Program Structure for Third Year Computer Engineering
Semester-VI- Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) TH – P – TUT	Total (Hrs.)	Credits Assigned TH – P – TUT	Total Credits	Course Category
CEC601	System Programming & Compiler Construction	3– 0 – 0	03	3 – 0 – 0	03	PC
CEC602	Cryptography & System Security	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEC603	Mobile Computing	3– 0 – 0	03	3 – 0 – 0	03	PC
CEC604	Artificial Intelligence	3– 0 – 0	03	3 – 0 – 0	03	PC
CEDLC605	Department Level Elective -2	3 – 0 –0	03	3 – 0 – 0	03	DLE
CEL601	System Programming & Compiler Construction Lab	0 – 2 –0	02	0 –1 – 0	01	PC
CEL602	Cryptography & System Security Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEL603	Mobile Computing Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEL604	Artificial Intelligence Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEPR64	Project Based Learning - Minor Project Lab-II	0 – 2 – 0	02*	0 – 1 – 0	01	PBL
CEXS69	Skill Based Learning: Cloud Computing (SAT-IX)	0 – 2 – 0	02$	0 – 1 – 0	01	SAT
CEXT610	Technology Based Learning (SAT-X) Courses like Coursera, NPTEL etc.	0 – 2 – 0	02$	0 – 1 – 0	01	SAT
INT61	Internship-V	2 to 4 Weeks		--	--	INT
Total		**15-14-0**	**29**	**15 - 07 - 00**	**22**	

*Load of learner, not the faculty $SAT Hours are under Practical head but can be taken as Theory or Practical or both as per the need.

Minor Project I and II Students can form groups with minimum 2 (Two) andmaximum 4(Four)
Faculty Load: 1 hour per week per four groups

Semester-VI-Examination Scheme

Course Code	Course Name	Marks									
		CA				ESE	TW	O*	P	P&O	Total
		T-1	T-2	Average (T-1 & T-2)	IA						
CEC601	System Programming & Compiler Construction	30	30	30	10	60	--	--	--	--	100
CEC602	Cryptography & System Security	30	30	30	10	60	--	--	--	--	100
CEC603	Mobile Computing	30	30	30	10	60	--	--	--	--	100
CEC604	Artificial Intelligence	30	30	30	10	60	--	--	--	--	100
CEDLC605	Department Level Elective -2	30	30	30	10	60	--	--	--	--	100
CEL601	System Programming & Compiler Construction Lab	--	--	--	--	--	25	25	--	--	50
CEL602	Cryptography & System Security Lab	--	--	--	--	--	25	25	--	--	50
CEL603	Mobile Computing Lab	--	--	--	--	--	25	25	--	--	50
CEL604	Artificial Intelligence Lab	--	--	--	--	--	25	--	--	--	25
CEPR64	Project Based Learning - Minor Project Lab-II	--	--	--	--	--	25	--	--	25	50
CEXS69	Skill Based Learning: Cloud Computing (SAT-IX)	--	--	--	--	--	25	--	--	--	25
CEXT610	Technology Based Learning (SAT-X) Courses like Coursera, NPTEL etc.	--	--	--	--	--	25	--	--	--	25
INT61	Internship-V	--	--	--	--	--	--	--	--	--	--
Total		**150**	**150**	**150**	**50**	**300**	**175**	**75**	**--**	**25**	**775**

Department Level Electives

Department Optional Courses	Semester	Group (A, B, C, D)	Choice of Group
Department Level Elective -2	VI	CEDLC6051: Quantitative Analysis CEDLC6052: Multimedia System CEDLC6053: Infrastructure Security CEDLC6054: Digital Signal & Image Processing	Group A: Databases/Data Science Group B: Network & Communications Group C: Security / IoT / Blockchain Group D: AI/ ML/ DL

Course Code	Course Name	Credits (TH+P+TUT)
CEC601	System Programming & Compiler Construction	3-0-0

Prerequisite:	1. Data Structures 2. Theoretical computer science 3. Operating system 4. Computer Organization and Architecture 5. Microprocessor
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 how the analysis phase of the 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:	**After the successful completion of this course, the 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 lexical Analyser and different parsers. 6. Justify the need synthesis phase to produce object code optimized in terms of high execution speed and less memory usage.

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i.Prerequisite and Course Outline	Prerequisite Concept and Course Introduction		**02**	**02**
1. Introduction to System Software	Concept of System Software, Goals of system softwares, system program and system programming.	**CO1**	**01**	**02**
	Introduction to various system programs such as Assembler, Macro processor, Loader, Linker, Compiler, Interpreter, Device Drivers, Operating system, Editors, Debuggers.		**01**	
2. Assemblers	Elements of Assembly Language programming, Assembly scheme.	**CO2**	**02**	**08**
	Pass structure of assembler, Assembler Design: Two pass assembler Design		**04**	
	Single pass Assembler Design , data structures used.		**02**	
3. Macros and Macro Processor	Introduction, Macro definition and call, Features of Macro facility: Simple, parameterized, conditional and nested.	**CO3**	**03**	**06**
	Design of Two pass macro processor, data structures used.		**03**	

4. Loaders and Linkers	Introduction, functions of loaders, Relocation and Linking concept.	**CO4**	**01**	**03**
	Different loading schemes: Relocating loader, Direct Linking Loader, Dynamic linking and loading.		**02**	
5. Compilers: Analysis Phase	Introduction to compilers, Phases of compilers. Lexical Analysis- Role of Finite State Automata in Lexical	**CO5**	**02**	**11**
	Analysis, Design of Lexical analyser.		**02**	
	Data structures used Syntax Analysis- Role of Context Free Grammar in Syntax analysis, Types of Parsers: Top down parser- LL(1), Bottom up parser- SR Parser ,Operator precedence parser, SLR, Semantic Analysis, Syntax directed definitions.		**07**	
6. Compilers: Synthesis phase	Intermediate Code Generation: Types of Intermediate codes: Syntax tree, Postfix notation, Three address codes: Triples and Quadruples	**CO6**	**03**	**09**
	Code Optimization: Need and sources of optimization, Code optimization techniques: Machine Dependent and Machine Independent.		**03**	
	Code Generation: Issues in the design of code generator, code generation algorithm. Basic block and flow graph		**03**	
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	**01**
Total Hours				**42**

Books:	
Text Books	1. D. M Dhamdhere: 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 Com.
Reference Books	1. "Lex & yacc", 2nd Edition by John R. Levine, Tony Mason & Doug Brown O'Reilly 2. "Compiler construction", D. M. Dhamdhere 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:	
Continuous Assessment for 40 marks: 1. Test 1 – 30 marks 2. Test 2 –30 marks	

3. Internal assessment --10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits (TH+P+TUT)
CEC602	Cryptography & System Security	3-0-0

Prerequisite:	Computer Networks
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 4. To develop the ability to use existing cryptographic utilities to build programs for secure communication
Course Outcomes:	**At the end of the course, the students will be able to:** 1. Describe the concepts of modular arithmetic and number theory. 2. Apply different encryption and decryption techniques to solve problems related to confidentiality and authentication 3. Apply different message digest and digital signature algorithms to verify integrity and achieve authentication and design secure applications 4. Interpret network security basics, analyse different attacks on networks and evaluate the performance of firewalls and security protocols. 5. Analyse system security concept to recognize malicious code. 6. Develop system security aspects.

