SOMAIYA
VIDYAVIHAR
K J Somaiya Institute of Technology
An Autonomous Institute Permanently Affiliated to the University of Mumbai

Autonomy Syllabus Scheme III (2023-24)

(As per NEP 2020 Guidelines)

for

Four Year Multidisciplinary

Bachelors of Technology (B.Tech.) Computer Engineering

with

Multiple Entry and Multiple Exit Options

Levels 4.5 - 6

(First Year Effective from A.Y. 2023-24,
Second Year Effective from A.Y. 2024-25,
Third Year Effective from A.Y. 2025-26,
Last Year Effective from A.Y. 2026-27)

Nomenclature and Alignment of Verticals and Components

Verticals as per NEP 2020 Guidelines	Components Aligning with KJSIT Autonomy Syllabus Scheme I / II / II B	Nomenclature for KJSIT Autonomy Syllabus Scheme III Aligned with NEP 2020 Guidelines
Basic and Engineering Science Courses	Basic Science (BS) Course	Basic Science (BS) Courses
	Engineering Science (ES) Course	Engineering Science (ES) Courses
Major Courses	Professional Core (PC) Courses	Major / Professional Core (PC) Courses
	Professional Elective - Department-level (PE-DLC) Courses	Major / Professional Elective - Department-level (PE-DLC) Courses
Generic / Open Elective Courses	Open Elective - Institute-level (OE-ILC) Courses	Open Elective - Institute-level (OE-ILC) Courses
Multidisciplinary Minor Courses	-	Multidisciplinary Minor (MM) Courses
Vocational Skill Courses	Workshop I; Workshop II; SAT Courses – TBL	Vocational Skill - SAT (VS-SAT) Courses
Skill Enhancement Courses	SAT Courses – SBL (Program Specific)	Skill Enhancement - SAT (SE-SAT) Courses
Ability Enhancement Courses	Professional Communication Skills; SAT Course – SBL (Foreign and/or Indian Modern Languages)	Ability Enhancement - SAT (AE - SAT) Courses
Indian Knowledge System Courses	-	Indian Knowledge System - SAT (IKS - SAT) Courses
Value Education Courses	SAT Course – ABL (National, Global, Societal and Environmental Aspects); Business Communication & Ethics	Value Education - SAT (VE - SAT) Courses
Field Projects / Community Engagement Projects	PBL – Mini, Minor, Major	Community Engagement – Project-Based Learning (PBL)
Internship / Apprenticeship	Internship	Internship (INT)
Co-curricular Courses	Student Induction Program	Co-curricular - SAT (CC - SAT) Courses

Other Abbreviations:

- SAT – Skill/Activity/Technology-Based Learning (Exposure Courses)
- TH – Theory
- P – Practical
- TUT – Tutorial
- T1 – Test 1
- T2 – Test 2
- CA – Continuous Assessment Test (T = T1 + T2)
- ESE – End Semester Exam
- TW – Term Work
- O – Oral Exam , P – Practical Exam , P&O – Practical & Oral Exam

SEMESTER VI
TEACHING SCHEME

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		Course Category
		TH – P – TUT	Total	TH – P – TUT	Total	
CEC601	System Programming & Compiler Construction	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEC602	Deep Learning	3 – 0 – 0	03	3 – 0 – 0	03	PC
CEDLC603	Major / Professional Elective - Department-level Course – II	3 – 0 – 0	03	3 – 0 – 0	03	PE-DLC
CEC604	Multidisciplinary Minor Course	3 – 0 – 0	03	3 – 0 – 0	03	MM
ILC605	Open Elective - Institute-level – I	3 – 0 – 0	03	3 – 0 – 0	03	OE-ILC
CEL601	System Programming & Compiler Construction Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEL602	Deep Learning Lab	0 – 2 – 0	02	0 – 1 – 0	01	PC
CEDLL603	Major / Professional Elective - Department-level Lab – II	0 – 2 – 0	02	0 – 1 – 0	01	PE-DLC
CEPR64	Community Engagement PBL – Innovation-Based Major Project A	0 – 6 – 0	06[$]	0 – 3 – 0	03	PBL
CEXT612	Vocational Skill – SAT XII: Technology-Based Learning: Cloud Computing Lab	0 – 4[*] – 0	04	0 – 2 – 0	02	VS-SAT
Total		**15 – 16 – 0**	**31**	**15 – 8 – 0**	**23**	

[*]SAT can be conducted as TH or P or both as required. [$]Load of learner, not the faculty.
[**]02 Hours class-wise and 02 Hours batch-wise.

Professional Electives - Department Level Elective Courses and Labs (PE-DLC – II)

Group A: Databases/ Data Science	Group B: Network and Communications	Group C: Security/ IoT/ Blockchain	Group D: AI/ML/DL
CEDLC6031: Quantitative Analysis	CEDLC6032: Multimedia Systems	CEDLC6033: Infrastructure Security	CEDLC6034: Artificial Intelligence and Soft Computing
CEDLL6031: Quantitative Analysis Lab	CEDLL6032: Multimedia Systems Lab	CEDLL6033: Infrastructure Security Lab	CEDLL6034: Artificial Intelligence and Soft Computing Lab

EXAMINATION SCHEME

Course Code	Course Name	CA Marks			ESE		TW / O / P Marks				Total Marks
		T1	T2	T = T1 + T2	Marks	Duration (in Hrs)	TW	O	P	P&O	
CEC601	System Programming & Compiler Construction	20	20	40	60	2.5	-	-	-	-	100
CEC602	Deep Learning	20	20	40	60	2.5	-	-	-	-	100
CEDLC603	Major / Professional Elective - Department-level Course – II	20	20	40	60	2.5	-	-	-	-	100
CEC604	Multidisciplinary Minor Course	-	-	-	-	-	50	50	-	-	100
ILC605	Open Elective - Institute-level – I	20	20	40	60	2.5	-	-	-	-	100
CEL601	System Programming & Compiler Construction Lab	-	-	-	-	-	25	-	-	25	50
CEL602	Deep Learning Lab	-	-	-	-	-	25	-	25	-	50
CEDLL604	Major / Professional Elective - Department-level Lab – II	-	-	-	-	-	25	-	-	-	25
CEPR64	Community Engagement PBL – Innovation-Based Major Project A	-	-	-	-	-	25	-	-	50	75
CEXT612	Vocational Skill – SAT XII: Technology-Based Learning: Cloud Computing Lab	-	-	-	-	-	50	-	-	-	50
Total		**80**	**80**	**160**	**240**	**-**	**200**	**50**	**25**	**75**	**750**

Professional Electives - Department Level Elective Courses and Labs (PE-DLC – II)

Group A: Databases/ Data Science	Group B: Network and Communications	Group C: Security/ IoT/ Blockchain	Group D: AI/ML/DL
CEDLC6031: Quantitative Analysis	CEDLC6032: Multimedia Systems	CEDLC6033: Infrastructure Security	CEDLC6034: Artificial Intelligence and Soft Computing
CEDLL6031: Quantitative Analysis Lab	CEDLL6032: Multimedia Systems Lab	CEDLL6033: Infrastructure Security Lab	CEDLL6034: Artificial Intelligence and Soft Computing Lab

Institute Level Electives

Institute level Optional Courses	Semester	Subject
Institute Optional Course -1	VI	ILC6051: Product Lifecycle Management ILC6052: Reliability Engineering ILC6053: Management Information System ILC6054: Design of Experiments ILC6055: Operation Research ILC6056: Cyber Security and Laws ILC6057: Disaster Management and Mitigation Measures ILC6058: Energy Audit and Management ILC6059: Development Engineering

Course Code	Course Name	Credits (TH+P+TUT)
CEC601	**System Programming and 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 and Describe the various phases of Compiler 2. Use different compiler tools like LEX and YACC 3. Understand the parser and its types i.e. Top-Down and Bottom-up parsers and construction of LL, SLR, CLR, and LALR parsing table. 4. Justify the need synthesis phase to produce object code optimized in terms of high execution speed and less memory usage. 5. Understand the target machine’s run time environment, its instruction set for code generation and techniques used for code optimization. 6. Understand use of machine learning to design smarter, self-tuning compilers.

