oral examination is to be conducted based on the above syllabus



## **Topics For Experiment:**

1. Modeling using xADL
2. Analysis - Case study
3. Visualization using xADL 2.0
4. Integrate software components using a middleware
5. Use middleware to implement connectors
6. Wrapper to connect two applications with different architectures
7. Creating web service
8. Architecture for any specific domain

## **Books:**

### **Text Books:**

1. "Software Architecture: Foundations, Theory, and Practice" by Richard N. Taylor, Nenad Medvidovic, Eric Dashofy, ISBN: 978-0-470-16774-8
2. M. Shaw: Software Architecture Perspectives on an Emerging Discipline, Prentice-Hall.
3. Len Bass, Paul Clements, Rick Kazman: Software Architecture in Practice, Pearson.

### **References:**

1. "Pattern Oriented Software Architecture" by Frank Buchnan et al, Wiley India.
2. "The Art of Software Architecture" by Stephen T. Albin.

Course Code	Course/Subject Name	Credits
CPE7025	<b>Soft Computing</b>	5

**Objectives:**

1. To Conceptualize the working of human brain using ANN.
2. To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
3. To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
4. To provide the mathematical background for carrying out the optimization and familiarizing genetic algorithm for seeking global optimum in self-learning situation.

**Outcomes:** Learner will be able to...

1. Ability to analyze and appreciate the applications which can use fuzzy logic.
2. Ability to design inference systems.
3. Ability to understand the difference between learning and programming and explore practical applications of Neural Networks (NN).
4. Ability to appreciate the importance of optimizations and its use in computer engineering fields and other domains.
5. Students would understand the efficiency of a hybrid system and how Neural Network and fuzzy logic can be hybridized to form a Neuro-fuzzy network and its various applications.

Module	Detailed Contents	Hours
<b>01</b>	<b>Introduction to Soft Computing</b> 1.1 Soft computing Constituents, Characteristics of Neuro Computing and Soft Computing, Difference between Hard Computing and Soft Computing, Concepts of Learning and Adaptation.	<b>04</b>
<b>02</b>	<b>Neural Networks</b> <b>2.1 Basics of Neural Networks:</b> Introduction to Neural Networks, Biological Neural Networks, McCulloch Pitt model, <b>2.2 Supervised Learning algorithms:</b> Perceptron (Single Layer, Multi layer), Linear separability, Delta learning rule, Back Propagation algorithm, <b>2.3 Un-Supervised Learning algorithms:</b> Hebbian Learning, Winner take all, Self Organizing Maps, Learning Vector Quantization.	<b>14</b>

<b>03</b>	<b>Fuzzy Set Theory</b> 3.1 Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Properties of membership function, Fuzzy extension principle, Fuzzy Systems- fuzzification, defuzzification and fuzzy controllers.	<b>14</b>
<b>04</b>	<b>Hybrid system</b> 4.1 Introduction to Hybrid Systems, Adaptive Neuro Fuzzy Inference System(ANFIS).	<b>04</b>
<b>05</b>	<b>Introduction to Optimization Techniques</b> <b>5.1 Derivative based optimization-</b> Steepest Descent, Newton method. <b>5.2 Derivative free optimization-</b> Introduction to Evolutionary Concepts.	<b>06</b>
<b>06</b>	<b>Genetic Algorithms and its applications:</b> 6.1 Inheritance Operators, Cross over types, inversion and Deletion, Mutation Operator, Bit-wise Operators, Convergence of GA, Applications of GA.	<b>06</b>

### Term Work:

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/case studies): ..... (15) Marks.
- Assignments:..... (05) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

### Practical/Oral examination:

Oral examination will be based on the above syllabus.

### PRACTICALS:

All the programs should be implemented in C/C++/Java/MATLAB under Windows or Linux environment. Experiments can also be conducted using available open source tools like OCTAVE and SCILAB

### LIST OF SC PRACTICAL / EXPERIMENTS

1. One case study on Fuzzy/Neural/GA based papers published in IEEE/ACM/Springer or any prominent journal.
2. To implement Fuzzy Sets.

3. To implement Fuzzy Relations.
4. To implement Fuzzy Controllers.
5. To implement Basic Neural Network learning rules.
6. To implement any Supervised Learning algorithm.
7. To implement any Unsupervised Learning algorithm.
8. To implement a simple application using Genetic Algorithm.

Any other practical covering the syllabus topics and subtopics can be conducted.

**Reference Books (for practicals) :**

1. S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
2. S.Rajasekaran and G.A.Vijayalakshmi Pai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.
3. Hagan, Demuth, Beale, "Neural Network Design" CENGAGE Learning, India Edition.
4. Satish Kumar, "Neural Networks –A classroom approach", Second Edition, TMH Publication.

**Text Books:**

1. Timothy J.Ross "Fuzzy Logic With Engineering Applications" Wiley.
2. S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
3. S.Rajasekaran and G.A.Vijayalakshmi Pai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.
4. J.-S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.
5. Jacek.M.Zurada "Introduction to Artificial Neural Systems" Jaico Publishing House.

**Reference Books:**

1. Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.
2. Zimmermann H.S "Fuzzy Set Theory and its Applications" Kluwer Academic Publishers.
3. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
4. Hagan, Demuth, Beale, "Neural Network Design" CENGAGE Learning, India Edition.

Course Code	Course/Subject Name	Credits
CPE7026	<b>Enterprise Resource Planning and Supply Chain Management (ERP &amp; SCM)</b>	5

**Objectives:**

1. To understand the technical aspects of ERP and SCM systems.
2. To understand the steps and activities in the ERP and SCM life cycle.
3. To identify and describe typical functionality in an ERP and SCM system.
4. To understand tools and methodology used for designing ERP and SCM for an Enterprise.

**Outcomes:** Learner will be able to...

1. To conceptualize the basic structure of ERP and SCM
2. To identify implementation strategy used for ERP and SCM.
3. To apply design principles for various business module in ERP and SCM.
4. To apply different emerging technologies for implementation of ERP and SCM.

Module	Detailed Contents	Hours
<b>Enterprise Resource Planning</b>		
<b>01</b>	<b>Introduction</b> 1.1 What is an Enterprise, Introduction to ERP, Need for ERP, Structure of ERP, Scope and Benefits, Typical business processes.	02
<b>02</b>	<b>ERP and Technology</b> 2.1 ERP and related technologies, Business Intelligence, E-business and E-commerce, Business Process Reengineering,	04
<b>03</b>	<b>ERP and Implementation</b> 3.1 ERP implementation and strategy, Implementation Life cycle, Pre-implementation task, requirement definition, implementation methodology.	06
<b>04</b>	<b>ERP Business Modules</b> 4.1 Modules: Finance, manufacturing, human resources, quality management, material management, marketing. Sales distribution and service.	08
<b>05</b>	<b>Extended ERP</b> 5.1 Enterprise application Integration (EAI), open source ERP, cloud ERP.	04
<b>Supply Chain Management (SCM)</b>		
<b>06</b>	<b>Introduction and strategic decisions in SCM</b>	08

	6.1 Introduction to SCM, Generic Types of supply chain, Major Drivers of Supply chain, Strategic decisions in SCM, Business Strategy, CRM strategy, SRM strategy, SCOR model.	
<b>07</b>	<b>Information Technology in SCM</b> 7.1 Types of IT Solutions like Electronic Data Inter change (EDI), Intranet/ Extranet, Data Mining/ Data Warehousing and Data Marts, E-Commerce, E- Procurement, Bar coding, RFID, QR code.	06
<b>08</b>	<b>Mathematical modelling for SCM</b> 8.1 Introduction, Considerations in modelling SCM systems, Structuring the logistics chain, overview of models: models on transportation problem, assignment problem, vehicle routing problem, Model for vendor analysis, Make versus buy model.	06
<b>09</b>	<b>Agile Supply Chain</b> 9.1 Introduction, Characteristics of Agile Supply Chain, Achieving Agility in Supply Chain.	02
<b>10</b>	<b>Cases of Supply Chain</b> 10.1 Cases of Supply Chain like, News Paper Supply Chain, Book Publishing, Mumbai Dabbawala, Disaster management, Organic Food, Fast Food.	02

### Term Work:

The distribution of marks for term work shall be as follows:

- Mini project:..... (20) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

### Practical/Oral examination:

**Oral examination will be based on the above syllabus.**

The lab will be conducted on mini project which may be conducted on the following:

- 1) Simulating business processes of an Enterprise.
- 2) Designing a web portal for an Enterprise using E-business Models.
- 3) E-procurement model.
- 4) Open source ERP
- 5) Cloud ERP
- 6) Business process agility
- 7) SCM model.
- 8) Implementing Business Intelligence
- 9) Any other relevant topics covering the syllabus.