Module No. & Name	Sub Topics	CO Mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	**01**	**02**
1. Introduction - Number Theory and Basic Cryptography	Security Goals, Attacks, Services and Mechanisms, Techniques. Modular Arithmetic: Euclidean Algorithm, Fermat ‘s and Euler ‘s theorem	**CO1**	**02**	**08**
	Classical Encryption techniques, Symmetric cipher model,		**02**	
	Mono-alphabetic and polyalphabetic substitution techniques: Vigenère cipher, Playfair cipher, Hill cipher.		**03**	
	Transposition techniques: keyed and keyless transposition ciphers		**01**	

2. Symmetric and Asymmetric key Cryptography and key Management	Block cipher principles, block cipher modes of operation, DES, Double DES, Triple DES, Advanced Encryption Standard (AES). Stream Ciphers: RC4 algorithm, public	**CO2**	**03**	**11**
	key cryptography: Principles of public key cryptosystems-The RSA Cryptosystem.		**02**	
	The knapsack cryptosystem, Symmetric Key Distribution: KDC.		**02**	
	Needham-schroeder protocol. Kerberos: Kerberos Authentication protocol.		**02**	
	Symmetric key agreement: Diffie Hellman, Public key Distribution: Digital Certificate: X.509, PKI		**02**	
3. Cryptographic Hash Functions	Cryptographic hash functions, Properties of secure hash function.	**CO2**	**01**	**03**
	MD5, SHA-1, MAC, HMAC, CMAC		**02**	
4 Authentication Protocols & Digital Signature Schemes	User Authentication, Entity Authentication: Password Base.	**CO3,**	**01**	**05**
	Challenge Response Based, Digital Signature.		**01**	
	Attacks on Digital Signature, Digital Signature Scheme: RSA		**02**	
5 Network Security and Applications	Network security basics: TCP/IP vulnerabilities (Layer wise).	**CO4, CO5**	**02**	**09**
	Network Attacks: Packet Sniffing, ARP spoofing, port scanning, IP spoofing.		**02**	
	Denial of Service: DOS attacks, ICMP flood, SYN flood, UDP flood.		**02**	
	Distributed Denial of Service, Internet Security Protocols: PGP, SSL, IPSEC.		**02**	
	Network security: IDS, Firewalls.		**01**	
6 System Security	Buffer Overflow	**CO5, CO6**	**01**	**03**
	Malicious Programs: Worms and Viruses.		**01**	
	SQL injection		**01**	
ii. Course Conclusion	Recap of Modules, Outcomes, Application and Summarization.		**01**	**01**
Total Hrs:				**42**

Books:

Text Books	1. William Stallings, ***"Cryptography and Network Security, Principles and Practice"***, 6th Edition, Pearson Education, March 2013 2. Behrouz A. Ferouzan, ***"Cryptography & Network Security"***, Tata McGraw Hill 3. Behrouz A. Forouzan&DebdeepMukhopadhyay,***"Cryptography and Network Security"*** 3rd Edition, McGraw Hill
Reference Books	1. Bruce Schneier,***"Applied Cryptography, Protocols Algorithms and Source Code in C",*** Second Edition, Wiley. 2. AtulKahate, ***"Cryptography and Network Security",***Tata McGraw-Hill Education, 2003

	3. Eric Cole, ***"Network Security Bible",***Second Edition, Wiley, 2011

Assessment:

Continuous Assessment for 40 marks:

1.Test 1 – 30 marks
2.Test 2 – 30 marks
3.Internal assessment --10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits (TH+P+TUT)
CEC603	Mobile Computing	3-0-0
Prerequisite:	Computer Networks	
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:	**After the successful completion of this course, learner will be able to:** 1. Identify basic concepts and principles in computing, cellular architecture. 2. Describe the components and functioning of mobile networking. 3. Classify a variety of security techniques in mobile network. 4. Apply the concepts of WLAN for local as well as remote applications. 5. Describe Long Term Evolution (LTE) architecture and its interfaces. 6. Use of 5G technology.	

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction to Mobile Computing	Introduction to Mobile Computing, Telecommunication Generations, Cellular systems, Electromagnetic Spectrum, Antenna,	CO1	02	04
	Signal Propagation, Signal Characteristics, Multiplexing, Spread Spectrum: DSSS & FHSS, Co-channel interference		02	
2. GSM Mobile services	GSM Mobile services, System Architecture, Radio interface,	CO2	02	08
	Protocols, Localization and Calling, Handover, security (A3, A5 & A8)		02	
	GPRS system and protocol architecture UTRAN, UMTS core network; Improvements on Core Network		04	

3. Mobile Networking	Medium Access Protocol, Internet Protocol and Transport layer Mobile IP: IP Packet Delivery, Agent Advertisement	**CO3**	**02**	**07**
	Discovery, Registration, Tunneling and Encapsulation, Reverse Tunneling		**02**	
	Mobile TCP: Traditional TCP, Classical TCP Improvements like Indirect TCP, Snooping TCP & Mobile TCP		**03**	
4. Wireless Local Area Networks	**Wireless Local Area Networks:** Introduction, Infrastructure and ad-hoc network	**CO4**	**01**	**06**
	IEEE 802.11: System architecture , Protocol architecture , Physical layer, Medium access control layer, MAC management, 802.11a, 802.11b standard		**02**	
	Wi-Fi security : WEP ,WPA, Wireless LAN Threats ,Securing Wireless Networks Bluetooth: Introduction, User Scenario, Architecture, protocol stack		**03**	
5. Mobility Management	**Mobility Management :** Introduction, IP Mobility, Optimization, IPv6	**CO5**	**03**	**06**
	Macro Mobility : MIPv6, FMIPv6 Micro Mobility: CellularIP, HAWAII, HMIPv6		**03**	
6. Long-Term Evolution (LTE) of 3GPP & 5G	**Long-Term Evolution (LTE) of 3GPP :** LTE System Overview, Evolution from UMTS to LTE LTE/SAE Requirements, SAE Architecture	**CO6**	**02**	**08**
	EPS: Evolved Packet System, E-UTRAN, Voice over LTE (VoLTE), Introduction to LTE-Advanced		**02**	
	Self Organizing Network (SON-LTE), SON for Heterogeneous Networks (HetNet)		**02**	
	Introduction to 5G,5G architecture,5G Technology Generations (2G, 3G, 4G and 5G)		**02**	
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	--	**01**	**01**
Total Hours				**42**
Books:				