Module	Content	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
1.Introduction to System Software	Concept of System Software, Goals of system software, 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.	**CO1**	**03**	**07**
	Introduction to Compiler: Phases and passes, Bootstrapping, Finite state machines and regular expressions and their applications to lexical analysis, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical-analyzer generator.		**04**	
2.Compiler	LEX compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC.	**CO2**	**04**	**07**
	The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG.		**03**	
3. Parsers	Basic Parsing Techniques: Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items.	**CO3**	**03**	**07**

	Constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables.		**04**	
4.Syntax-directed Translation	Syntax-directed Translation schemes, Implementation of Syntax-directed Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser.	**CO4**	**05**	**07**
	More about translation: Array references in arithmetic expressions, procedures call, declarations and case statements.		**02**	
5.Code Generation: & **Optimization**	Code Generation: Design Issues, the Target Language. Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Code Generator.	**CO5**	**04**	**07**
	Code optimization: Machine- Independent Optimizations, Loop optimization, DAG representation of basic blocks, value numbers and algebraic laws, Global Data-Flow analysis.		**03**	
6. AI/ML based Compilers:	Machine Learning–based compiler heuristics, Reinforcement learning for optimization pipelines, Predictive modelling for cost & performance estimation	**CO6**	**04**	**07**
	Neural program optimizers (e.g., AlphaDev-style search), Generative models assisting code transformations, Compilers for AI models		**03**	
Total Hours				**42**

Books:

Text Books	1. D. M Dhamdhere, "Systems programming", Tata McGraw Hill. 2. J.P. Bennet, "Introduction to Compiler Techniques", Second Edition, McGraw-Hill,2003. 3. Henk Alblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001. 4. V Raghvan, " Principles of Compiler Design", McGraw-Hill.
Reference Books	1. Aho, Sethi & Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education 2. K. Muneeswaran, Compiler Design, First Edition, Oxford University Press 3. J.P. Bennet, "Introduction to Compiler Techniques", Second Edition, McGraw-Hill,2003. 4. Henk Alblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001.

Assessment:

Continuous Assessment for 40 marks:
1. Test 1 – 20 marks
2. Test 2 –20 marks

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

Course Code	Course Name	Credits (TH+P+TUT)
CEC602	**Deep Learning**	3 - 0 – 0

Prerequisite:	1. Machine Learning 2. Basic Mathematics and Statistics Concepts
Course Objectives:	1. To acquire knowledge of the basic concepts of Neural Network & Deep Learning 2. To design the Deep Neural Network and layered learning approach 3. To explain the concept of Convolution Neural Network and Recurrent Neural Network 4. To explore advanced technology in Deep Neural Network through various applications
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Explain the fundamentals concepts of Deep Neural networks 2. Perceive the role of Multilayer feed forward Network into Deep Neural Network 3. Comprehend the meaning of Regularization and Optimization for deep Learning 4. Describe the concept of Convolution Neural Network 5. Explore the concept of Recurrent Neural Network and Transformer-based models. 6. Describe Auto Encoder and Generative AI in Deep Learning

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
1.**Introduction to Deep Learning**	Biological neuron, Mc-Culloch Pitts Neuron, Perceptron, Perceptron Learning, Multilayer Perceptron: Linearly separable, linearly non-separable classes	**CO1**	**03**	**06**
	Deep Networks: Fundamental, Key Characteristics, History & evolution: Traditional ANN, Three Classes of Deep Learning, Applications of Deep Learning, Challenges & Limitations of Deep Learning		**03**	
2. Multilayer Feedforward Network	Multi Layered Feed Forward Neural Network, Generalized delta learning rules, Feedforward recall, Error backpropagation training	**CO2**	**03**	**07**
	Learning factors, Training and convergence-Practical and Designs issues, Activation functions: Linear, Softmax, ReLU, Leaky ReLU, GELU, Swish, Mish; Loss functions: Squared Error loss, Cross Entropy, Choosing output function and loss function		**04**	
3. Regularization and Optimization for Deep Learning	Regularization: Overfitting, Dropout, Parameter Norm Penalties, Dataset Augmentation	**CO3**	**03**	**07**
	Optimization: Challenges in Neural Network Optimization, Gradient Descent, Stochastic Gradient Descent Algorithm, Momentum Based GD, Nesterov Accelerated GD, AdaGrad, Adam, RMSProp.		**04**	

4. Convolutional Neural Networks	Introduction to Convolutional Neural Networks, Convolution operation, Padding, Stride, Relation between input, output and filter size, CNN architecture: Convolution layer, Pooling Layer, Weight Sharing in CNN, Fully Connected NN vs CNN, Variants of basic Convolution function, Depth wise separable CNN.	**CO4**	**04**	**07**
	Modern Deep Learning Architectures: LeNET: Architecture, AlexNET: Architecture, VGG, ResNet		**03**	
5. Recurrent and Recursive Networks	Unfolding Computational Graph, Recurrent Neural Network(RNN), Bidirectional RNNs, Encoder-Decoder sequence to sequence Architecture, Deep Recurrent Network	**CO5**	**04**	**08**
	Recursive Neural Network, Long Short Term Memory networks(LSTM) and Gated RNN (GRU), Introduction to attention network and transformer.		**04**	
6. Auto Encoder and Generative AI	Overview of auto encoders: Introduction, Linear Autoencoder, Undercomplete Autoencoder, Overcomplete Autoencoders, Regularization in Autoencoders, Denoising Autoencoders, Sparse Autoencoders, Contractive Autoencoders, Variational Autoencoder (VAE)	**CO6**	**03**	**07**
	Generative adversarial network (GAN): architecture, Modern advancements: Style GAN, Diffusion Models: Denoising Diffusion Probabilistic Models (DDPM), Stable Diffusion		**04**	
Total Hours				**42**

Books:

Text Books	1. Ian Goodfellow, Yoshua Bengio, Aaron Courvile, "Deep Learning", MIT Press Ltd, 1st Edition 2. JM Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House 3. Li Deng and Dong Yu, "Deep Learning Methods and Applications", Now publishers Inc 4. Buduma, N. and Locascio, N., "Fundamentals of deep learning: Designing next-generation machine intelligence algorithms" 2017, O'Reilly Media, Inc. 5. Aston Zhang, Zachary C. Lipton, Mu Li, Alexander J. Smola, "Dive into Deep Learning"
Reference Books	1. Satish Kumar, "Neural Networks A Classroom Approach", Tata McGraw-Hill. 2. Charu C. Aggarwal, "Neural Networks and Deep Learning" , Springer, 1st Edition 3. François Chollet, "Deep learning with Python "(Vol. 361). 2018 New York: Manning 4. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow", (3rd Edition)

Useful Links:

1. https://nptel.ac.in/courses/106/106/106106184/
2. https://deeplearningbook.org
3. https://keras.io/guides/
4. https://paperswithcode.com/
5. https://www.manning.com/books/deep-learning-with-python
6. https://d2l.ai/d2l-en.pdf
7. **HuggingFace:** https://huggingface.co/

Assessment:

Continuous Assessment for 40 marks:

1. Test 1– 20 marks
2. Test 2– 20 marks

End Semester Theory Examination will be of 60-Marks for 2hr 30min duration.