**Text Books:**

1. Enterprise Resource Planning : concepts & practices, by V.K. Garg & N.K. Venkatakrisnan ; PHI.
2. Supply Chain Management Theories & Practices: R. P. Mohanty, S. G. Deshmukh, - Dreamtech Press.
3. ERP Demystified: II Edition, by Alexis Leon, McGraw Hill .
4. Enterprise wide resource planning: Theory & practice: by Rahul Altekar, PHI.

**Reference Books:**

1. ERP to E<sup>2</sup>ERP: A Case study approach, by Sandeep Desai, Abhishek Srivastava, PHI.
2. Managerial Issues of ERP system, by David Olson, McGraw Hill.

Course Code	Course/Subject Name	Credits
CPE7022	<b>Computer Simulation and Modeling</b>	5

**Course Objectives:**

This course presents an introduction to discrete event simulation systems. Emphasis of the course will be on modeling and the use of simulation languages/software to solve real world problems in the manufacturing as well as services sectors. The course discusses the modeling techniques of entities, queues, resources and entity transfers in discrete event environment. The course will teach the students the necessary skills to formulate and build valid models, implement the model, perform simulation analysis of the system and analyze results properly. The “theory” of simulation involves probability and statistics, thus a good background in probability and statistics is a required prerequisite

**Course Outcomes:**

1. Apply simulation concepts to achieve in business, science, engineering, industry and services goals
2. Demonstrate formulation and modeling skills.
3. Perform a simulation using spreadsheets as well as simulation language/package
4. Generate pseudorandom numbers using the Linear Congruential Method
5. Evaluate the quality of a pseudorandom number generator using statistical tests
6. Analyze and fit the collected data to different distributions

Module	Detailed Contents	Hours
<b>Computer Simulation and Modeling</b>		
<b>01</b>	Introduction to Simulation. Simulation Examples. General Principles	15
<b>02</b>	Statistical Models in simulation. Queuing Models	08
<b>03</b>	Random Number Generation. Testing random numbers (Refer to Third edition) Random Variate Generation: Inverse transform technique, Direct Transformation for the Normal Distribution, Convolution Method, Acceptance-Rejection Technique (only Poisson Distribution).	09



<b>04</b>	Analysis of simulation data : Input Modeling ,Verification, Calibration and Validation of Simulation , Models , Estimation of absolute performance.	12
<b>05</b>	Application : Case study on 1. Processor and Memory simulation 2. Manufacturing & Material handling	04

**Text Books:**

Discrete Event System Simulation; Third Edition, Jerry Banks, John Carson, Barry Nelson, and David M. Nicol, Prentice-Hall

Discrete Event System Simulation; Fifth Edition, Jerry Banks, John Carson, Barry Nelson, and David M. Nicol, Prentice-Hall

**References:**

4. System Modeling & Analysis; Averill M Law, 4<sup>th</sup> Edition TMH.
5. Principles of Modeling and Simulation; Banks C M , Sokolowski J A; Wiley
6. System Simulation ; Geoffrey Gordon ; EEE
7. System Simulation with Digital Computer; Narsing Deo, PHI

**Term work:**

Laboratory work: 10 marks

Mini Simulation Project presentation: 10 marks

Attendance : 5 marks

**Suggested Practical List (If Any):**

Perform simulation exercises given in the text book (third edition) using spreadsheets and/or simulation language/package

5. Queue- single server, multi-server, classic case- dump truck
6. Inventory – Lead time=0, lead time fixed, lead time probabilistic
7. Reliability problem
8. Tutorials on statistical models
9. Random number generate and test
10. Goodness of fit test
11. Output analysis – Point estimate and Confidence Interval

Simulation: Real World Examples – can be in the field of business, transportation, medical, computing, manufacturing and material handling- Presentation to be taken.

**Practical/Oral examination:**

**Oral examination will be based on the above syllabus.**

Course Code	Course/Subject Name	Credits
CPL701	<b>Network threats and attacks Laboratory</b>	02

**Outcomes: After completion of this Laboratory course learner will be able To**

1. Use network-based tools for network analysis
2. Use techniques for Network scanning
3. Identify network vulnerability
4. Use tools to simulate intrusion detection system
5. To understand and install a firewall

Module	Detailed Contents
<b>01</b>	<p><b>1.1 Title:</b> Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.</p> <p><b>Objective:</b> Objective of this module to how to gather information about the networks by using different n/w reconnaissance tools.</p> <p><b>Scope:</b> Network analysis using network based tools</p> <p><b>Technology:</b> Networking</p>
<b>02</b>	<p><b>2.1 Title:</b> Study of packet sniffer tools like wireshark, ethereal, tcpdump etc. You should be able to use the tools to do the following</p> <ol style="list-style-type: none"> <li>1. Observer performance in promiscuous as well as non-promiscuous mode.</li> <li>2. Show that packets can be traced based on different filters.</li> </ol> <p><b>Objective:</b> Objective of this module is to observer the performanance in promiscuous &amp; non-promiscuous mode &amp; to find the packets based on different filters.</p> <p><b>Scope:</b> Packet grapping, message and protocol analysis</p> <p><b>Technology:</b> Networking</p>
<b>03</b>	<p><b>3.1 Title:</b> Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, etc.</p> <p><b>Objective:</b> objective of this module to learn nmap installation &amp; use this to scan different ports.</p> <p><b>Scope:</b> used for ip spoofing and port scanning</p> <p><b>Technology:</b> Networking</p>

04	<p><b>4.1 Title:</b> Detect ARP spoofing using open source tool ARPWATCH.</p> <p><b>Objective:</b> Objective of the module to find ARP spoofing using open source.</p> <p><b>Scope:</b> Ip spoofing using arp packaging tool</p> <p><b>Technology:</b> Networking</p>
05	<p><b>5.1 Title:</b> Use the Nessus tool to scan the network for vulnerabilities.</p> <p><b>Objective:</b> Objective of the module is scan system and network analysis.</p> <p><b>Scope:</b> It used for system analysis, security and process analysis</p> <p><b>Technology:</b> Networking</p>
06	<p><b>6.1 Title:</b> Implement a code to simulate buffer overflow attack.</p> <p><b>Objective:</b> Objective of the module Is to check buffer overflow in an NS2 environment</p> <p><b>Scope:</b> It uses to analyse memory overflow attack</p> <p><b>Technology:</b> Networking</p>
07	<p><b>7.1 Title:</b> Set up IPSEC under LINUX</p> <p><b>Objective:</b> Objective of the module for implementing security vulnerabilities</p> <p><b>Scope:</b> to study different ipsec tools.</p> <p><b>Technology:</b> Networking</p>
08	<p><b>8.1 Title:</b> Install IDS (e.g. SNORT) and study the logs.</p> <p><b>Objective:</b> Simulate intrusion detection system using tools such as snort</p> <p><b>Scope:</b> It is used for intrusion detection system vulnerability scans</p> <p><b>Technology:</b> Networking</p>
09	<p><b>9.1 Title:</b> Use of iptables in linux to create firewalls.</p> <p><b>Objective:</b> To study how to create and destroy firewall security parameters.</p> <p><b>Scope:</b> system security and network security</p> <p><b>Technology:</b> Networking</p>
10	<p><b>10.1 Title:</b> Mini project</p> <p><b>Objective:</b> To implement Networking concepts</p>

	<p><b>Scope:</b> To understand Network &amp; system tools</p> <p><b>Technology:</b> Networking</p>
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**Term Work:**

The distribution of marks for term work shall be as follows:

- Lab Assignments:..... (10)
- Mini project:..... (10) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

**Oral examination:**

Oral examination is to be conducted by pair of internal and external examiners based on above syllabus and the mini projects done.