Text Books	1. Jochen Schilller, “Mobile Communication”, Addision wisely, Pearson Education 2. William Stallings “Wireless Communications & Networks”, Second Edition, Pearson Education 3. Christopher Cox, “An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G 4. Mobile Communications”, Wiley publications Raj Kamal, “Mobile Computing”, 2/e, Oxford Universit Press-New
Reference Books	1. Seppo Hamalainen, Henning Sanneck , Cinzia Sartori, “LTE Self-Organizing Networks (SON): Network Management Automation for Operational Efficiency”, Wiley publications 2. Ashutosh Dutta, Henning Schulzrinne “Mobility Protocol and Handover 3. Optimization: Design, Evaluation and Application”, IEEE Press, Wiley Publication 4. Michael Gregg, “Build your own security lab”, Wiley India edition 5. Dipankar Raychaudhuri, Mario Gerla, “Emerging Wireless Technologies and the 6. Future Mobile Internet”, Cambridge 7. Andreas F. Molisch, “Wireless Communications”, Second Edition, Wiley Publication
Useful Links:	
https://www.coursera.org/learn/smart-device-mobile-emerging-technologies	
Assessment:	
Continuous Assessment for 40 marks: 1. Test 1 – 30 marks 2. Test 2 – 30 marks 3. Internal assessment --10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty	
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.	

Course Code	Course Name	Credits (TH+P+TUT)
CEC604	**Artificial Intelligence**	**3-0-0**
Prerequisite:	1. Algorithm 2. Discrete structure 3. Data structure	
Course 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 enables 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	
Course Outcomes:	**At the end of the course, the students will be able to** 1. Describe the basic concepts of AI 2. Develop a basic understanding of AI building blocks presented in intelligent agents. 3. Choose an appropriate problem-solving method and knowledge representation technique. 4. Design models for reasoning with uncertainty as well as the use of unreliable information. 5. Analyze the strength and weaknesses of AI approaches to knowledge–intensive problem solving. 6. Design and develop AI applications in real world scenarios.	

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1.Introduction to Artificial Intelligence	Introduction, Intelligent Systems: Categorization of Intelligent System,	**CO1**	**01**	**03**
	Components of AI Program, Foundations of AI, Sub-areas of AI, Applications of AI, Current trends in AI.		**02**	
2. Intelligent Agents	Agents and Environments, the concept of rationality, the nature of environment, the structure of Agents, Types of Agents, Learning Agent	**CO2**	**03**	**05**
	Solving problem by Searching: Problem Solving Agent, Formulating Problems, Example Problems		**02**	
3. Problem solving	Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID)	**CO3**	**02**	**10**
	Informed Search Methods: Greedy best first Search, A* Search, Memory bounded heuristic Search		**03**	

	Local Search Algorithms and Optimization Problems: Hill climbing search Simulated annealing, Genetic algorithms		**03**	
	Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning		**02**	
4. Knowledge and Reasoning	Knowledge based Agents, Brief Overview of propositional logic	**CO5**	**02**	**11**
	First Order Logic: Syntax and Semantic, Inference in FOL, Forward chaining, backward Chaining. Knowledge Engineering in First-Order Logic, Unification, Resolution		**05**	
	Uncertain Knowledge and Reasoning: Uncertainty, Representing knowledge in an uncertain domain, The semantics of belief network, Simple Inference in belief network		**04**	
5. Planning and Learning	The planning problem, Planning with state space search, Partial order planning, Hierarchical planning, Conditional Planning	**CO5**	**03**	**05**
	Learning: Forms of Learning, Theory of Learning, PAC learning. Introduction to statistical learning (Introduction only) Introduction to reinforcement learning: Learning from Rewards, Passive Reinforcement Learning, Active reinforcement Learning		**02**	
6 Expert system & AI Applications	Expert system: Introduction, Characteristics, Architecture of ES, Hybrid Approach - Fuzzy Neural Systems	**CO6**	**02**	**05**
	Application: Language Models – Information Retrieval- Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition, Robotics - Robots, Robot hardware, Problems Robotics can solve ,AI applications in Healthcare, Retail, Banking		**03**	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization.	**--**	**01**	**01**
Total:				**42**

Books:	
Text Books	1. Stuart J. Russell and Peter Norvig, "***Artificial Intelligence: A Modern Approach***", Fourth Edition" Pearson Education, 2020. 2. Saroj Kaushik, "***Artificial Intelligence***", Cengage Learning, First edition, 2011 3. George F Luger, "***Artificial Intelligence***" Low Price Edition, Fourth edition, Pearson Education.,2005
Reference Books	1. Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.

	2. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication 3. Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson Education. 4. Elaine Rich and Kevin Knight, "***Artificial Intelligence***", Third Edition, McGraw Hill Education,2017.

Useful Links:

1. https://www.coursera.org/learn/introduction-to-ai

2.Artificial intelligence and expert systems: a ... - IEEE Xplorehttps://ieeexplore.ieee.org › document

Assessment:

Continuous Assessment for 40 marks:

1.Test 1 – 30 marks

2.Test 2 – 30 marks

3.Internal assessment --10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

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Course Code	Course Name	Credits (TH+P+TUT)
CEDLC6051	**Quantitative Analysis**	**3-0-0**
Prerequisite:	Applied Mathematics	
Course Objectives:	1. Introduction to the basic concepts in Statistics 2. Understand concept of data collection & sampling methods. 3. Introduction to Regression, Multiple Linear Regression 4. Draw interference using Statistical inference methods 5. Tests of hypotheses	
Course Outcomes:	**At the end of the course, the students should be able to..** 1. Recognize the need of Statistics and Quantitative Analysis 2. Apply the data collection and the sampling methods. 3. Analyze using concepts of Regression. 4. Analyze using concepts of Multiple Linear Regression. 5. Formulate Statistical inference drawing methods. 6. Apply Testing of hypotheses.	