Course Code	Course Name	Credits (TH+P+TUT)
DLC6031	**Quantitative Analysis**	**3 -1 -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 Simple linear Regression, Multiple Linear Regression 4. Draw interference using Statistical inference methods	
Course Outcomes:	**At the end of the course, the students will be able to** 1. Explain the need of Statistics and classify data collection methods 2. Organize Statistical data and choose appropriate sampling methods 3. Analyze variables using correlation and Simple Regression Analysis 4. Analyze variables using partial and multiple correlation and Multiple Linear Regression Analysis 5. Describe statistical inferences using appropriate estimation and testing methods 6. Analyze hypothesis testing methods to assess the significance of data-driven claims	

Module No & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/Module
1. Statistics- An Overview and Data collection	Definition of Statistics, Functions of Statistics, Application of Statistics, Limitations of Statistics, Statistical Method vs. Experimental Method	**CO1**	**03**	**07**
	Primary & Secondary data, Methods of Collecting Primary data, Sources of secondary data, Precautions to be taken before using secondary data		**04**	
2. Analysis, Interpretation of data & Sampling Methods	Statistical data- Classification, Tabulation, Diagrammatic & Graphical representation of data	**CO2**	**04**	**07**
	Census or Population vs Sampling, Methods of Sampling- Probability sampling, Non Probability Sampling, Statistical errors-Absolute Error, Relative Error		**03**	
3. Introduction to Correlation and Regression	Introduction to Correlation, Types of Correlation, Methods of studying correlation-Scatter diagram method, Graphic method, Karl Pearson's coefficient of correlation	**CO3**	**03**	**07**
	Introduction to Regression Analysis, Examples based on Deviation taken from Arithmetic Means of X and Y, Deviation taken from Assumed Means, Standard error of estimate, Measure for Model Fit -MAE , MAPE, MSE, RMSE		**04**	

4. Correlation and Multiple Linear Regression	Partial Correlation Coefficients, Multiple Correlation Coefficient	**CO4**	**03**	**07**
	Introduction to Multiple Regression Analysis, Examples based on normal equation for the least square regression, Deviation taken from actual means.		**04**	
5. Statistical Inference	Introduction to Statistical inference, Method of moments, Method of maximum likelihood, Properties of point Estimator	**CO5**	**04**	**07**
	Hypothesis Testing, Types of Errors in Testing of Hypothesis, Two tailed and one tailed tests of Hypothesis.		**03**	
6.Tests of Significance	Tests of significance for large samples- Z test	**CO6**	**03**	**07**
	Tests of significance for small samples- four types of t test		**04**	
Total Hours				**42**
Books:				
Text Books	1. Agarwal, B.L. (2006):-Basic Statistics. Wiley Eastern Ltd., New Delhi 2005. 2. Gupta, S. P. (2011):-Statistical Methods. Sultan chand &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. 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 – 20 marks 2. Test 2 – 20 marks				
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.				

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC6032	**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
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**	**09**
	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 Compression Techniques: fundamentals (coding, interpixel and psychovisual redundancies), Types –	**CO2**	**04**	

	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**	**08**	**08**
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 – 20 marks
2. Test 2 – 20 marks

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

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC6033	**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	
Course Outcomes:	After the successful completion of this course, learner will be able to: 1. Identify the concept of vulnerabilities, attacks and protection mechanisms 2. Apply cryptographic techniques for confidentiality, integrity, authentication, and secure communication. 3. Analyze software vulnerabilities and attacks on databases and operating systems. 4. Use security protocols in the context of wireless communication. 5. Apply various security solutions for Web Applications and Cloud infrastructure. 6. Design appropriate security policies to protect infrastructure components.	

Module No. & Name	Sub Topics	CO mapped	Hrs/ Sub topic	Total Hrs/ Module
1. Foundation of Infrastructure & System Security	Cyber-attacks, Vulnerabilities, Threat Models, Defense Mechanisms	**CO1**	**02**	**08**
	Authentication: Password, Token, Biometric Access Control Models: DAC, MAC, RBAC		**03**	
	ABAC, Bell-LaPadula, BIBA Security Goals, Services, Techniques		**03**	
2. Cryptography & Secure Communications	Number Theory & Modular Arithmetic Classical Ciphers: Vigenère, Playfair, Hill, Transposition Symmetric Encryption: DES, 3DES, AES, RC4	**CO2**	**03**	**08**
	Public Key Cryptography: RSA, Diffie-Hellman Digital Signatures, Hashing (MD5, SHA) Authentication Protocols: Kerberos		**03**	
	Needham–Schroeder Protocol, Public Key Infrastructure (PKI), X.509 Certificates: Standard digital certificates used in PKI.		**02**	

3. Software, OS & Database Security	Software Vulnerabilities: Buffer Overflow, Format String.	**CO3**	**02**	**08**
	SQL Injection, XSS Malware: Virus, Worm, Trojan, Rootkit OS Security: Memory Protection,		**03**	
	File Protection, Linux/Windows Hardening Database Security: Integrity, Inference Attacks, Multilevel Security		**03**	
4. Network & Wireless Infrastructure Security	TCP/IP Vulnerabilities, Packet Sniffing, ARP Spoofing, Port Scanning, DoS/DDoS Attacks, SSL/TLS, IPsec, PGP IDS/IPS.	**CO4**	**03**	**06**
	Firewalls, Digital certificate Wireless Security: GSM, UMTS, 4G, 5G, IEEE 802.11, VPN, WIDS		**03**	
5. Web, Cloud & Application Security	Web Security: Session Management, Cookies, HTTPS, SSH,Client-side attacks and defenses,Server-side attacks and defenses,Browser Attacks: Clickjacking, CSRF, Session Hijacking	**CO5**	**04**	**08**
	OWASP Top 10, Phishing, DNS Attacks, Email Security Cloud Security: IAM, Application Security, OAuth, SAML		**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. & Legal Issues	**CO6**	**04**	**04**
Total Hours				**42**

Books:

Text Books

1. Stallings, William, Computer Security: Principles and Practice, 5th Edition, Pearson Education, 2024.
2. Pfleeger, Charles P., Shari Lawrence Pfleeger & Lizzie Coles-Kemp, Security in Computing, 6th Edition, Addison-Wesley Professional, 2024.
3. Menezes, Bernard L., & Ravinder Kumar, Cryptography, Network Security, and Cyber Laws, Cengage Learning, latest edition.
4. Cole, Eric, Ronald L. Krutz & James W. Conley, Network Security Bible, 2nd Edition, Wiley.

Reference Books

1. Stuttard, Dafydd & Pinto, Marcus, The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, 2nd Edition, Wiley, 2011.
2. Gollmann, Dieter, Computer Security, 3rd Edition, Wiley.
3. Boyle, Tim, CCNA Security Study Guide, Wiley/Sybex (latest edition aligned with current CCNA Security).
4. Bishop, Matt, Introduction to Computer Security, Pearson/Addison-Wesley (1st Edition — standard reference).
5. Mather, Tim, Kumaraswamy, Subra & Latif, Shahed, Cloud Security and

	Privacy: An Enterprise Perspective on Risks and Compliance, O'Reilly (1st Edition).

Useful Links:

1. 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:

1. Test 1 – 20 marks
2. Test 2 – 20 marks

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

Course Code	Course Name	Credits (TH+P+TUT)
CEDLC6034	Artificial Intelligence & Soft Computing	3-0-0

Prerequisite:	1.Algorithm 2.Discrete structure 3.Data structure
Course Objectives:	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 familiarize with Fuzzy Logic system. 4. Understand the basics Genetic algorithm
Course Outcomes:	At the end of the course, the students will 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 and reasoning. 4. Apply fuzzy logic sets and membership functions. 5. Design fuzzy controller system. 6. Analyze evolutionary systems.

Module No & Name	Sub Topics	CO mapp	Hrs/Sub topic	Total Hrs/Module
Prerequisite				
1.Introduction to Artificial Intelligence and Intelligent Agents	Introduction, Intelligent Systems: Categorization of Intelligent System, Sub-areas of AI, The concept of rationality	**CO1**	**03**	**07**
	Agents and Environments: The nature of environment, The structure of Agents, Types of Agents, Learning Agent		**02**	
	Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques.		**02**	
2. Problem solving	Solving problem by Searching: Problem Solving Agent, Formulating Problems, Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Methods: A* Search	**CO2**	**04**	**07**
	Local Search Algorithms and Optimization Problems: Hill climbing search Simulated annealing, Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning		**03**	
3. Knowledge Reasoning and Uncertain	Knowledge based Agents, Brief Overview of propositional logic.	**CO3**	**03**	**07**

Knowledge	First Order Logic: Forward chaining, backward Chaining. Unification, Resolution. Semantics of belief network, Simple Inference in belief network.		**04**	
4.Introduction to Fuzzy logic	Introduction to Fuzzy Set: Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation.	**CO4**	**03**	**07**
	Fuzzy relations and membership functions, fuzzy Application		**04**	
5. Fuzzy Inference systems	Fuzzy Logic basics for inference system , Fuzzy Rules and Fuzzy Reasoning.	**CO5**	**03**	**07**
	Fuzzy inference systems: Fuzzification of input variables, defuzzification and fuzzy controllers.		**04**	
6. Advance Evolutionary Methods	Introduction Genetic Algorithm: Introduction to Evolutionary Computing, Building Blocks and the Coding Problems, messy Genetic algorithms, Alternative, Selections Schemes, Adaptive Genetic Algorithm.	**CO6**	**03**	**07**
	Introduction to Swarm Optimization, Global Best PSO, Local, Best PSO, g-best versus l-best PSO, Velocity Components.		**02**	
	Introduction to Ant Colony Optimization Meta-Heuristic, Foraging Behaviour of Ants, Stigmergy and Artificial Pheromone, Simple Ant Colony Optimization, Ant System, Ant Colony System.		**02**	
Total Hours				**42**