**References:**

1. Network Security Assessment by Chris McNab, O'Reilly
2. Network Security Hacks, Andrew Lockhart, O'Reilly
3. The Web Application Hacker's Handbook 2<sup>nd</sup> Edition by Dafydd Stuttard & Marcus Pinto,Wiley Publication(2014).
4. Securing the Virtual Environment by Davi Ottenheimer & Matthew Wallace,Willey Publication(2012).

Course Code	Course/Subject Name	Credits
CPC801	<b>Data Warehousing and Mining</b>	5

**Objectives:**

1. To study the methodology of engineering legacy databases for data warehousing and data mining to derive business rules for decision support systems.
2. To analyze the data, identify the problems, and choose the relevant models and algorithms to apply.

**Outcomes:** Learner will be able to...

1. Enable students to understand and implement classical algorithms in data mining and data warehousing; students will be able to assess the strengths and weaknesses of the algorithms, identify the application area of algorithms, and apply them.
2. Students would learn data mining techniques as well as methods in integrating and interpreting the data sets and improving effectiveness, efficiency and quality for data analysis.

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Introduction to Data Warehousing</b> 1.1 The Need for Data Warehousing; Increasing Demand for Strategic Information; Inability of Past Decision Support System; Operational V/s Decisional Support System; Data Warehouse Defined; Benefits of Data Warehousing ;Features of a Data Warehouse; The Information Flow Mechanism; Role of Metadata; Classification of Metadata; Data Warehouse Architecture; Different Types of Architecture; Data Warehouse and Data Marts; Data Warehousing Design Strategies.	04
<b>02</b>	<b>Dimensional Modeling</b> 2.1 Data Warehouse Modeling Vs Operational Database Modeling; Dimensional Model Vs ER Model; Features of a Good Dimensional Model; The Star Schema; How Does a Query Execute? The Snowflake Schema; Fact Tables and Dimension Tables; The Factless Fact Table; Updates To Dimension Tables: Slowly Changing Dimensions, Type 1 Changes, Type 2 Changes, Type 3 Changes, Large Dimension Tables, Rapidly Changing or Large Slowly Changing Dimensions, Junk Dimensions, Keys in the Data Warehouse Schema, Primary Keys, Surrogate Keys & Foreign Keys; Aggregate Tables; Fact Constellation Schema or Families of Star.	06
<b>03</b>	<b>ETL Process</b> 3.1 Challenges in ETL Functions; Data Extraction; Identification of Data Sources; Extracting Data: Immediate Data Extraction, Deferred Data Extraction; Data Transformation: Tasks Involved in Data Transformation, Data Loading: Techniques of Data Loading, Loading the Fact Tables and Dimension Tables Data Quality; Issues in Data Cleansing.	06
<b>04</b>	<b>Online Analytical Processing (OLAP)</b>	04

	4.1 Need for Online Analytical Processing; OLTP V/s OLAP; OLAP and Multidimensional Analysis; Hypercubes; OLAP Operations in Multidimensional Data Model; OLAP Models: MOLAP, ROLAP, HOLAP, DOLAP;	
<b>05</b>	<b>Introduction to data mining</b> 5.1 What is Data Mining; Knowledge Discovery in Database (KDD), What can be Data to be Mined, Related Concept to Data Mining, Data Mining Technique, Application and Issues in Data Mining	02
<b>06</b>	<b>Data Exploration</b> 6.1 Types of Attributes; Statistical Description of Data; Data Visualization; Measuring similarity and dissimilarity.	02
<b>07</b>	<b>Data Preprocessing</b> 7.1 Why Preprocessing? Data Cleaning; Data Integration; Data Reduction: Attribute subset selection, Histograms, Clustering and Sampling; Data Transformation & Data Discretization: Normalization, Binning, Histogram Analysis and Concept hierarchy generation.	04
<b>08</b>	<b>Classification</b> 8.1 Basic Concepts; <b>Classification methods:</b> 1. Decision Tree Induction: Attribute Selection Measures, Tree pruning. 2. Bayesian Classification: Naïve Bayes' Classifier. <b>8.2 Prediction:</b> Structure of regression models; Simple linear regression, Multiple linear regression. <b>8.3 Model Evaluation &amp; Selection:</b> Accuracy and Error measures, Holdout, Random Sampling, Cross Validation, Bootstrap; Comparing Classifier performance using ROC Curves. <b>8.4 Combining Classifiers:</b> Bagging, Boosting, Random Forests.	06
<b>09</b>	<b>Clustering</b> 9.1 What is clustering? Types of data, Partitioning Methods (K-Means, K-Medoids) Hierarchical Methods(Agglomerative , Divisive, BRICH), Density-Based Methods ( DBSCAN, OPTICS)	06
<b>10</b>	<b>Mining Frequent Pattern and Association Rule</b> 10.1 Market Basket Analysis, Frequent Itemsets, Closed Itemsets, and Association Rules; Frequent Pattern Mining, Efficient and Scalable Frequent Itemset Mining Methods, The Apriori Algorithm for finding Frequent Itemsets Using Candidate Generation, Generating Association Rules from Frequent Itemsets, Improving the Efficiency of Apriori, A pattern growth approach for mining Frequent Itemsets; Mining Frequent itemsets using vertical data formats; Mining closed and maximal patterns; Introduction to Mining Multilevel Association Rules and Multidimensional Association Rules; From Association Mining to Correlation Analysis, Pattern Evaluation Measures; Introduction to Constraint-Based Association Mining.	08

## **Term Work:**

Term work should consist of at least of the following:

1. One case study given to a group of 3 /4 students of a data mart/ data warehouse.
  - a. Write Detail Statement Problem and creation of dimensional modeling (creation star and snowflake schema)
  - b. Implementation of all dimension table and fact table
  - c. Implementation of OLAP operations.
2. Implementation of classifier like Decision tree, Naïve Bayes, Random Forest using any languages like Java
3. Use WEKA to implement like Decision tree, Naïve Bayes, Random Forest
4. Implementation of clustering algorithm like K-means, K- Medoids, Agglomerative, Divisive using languages any like Java, C# , etc.
5. Use WEKA to implement the following Clustering Algorithms – K-means, Agglomerative, Divisive.
6. Implementation Association Mining like Apriori, FPM using languages like Java, C#, etc.
7. Use WEKA to implement Association Mining like Apriori, FPM.
8. Use R tool to implement Clustering/Association Rule/ Classification Algorithms.
9. Detailed study of any one BI tool like Oracle BI, SPSS, Clementine, and XLMiner etc. (paper Assignment)

## **Internal Assessment:**

Internal Assessment consists of two tests. Test 1, an Institution level central test, is for 20 marks and is to be based on a minimum of 40% of the syllabus. Test 2 is also for 20 marks and is to be based on the remaining syllabus. Test 2 may be either a class test or assignment on live problems or course project

## **Practical/Oral examination:**

An oral exam will be held based on the above syllabus

## **Text Books:**

- 1) Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3<sup>rd</sup> Edition



- 2) Paulraj Ponniah, "Data Warehousing: Fundamentals for IT Professionals", Wiley India
- 3) Reema Theraja "Data warehousing", Oxford University Press.
- 4) M.H. Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education

### **Reference Books:**

- 1) Randall Matignon, "Data Mining using SAS enterprise miner ", Wiley Student edition.
- 2) Alex Berson , S. J. Smith, "Data Warehousing, Data Mining & OLAP" , McGraw Hill.
- 3) Vikram Pudi & Radha Krishna, "Data Mining", Oxford Higher Education.
- 4) Daniel Larose, "Data Mining Methods and Models", Wiley India.

Course Code	Course/Subject Name	Credits
CPC802	<b>Human Machine Interaction</b>	5

**Objectives:**

1. To stress the importance of a good interface design.
2. To understand the importance of human psychology in designing good interfaces.
3. To motivate students to apply HMI in their day – to – day activities.
4. To bring out the creativity in each student – build innovative applications that are user friendly.
5. To encourage students to indulge into research in Machine Interface Design.

**Outcomes:** Learner will be able to...

1. To design user centric interfaces.
2. To design innovative and user friendly interfaces.
3. To apply HMI in their day-to-day activities.
4. To criticise existing interface designs, and improve them.
5. To Design application for social and technical task.