Module No & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs /Modul
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1. Introduction to Statistics	Functions – Importance – Uses and Limitations of Statistics.	**CO1**	**02**	**06**
	Statistical data– Classification, Tabulation, Diagrammatic & Graphic representation of data Primary & Secondary data, Sources of data, Methods of collecting data.		**04**	
2. Data Collection & Sampling Methods	Sampling – Census & Sample methods –Methods of sampling, Probability Sampling and Non-Probability Sampling.	**CO2**	**04**	**06**
	Mathematical and Statistical Equation – Meaning of Intercept and Slope – Error term		**05**	
3. Introduction to Regression	Measure for Model Fit –R2 – MAE – MAPE.	**CO3**	**03**	**08**
	Multiple Linear Regression Model, Partial Regression Coefficients		**02**	
4. Introduction to Multiple Linear Regression	Testing Significance overall significance of Overall fit of the model, Testing for Individual Regression Coefficients	**CO4**	**02**	**08**
	Random sample -Parametric point estimation unbiasedness and consistence		**06**	
5. Statistical inference	Method of moments and method of maximum likelihood.	**CO5**	**03**	**06**
	Functions – Importance – Uses and Limitations of Statistics.		**03**	

6. Tests of hypotheses	Null and Alternative hypotheses. Types of errors.	**CO6**	**03**	**05**
	Neyman-Pearson lemma- MP and UMP tests.		**02**	
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	**01**
Total:				**42**

Books:	
Text Books	1. Agarwal, B.L. (2006):-Basic Statistics. Wiley Eastern Ltd., New Delhi 2005. 2. Gupta, S. P. (2011):-Statistical Methods. Sultanchand&Sons, New Delhi 3. Sivathanupillai, M &Rajagopal, K. R. (1979):-Statistics for Economics Students. 4. Hogg, R.V. and Craig, A.T.(2006), An introduction to mathematical statistics, Amerind publications.
Reference Books	1. Arora, P.N., SumeetArora, S. Arora (2007):- Comprehensive Statistical Methods. Sultan 2. Montgomery, D.C. , Peck E.A, & Vining G.G.(2003). Introduction to Linear Regression 3. Mood AM, Graybill FA, and Boes, D.C.(1985), Introduction to the theory of statistics, 4. Kapur, J.N. and Saxena, H.C.(1970), Mathematical statistics, Sultan Chand & company, New Delhi.
Assessment:	
Continuous Assessment for 40 marks: 1. Test 1 – 30 marks 2. Test 2 – 30 marks 3. Internal assessment --10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty	
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.	

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC6052	Multimedia System	3 - 0 – 0
Prerequisite:	Computer Fundaments and Graphics	
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. Identify basics of multimedia and multimedia system architecture. 2. Describe different multimedia components. 3. Explain file formats for different multimedia components. 4. Analyze the different compression algorithms. 5. Describe various multimedia communication techniques. 6. Apply different security techniques in multimedia environment.	

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topic	Total Hrs/ Module
i. Prerequisites and Course outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1.Introduction to Multimedia	Overview**:** Objects and Elements of Multimedia**,** Applications of Multimedia	**CO1, CO2**	**02**	**07**
	Multimedia Systems Architecture – IMA, Workstation, Network,Types of Medium (Perception, Representation)		**02**	
	Interaction Techniques:I/O devices - Salient features (Electronic Pen, Scanner, Digital Camera, Printers, plotters), Storage Media (Jukebox, DVD), Multimedia Databases		**03**	
2. Text & Digital Image	**Text:** Visual Representation, Digital Representation; File Formats: RTF, TIFF**;** Compression Techniques: Huffman Coding, RLE, CCITT group 3 1D.	**CO1, CO2**	**02**	**07**
	Digital: Digital Image Representation (2D format, resolution) Types of Images (monochrome, gray, color), examples of images (X-Ray, fractal, synthetic, acoustic). File formats: BMP, JPG	**CO2**	**02**	

	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	**CO1**	**03**	
3. Digital Audio	Basic Sound Concepts: computer representation of sound. File Formats – WAV, MPEG Audio. Compression: PCM, DM, DPCM.	**CO3**	**06**	**06**
4. Digital Video	Digitization of Video, types of video signals (component, composite and Svideo) File Formats: MPEG Video, H.261 Compression: MPEG	**CO4**	**06**	**06**
5. Multimedia Network Communication and Representation	Quality of Service, Multimedia over IP (RTP, RTSP, RTCP, RSVP)	**CO5**	**03**	**06**
	Representation- Authoring systems and user interface	**CO2**	**03**	
6. Multimedia Security	Requirements and properties; Mechanisms – Digital Signatures, Steganographic methods;Sample applications – unidirectional distributed systems, information systems, and conference systems	**CO6**	**07**	**07**
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	**01**
Total Hours				**42**

Books:	
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
Useful Links:	
1. https://nptel.ac.in/courses/117/105/117105081/ 2. https://nptel.ac.in/courses/117/105/117105081/ 3. http://www.cse.unsw.edu.au/~cs9519/lecture_notes_06/L1_COMP9519_4in1.pdf	
Continuous Assessment for 40 marks: 1.Test 1 – 30 marks	

2.Test 2 – 30 marks
3.Internal assessment --10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC6053	**Infrastructure Security**	3 - 0 – 0

Prerequisite:	Computer Networks, Operating System
Course Objectives:	1. To understand underlying principles of infrastructure security 2. To explore software vulnerabilities, attacks and protection mechanisms 3. To get familiar with security aspects of wireless network infrastructure and protocols 4. To investigate web server vulnerabilities and their countermeasures 5. To develop policies for security management and mitigate security related risks in the organization 6. To require knowledge of different security policies
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Apply the concept of vulnerabilities, attacks and protection mechanisms 2. Analyze software vulnerabilities and attacks on databases and operating systems 3. Use security protocols in the context of wireless communication 4. Apply various security solutions for Web and Cloud infrastructure 5. Evaluate different attacks on Open Web Applications and Web services 6. Design appropriate security policies to protect infrastructure components

Module No. & Name	Sub Topics	CO mapped	Hrs/ Sub topic	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1. Introduction	Cyber-attacks, Vulnerabilities, Defense Strategies and Techniques, Authentication Methods- Password, Token and Biometric, Access Control Policies and Models (DAC, MAC, RBAC, ABAC, BIBA, Bell LaPadula), Authentication and Access Control Services.	**CO1**	**05**	**05**
2. Software Security	Software Vulnerabilities: Buffer overflow, Format String, Cross-Site Scripting, SQL Injection, Malware: Viruses, Worms, Trojans, Logic Bomb, Bots, Rootkits.	**CO2**	**03**	**09**
	Operating System Security: Memory and Address Protection, File Protection Mechanism, User Authentication. Linux and Windows: Vulnerabilities, File System Security.		**03**	
	Database Security: Database Security Requirements, Reliability and Integrity, Sensitive Data, Inference Attacks, Multilevel Database Security.		**03**	