Books:

Text Books	1. Stuart J. Russell and Peter Norvig, "*Artificial Intelligence: A Modern Approach*", Fourth Edition" Pearson Education, 2020. 2. George F Luger, "*Artificial Intelligence*" Low Price Edition, Fourth edition, Pearson Education.,2005 3. S. N. Sivanandam & S. N. Deepa, "Principles of Soft Computing", 2nd edition, Wiley India, 2008. 4. Ulrich Bodenhofer , " Genetic Algorithms Theory and Applications "Lecture Notes Third Edition—Winter 2003/2004"
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.David E. Goldberg, "Genetic Algorithms-In Search, optimization and Machine learning", Pearson Education. 4. J. S. R. Jang, C.T. Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson Education,

Useful Links:

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

2 . https://onlinecourses.nptel.ac.in/noc22_cs54/preview

3. https://nptel.ac.in/courses/106106140

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 for 40% of syllabus – 20 marks
2. Test 2 for 40% of syllabus – 20 marks

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

Course Code	Course Name	Credits (TH+P+TUT)
CEC6041	**Advanced IoT & Capstone Project**	**3-0-0**

Prerequisite:	C Programming
Course Objectives:	1. To develop systems using IR sensors, cameras, and buzzers for motion detection and real-time alerting 2. To implement an energy-efficient lighting solution for homes and buildings using IoT sensors. 3. To create IoT solutions for monitoring vital signs (pulse, oxygen levels) and healthcare devices 4. To develop communication aids for people with disabilities using IoT- based systems. 5. To design and deploy a complete IoT solution to address a real-world problem.
Course Outcomes:	Upon completing this course, students will be able to: 1. Understand the security model of IOT 2. Understand the need of fog computing. 3. Design a IOT product with user experience 4. Analyze the product design. 5. Integrate the IOT embedded device with UX. 6. Design an IOT product as responsible IOT device.

Module No. & Name	**Sub Topics**	**CO mapped**	**Hrs / Sub topics**	**Total Hrs**
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1. IoT Security	IOT Reference Models, IOT Security Threats, IOT security Overview	CO1	**02**	**08**
	IOT Security Overview-IoT Protocols, Network and Transport Layer Challenges, IoT Gateways and Security, IoT Routing Attacks, Bootstrapping and Authentication, Authorization Mechanisms,IoT OAS		**03**	
	Security Frameworks for IoT-Light Weight Cryptography, Asymmetric LWC Algorithms Key Agreement, Distribution, and Bootstrapping		**02**	
	Privacy in IoT Networks-Secure Data Aggregation, Enigma, Zero Knowledge Protocol Privacy in Beacons		**01**	

2. Fog Computing: Principles, Architectures, and Applications	Introduction, Motivating scenario, Definition and characteristics, Applications- Healthcare, Augmented Reality, Caching & Preprocessing, Research Direction and Enablers, Commercial products,	CO2	**05**	**05**
3. User Experience Design for the Internet of Things?	How Is UX for IoT Different? A Design Model for IoT Things: The Technology of Connected Devices-Types of Connected Device, Multipurpose Computers, Bridging Physical and Digital: Sensors and Actuators, The Challenge of Powering Devices, Conserving Battery Life Networks: The Technology of Connectivity-Why Is Networking Relevant to IoT UX?,Networking Issues That Cause UX Challenges for IoT, The Architecture of the Internet of Things, Types of Network ,Network Communication Patterns, Internet Service	CO3	**07**	**07**
4. Product/Service Definition and Strategy	Making Good Products, From Innovation to Mass Market, Tools Versus Products, What Makes a Good Product?, Services in IoT,Business Models, The Role of Research in Connected Product Design, Initial Questions and Concepts, Techniques: from Asking to Watching to Making	CO4	**07**	**07**
5. Embedded Device Design	An Introduction to Thinking About Physical Objects in IoT,Making Stuff: Differences to UX,Essentials of the Design Process, Three Faces of a Physical Product, Design of a 3D printer	CO5	**05**	**05**
6.Responsible IoT Design	Security,Privacy,Environment,Social Engineering	CO6	**06**	**06**
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.		**01**	**01**
			Total Hours	**42**

Books	
Text Books:	1. Jake VanderPlas,“ Python Data Science Handbook”, O’Reilly publication,2016
Reference Books:	1. Internet of Things, Principles and Paradigms by Rajkumar Buyya 2. Designing Connected Products-UX for the Consumer Internet of Things by Claire Rowland, Elizabeth Goodman, Martin Charlier,Ann Light, and Alfred Lui
Useful Online Resource Links:	1. https://spoken-tutorial.org/watch/Arduino/Introduction+to+Arduino/English/ 2. https://mqtt.org/ 3. https://github.com/microsoft/IoT-For-Beginners
Term Work (TW):	1. Term work should consist of Presentations / Assignments / Class Participation and Performance / Group Activities / etc. 2. Term work evaluation shall be for Total 50 Marks based on performance.
End Semester Examination (ESE):	End Semester evaluation shall be of Total 50 Marks in the form of Oral Examination.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
CEC6042	Geomatics	03	-	-	03

Prerequisites:	**Course 1**
Course Objectives (COBs):	1. To introduce the relevance of Geoinformatics to Urban Planning and Management 2. To expose recent developments in Geoinformatics for Urban Planning and Management 3. To sensitize the importance of inclusive urban planning towards sustainable development 4. Urban Planning and Change Detection 5. Urban Structuring and population estimation
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Understand the basics of urban mapping and plan preparation 2. Apply remote sensing techniques in urban mapping 3. Utilize remote sensing in the preparation of urban plans 4. Change detection analysis and urban sprawl 5. E – Governance and Urban structure 6.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**01**
1. Introduction to Urban Planning	Concepts of Urbanization, Evolution of City Building, Urban Growth, Human Settlement Planning	**CO1**	**09**	**09**
2. Urban Ecology and Environment	Components of natural and built environment, impact of urbanization on ecosystems	**CO1**	**09**	**09**
3. Remote Sensing for Urban Studies	Planning of Transport, Energy, Water Supply, Solid Waste, and Social Infrastructure	**CO2, CO3**	**09**	**09**
4. Urban Infrastructu r e Planning	Planning of Transport, Energy, Water Supply, Solid Waste, and Social Infrastructure	**CO1, CO4**	**07**	**07**
5. Urban Information System	Classification of information, Digital Surface Models, Population Estimation	**CO1, CO5**	**04**	**04**
6. Climate Models	Urban climate Analysis, Land Surface Temperature and Urban Heat Island	**CO1, CO5**	**03**	**03**
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**-**	**01**	**01**
Total Hours				**42**

Books	
Text Books:	1. Netzband, M., Stefanov, W. L., & Redman, C. (Eds.). *Applied Remote Sensing for Urban Planning, Governance and Sustainability*. Springer, 1st Edition, 2007. 2. Rashed, T., & Jürgens, C. (Eds.). *Remote Sensing of Urban and Suburban Areas*. Springer, 1st Edition, 2010.
Reference Books:	1. Donnay, J. P., & Barnsley, M. J. *Remote Sensing and Urban Analysis*. 1st Edition, Taylor & Francis, 2005. 2. Weng, Q., & Quattrochi, D. A. (Eds.). *Urban Remote Sensing*. 1st Edition, CRC Press, 2006.
Useful Online Resource Links:	1. https://www.worldbank.org/en/topic/urbandevelopment/overview 2. https://geographycasestudy.com/urban-growth-and-urbanization/ 3. https://planningtank.com/urbanisation/urbanisation-urban-growth
Term Work (TW):	• Term work should consist of Presentations / Assignments / Class Participation and Performance / Group Activities / etc. • Term work evaluation shall be for Total 50 Marks based on performance.
End Semester Examination (ESE):	End Semester evaluation shall be of Total 50 Marks in the form of Oral Examination.