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Introduction</b> 1.1 Introduction to Human Machine Interface, Hardware, software and operating environment to use HMI in various fields. 1.2 The psychopathology of everyday things – complexity of modern devices; human-centered design; fundamental principles of interaction; Psychology of everyday actions- how people do things; the seven stages of action and three levels of processing; human error;	10
<b>02</b>	<b>Understanding goal directed design</b> 2.1 Goal directed design; Implementation models and mental models; Beginners, experts and intermediates – designing for different experience levels; Understanding users; Modeling users – personas and goals.	08
<b>03</b>	<b>GUI</b> 3.1 benefits of a good UI; popularity of graphics; concept of direct manipulation; advantages and disadvantages; characteristics of GUI; characteristics of Web UI; General design principles.	08
<b>04</b>	<b>Design guidelines</b> 4.1 perception, Gestalt principles, visual structure, reading is unnatural, color, vision, memory, six behavioral patterns, recognition and recall, learning, factors affecting learning, time.	08
<b>05</b>	<b>Interaction styles</b> 5.1 menus; windows; device based controls, screen based controls;	06
<b>06</b>	<b>Communication</b> 6.1 text messages; feedback and guidance; graphics, icons and images; colours.	08

## **Term Work:**

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/case studies): ..... (15) Marks.
- Assignment:..... (05) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

## **Internal Assessment:**

Internal Assessment consists of two tests. Test 1, an Institution level central test, is for 20 marks and is to be based on a minimum of 40% of the syllabus. Test 2 is also for 20 marks and is to be based on the remaining syllabus. Test 2 may be either a class test or assignment on live problems or course project

## **Practical/Oral examination:**

**Oral examination will be based on the above syllabus.**

## **Laboratory:**

Students are free to choose any tool that they feel appropriate for a given experiment. Each experiment will involve research about a certain category of people, and then developing an appropriate interface.

Students are expected to perform at least eight experiments from the given list.

## **LIST OF HMI PRACTICAL / EXPERIMENTS**

1. Know your client –
  - a. Children (4-5 years of age): An application to teach math.
  - b. Teenagers: Design a digital diary for young teens to help them overcome various social pressures they deal with during their teen years. The diary should also be like a self help tool which would help them deal with incidents like bullying, peer pressure, etc.. This is an open project and you can think in any direction to make the children sail through their teen years while trying to discover life around them.
  - c. Older generation: Folks from the older generation has been very wary of using their credit card on the Internet. They have various concerns when it comes to paying their bills. Also because of their old age, it will be beneficial for them to use the internet and pay their phone, electricity, gas, etc. bills
  - d. Rural people: ATVM for train ticketing in rural area

2. Understand the trouble of interacting with machines - Redesign interfaces of home appliances like microwave oven, land-line phone, fully automatic washing machine.
3. Learn HCI design principles – heuristic evaluation: Identify 5 different websites catering to one specific goal (eg. Goal – on-line shopping and 5 different websites – ebay, amazon, flipkart, zovi, myntra) and perform a competitive analysis on them to understand how each one caters to the goal, the interactions and flow of the payment system and prepare a report on the same..
4. Learn the importance of menus and navigation – website redesign: News websites like CNN are always cluttered with information. It takes the user a few minutes to find his way through and maybe more minutes to look for some specific information. Redesign the news websites to make it look less cluttered, provide relevant information (a person sitting in Russia should not get US news as top news), intelligently dig information that he might be interested in based on his searches on the web.
5. Learn the importance of connecting humans – service design : How often have you found yourself waiting at the airport for a flight that is delayed or you’ve missed it and the next one is 4 hours from now, or waiting for a connecting flight? Design an experience for passengers to deal with the long waiting hours.
6. Learn the use of statistical graphics – expense tracker: Matt is a young engineer who just finished his summer internship at a leading Software Company in the United States. He has never been independent in handling his own finances and after this internship his father has asked him to start managing his money on his own. He is looking for a tool/app/software that would help him budget his finances, create goals and track them, categorize and track his credit card spending and also get insights on the various types of categories he’s spending on. Design a tool/app/software that would help Matt manage his personal finances given the above requirement.
7. Learn the importance of graphics – way finding: Design a map for someone who is new to the city/town/village and is trying to understand how to commute from one place to another (inspired by New York Subway Maps, London Subway Maps)
8. Icon designing: Choose a unique domain, design a few icons and show how it can be accommodated on an interface.
9. Understand the need of colors and animation – web site for an artist: A celebrity in some form of art like music, dance, painting, martial arts, etc (not actors). This site will be used to display his works and should portray his character.
10. Understand the various input methods available for interaction – concept generation: Study the various technologies for typing – standard keyboards QWERTY, T9 (predictive text), multi-touch (SYWPE, etc.), gestures and brainstorm on the various ways in which you could improve one of the existing technologies. You could choose any of the different input types.

11. Any other new relevant topics covering the above syllabus.

**Text Books:**

1. Alan Dix, J. E. Finlay, G. D. Abowd, R. Beale “Human Computer Interaction”, Prentice Hall.
2. Wilbert O. Galitz, “The Essential Guide to User Interface Design”, Wiley publication.
3. Alan Cooper, Robert Reimann, David Cronin, “About Face3: Essentials of Interaction design”, Wiley publication.
4. Jeff Johnson, “Designing with the mind in mind”, Morgan Kaufmann Publication.
5. Donald A. Normann, “Design of everyday things”, Basic Books; Reprint edition 2002.

**Reference Books:**

1. Donald A. Norman, “The design of everyday things”, Basic books.
2. Rogers Sharp Preece, “Interaction Design:Beyond Human Computer Interaction”, Wiley.
3. Guy A. Boy “The Handbook of Human Machine Interaction”, Ashgate publishing Ltd.

Course Code	Course/Subject Name	Credits
CPC803	<b>Parallel and Distributed Systems</b>	5

**Objectives:**

1. To provide students with contemporary knowledge in parallel and distributed systems
2. To equip students with skills to analyze and design parallel and distributed applications.
3. To provide master skills to measure the performance of parallel and distributed algorithms

**Outcomes:** Learner will be able to...

1. Apply the principles and concept in analyzing and designing the parallel and distributed system
2. Reason about ways to parallelize problems.
3. Gain an appreciation on the challenges and opportunities faced by parallel and distributed systems.
4. Understand the middleware technologies that support distributed applications such as RPC, RMI and object based middleware.
5. Improve the performance and reliability of distributed and parallel programs.

Module	Detailed Contents	Hrs.
01	<b>Introduction</b> 1.1 Parallel Computing, Parallel Architecture, Architectural Classification Scheme, Performance of Parallel Computers, Performance Metrics for Processors, Parallel Programming Models, Parallel Algorithms.	06
02	<b>Pipeline Processing</b> 2.1 Introduction, Pipeline Performance, Arithmetic Pipelines, Pipelined Instruction Processing, Pipeline Stage Design, Hazards, Dynamic Instruction Scheduling,	06
03	<b>Synchronous Parallel Processing</b> 3.1 Introduction, Example-SIMD Architecture and Programming Principles, SIMD Parallel Algorithms, Data Mapping and memory in array processors, Case studies of SIMD parallel Processors	06
04	<b>Introduction to Distributed Systems</b> 4.1 Definition, Issues, Goals, Types of distributed systems, Distributed System Models, Hardware concepts, Software Concept, Models of Middleware, Services offered by middleware, Client Server model.	06
05	<b>Communication</b> 5.1 Layered Protocols, Remote Procedure Call, Remote Object Invocation, Message Oriented Communication, Stream Oriented Communication	04
06	<b>Resource and Process Management</b> 6.1 Desirable Features of global Scheduling algorithm, Task assignment approach, Load balancing approach, load sharing approach, Introduction to process management, process migration, Threads, Virtualization, Clients, Servers, Code Migration	06
07	<b>Synchronization</b>	08

	<p>7.1 Clock Synchronization, Logical Clocks, Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm, Requirements of Mutual Exclusion Algorithms, Performance measure, Non Token based Algorithms: Lamport Algorithm, Ricart–Agrawala’s Algorithm, Maekawa’s Algorithm</p> <p>7.2 Token Based Algorithms: Suzuki-Kasami’s Broadcast Algorithms, Singhal’s Heuristic Algorithm, Raymond’s Tree based Algorithm, Comparative Performance Analysis.</p>	
<b>08</b>	<p><b>Consistency and Replication</b></p> <p>8.1 Introduction, Data-Centric and Client-Centric Consistency Models, Replica Management.</p> <p><b>Distributed File Systems</b></p> <p>8.2 Introduction, good features of DFS, File models, File Accessing models, File-Caching Schemes, File Replication, Network File System(NFS), Andrew File System(AFS), Hadoop Distributed File System and Map Reduce.</p>	<b>06</b>

**Term Work:**

Term work should consist of at least 10 experiments, 2 assignments based on above theory syllabus.