3. Wireless Security	Mobile Device Security- Security Threats, Device Security, GSM, UMTS, 4G and 5G Security, IEEE 802.11x Wireless LAN Security, VPN Security, Wireless Intrusion Detection System (WIDS).	**CO3**	**06**	**06**
4. Cloud Security	Cloud Security Risks and Countermeasures, Data Protection in Cloud, Cloud Application Security, Cloud Identity and Access Management, Cloud Security as a Service, SAML, OAuth.	**CO4**	**06**	**06**
5. Web Security	Web Security Considerations, Session Management, Cookies, SSL, HTTPS, SSH, Privacy on Web, Web Browser Attacks, Account Harvesting, Web Bugs, Click jacking, Cross- Site Request Forgery, Session Hijacking and Management.	**CO5**	**05**	**09**
	Phishing and Pharming Techniques, DNS Attacks, Web Service Security, Secure Electronic Transaction, Email Attacks, Web Server Security as per OWASP, Firewalls, Penetration Testing.		**04**	
6. Information Security and Risk Management	Security Policies, Business Continuity Plan, Risk Analysis, Incident Management, Legal System and Cybercrime, Ethical Issues in Security Management.	**CO6**	**04**	**04**
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	**01**
Total Hours				**42**

Books:

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. Web Application Hackers Handbook by Wiley 2. Computer Security, Dieter Gollman, Third Edition, Wiley 3. CCNA Security Study Guide, Tim Boyle, Wiley 4. Introduction to Computer Security, Matt Bishop, Pearson 5. Cloud Security and Privacy, Tim Mather, Subra Kumaraswamy, Shahed Latif , O'Riely

Useful Links:

1. https://nptel.ac.in/courses/106/106/106106129/
2. https://nptel.ac.in/courses/106/106/106106141/
3. https://nptel.ac.in/courses/106/106/106106178/
4. https://nptel.ac.in/courses/106/106/106106199/
5. https://www.coursera.org/learn/information-security-data

Assessment:

Continuous Assessment for 40 marks:

4. Test 1 – 30 marks
5. Test 2 – 30 marks
6. Internal assessment--10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Examination will be of 60 marks for 02 hrs 30 min duration

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC6054	**Digital Signal and Image Processing**	**3-0-0**
Prerequisite:	Applied Engineering Mathematics	
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 course, learners will be able to:** 1. Explain the concept of DT Signal and DT Systems 2. Analyze discrete time signals and systems 3. Implement Digital Signal Transform techniques DFT and FFT. 4. Explain the basics of image models and applications to image enhancement. 5. Apply the knowledge of different types of filters to process the image. 6. Apply the segmentation algorithms to images	

Module No & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1. Discrete-Time Signal and Discrete-Time System	Introduction to Digital Signal Processing, Sampling and Reconstruction	**CO1**	**02**	**10**
	Standard DT Signals, Concept of Digital, Frequency, Representation of DT signal using Standard DT Signals, Signal Manipulations (shifting, reversal, scaling, addition, multiplication).)		**03**	
	Classification of Discrete-Time Signals, Classification of Discrete- Systems Linear Convolution formulation for 1-D signal (without mathematical proof), Circular Convolution (without mathematical proof), Linear convolution using Circular Convolution. Auto and Cross Correlation formula evaluation		**03**	
	Concept of LTI system, Output of DT system using Time Domain Linear Convolution		**02**	

2. Discrete Fourier Transform	Introduction to DTFT, DFT, Relation between DFT and DTFT, IDFT,Properties of DFT without mathematical proof (Scaling and Linearity, Periodicity, Time Shift and Frequency Shift, Time Reversal,Convolution Property andParseval'sEnergy Theorem).	**CO2**	**03**	**05**
	DFT computation using DFT properties. Convolution of long sequences, Introduction to 2-D DFT		**02**	
3. Fast Fourier Transform	Need of FFT, Radix-2 DIT-FFT algorithm, DIT-FFT Flow graph for N=4 and 8	**CO3**	**02**	**04**
	Inverse FFT algorithm, Spectral Analysis using FFT		**02**	
4. Digital Image Fundamentals	Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization,	**CO4**	**02**	**05**
	Representation of Digital Image, Connectivity		**01**	
	Image File Formats: BMP, TIFF and JPEG		**02**	
5. Image Enhancement in Spatial domain	Gray Level Transformations, Zero Memory Point Operations,	**CO5**	**02**	**09**
	Histogram Processing, Histogram equalization,		**02**	
	Neighborhood processing, Image averaging, Image Subtraction, Smoothing Filters - Low pass averaging, Sharpening Filters-High Pass Filter, High Boost Filter, Median Filter for reduction of noise		**05**	
6. Image Segmentation	Fundamentals, Segmentation based on Discontinuities and Similarities	**CO6**	**01**	**06**
	Point, line and Edge Detection, Image edge detection using Robert, Prewitt and Sobel masks, Image edge Detection using Laplacian mask,		**03**	
	Region based segmentation: Region Growing, Region Splitting and Merging		**02**	
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	**01**
Total Hours				**42**

Books:	
Text Books	1. John G. Proakis, Dimitris and G .Manolakis, *"Digital Signal Processing: Principles,*Algorithms, and Applications", 4th Edition, Pearson Education, 2007 2. A. Anand Kumar, *"Digital Signal Processing*", 2nd Edition, PHI Learning Pvt. Ltd. 2014. 3. Rafel C. Gonzalez and Richard E. Woods, *"Digital Image Processing", Pearson* 4. Education Asia, 4th Edition, 2018 S. Sridhar*, "Digital Image Processing"*, 2nd Edition, Oxford University Press, 2012.

Reference Books	1. Sanjit Mitra, *"Digital Signal Processing: A Computer Based Approach",* 4th Edition, Tata McGraw Hill, 2013 2. S. Salivahanan, A. Vallavaraj, and C. Gnanapriya, *"Digital Signal Processing"*, 2nd Edition, Tata McGraw Hill Publication, 2011. *3.* S. Jayaraman, E. Esakkirajan and T. Veerkumar, *"Digital Image Processing", 3rd* Edition, Tata McGraw Hill Education Private Ltd, 2009. 4. Anil K. Jain, *"Fundamentals of Digital Image Processing",* 4th Edition, Prentice Hall of India Private Ltd,.1989
Useful Links:	
1.https://nptel.ac.in/courses/	
2.https://swayam.gov.in	
Assessment:	
Continuous Assessment for 40 marks: 1. Test 1 – 30 marks 2. Test 2 – 30 marks 3. Internal assessment --10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty	
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.	