Course Code	Course Name	Credits			
		TH	P	TUT	Total
CEC6043	Industrial Biotechnology	03	-	-	03

Prerequisites:	
Course Objectives (COBs):	1. Discuss the applications of biotechnology in the food industry. 2. Understand the role of biotechnology methods and tools in drug development and other applications in the pharmaceutical Industry. 3. Understand the basics of food, nutrition and health.
Course Outcomes (COs):	After the successful completion of this course, learner will be able to: 1. Discuss the various aspects of dairy food process technology. 2. Comprehend the relation between food , nutrition and health 3. Importance of modern food products- nutraceuticals, functional food Probiotics, prebiotics and synbiotics 4. Discuss application of biotechnology in pharmaceutical Industry. 5. Understand the application of biotechnology in preclinical studies. 6. Comprehend the steps of a clinical study and clinical data management.

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.			**01**
1. Dairy	Milk composition	**CO1**	**01**	**06**
	Purity checking of milk,Thermal processing of milk – Pasteurization		**01**	
	Low-temperature long time (LTLT), High temperature short time (HTST), Sterilization and Ultra high temperature (UHT)		**03**	
	Packaging of milk		**01**	
2. Dairy	Microbiology of milk & milk products - butter, cheese, ice-cream.	**CO1**	**02**	**07**
	Fermentation of milk– Cheese, yogurt, probiotic dairy products.		**02**	
	Processing of evaporated and dried milk products.		**01**	
	By-products of dairy processing – Lactose production from whey protein.		**02**	
3. Food	**Food and nutrition** Basic terms used in study of food and nutrition, BMI, Nutritional Status and RDA.	**CO2**	**02**	**07**
	Understanding the relationship between food, nutrition, and health.		**02**	
	Concept of Balanced Diet, Food (Carbohydrates, lipids, proteins and vitamins), Groups, Food Pyramid.		**02**	
	Disorders of Nutrition.		**01**	

4. Food	**Nutraceuticals and functional foods** Definition, history, types and sources of nutraceuticals.	**CO3**	**02**	**07**
	Dietary supplements, fortified foods, and functional foods.		**02**	
	Future prospects of functional foods and nutraceuticals and their potential for use in improving health.		**02**	
	Concept of probiotics, prebiotics and synbiotics.		**02**	
5. Pharma	Concept of Biopharmaceuticals, Applications of recombinant DNA technology in producing drugs- examples Humulin, Interferons and other commercial drugs.	**CO4**	**02**	**06**
	Hybridoma technology, animal cell culture and plant tissue culture for producing biopharmaceutics.		**02**	
	Bioprospecting of drugs from natural sources. Screening of Natural products for lead identification. Microbial genome mining		**02**	
6. Pharma	Understanding the role of Biotechnology in Preclinical Studies	**CO5, CO 6**	**01**	**07**
	Evaluation of Pharmacokinetics and Pharmacodynamics properties of the drug based on Cell culture and Animal Based experiments.		**02**	
	Understanding the role of Biotechnology in different phases of Clinical trials and Clinical Data Management		**02**	
	Phase 1: Evaluating Safety and dosing. Phase 2 and 3: Safety and efficacy.		**02**	
	Introduction to steps of effective Clinical Data Management		**01**	
ii. Course conclusion	Recap of Modules, Outcomes, Applications, and Summarization.			**01**
Total Hours				**42**

Books:	
Text Books:	1. Handbook of Pharmaceutical Biotechnology Editor(s): Shayne Cox Gad Ph.D. , D.A.B.T.First published:24 August 2006 Print ISBN:9780471213864 |Online ISBN: 9780470117118 |DOI:10.1002/0470117117. 2. Fundamentals of Clinical Trials. Lawrence M. Friedman, Curt D. Furberg, David L. DeMets, David M. Reboussin, Christopher B. Granger. Springer, 27 Aug 2015.
Reference Books:	1. Introduction to Pharmaceutical Biotechnology, Volume 1: Basic Techniques and Concepts. Saurabh Bhatia, Divakar Goli, IOP Publishing Limited, 23 May 2018 - Science. 2. Wildman, R. E. (2016). Handbook of Nutraceuticals and Functional Foods. CRC Press. 3. John Shi (2016), Functional Food Ingredients and Nutraceuticals: Processing Technologies, Second edition, CRC Press
Useful Links:	

<table>
<tr><td colspan="2">https://pharmacentral.com/learning-hub/technical-guides/drug-discovery-and-development-a-step-by-step-guide/.
Tuda, F. et al. (2022). Pharmaceutical Biotechnology: The Role of Biotechnology in the Drug Discovery and Development. In: Anwar, M., Ahmad Rather, R., Farooq, Z. (eds) Fundamentals and Advances in Medical Biotechnology. Springer, Cham. https://doi.org/10.1007/978-3-030-98554-7_9.</td></tr>
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Term work evaluation shall be for Total 50 Marks based on performance.</td></tr>
<tr><td>End Semester Examination (ESE):</td><td>End Semester evaluation shall be of Total 50 Marks in the form of Oral Examination.</td></tr>
</table>

Course Code	Course Name	Credits			
		TH	P	TUT	Total
CEC6044	Strategic Management and IPR for Start-ups	03	-	-	03
Note: Hands-on activities shall be conducted during Theory Classes.					
Prerequisites:	Design Thinking, Business Model Development and Prototyping				
Course Objectives (COBs):	1. To understand the key legal elements of venture structuring, co-founder agreements, and conflict resolution. 2. To educate learners on the importance of IPR for start-ups. 3. To teach negotiation and leadership skills for funding, partnerships, and team scaling. 4. To explore strategies and metrics for scaling a start-up and expanding into new markets. 5. To explore sustainable and ethical business practices. 6. To synthesize learning into a comprehensive start-up plan.				
Course Outcomes (COs):	Upon completion of the course, the learners will be able to: 1. Design legal framework and compliance requirements for start-ups. 2. Identify and outline Intellectual Property Rights (IPR) strategy for a start-up. 3. Apply negotiation techniques and leadership strategies to secure funding and build teams. 4. Identify growth opportunities and apply strategies for market expansion. 5. Propose strategies for creating ethical and sustainable business ventures. 6. Create and present a comprehensive start-up plan that includes scaling, funding, and IPR strategies.				

Module No. and Name	Subtopics	COs Mapped	Hours / Subtopic	Total Hours / Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction	-	02	02
1. Venture Structuring and Legal Aspects of Start-ups	Business Structures: LLP, Pvt. Ltd., etc.	CO1	01	06
	Venture Registration Processes		02	
	Co-founder and Shareholder Agreements		01	
	Conflict Resolution and Compliance		01	
	Risk Management		01	
2. Intellectual Property Rights (IPR)	Introduction to Intellectual Property Rights (IPR), Importance and Types of IPR: Patents, Trademarks, Copyrights	CO2	02	08
	IPR for Start-ups		01	
	IPR Filing Processes in India		01	
	IP Challenges and Solutions for Start-ups		02	
	IP Commercialization and Monetization		02	
3. Negotiation, Partnerships and	Crafting a Winning Pitch	CO3	02	08
	Legal and Compliance Aspects in Funding		02	
	Negotiation Techniques for Partnerships, Funding, and Vendor Relationships		02	

Leadership in Start-ups	Leadership and Team Building for Scaling, Motivating Teams in Startup Settings		**02**	
4. Growth and Strategic Scaling	Metrics for Scaling: Product-Market Fit, Traction	**CO4**	**02**	**05**
	Market Expansion Strategies, Growth Hacking Techniques		**02**	
	Case Studies of Scalable Start-ups		**01**	
5. Business Sustainability and Ethics	Sustaining a Business: Managing Cash Flows, Employee Retention	**CO5**	**02**	**06**
	Corporate Social Responsibility (CSR)		**01**	
	Ethical Dimensions in Start-ups		**02**	
	Case Studies of Sustainable Start-ups		**01**	
6. Capstone Project	Group Project: Comprehensive Start-up Plan	**CO6**	**02**	**06**
	Presentations: Funding Pitch, IPR Plan, and Growth Strategy		**02**	
	Feedback and Evaluation		**02**	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization	**-**	**01**	**01**
Total Hours				**42**