The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments): ..... (15) Marks.
- Assignments: ..... (05) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

**Internal Assessment:**

Internal Assessment consists of two tests. Test 1, an Institution level central test, is for 20 marks and is to be based on a minimum of 40% of the syllabus. Test 2 is also for 20 marks and is to be based on the remaining syllabus. Test 2 may be either a class test or assignment on live problems or course project

**Practical/Oral examination:**

**Oral Examination will be based on above syllabus**

## **Syllabus for Practical**

Suggested topics for experiment but not limited to:

1. Load Balancing Algorithm.
2. Scalability in Distributed Environment
3. Client/server using RPC/RMI.
4. Inter-process communication
5. Election Algorithm.
6. Distributed Deadlock.
7. Name Resolution protocol.
8. Clock Synchronization algorithms.
9. Mutual Exclusion Algorithm.
10. Group Communication.
11. CORBA architecture.
12. Parallel Algorithms.
13. Message Passing Interface.

## **Text Books**

1. M.R. Bhujade, "Parallel Computing", 2nd edition, New Age International Publishers 2009.
2. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms, 2nd edition, Pearson Education, Inc., 2007, ISBN: 0-13-239227-5.

## **Reference Books**

1. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design" (4th Edition), Addison Wesley/Pearson Education.
2. Pradeep K Sinha, "Distributed Operating Systems : Concepts and design", IEEE computer society press



Course Code	Course/Subject Name	Credits
CPE8031	<b>Elective-III Machine Learning</b>	5

**Objectives:**

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To become familiar with regression methods, classification methods, clustering methods.
3. To become familiar with support vector machine and Dimensionality reduction Techniques.

**Outcomes:** Learner will be able to...

1. Ability to analyze and appreciate the applications which can use Machine Learning Techniques.
2. Ability to understand regression, classification, clustering methods.
3. Ability to understand the difference between supervised and unsupervised learning methods.
4. Ability to appreciate Dimensionality reduction techniques.
5. Students would understand the working of Reinforcement learning.

Module	Detailed Contents	Hrs.
01	<b>Introduction to Machine Learning</b> 1.1 What is Machine Learning?, Key Terminology, Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, How to choose the right algorithm, Steps in developing a Machine Learning Application.	06
02	<b>Learning with Regression</b> 2.1 Linear Regression, Logistic Regression.	04
03	<b>Learning with trees</b> 3.1 Using Decision Trees, Constructing Decision Trees, Classification and Regression Trees (CART).	08
04	<b>Support Vector Machines(SVM)</b> 4.1 Maximum Margin Linear Separators, Quadratic Programming solution to finding maximum margin separators, Kernels for learning non-linear functions.	06
05	<b>Learning with Classification</b> 5.1 Rule based classification, classification by backpropagation, Bayesian Belief networks, Hidden Markov Models.	06
06	<b>Dimensionality Reduction</b> 6.1 Dimensionality Reduction Techniques, Principal Component Analysis, Independent Component Analysis.	06
07	<b>Learning with Clustering</b> 7.1 K-means clustering, Hierarchical clustering, Expectation Maximization	06

	Algorithm, Supervised learning after clustering, Radial Basis functions.	
<b>08</b>	<b>Reinforcement Learning</b> 8.1 Introduction, Elements of Reinforcement Learning, Model based learning, Temporal Difference Learning, Generalization, Partially Observable States.	06

### Term Work:

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments): ..... (15) Marks.
- Assignments:..... (05) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

### Internal Assessment:

Internal Assessment consists of two tests. Test 1, an Institution level central test, is for 20 marks and is to be based on a minimum of 40% of the syllabus. Test 2 is also for 20 marks and is to be based on the remaining syllabus. Test 2 may be either a class test or assignment on live problems or course project

### Practical/Oral examination:

Oral examination will be based on the above syllabus.

#### LIST OF ML PRACTICAL / EXPERIMENTS

1. To implement Linear Regression
2. To implement Logistic Regression
3. To implement ID3.
4. To implement Support Vector Machine.
5. To implement Bayesian Classification.
6. To implement K-Nearest Neighbour.
7. To implement k-means Clustering.
8. To implement Agglomerative Clustering.

Any other practical covering the syllabus topics and subtopics can be conducted.

**Text Books:**

1. Peter Harrington “Machine Learning In Action”, DreamTech Press
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press
3. Tom M.Mitchell “Machine Learning” McGraw Hill
4. Stephen Marsland, “Machine Learning An Algorithmic Perspective” CRC Press

**Reference Books:**

1. William W.Hsieh, “Machine Learning Mehods in the Environmental Sciences”, Cambridge
2. Han Kamber, “Data Mining Concepts and Techniques”, Morgann Kaufmann Publishers
3. Margaret.H.Dunham, “Data Mining Introductory and Advanced Topics”, Pearson Education

Course Code	Course/Subject Name	Credits
CPE8032	<b>Elective-III Embedded Systems</b>	5

**Objectives:**

1. Develop, among students, an understanding of the technologies behind the embedded computing systems; and to differentiate between such technologies.
2. Make aware of the capabilities and limitations of the various hardware or software components.
3. Evaluate design tradeoffs between different technology choices.
4. Complete or partial design of such embedded systems

**Outcomes:** Learner will be able to...

1. Describe the special requirements that are imposed on embedded systems
2. Describe the key properties of microprocessor and digital signal processor
3. Sketch a design of an embedded system around a microprocessor or DSP
4. Explain how microprocessor, memory, peripheral components and buses interact in an embedded system
5. Evaluate how architectural and implementation decisions influence performance and power dissipation
6. Produce efficient code for embedded systems
7. Point out the role of the compiler in the embedded system design process
8. Define the properties of a real-time operating system
9. Estimate the requirement for additional hardware for optimized performance
10. Understand and distinguish between the RISC and the Advanced RISC architecture
11. Utilize embedded systems to perform operations such as signal processing in real time
12. Develop drivers for external peripheral devices as per requirement.

Module	Detailed Contents	Hrs.
01	<b>Introduction to computational technologies</b> 1.1 Review of computation technologies (ARM, RISC, CISC, PLD, SOC), architecture, event managers, hardware multipliers, pipelining. Hardware/Software co-design. Embedded systems architecture and design process.	08
02	<b>Program Design and Analysis</b> 2.1 Integrated Development Environment (IDE), assembler, linking and loading. Program-level performance analysis and optimization, energy and power analysis and program size optimization, program validation and testing. Embedded Linux, kernel architecture, GNU cross platform tool chain. Programming with Linux environment.	08
03	<b>Process Models and Product development life cycle management</b> 3.1 State machine models: finite-state machines (FSM), finite-state machines with data-path model (FSMD), hierarchical/concurrent state machine	08

	model (HCFSM), program-state machine model (PSM), concurrent process model. Unified Modeling Language (UML), applications of UML in embedded systems. IP-cores, design process model. Hardware software co-design, embedded product development life cycle management.	
<b>04</b>	<b>High Performance 32-bit RISC Architecture</b> 4.1 ARM processor family, ARM architecture, instruction set, addressing modes, operating modes, interrupt structure, and internal peripherals. ARM coprocessors, ARM Cortex-M3.	<b>08</b>
<b>05</b>	<b>Processes and Operating Systems</b> 5.1 Introduction to Embedded Operating System, multiple tasks and multiple processes. Multi rate systems, preemptive real-time operating systems, priority-based scheduling, inter-process communication mechanisms. Operating system performance and optimization strategies. Examples of real-time operating systems.	<b>08</b>
<b>06</b>	<b>Real-time Digital Signal Processing (DSP)</b> 6.1 Introduction to Real-time simulation, numerical solution of the mathematical model of physical system. DSP on ARM, SIMD techniques. Correlation, Convolution, DFT, FIR filter and IIR Filter implementation on ARM. Open Multimedia Applications Platform (OMAP)	<b>08</b>

### Term Work:

Term work should consist of at least 10 practicals and one mini project. Objective type term work test shall be conducted with a weightage of 10 marks.