Lab Code	Lab Name	Credits (P+TUT)
CEL601	System Programming and Compiler Construction Lab	1- 0

Lab Prerequisite:	1. Data Structures, 2. Theoretical computer science, 3. Operating system. 4. Computer Organization and Architecture, 5. Microprocessor
Lab Objectives:	1. The need for modular design. 2. The need for well-defined data structures and their storage management 3. The increase in the complexity of translators as we move from assembly level to high level programming 4. The need to produce an efficient machine code that is optimized for both execution speed and memory requirement.
Lab Outcomes (LOs):	**At the end of the course, the student 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 two pass macro processor and expand the macro. 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. 6. Explore various tools like LEX and YACC 7. Apply ethical principles like timeliness and adhere to the rules of the laboratory

Lab No	Experiment Title	LO mapped	Hrs/Lab
0	Prerequisite	-	**02**
1	Implementation of pass1 of two pass assembler	**LO1, LO7**	**02**
2	Implementation of pass2 of two pass aseembler	**LO1, LO7**	**02**
3	Implementation of two pass Macro Processor	**LO2, LO7**	**02**
4	Implementation of Lexical Analyzer	**LO3, LO7**	**02**
5	Implementation of Parser (Any one)	**LO4, LO7**	**02**
6	Implementation of Intermediate code generation phase of compiler	**LO5, LO7**	**02**
7	Implementation of code generation phase of compiler	**LO5, LO7**	**02**
8	Study and implement experiments on LEX.	**LO6, LO7**	**02**
9	Study and implement a parser using YACC	**LO6, LO7**	**02**
10	Implement a program to remove left recursion	**LO4, LO7**	**02**
11	Implement a program to find First and Follow	**LO4, LO7**	**02**

Term work:

1. Term work should consist of minimum 10 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course "System Programming & Compiler Construction"

3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

Oral :

Oral examination will be based on theory and practical syllabus of **CEL601 and CEC601**

Lab Code	Lab Name	Credits (P+TUT)
CEL602	**Cryptography & System Security Lab**	1- 0

Lab Prerequisite:	Computer Network.
Lab Objectives:	1. To apply various encryption techniques 2. To study and implement various security mechanism 3. To explore the network security concept and tools
Lab Outcomes (LOs):	**At the end of the course, the students will be able to..** 1. Apply the knowledge of symmetric and asymmetric cryptography to implement simple ciphers 2. Construct and analysis the RSA Cryptosystem. 3. Set up firewalls and intrusion detection systems using open-source technologies and to explore email security 4. Explore various attacks like buffer-overflow and web application attack. 5. Apply methods for authentication, access control, intrusion detection and prevention. 6. Identify and mitigate security vulnerabilities Cross-Cite Scripting 7. Apply ethical principles like timeliness and adhere to the rules of the laboratory

Lab No	Experiment Title	LO mapped	Hrs/ Lab
0	Prerequisite	-	**02**
1	Design and Implementation of a product cipher using Substitution and Transposition ciphers	**LO1, LO7**	**02**
2	Implementation and analysis of RSA cryptosystem	**LO2, LO7**	**02**
3	Implementation of Diffie Hellman Key exchange algorithm	**LO1, LO7**	**02**
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.	**LO3, LO7**	**02**
5	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, ns lookup to gather information about networks and domain registrars	**LO3, LO7**	**02**
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	**LO4, LO7**	**02**
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	**LO4, LO7**	**02**

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	**LO4, LO7**	**02**
9	Simulate DOS attack using Hping, hping3 and other tools	**LO4, LO7**	**02**
10	Simulate buffer overflow attack using Ollydbg, Splint, Cppchecketc	**LO5, LO7**	**02**
11	a. Set up IPSEC under LINUX. b. Set up Snort and study the logs	**LO5, LO7**	**02**
12	Setting up personal Firewall using iptables	**LO5, LO7**	**02**
13	Explore the GPG tool of linux to implement email security	**LO5, LO7**	**02**
14	SQL injection attack, Cross-Cite Scripting attack simulation	**LO6, LO7**	**02**
15	Case Study /Seminar: Topic beyond syllabus related to topics covered.	**LO5, LO7**	**02**

Term Work:

1 Term work should consist of 10 experiments.
2 Journal must include at least 2 assignments on content of theory and practical of "Cryptography and System Security"
3 The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4 The distribution of marks for term work shall be as follows:
Lab Performance : 20 Marks
Assignments 05 Marks
5 Final oral marks 25

Oral:

Oral exam will be based on theory and practical list **CEL602, CEC602**

Lab Code	Lab Name	Credits (P-TUT)
CEL603	Mobile Application Development Lab	1- 0
Lab Prerequisite:	Database Concepts	
Lab Objectives:	1. To learn the mobile computing tools and software for implementation. 2. To understand the security algorithms in mobile networks 3. To learn security concepts	
Lab Outcomes (LOs):	**At the end of the course, the student will be able to** 1. Develop and demonstrate mobile applications using various tools 2. Articulate the knowledge of GSM, CDMA & Bluetooth technologies and demonstrate it. 3. Demonstrate frequency reuse, hidden/exposed terminal problem 4. Implement security algorithms for mobile communication network 5. Demonstrate simulation and compare the performance of Wireless LAN 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory	

Lab No.	Experiment Title	LO mapped	Hrs/ Lab
0	Prerequisite	-	**02**
1	Implementation a Bluetooth network with application as transfer of a file from one device to another.	**LO2, LO6**	**02**
2	To implement a basic function of Code Division Multiple Access (CDMA).	**LO2, LO6**	**02**
3	Implementation of GSM security algorithms (A3/A5/A8)	**LO4, LO6**	**02**
4	Illustration of Hidden Terminal/Exposed terminal Problem. Consider two Wi-fi 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 irrespective of the distance of separation. To study how RTS/CTS helps in wireless networks, 1. No RTS/CTS is being sent. 2. Nodes do exchange RTS/CTS packets. Compare the no. of packet retransmissions required in both the cases (as obtained in the output) and compare the results.	**LO3, LO6**	**02**

5	To setup & configuration of Wireless Access Point (AP). 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.	**LO5, LO6**	**02**
6	Study of security tools (like Kismet,Netstumbler)	**LO4, LO6**	**02**
7	Develop an application that uses GUI components.	**LO1, LO6**	**02**
8	Write an application that draws basic graphical primitives on the screen.	**LO1, LO6**	**02**
9	Develop an application that makes use of databases.	**LO1, LO6**	**02**
10	Develop a native application that uses GPS location information.	**LO2, LO6**	**02**
11	Implement an application that creates an alert upon receiving a message.	**LO2, LO6**	**02**
12	Implementation of income tax/loan EMI calculator and deploy the same on real devices (Implementation of any real time application)	**LO2, LO6**	**02**

Term work:

1. Term work should consist of minimum 10 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course “Data Warehousing and Mining”
3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

Oral :
Oral examination will be based on a complete theory and practical syllabus **CEC603, CEL603**

Course Code	Course Name	Credits (P+TUT)
CEL604	**Artificial Intelligence Lab**	**1-0**

Prerequisite:	1.Algorithm 2.Discrete structure 3.Data structure
Course Objectives:	**1**.To realize the basic techniques to build intelligent systems 2.To apply appropriate search techniques used in problem solving 3.To create knowledge base for uncertain data
Lab Outcomes:	**At the end of the course, the students will be able to** 1. Identify languages and technologies for Artificial Intelligence 2. Apply uninformed and informed searching techniques for real world problems. 3. Create a knowledge base using any AI language 4. Apply machine learning techniques to solve for real world problem. 5. Apply ethical principles like timeliness and adhere to the rule of the laboratory