Text Books:	1. V. Harnish, "Scaling Up: How a Few Companies Make It and Why the Rest Don't", Gazelles, Inc., 2014. 2. D. Keeling, "Startup Guide to Intellectual Property: Early Stage Protection of IP", CreateSpace Independent Publishing Platform, 2014.
Reference Books:	1. B. Feld and J. Mendelson, "Venture Deals: Be Smarter Than Your Lawyer and Venture Capitalist", Wiley, 2016. 2. E. Ries. "The Lean Startup: How today's entrepreneurs use continuous innovation to create radically successful businesses", Crown Business, 2011.
Useful Online Resource Links:	1. https://onlinecourses.swayam2.ac.in/ntr24_ed05/preview 2. https://onlinecourses.nptel.ac.in/noc21_mg63/preview 3. https://www.udemy.com/course/sustainability-management-in-business 4. https://www.coursera.org/learn/intellectual-property-for-entrepreneurs
Term Work (TW):	• Term work will consist of Presentations / Assignments / Class Participation and Performance / Group Activities / etc. • Term work evaluation shall be for Total 50 Marks based on performance.
End Semester Examination (ESE):	End Semester evaluation shall be of Total 50 Marks in the form of Oral Examination.

Institute Level Open Electives

Course Code	Course Name	Credits (TH+P+TUT)
ILC6051	**Product Life Cycle Management**	**3 - 0 - 0**

Prerequisite:	**--**
Course 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
Course Outcomes:	**After the successful completion of this course, 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 molding, machining, sheet metal working etc. 4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant 5. Analyze the environmental aspects in product design. 6. Assess the life cycle of the product and cost.

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**		**02**
1.Introduction to Product Lifecycle Management (PLM)	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	**CO1**	**05**	**10**
	PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM.		**05**	

1. Product Design	**Product Design:** 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,	**CO2**	**05**	**09**
	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		**04**	
2. Product Data Management (PDM)	Product Data Management (PDM):Product and Product Data, PDM systems and importance, Components of PDM,	**CO3**	**03**	**05**
	Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation		**02**	
3. Virtual Product Development Tools	For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up Model building,	**CO4**	**03**	**05**
	Model analysis, Modeling and simulations in Product Design, Examples/Case Studies		**02**	
4. Integration of Environmental Aspects in Product Design	Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies.	**CO5**	**02**	**05**
	End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design		**03**	
5. Life Cycle Assessment and Life Cycle	Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment,	**CO6**	**03**	**05**

Cost Analysis:	Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis		**02**	
ii. Course Conclusion	Recap of Modules, Outcomes, Application and Summarization	**-**		**01**
Total Hours				**42**

Books:	
Text Books	1. John Stark, ―Product Lifecycle Management: Paradigm for 21st Century Product Realisation‖, Springer-Verlag, 2004. ISBN: 1852338105. 2. Saaksvuori Antti, Immonen Anselmie, ―Product Life Cycle Management‖, Springer, Dreamtech, ISBN: 3540257314.
Reference Books	1. Fabio Giudice, Guido La Rosa, Antonino Risitano, ‖Product Design for the environment-A life cycle approach‖, Taylor & Francis 2006, ISBN: 0849327229. 2. Michael Grieve, ―Product Lifecycle Management: Driving the next generation of lean thinking‖, Tata McGraw Hill, 2006, ISBN: 0070636265.
Assessment:	
Continuous Assessment for 40 marks: 1. Test 1– 20 marks 2. Test 2– 20 marks	
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.	

Course Code	Course Name	Credits (TH+P+TUT)
ILC6052	Reliability Engineering	3 - 0 - 0

Course 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 systemreliability of simple and complex systems. 4. To understand the various aspects of Maintainability, Availability and FMEA procedure.
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Apply the concept of Probability to engineering problems 2. Apply various reliability concepts to calculate different reliabilityparameters 3. Estimate the system reliability of simple and complex systems 4. Apply different techniques for reliability analysis. 5. Compare different design methods. 6. Carry out a Failure Mode Effect and Criticality Analysis.

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**		**02**
1. Probability theory, Probability Distributions, Measures of Dispersion	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Bay‘s Theorem.	**CO1**	**02**	**08**
	Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between themand their significance		**02**	
	Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.		**04**	
2. Reliability Concepts, Failure Data Analysis, Reliability Hazard Models	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve.	**CO2**	**02**	**08**
	Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions		**04**	
	Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.		**02**	
3. System	System Configurations: Series, parallel, mixed	**CO3**		**05**

Reliability	configuration, k out of n structure, Complex systems.			
4. Reliability Improvement	Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis.	**CO4**	**04**	**08**
	System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method		**04**	
5. Maintainability and Availability	System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics,.	**CO5**	**03**	**05**
	Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects		**02**	
6. Failure Mode, Effects and Criticality Analysis	Failure mode effects analysis, severity/criticality analysis, FMECA examples.	**CO6**	**02**	**05**
	Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis.		**03**	
ii. **Course Conclusion**	Recap of Modules, Outcome, Applications, and Summarization.	**-**		**01**
Total Hours				**42**

Books:

Text Books	1. Charles E. Ebeling, ―Reliability and Maintainability Engineering‖, Tata McGraw Hill. 2. P.D.T. Conor, ―Practical Reliability Engg.‖, John Wiley & Sons, 1985. 3. K.C. Kapur, L.R. Lamberson, ―Reliability in Engineering Design‖, John Wiley & Sons.
Reference Books	1. L.S. Srinath, ―Reliability Engineering‖, Affiliated East-Wast Press (P) Ltd., 1985. 2. B.S. Dhillion, C. Singh, ―Engineering Reliability‖, John Wiley & Sons, 1980. 3. Murray R. Spiegel, ―Probability and Statistics‖, Tata McGraw-Hill Publishing Co. Ltd.

Assessment:

Continuous Assessment for 40 marks:

1. Test 1– 20 marks
2. Test 2– 20 marks

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

Course Code	Course Name	Credits (TH+P+TUT)
ILC6053	**Management Information System**	**3 - 0 - 0**

Course 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.
Course Outcomes (COs):	**Upon completion of the course, the learners will be able to:** 1. Describe how information system transforms business. 2. Explain the impact information systems have on an organization. 3. Describe IT infrastructures and its components and its current trends. 4. Explain the principal tools and technologies for accessing information from databases. 5. Explain how to improve business performance and decision making. 6. Describe types of systems used for enterprise-wide knowledge management.

Module	Detailed Contents	CO Mapped	Hrs / Sub Topics	Total Hrs/ module
i. **Prerequisites and Course Outline**	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1.Introduction to Information System	Computer Based Information Systems, Impact of IT on organizations.	**CO1**	**02**	**04**
	Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	**CO1**	**02**	
1.**Data and Knowledge Management**	Data and Knowledge Management: Database Approach, Big Data, Data Warehouse and Data Marts, Knowledge Management.	**CO2 CO3**	**04**	**07**
	Business intelligence (BI): Managers and Decision Making, BI for Data Analysis and Presenting Results.	**CO2 CO3**	**03**	
2.**Ethical Issues and Privacy**	Ethical Issues and Privacy: Information Security.	**CO3**	**03**	**07**
	Threat to IS, and Security Controls.	**CO3**	**04**	
3.**Social Computing (SC)**	Social Computing (SC): Web 2.0 and 3.0, SC in Business-Shopping, Marketing.	**CO4**	**03**	**07**
	Operational and Analytic CRM, E-business and E-Commerce – B2B B2C. Mobile Commerce.	**CO4**	**04**	
4.**Computer**	Computer Networks Wired and Wireless technology.	**CO5**	**03**	**06**

Networks	Pervasive Computing, Cloud Computing Model.	**CO5**	**03**	
5.**System Design: Methodology and Consideratios**	Information System within Organization: Transaction Processing Systems, Functional Area Information System.	**CO6**	**04**	**08**
	ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System Development life cycle models; Managing Without Authority; Areas of Further Study.	**CO6**	**04**	
ii. **Course Conclusion**	Recap of Modules, Outcome, Applications, and Summarization.	**-**	**01**	**01**

Text Books:	1. K. Rainer, Brad Prince, Management Information Systems, Wiley. 2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, Prentice Hall.
Reference Books:	1. S. Jawadekar, Management Information Systems, McGraw Hill. 2. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall.
Useful Links:	1. https://www.nptel.ac.in/ 2. https://www.coursera.org/
Continuous Assessment (CA):	• Continuous Assessment shall be conducted for Total 40 Marks (Test 1: 20 Marks, Test 2: 20 Marks). • Test 1 shall be conducted on completion of approx. 40% syllabus and Test 2 shall be conducted on completion of additional 40% syllabus (but excluding contents covered in Test 1). Duration of each test shall be one hour.