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/projects): ..... (10) Marks.
- Mini project: ..... (10) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

The final certification and acceptance of Term Work ensures the satisfactory performance of laboratory work and minimum passing in term work.

### Internal Assessment:

Internal Assessment consists of two tests. Test 1, an Institution level central test, is for 20 marks and is to be based on a minimum of 40% of the syllabus. Test 2 is also for 20 marks and is to be based on the remaining syllabus. Test 2 may be either a class test or assignment on live problems or course project

### Practical/Oral examination:

**Oral examination will be based on the above syllabus.**

## **List of Experiments:**

### **Topic-1: Troubleshooting Tools [Any One]**

In-Circuit Emulator (ICE) and In-Circuit Debugger (ICD), Logic Analyzer, Spectrum Analyzer, Pattern generator and Digital Storage Oscilloscope.

### **Topic -2: ARM Processors & Interfaces [Any Four]**

LEDs and Keyboard Interface, LCD Interface, Counting external events with on chip counters, Real Time Clock (RTC), Pulse Width Modulation (PWM), Relay and Buzzer Control for alarm events, Stepper Motor Control , On chip ADC/DAC SPI / I2C / UART Interface, Bluetooth/Zig-bee interface.

### **Topic-3: Real-time Signal Processing ARM-DSP [Any Two]**

Real-time physical model simulation, Correlation, convolution, DFT, FIR or IIR design, Real-time DAS and GUI using PC and ARM, Design with Programmable Logic Devices (CPLD/FPGA).

### **Topic-4: Device Driver Development [Any One]**

Drivers for CAN, Drivers for USB, Drivers for Ethernet, SVGA, Drivers for Graphics TFT LCD.

### **Topic-5: Real Time Operating System (RTOS) [Any Two]**

RTLinux , MicroC/OS\_II, VxWorks, WIN CE, QNX, Palm OS, Symbian OS, Android OS or equivalent OS.

## **Text Books:**

1. Embedded Systems an Integrated Approach – Lyla B Das, Pearson
2. Computers as Components – Marilyn Wolf, Third Edition Elsevier
3. Embedded Systems Design: A Unified Hardware/Software Introduction – Frank Vahid and Tony Givargis, John Wiley & Sons
4. An Embedded Software Primer – David E. Simon – Pearson Education Sough Asia
5. ARM System Developer's Guide Designing and Optimizing System Software – Andrew N. Sloss, Dominic Syms and Chris Wright – Elsevier Inc.

## **Reference Books:**

1. Embedded Systems, Architecture, Programming and Design – Raj Kamal – Tata McGraw Hill
2. Embedded Linux – Hollabaugh, Pearson Education

3. Embedded Realtime Systems Programming – Sriram V Iyer, Pankaj Gupta – Tata McGraw Hill.
4. Fundamentals of Microcontrollers and Applications in Embedded Systems – Ramesh Gaonkar – Penram International Publishing (India) Pvt. Ltd.
5. Embedded / Real-Time Systems: Concepts, Design & Programming – Dr. K. V. K. K. Prasad – Dreamtech Press, India.

Course Code	Course/Subject Name	Credits
CPE8033	<b>Elective-III Adhoc Wireless Networks</b>	5

**Objectives:**

1. To Identify the major issues associated with ad-hoc networks
2. To identify the requirements for protocols for wireless ad-hoc networks as compared to the protocols existing for wired network.
3. To explore current ad-hoc technologies by researching key areas such as algorithms, protocols, hardware, and applications.
4. To Provide hands-on experience through real-world programming projects
5. To provide advanced in –depth networking materials to graduate students in networking research.

**Outcomes:** Learner will be able to...

1. Define characteristics and features of Adhoc Networks
2. Appreciate the designing of MAC protocol for Adhoc networks
3. Implement few protocols
4. Apply security principles for routing

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Introduction</b> 1.1 Introduction to wireless Networks. Characteristics of Wireless channel, Issues in Ad hoc wireless networks, Adhoc Mobility Models:- Indoor and outdoor models. 1.2 Adhoc Networks: Introduction to adhoc networks – definition, characteristics features, applications.	04
<b>02</b>	<b>MAC Layer</b> 2.1 MAC Protocols for Ad hoc wireless Networks: Introduction, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals and Classification of a MAC protocol, Contention based protocols with reservation mechanisms. 2.2 Scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15, 802.16, HIPERLAN.	10
<b>03</b>	<b>Network Layer</b> 3.1 Routing protocols for Ad hoc wireless Networks: Introduction, Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, Table driven routing protocol, On-demand routing protocol. 3.2 Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.	10
<b>04</b>	<b>Transport Layer</b> 4.1 Transport layer protocols for Ad hoc wireless Networks: Introduction, Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless	07



	Networks, Classification of transport layer solutions, TCP over Ad hoc wireless Networks, Other transport layer protocols for Ad hoc wireless Networks.	
<b>05</b>	<b>Security</b> 5.1 Security: Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning, Network security attacks, Key management, Secure routing in Ad hoc wireless Networks.	07
<b>06</b>	<b>QoS</b> 6.1 Quality of service in Ad hoc wireless Networks: Introduction, Issues and challenges in providing QoS in Ad hoc wireless Networks, Classification of QoS solutions, MAC layer solutions, network layer solutions.	07

### Term Work:

- Term work should consist of at least 12 experiments.
- Journal must include at least 2 assignments.
- The final certification and acceptance of term work indicates that performance in laboratory work is satisfactory and minimum passing marks may be given in term work.

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments): ..... (15) Marks.
- Assignment:..... (05) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

### Internal Assessment:

Internal Assessment consists of two tests. Test 1, an Institution level central test, is for 20 marks and is to be based on a minimum of 40% of the syllabus. Test 2 is also for 20 marks and is to be based on the remaining syllabus. Test 2 may be either a class test or assignment on live problems or course project

### Practical/Oral examination:

oral examination based on above syllabus will be conducted

#### Suggested Practicals for Adhoc Wireless

1. Installation of NS2 in Ubuntu 12.04 Linux.
2. Build and exchange data in simple infrastructure and Adhoc network by using personal computer and Android based mobile.
3. Develop sample wireless network in which
  - a. implement AODV and AOMDV protocol

- b. Calculate the time to receive reply from the receiver using NS2.
- c. Generate graphs which show the transmission time for packet.
4. Implement wireless network. Capture data frame and identify fields using NS2.
5. Configure Wireless Access Point (WAP) and build different networks.
6. Implement Mobile device as a wireless access point.
7. Communicate between two different networks which has following specifications:
  - a. One network has Class A network with “Tora protocol”
  - b. Second has Class B network “AODV protocol”

**Practical exam will be based on the above syllabus.**

### **Text Books:**

1. Siva Ram Murthy and B.S.Manoj, “Ad hoc Wireless Networks Architectures and protocols”, 2nd edition, Pearson Education, 2007
2. Charles E. Perkins, “Adhoc Networking”, Addison – Wesley, 2000
3. C. K. Toh, “Adhoc Mobile Wireless Networks”, Pearson Education, 2002

### **Reference Books:**

1. Matthew Gast, “802.11 Wireless Networks: The Definitive Guide”, 2nd Edition, O'Reilly Media, April 2005.
2. Stefano Basagni, Marco Conti, Silvia Giordan and Ivan Stojmenovic, “Mobile Adhoc Networking”, Wiley-IEEE Press, 2004.
3. Mohammad Ilyas, “The handbook of Adhoc Wireless Networks”, CRC Press, 2002

Course Code	Course/Subject Name	Credits
CPE8034	<b>Elective-III Digital Forensics</b>	5

**Objectives:**

1. To focus on the procedures for identification, preservation, and extraction of electronic evidence, auditing and investigation of network and host system intrusions, analysis and documentation of information gathered, and preparation of expert testimonial evidence.
2. To provide hands on experience on various forensic tools and resources for system administrators and information system security officers.