Lab No	Suggested experiment title	LO mapped	Hrs/ Lab
0	**Prerequisite**		**2**
1	Select a case study on AI applications published in IEEE/ACM/Springer or any prominent journal	**LO4, LO5**	**2**
2	Assignments on State space formulation and PEAS representation for various AI applications	**LO2,LO5**	**2**
3	Program on uninformed search methods	**LO1,LO2 , LO5**	**2**
4	Program on informed search methods.	**LO1,LO2, LO5**	**2**
5	Program on Local Search Algorithm.	**LO1,LO2, LO5**	**2**
6	Program on Game playing (adversarial search.) algorithms.	**LO1,LO2, LO5**	**2**
7	Program on unification	**LO1,LO3, LO5**	**2**
8	Program to create knowledgebase	**LO1,LO3,LO5**	**2**
9	Implantation of any one type of Planning	**LO1,LO3, LO5**	**2**
10	Implementation for Bayes Belief Network	**LO1,LO4, LO5**	**2**
11	Program on machine learning-supervised learning	**LO1,LO4, LO5**	**2**
12	Program on reinforcement learning-passive or active learning	**LO1,LO4, LO5**	**2**

Books:	
Text Books	1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition 2. Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2, 3rd Edition

Useful Links:

1.https://www.tutorialspoint.com/artificial_intelligence_with_python/artificial_intelligence_with_python_tutorial.pdf

2. https://stacks.stanford.edu/file/druid:qn160ck3308/qn160ck3308.pdf

3. https://freecomputerbooks.com/Artificial-Intelligence-with-Python.html
Term work:
1. Term work should consist of minimum 10 experiments 2. Journal must include at least 2 assignments on the content of theory and practical of the course “Artificial Intelligence” 3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work. 4. Total 25 Marks (Experiments: 20-marks, Assignments: 05-marks)

Course Code	Course Name	Credits (P+TUT)
CEPR64	**Project-Based Learning: Minor-Project – II**	**1-0**

PBL Objectives:	1. To understand and identify the problem statement. 2. To apply basic engineering fundamentals and attempt to find solutions to the problems. 3. Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach 4. To develop communication skills and improve teamwork amongst group members and inculcate the process of self-learning and research.
PBL Outcomes (LOs):	**After completion of this course students will be after to.** 1. Identify societal/research/innovation/entrepreneurship problems through appropriate literature surveys 2. Identify Methodology for solving above problem and apply engineering knowledge and skills to solve, validate the results using test cases/benchmark data/theoretical/references/experiments/simulations 3. Use standard norms of engineering practices and project management principles to analyze and evaluate the impact of solution/product/research/innovation /entrepreneurship towards societal/environmental/sustainable development. 4. Communicate through technical report writing and oral presentations. 5. The work may result in research/white paper/ article/blog writing and publication ● The work may result in business plan for entrepreneurship product created ● The work may result in patent filing. 6. Gain technical competency towards participation in Competitions, Hackathons, etc. 7. Demonstrate capabilities of self-learning, leading to lifelong learning to develop interpersonal skills to work as a member of a group or as leader.

Guidelines for Minor Project-II	
1	Minor 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 (frontend-backend) and hardware, statistical data analysis, creating awareness in society/environment etc.
2	Students shall form a group of 3 students, as it is a group activity.
3	Students should do survey and identify needs, which shall be converted into problem statement for minor project in consultation with faculty supervisor/head of department/internal committee of faculties.
4	Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of minor project.

5	The work may result in research/white paper/ article/blog writing and publication and also the work may result in business plan for entrepreneurship product created. The work may result in patent filing.
6	Faculty supervisor may give inputs to students during minor project activity; however, focus shall be on self-learning.
7	Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
8	Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
9	The solution to be validated with proper justification and report to be compiled in standard Format. Software requirement specifications (SRS) documents, research papers, competition certificates may be submitted as part of annexure to the report.
10	With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Minor Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Minor Project I & II in semesters V and VI.
11	However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Minor Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Minor Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.
Term Work:	
The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of minor project to be evaluated on continuous basis, based on the SRS document submitted. minimum two reviews in each semester.	
In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions. Also based on the Log Book maintained by the students.	

Distribution of Term work marks for both semesters shall be as below:		**Marks**
1	Marks awarded by guide	10
2	Marks awarded by review committee	10
3	Quality of Project report	05
Review / progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines		

One-year project:	
1	In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group. • First shall be for finalization of problem • Second shall be on finalization of proposed solution of problem.

2	In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester. • First review is based on readiness of building working prototype to be conducted. • Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.
Half-year project:	
1	In this case in one semester students' group shall complete project in all aspects including, • Identification of need/problem • Proposed final solution • Procurement of components/systems • Building prototype and testing
2	Two reviews will be conducted for continuous assessment, • First shall be for finalization of problem and proposed solution • Second shall be for implementation and testing of solution.
Assessment criteria of Minor Project.	
Minor Project shall be assessed based on following criteria;	
1	Clarity of problem and quality of literature Survey for problem identification
2	Requirement gathering via SRS/ Feasibility Study
3	Completeness of methodology implemented
4	Design, Analysis and Further Plan
5	Novelty, Originality or Innovativeness of project
6	Societal / Research impact
7	Effective use of skill set : Standard engineering practices and Project management Standard
8	Contribution of an individual's as member or leader
9	Clarity in written and oral communication
10	Verification and validation of the solution/ Test Cases
11	Full functioning of working model as per stated requirements
12	Technical writing /competition/hackathon outcome being met
In one year project (sem V and VI), first semester evaluation may be based on first 10 criteria and remaining may be used for second semester evaluation of performance of students in mini projects.	
In case of half year projects (completing in VI sem) all criteria's in generic may be considered for evaluation of performance of students in minor projects.	
Guidelines for Assessment of Minor Project Practical/Oral Examination:	
1	Report should be prepared as per the standard format.
2	Minor Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by the head of Institution.
3	Students shall be motivated to publish a paper/participate in competition based on the work in Conferences/students competitions.