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

Course Code	Course Name	Credits (TH+P+TUT)
ILC6054	**Design of Experiments**	3-0-0

Prerequisites:	---
Course 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 designs for robustness and optimization
Course Outcomes (COs):	**Upon completion of the course, the learners will be able to:** 1. Plan data collection to turn data into information and to make decisions that lead to appropriate action. 2. Analyze the different fitting regression models. 3. Apply different two-level factorial designs. 4. Differentiate the different fractional factorial methods. 5. Apply the methods taught to real life situations. 6. Explain methods to plan, analyze, and interpret the results of experiments.

Module	Detailed Contents	CO Mapped	Hrs/ Sub topic	Total Hrs/ Module
i. Prerequisites and Course outline	Prerequisite Concepts and Course Introduction.	**-**	**02**	**02**
1. **Introduction**	Strategy of Experimentation, Typical Applications of Experimental Design.	**CO1**	**01**	**03**
	Guidelines for Designing Experiments, Response Surface Methodology.	**CO1**	**02**	
2. **Fitting Regression Models**	Linear Regression Models, Estimation of the Parameters in Linear Regression Models, Hypothesis Testing in Multiple Regression.	**CO2**	**04**	**08**
	Confidence Intervals in Multiple Regression, Prediction of new response observation, Regression model diagnostics, Testing for lack of fit.	**CO2**	**04**	
3. **Two Levels Factorial Designs**	The 2^2 Design, The 2^3 Design, The General2k Design.	**CO3**	**03**	**07**
	A Single Replicate of the 2^k Design, The Addition of Center Points to the 2^k Design, Blocking in the 2^k Factorial Design, Split-Plot Designs.	**CO3**	**04**	
4. **Two Levels Fractional Factorial Methods**	The One-Half Fraction of the 2^k Design, The One-Quarter Fraction of the 2^k Design, The General 2^{k-p} Fractional Factorial Design.	**CO4**	**04**	**07**
	Resolution III Designs, Resolution IV and V Designs, Fractional Factorial Split-Plot Designs.	**CO4**	**03**	
5. Response Surface Methods	Introduction to Response Surface Methodology, The Method of Steepest Ascent.	**CO5**	**04**	**07**
	Analysis of a Second-Order Response Surface,	**CO5**	**03**	

and Designs	Experimental Designs for Fitting Response Surfaces.			
6. **Taguchi Approach**	Crossed Array Designs and Signal-to-Noise Ratios.	**CO6**	**02**	**04**
	Analysis Methods, Robust design examples.	**CO6**	**02**	
iii. **Course conclusion**	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	
Total Hrs				**42**
Text Books:	1. R. Mayers, D. Montgomery and C. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, John Wiley & Sons, New York. 2. D. Montgomery, Design and Analysis of Experiments, John Wiley & Sons, New York. 3. W. Dimond, Peactical Experiment Designs for Engineers and Scientists, John Wiley and Sons.			
Reference Books:	1. G. Box, J Hunter and W. Hunter, Statics for Experimenters: Design, Innovation and Discovery, Wiley. 2. A. Dean, and D. Voss, Design and Analysis of Experiments, Springer. 3. P. Ross, Taguchi Technique for Quality Engineering, McGraw Hill. 4. M. Phadake, Quality Engineering using Robust Design, Prentice Hall.			
Useful Links:				
1. https://nptel.ac.in/courses/110/105/110105087/ 2. https://www.udemy.com/course/design-of-experiments-i/				
Continuous Assessment for 40 marks: 1. Test 1– 20 marks 2. Test 2– 20 marks				
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.				

Course Code	Course Name	Credits (TH+P+TUT)
ILC6055	**Operations Research**	3-0-0

Course 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
Course Outcomes:	**Learner will be able to…** **1.** Define and formulate linear programming problems and solve them by applying appropriate techniques. **2.** Determining the optimum solution for transportation and Assignment models. **3.** Choose the appropriate queuing model for a given practical application and propose the best strategy and value of the given game model. **4.** Use CPM and PERT techniques, to plan, schedule and control project activities. Determining the optimum sequence to process jobs. **5.** Judge classical & probabilistic inventory models and simulate different real life probabilistic situation using Monte Carlo simulation technique. **6.** Selecting the best strategy from various alternatives by applying various Tools and methodology for decision-making.

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
i. Prerequisite and Course outline	Prerequisite concepts, Introduction, Structure ofthe Mathematical Model, Limitations of operational research.	**-**	**01**	**01**
1.Linear Programming	1.1 Linear Programming: Problem formulation, Graphical Method and simplex method.	**CO1**	**04**	**10**
	1.2 Artificial Variable Simplex Techniques:Big-M Method and Two-Phase Method.	**CO1**	**03**	
	1.3 Advanced Topics in Linear Programming: Duality in Linear Programming and the Dual Simplex Method.	**CO1**	**03**	
2.Transportation models and Assignment models	2.1 Transportation Model: North-west corner method, Row Minima method, Column Minima method, Least – cost method, Vogel‘s Approximation method, Optimality by MODI method and Unbalanced Transportation Problem.	**CO2**	**03**	**06**

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
	2.2 Assignment Model: The Hungarian method for solution of Assignment problems, Unbalanced assignment problem and maximization problem.	**CO2**	**03**	
3.Queuing Model and Game Theory	3.1 Queuing Models: Introduction, Single-channel, Finite population model with Poisson Arrivals and Exponential Service Times (Limited Source Model).	**CO3**	**03**	**06**
	3.2 Game Theory, 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.	**CO3**	**03**	
4. Network analysis in project planning and Sequencing models	4.1 Project Management: Phases of project management, Network construction, Critical Path Method (CPM) and Process Evaluation & Review Techniques (PERT). (Exclude Cost analysis, crashing, resource scheduling and updating)	**CO4**	**04**	**07**
	4.2 Sequencing Models: Processing n jobs through one machine, two machines and three machines, Processing n jobs through m machines.	**CO4**	**03**	
5. Inventory Control and Simulation	5.1 Inventory Models: Introduction, Inventory models with Deterministic demand (with and without shortages) and Inventory models with price breaks.	**CO5**	**04**	**07**
	5.2 Simulation: Definition, Types of Simulation Models, Monte Carlo Technique, Practical Problems, Applications in Queuing and Inventory problems.	**CO5**	**03**	
6. Decision Theory	Steps in Decision theory approach, Decision – Making Environments, Decision making under conditions of certainty and uncertainty, Decision making under conditions of Risk and Decision Trees.	**CO6**	**04**	**04**
ii. Course Conclusion	Recap of Modules, Outcomes, Applications and Summarization	–	**01**	**01**
		Total		**42**

Reference Books:	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

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc19_ma29/preview

2. https://www.coursera.org/courses?query=operations%20research

Continuous Assessment (CA):

The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1 (T-1)	20 marks
2.	Class Test 2 (T-2)	20 marks

Class Tests (20 Marks):

Two class tests of 30 marks each should be conducted in a semester. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus (but excluding contents covered in Test I) is completed.

Average of the two class tests (T-1 and T-2) will be considered.