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Introduction:</b> 1.1 Introduction of Cybercrime: Types, The Internet spawns crime, Worms versus viruses, Computers' roles in crimes, Introduction to digital forensics, Introduction to Incident - Incident Response Methodology – Steps - Activities in Initial Response, Phase after detection of an incident.	09
<b>02</b>	<b>Initial Response and forensic duplication</b> 2.1 Initial Response & Volatile Data Collection from Windows system - Initial Response & Volatile Data Collection from Unix system - Forensic Duplication: Forensic duplication: Forensic Duplicates as Admissible Evidence, Forensic Duplication Tool Requirements, Creating a Forensic. 2.2 Duplicate/Qualified Forensic Duplicate of a Hard Drive.	08
<b>03</b>	<b>Preserving and Recovering Digital Evidence</b> 3.1 File Systems: FAT, NTFS - Forensic Analysis of File Systems - Storage Fundamentals: Storage Layer, Hard Drives Evidence Handling: Types of Evidence, Challenges in evidence handling, Overview of evidence handling procedure.	09
<b>04</b>	<b>Network Forensics</b> 4.1 Intrusion detection; Different Attacks in network, analysis Collecting Network Based Evidence - Investigating Routers - Network Protocols - Email Tracing- Internet Fraud.	07
<b>05</b>	<b>System investigation</b> 5.1 Data Analysis Techniques - Investigating Live Systems (Windows & Unix) Investigating 5.2 Hacker Tools - Ethical Issues – Cybercrime.	08
<b>06</b>	<b>Bodies of law</b> 6.1 Constitutional law, Criminal law, Civil law, Administrative regulations, Levels of law: Local laws, State laws, Federal laws, International laws , Levels of culpability: Intent, Knowledge, Recklessness, Negligence Level and burden of proof : Criminal versus civil cases ,Vicarious liability, Laws related to computers: CFAA, DMCA, CAN Spam, etc.	07

### **Term Work:**

- Term work should consist of at least 12 experiments.
- Journal must include at least 2 assignments.
- The final certification and acceptance of term work indicates that performance in laboratory work is satisfactory and minimum passing marks may be given in term work.

The distribution of marks for term work shall be as follows:

• Laboratory work (experiments): .....	(15)	Marks.
• Assignment: .....	(05)	Marks.
• Attendance .....	(05)	Marks
<b>TOTAL: .....</b>	<b>(25)</b>	<b>Marks.</b>

### **Internal Assessment:**

Internal Assessment consists of two tests. Test 1, an Institution level central test, is for 20 marks and is to be based on a minimum of 40% of the syllabus. Test 2 is also for 20 marks and is to be based on the remaining syllabus. Test 2 may be either a class test or assignment on live problems or course project.

### **Practical/Oral examination:**

**Oral exam will be based on the above syllabus.**

### **Text Books:**

1. Kevin Mandia, Chris Prorise, "Incident Response and computer forensics", Tata McGrawHill, 2006
2. Peter Stephenson, "Investigating Computer Crime: A Handbook for Corporate Investigations", Sept 1999
3. Eoghan Casey, "Handbook Computer Crime Investigation's Forensic Tools and Technology", Academic Press, 1st Edition, 2001

### **References:**

1. Skoudis. E., Perlman. R. Counter Hack: A Step-by-Step Guide to Computer Attacks and Effective Defenses. Prentice Hall Professional Technical Reference. 2001
2. Norbert Zaenglein, "Disk Detective: Secret You Must Know to Recover Information From a Computer", Paladin Press, 2000
3. Bill Nelson, Amelia Philips and Christopher Steuart, "Guide to computer forensics investigation "Course technology, 4th edition

Course Code	Course/Subject Name	Credits
CPE8035	<b>Elective III - Big Data Analytics</b>	5

**Objectives:**

1. To provide an overview of an exciting growing field of big data analytics.
2. To introduce the tools required to manage and analyze big data like Hadoop, NoSql Map-Reduce.
3. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
4. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

**Outcomes:** Learner will be able to...

1. Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
2. Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.
3. Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.
4. Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

Module	Detailed Contents	Hrs.
<b>01</b>	<b>Introduction to Big Data</b> 1.1 Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Case Study of Big Data Solutions.	03
<b>02</b>	<b>Introduction to Hadoop</b> 2.1 What is Hadoop? Core Hadoop Components; Hadoop Ecosystem; Physical Architecture; Hadoop limitations.	03
<b>03</b>	<b>NoSQL</b> 3.1 What is NoSQL? NoSQL business drivers; NoSQL case studies; 3.2 NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns; 3.3 Using NoSQL to manage big data: What is a big data NoSQL solution? Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; Four ways that NoSQL systems handle big data problems	04
<b>04</b>	<b>MapReduce and the New Software Stack</b> <b>4.1 Distributed File Systems :</b> Physical Organization of Compute Nodes, Large-Scale File-System Organization. <b>4.2 MapReduce:</b> The Map Tasks, Grouping by Key, The Reduce Tasks,	06

	<p>Combiners, Details of MapReduce Execution, Coping With Node Failures.</p> <p><b>4.3 Algorithms Using MapReduce:</b> Matrix-Vector Multiplication by MapReduce , 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, Matrix Multiplication, Matrix Multiplication with One MapReduce Step.</p>	
<b>05</b>	<p><b>Finding Similar Items</b></p> <p>5.1 Applications of Near-Neighbor Search, Jaccard Similarity of Sets, Similarity of Documents, Collaborative Filtering as a Similar-Sets Problem .</p> <p>5.2 <b>Distance Measures:</b> Definition of a Distance Measure, Euclidean Distances, Jaccard Distance, Cosine Distance, Edit Distance, Hamming Distance.</p>	03
<b>06</b>	<p><b>Mining Data Streams</b></p> <p><b>6.1 The Stream Data Model:</b> A Data-Stream-Management System, Examples of Stream Sources, Stream Query, Issues in Stream Processing.</p> <p><b>6.2 Sampling Data in a Stream :</b> Obtaining a Representative Sample , The General Sampling Problem, Varying the Sample Size.</p> <p><b>6.3 Filtering Streams:</b> The Bloom Filter, Analysis.</p> <p><b>6.4 Counting Distinct Elements in a Stream</b> The Count-Distinct Problem, The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements .</p> <p><b>6.5 Counting Ones in a Window:</b> The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm, Decaying Windows.</p>	06
<b>07</b>	<p><b>Link Analysis</b></p> <p>7.1 PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: PageRank Iteration Using MapReduce, Use of Combiners to Consolidate the Result Vector.</p> <p>7.2 Topic sensitive Page Rank, link Spam, Hubs and Authorities.</p>	05
<b>08</b>	<p><b>Frequent Itemsets</b></p> <p><b>8.1 Handling Larger Datasets in Main Memory</b> Algorithm of Park, Chen, and Yu, The Multistage Algorithm, The Multihash Algorithm.</p> <p><b>8.2 The SON Algorithm and MapReduce</b></p> <p><b>8.3 Counting Frequent Items in a Stream</b> Sampling Methods for Streams, Frequent Itemsets in Decaying Windows</p>	05
<b>09</b>	<p><b>Clustering</b></p> <p>9.1 CURE Algorithm, Stream-Computing , A Stream-Clustering Algorithm, Initializing &amp; Merging Buckets, Answering Queries</p>	05

<b>10</b>	<b>Recommendation Systems</b> 10.1 A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering.	04
<b>11</b>	<b>Mining Social-Network Graphs</b> 11.1 Social Networks as Graphs, Clustering of Social-Network Graphs, Direct Discovery of Communities, SimRank, Counting triangles using Map-Reduce	04

### Term Work:

Assign a case study for group of 2/3 students and each group to perform the following experiments on their case-study; Each group should perform the exercises on a large dataset created by them.

The distribution of marks for term work shall be as follows:

- Programming Exercises: ..... (10) Marks.
- Mini project: ..... (10) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

### Internal Assessment:

Internal Assessment consists of two tests. Test 1, an Institution level central test, is for 20 marks and is to be based on a minimum of 40% of the syllabus. Test 2 is also for 20 marks and is to be based on the remaining syllabus. Test 2 may be either a class test or assignment on live problems or course project.

### Practical/Oral examination:

An oral exam will be held based on the above syllabus.

**Suggested Practical List:** Students will perform at least 8 programming exercises and implement one mini-project. The students can work in groups of 2/3.