Exposure Course Code	Exposure Course Name	Credits (P+TUT)
CEXS69	**Skill Based Learning: Cloud Computing (SAT-IX)**	**1-0**

Skill Prerequisite:	1. Concepts of Operating Systems 2. Concepts of Web Application
Skill Objectives:	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.
Skill Outcomes (SOs):	**On completion of the course learners will be able to..** 1. Adapt different types of virtualizations 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 using modern tools like AWS, GCP, Digital Ocean, MS Azure, etc. 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory

Lab No.	Experiment Title	LO mapped	Hrs/ Lab
0	Lab Prerequisites	**-**	**02**
1	**Title:** Study of NIST model of cloud computing. **Objective:** Understand deployment models, service models, advantages of cloud computing.	**LO1, LO6**	**02**
2	**Title:** Virtualization. **Objective**: Understand different types of virtualizations, Host and bare metal hypervisors and implement horizontal scalability. **Technology:** XEN/ Vmwares EXSi	**LO1, LO6**	**02**
3	**Title:** Infrastructure as a Service. **Objective:** Implement IaaS using your resources. **Technology:** Open Stack / Eucalyptus	**LO2, LO6**	**02**
4	**Title:** Identity Management in Cloud **Concept:** Simulate identity management in your private cloud. **Technology:** Open Stack	**LO3, LO6**	**02**
5	**Title:** Storage as a Service **Objective:** Explore Storage as a Service for remote file access using web interface. **Technology:** ownCloud	**LO5, LO6**	**02**
6	**Title:** Cloud Security **Objective:** Understand security of web server and data directory. **Technology:** ownCloud, etc	**LO3, LO6**	**02**
7	**Title:** Platform as a Service **Objective:** Deploy web applications on commercial cloud. **Technology:** Google appEngine/ Windows Azure	**LO4, LO5, LO6**	**02**

8	**Title:** Amazon Web Service, etc. **Objective:** To create and access VM instances and demonstrate various components such as EC2, S3, Simple DB, DynamoDB. **Technology:** AWS	**LO5, LO6**	**02**
9	**Title:** Software as a Service **Objective:** Understand on demand application delivery and Virtual desktop infrastructure. **Technology:** Ulteo	**LO5, LO6**	**02**
10	**Title:** Case study on Fog Computing **Objective**: To have a basic understanding of implementation/applications of fog computing.	**LO5, LO6**	**02**

Textbooks:

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

Virtual Lab / Internet Resource Links:

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
2. https://www.coursera.org/specializations/cloud-computing
3. www.openstack.org
4. https://www.digitalocean.com/

Term Work:

Term Work for 25 marks:

Programming labs to be conducted as 2hrs continuous theory + hands-on session. The assessment will be

- An online quiz conducted at the end of every 2-hr session consisting of 5 questions for a total of 10 marks. The average of best 10 quizzes will be considered toward 10 marks out of 25.
- Students should perform minimum 8 experiments. The programs performed along with the screenshot of output have to be submitted within two days. A cover page will be attached stating the aims and objectives. This will be considered towards 10 marks.

Exposure Course Code	Exposure Course Name	Credits
CEXT610	Technology Based Learning (SAT-X) Courses like Coursera, NPTEL etc.	01

Prerequisite:	Basic Engineering and Technology courses.
TBL Objectives:	1. To acquire competency in emerging areas of technology. 2. To create a mindset for life-long learning required to persist technological shifts and be abreast with the market trends. 3. To facilitate learning at self-paced schedules. 4. To boost time management ability and self-discipline. 5. To provide opportunities of strengthening digital footprints by showcasing the additional proficiency acquired as well as improve connectivity and networking. 6. To enhance employment and entrepreneurial opportunities requiring specialization.
TBL Outcomes:	1. Explain concepts of the emerging technology learned through the pursued course. 2. Describe social, ethical, and legal issues surrounding the learned technology. 3. Demonstrate professionalism and skills of digital age learning and working. 4. Demonstrate knowledge in entrance exams for higher technical education, placement interviews, and other avenues. 5. Analyze real-world case studies in society/industry for applicability of sustainable technological solutions. 6. Apply the acquired knowledge in developing technology-based solutions to real-world problems or other projects at hand.

Guidelines for Technology Based Learning:

1. Learners should enrol for an online course based on their area of interest concerning emerging areas of technology in consultation with Faculty Supervisor nominated by the Head of Department.
2. The course duration should be of minimum 04 weeks.
3. Students should watch all the videos of the course to learn the course in-depth and entirety.
4. Students should solve weekly assignments that are to be submitted online within the prescribed deadline.
5. Students should register and appear for the course certification exam on scheduled date and time.
6. Students should submit the certificate of course completion to the Faculty Supervisor.
7. Faculty Supervisor shall monitor students' participation and progress at every stage — from course enrolment to certification.

Useful Links:

1. https://swayam.gov.in
2. https://www.nptel.ac.in
3. https://www.coursera.org

Term Work:

Term Work shall be conducted for Total 25 Marks based on the following rubrics:

Performance Level	**Not Qualifying**	**Poor**	**Acceptable**	**Good**	**Excellent**
Marks	00	08	12	16	20
Compliance Status	Not Enrolled for any Course or Not Completed Course	Completed Course, Not Attempted Certification but Completed all Assignments.	Obtained Passing Grade or 40% of Total Score in Certification Exam **OR** Completed all Assignments with Score Above 70%.	Obtained First Class Grades or 60% of Total Score	Obtained Elite Grade or 75% of Total Score

Internship Code	Internship Name	Hours/Duration	Credits
INT65	**Internship-V**	**80-160 hrs (2-4 Weeks)**	

Prerequisite:	List of probable industries and organizations offering internships on live projects. Awareness about probable solutions for identified problem areas in rural India
Internship Objectives:	1. To understand the social, economic and administrative considerations of working environment in industries, government, NGOs and private organizations. 2. Learn to apply the Technical knowledge for solving real life problems.
Internship Outcomes:	**Upon completion of the course, students will be able to:** 1. Get an opportunity to get hired by the Industry/ organization. 2. Decide if working in the industry or set up a start-up would be best career option to pursue.

Activity- Rural Internships & Internships	**Supporting Activities to be completed under Internship**
	1. Long Term Goal under Rural Development Internships or
	2. Mandatory internship for developing project with:
	● Industries
	● Government Sector
	● Non-governmental Organization (NGO)
	● MSMEs

Term Work Assessment:

Duration to be considered for assessment:
Week Ends/ Semester Break/End of Semester (After ESE & Before Next Term Start)

Guidelines:	1. Batch wise Faculty Supervisor who is the proctor (mentor) of the batch will be allotted as in-charge for the course, at start of the Academic year. 2. Students will submit the participation certificate of the activities to the faculty mentors. 3. For working in cells related activities, Cell coordinator will submit list of actively involved & participated students of each department, semester wise to all department HODs, verified and authenticated by Dean Students Welfare. 4. HODs will circulate the student list to all faculty mentors for consideration of Hours spends under mentioned department activities. 5. Department IIIC Cell coordinator will collect, maintain each student proofs/reports from all faculty mentors, department internship analysis report will be prepared & submitted to Dean, IIIC for AICTE-CII survey data 6. Students will submit evaluation sheet by attaching Xerox copies of all participation/ IPR/ Copyright certificates & faculty mentor will verify it with original copies, for assessment purpose.