1. Study of Hadoop ecosystem
2. programming exercises on Hadoop
3. programming exercises in No SQL
4. Implementing simple algorithms in Map- Reduce (3) - Matrix multiplication, Aggregates, joins, sorting, searching etc.
5. Implementing any one Frequent Itemset algorithm using Map-Reduce
6. Implementing any one Clustering algorithm using Map-Reduce
7. Implementing any one data streaming algorithm using Map-Reduce
8. Mini Project: One real life large data application to be implemented (Use standard Datasets available on the web)

- a. Twitter data analysis
- b. Fraud Detection
- c. Text Mining etc.

### **Text Books:**

1. Anand Rajaraman and Jeff Ullman “Mining of Massive Datasets”, Cambridge University Press,
2. Alex Holmes “Hadoop in Practice”, Manning Press, Dreamtech Press.
3. Dan McCreary and Ann Kelly “Making Sense of NoSQL” – A guide for managers and the rest of us, Manning Press.

### **References:**

1. Bill Franks , “Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics”, Wiley
2. Chuck Lam, “Hadoop in Action”, Dreamtech Press



Course Code	Course/Subject Name	Credits
CPL801	<b>Cloud Computing Laboratory</b>	1

**Outcomes:** Learner will be able to...

1. Appreciate cloud architecture
2. Create and run virtual machines on open source OS
3. implement Infrastructure , storage as a Service.
4. Install and appreciate security features for cloud

Module	Detailed Contents	Lab Session
<b>01</b>	<p><b>Title:</b> Study of Cloud Computing &amp; Architecture.</p> <p><b>Concept:</b> Cloud Computing &amp; Architecture.</p> <p><b>Objective:</b> Objective of this module is to provide students an overview of the Cloud Computing and Architecture and different types of Cloud Computing</p> <p><b>Scope:</b> Cloud Computing &amp; Architecture Types of Cloud Computing .</p> <p><b>Technology:</b> ---</p>	<b>01</b>
<b>02</b>	<p><b>Title:</b> Virtualization in Cloud.</p> <p><b>Concept:</b> Virtualization</p> <p><b>Objective:</b> In this module students will learn, Virtualization Basics, Objectives of Virtualization, and Benefits of Virtualization in cloud.</p> <p><b>Scope:</b> Creating and running virtual machines on open source OS.</p> <p><b>Technology:</b> KVM, VMware.</p>	<b>02</b>
<b>03</b>	<p><b>Title:</b> Study and implementation of Infrastructure as a Service .</p> <p><b>Concept:</b> Infrastructure as a Service.</p> <p><b>Objective:</b> In this module student will learn Infrastructure as a Service and implement it by using OpenStack.</p> <p><b>Scope:</b> Installing OpenStack and use it as Infrastructure as a Service .</p> <p><b>Technology:</b> Quanta Plus /Aptana /Kompozer</p>	<b>02</b>
<b>04</b>	<p><b>Title:</b> Study and installation of Storage as Service.</p>	<b>02</b>

	<p><b>Concept:</b> Storage as Service (SaaS)</p> <p><b>Objective:</b> is that, students must be able to understand the concept of SaaS , and how it is implemented using ownCloud which gives universal access to files through a web interface.</p> <p><b>Scope:</b> is to installation and understanding features of ownCloud as SaaS.</p> <p><b>Technology:</b> ownCloud</p>	
05	<p><b>Title:</b> Implementation of identity management.</p> <p><b>Concept:</b> Identity Management in cloud</p> <p><b>Objective:</b> this lab gives an introduction about identity management in cloud and simulate it by using OpenStack</p> <p><b>Scope:</b> installing and using identity management feature of OpenStack</p> <p><b>Technology:</b> OpenStack</p>	02
06	<p><b>Title:</b> Write a program for web feed.</p> <p><b>Concept:</b> Web feed and RSS</p> <p><b>Objective:</b> this lab is to understand the concept of form and control validation</p> <p><b>Scope:</b> Write a program for web feed</p> <p><b>Technology:</b> PHP, HTML</p>	02
07	<p><b>Title:</b> Study and implementation of Single-Sing-On.</p> <p><b>Concept:</b> Single Sing On (SSO),openID</p> <p><b>Objective:</b> is to understand the concept of access control in cloud and single sing on (SSO), Use SSO and advantages of it, and also students should able to implementation of it.</p> <p><b>Scope:</b> installing and using JOSSO</p> <p><b>Technology:</b> JOSSO</p>	02
08	<p><b>Title:</b> Securing Servers in Cloud.</p> <p><b>Concept:</b> Cloud Security</p> <p><b>Objective:</b> is to understand how to secure web server, how to secure data directory and introduction to encryption for own cloud.</p>	02

	<p><b>Scope:</b> Installing and using security feature of ownCloud</p> <p><b>Technology:</b> ownCloud</p>	
09	<p><b>Title:</b> User Management in Cloud.</p> <p><b>Concept:</b> Administrative features of Cloud Managenet ,User Management</p> <p><b>Objective:</b> is to understand how to create, manage user and group of users accounts.</p> <p><b>Scope:</b> Installing and using Administrative features of ownCloud</p> <p><b>Technology:</b> ownCloud</p>	02
10	<p><b>Title:</b> Case study on Amazon EC2.</p> <p><b>Concept:</b> Amazon EC2</p> <p><b>Objective:</b> in this module students will learn about Amazon EC2. Amazon Elastic Compute Cloud is a central part of Amazon.com's cloud computing platform, Amazon Web Services. EC2 allows users to rent virtual computers on which to run their own computer applications</p>	01
11	<p><b>Title:</b> Case study on Microsoft azure.</p> <p><b>Concept:</b> Microsoft Azure</p> <p><b>Objective:</b> students will learn about Microsoft Azure is a cloud computing platform and infrastructure, created by Microsoft, for building, deploying and managing applications and services through a global network of Microsoft-managed datacenters. How it work, different services provided by it.</p> <p><b>Technology:</b> Microsoft azure</p>	01
12	<p><b>Title:</b> Mini project.</p> <p><b>Concept:</b> using different features of cloud computing creating own cloud for institute, organization etc.</p> <p><b>Objective:</b> is student must be able to create own cloud using different features which are learned in previous practices.</p> <p><b>Scope:</b> creating a cloud like social site for institute.</p> <p><b>Technology:</b> any open system used for cloud</p>	05

**Term Work:**

- Term work should consist of at least 6 experiments and a mini project.
- Journal must include at least 2 assignments.
- The final certification and acceptance of term work indicates that performance in laboratory work is satisfactory and minimum passing marks may be given in term work.

The distribution of marks for term work shall be as follows:

- Laboratory work (experiments): ..... (15) Marks.
- Mini project presentation: ..... (05) Marks.
- Attendance ..... (05) Marks
- TOTAL: ..... (25) Marks.**

**Text Books:**

1. Enterprise Cloud Computing by Gautam Shroff, Cambridge,2010
2. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley - India, 2010 , ISBN:978-0-470-58987-8
3. Getting Started with OwnCloud by Aditya Patawar , Packt Publishing Ltd, 2013
4. [www.openstack.org](http://www.openstack.org)

Course Code	Course/Subject Name	Credits
<b>CP701 / CP802</b>	<b>Project I/ II</b>	<b>3 / 6</b>

### **Guidelines for Project**

- o Students should do literature survey/visit industry/analyze current trends and identify the problem for Project and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem.
- o Students should attempt solution to the problem by experimental/simulation methods.
- o The solution to be validated with proper justification and report to be compiled in standard format.

### **Guidelines for Assessment of Project I**

- o Project I should be assessed based on following points
  - Quality of problem selected
  - Clarity of Problem definition and Feasibility of problem solution
  - Relevance to the specialization
  - Clarity of objective and scope
  - Breadth and depth of literature survey
- o Project I should be assessed through a presentation by the student project group to a panel of Internal examiners appointed by the Head of the Department/Institute of respective Programme.

### **Guidelines for Assessment of Project II**

- o Project II should be assessed based on following points
  - Quality of problem selected
  - Clarity of Problem definition and Feasibility of problem solution
  - Relevance to the specialization / Industrial trends
  - Clarity of objective and scope
  - Quality of work attempted
  - Validation of results
  - Quality of Written and Oral Presentation
- o Report should be prepared as per the guidelines issued by the University of Mumbai.
- o Project II should be assessed through a presentation by the student project group to a panel of Internal and External Examiners approved by the University of Mumbai
- o Students should be motivated to publish a paper based on the work in Conferences/students competitions