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

Course Code	Course Name	Credits (TH+P+TUT)
ILC6056	Cyber Security and Laws	3-0-0
Course 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	
Course Outcomes:	**Learner will be able to…** 1. Explain the concept of cybercrime and its effect on outside world 2. Classify and Examine the Cyber Offences and security implication. 3. Illustrate and identify the modus operandi followed in cyber-crimes. 4. Explain the aspects in Indian Cyber Laws 5. Explain the penalties in cyber law 6. Apply Information Security Standards compliance during software design and development	

Module	Detailed Contents	CO Mapped	Hrs/ Sub topic	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**	**-**	**02**
1. Introduction to Cybercrime	Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the	**CO1**	**04**	**04**
2. Cyber Offenses & Cybercrime	How criminal plan the attacks, Social Engg, Cyber stalking, Cyberc afé 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	**CO2**	**03**	**09**
	, 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,		**03**	
	Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops		**03**	
3. Tools and Methods Used in Cyberline	Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks.	**CO3**	**03**	**06**
	SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)		**03**	

4. The Concept of Cyberspace	E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law.	**CO4**	**04**	**08**
	The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law .		**02**	
	Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law		**02**	
5. Indian IT Act	Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	**CO5**	**06**	**06**
6. Information Security Standard compliances	SOX, GLBA,	**CO6**	**02**	**06**
	HIPAA, ISO,		**02**	
	FISMA, NERC, PCI.		**02**	
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**	**01**	**01**
Total Hrs				**42**

Text Books:	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
Reference Books:	1. Nina Godbole, *Information Systems Security,* Wiley India, New Delhi 2. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing. 3. William Stallings*, Cryptography and Network Security,* Pearson Publication
Useful Links:	1. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in 2. Website for more information , A Compliance Primer for IT professional https://www.sans.org/reading-room/whitepapers/compliance/ compliance-primer-professionals-33538

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 for 40% of syllabus – 20 marks
2. Test 2 for 40% of syllabus – 20 marks

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

Course Code	Course Name	Credits (TH+P+TUT)
ILC6057	Disaster Management and Mitigation Measures	3-0-0

Prerequisite:	Basics of Physics
Course 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
Course Outcomes:	**After the successful completion of this course, the learner will be able to:** 1. Illustrate the importance of Disaster Management 2. Discuss natural as well as manmade disaster and their extent and possible effects on the economy. 3. Use government policies, acts and various organizational structure associated with an emergency. 4. Devise various Framework for Disaster Management in India. 5. Reviewing various approaches of disaster relief measures. 6. Genralize the simple do_s and don_ts in such extreme events and act accordingly. 7.

Module No. & Name	Sub Topics	CO mapped	Hrs /Sub Topics	Total Hrs/ Module
i. Prerequisites and Course outline	Prerequisite Concepts and Course Introduction.	**-**		**02**
1. Introduction	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.	**CO1**	**03**	**03**
2. Natural Disaster and Manmade disasters	**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.	**CO2**	**05**	**09**
	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.		**04**	

3. Disaster Management, Policy and Administration	**Disaster management**: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management.	**CO3**	**03**	**06**
	Policy and administration: Importance and principles of disaster management policies, command and coordination 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.		**03**	
4. Institutional Framework for Disaster Management in India	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.	**CO4**	**03**	**06**
	Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. Use of Internet and software for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.		**03**	
5.Financing Relief Measures	Ways to raise finance for relief expenditure, role of government agencies and NGO _s in this process. .	**CO5**	**03**	**09**
	Legal aspects related to finance raising as well as overall management of disasters.		**03**	
	Various NGO _s and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. International relief aid agencies and their role in extreme events		**03**	
6.Preventive and Mitigation Measures	Pre-disaster, during disaster and post-disaster measures in some events in general Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication	**CO6**	**03**	**06**
	Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do _s and don't's in case of disasters and effective implementation of relief aids.		**03**	
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**		**01**
Total Hours				**42**

Books:	
Text Books	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.
Reference Books	1. Disaster management & rehabilitation by Rajdeep Dasgupta, Mittal Publications, New Delhi. 2. Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications 3. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications
Assessment:	
Continuous Assessment for 40 marks: 1. Test 1– 20 marks 2. Test 2– 20 marks	
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.	

Course Code	Course Name	Credits (TH+P+TUT)
ILC6058	Energy Audit and Management	3-0-0
Prerequisite:		
Course Objectives:	1. To understand the importance energy security for sustainable development andthe fundamentals of energy conservation. 2. To introduce performance evaluation criteria of various electrical and thermalinstallations to facilitate the energy management 3. To relate the data collected during performance evaluation of systems foridentification of energy saving opportunities.	
Course Outcomes:	**After the successful completion of this course, the learner will be able to:** 1. Illustrate present state of energy security and its importance. 2. Describe the basic principles and methodologies adopted in energy audit of autility. 3. Apply the energy performance evaluation of some common electrical installations and identify the energy saving opportunities. 4. Evaluate the energy performance evaluation of some common thermal installations and identify the energy saving opportunities 5. Analyze the data collected during performance evaluation and recommendenergy saving measures. 6. Reviewing the concepts of Energy Conservation in buildings	

Module No.	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**		**02**
1.Energy Scenario	Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance,	**CO1**	**02**	**04**
	Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance		**02**	
2. Energy Audit Principles	Definition, Energy audit- need, Types of energyaudit, Energy management (audit) approach- understanding energy costs	**CO2**	**02**	**08**
	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;		**04**	

	Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)		**02**	
3. Energy Management and Energy Conservation in Electrical System	Electricity billing, Electrical load management and maximum demand Control; Power factor improvement	**CO3**	**03**	**10**
	Energy efficient equipment's and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers.		**03**	
	Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives		**04**	
4. Energy Management and Energy Conservation in Thermal Systems	Review of different thermal loads; Energy conservation opportunities in: Steam distribution system.	**CO4**	**02**	**10**
	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		**04**	
	HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities		**04**	
5. Energy Performance Assessment	On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps.	**CO5**	**02**	**04**
	HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.		**02**	
6. Energy conservation in Buildings	Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	**CO6**		**03**
ii.Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	**--**		**01**
Total Hours				**42**

Books:	
Text Books	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
Reference Books	1. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press 2. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
Useful links:	
1. www.energymanagertraining.com 2. www.bee-india.nic.in	
Assessment:	
Continuous Assessment: 1. Test 1– 20 marks 2. Test 2– 20 marks	
End Semester theory Examination for 60 marks of 02 hrs 30 min duration	

Course Code	Course Name	Credits (TH+P+TUT)
ILC6059	**Development Engineering**	3 - 0 – 0
Prerequisites:	**-**	
Course 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 worklife and the personal life of modern Indian professionals 4. To understand the Nature and Type of Human Values relevant to Planning Institutions	
Course Outcomes:	**After the successful completion of this course, learner will be able to:** 1. Apply knowledge for Rural Development. 2. Demonstrate post-independence rural development. 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.	

Module No. & Name	Sub Topics	CO mapped	Hrs / Sub Topics	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	**-**		**02**
1.Introduction to Rural Development	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	**CO1**	**04**	**08**
	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		**04**	
2. Post-Independence rural Development	Post-Independence rural Development Balwant Rai Mehta Committee – three tier system of rural local Government.	**CO2**	**02**	**04**
	Need and scope for people _s participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development		**02**	

3. Rural Development Initiatives in Five Year Plans	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.	**CO3**	**03**	**06**
	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.		**03**	
4. Post 73rd Amendment Scenario	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;	**CO4**	**02**	**04**
	Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments		**02**	
5. Values and Science and Technology Material development	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education.	**CO5**	**03**	**10**
	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;		**05**	
	Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.		**02**	
6. Ethics Canons of ethics	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility.	**CO6**	**04**	**07**
	Work ethics; Professional ethics; Ethics in planning profession, research and education.		**03**	
ii. Course Conclusion	Recap of Modules, Outcomes, Application and Summarization.		**-**	**01**
Total Hours				**42**

Books:	
Text Books	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
Reference Books	1. Planning Guide to Beginners 2. Weaver, R.C., The Urban Complex, Doubleday. 3. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington. 4. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150. 5. Watson, V. Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395– 407
Assessment:	
Continuous Assessment 1. Test 1 – 20 marks 2. Test 2 – 20 marks	
End Semester Theory Examination will be of 60-Marks for 02 hrs 30 min duration.	

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

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):	After the successful completion of this course, the learner will be able to: 1.Generate machine code by using various databases generated in pass one of two pass assembler 2.Identify patterns, tokens & regular expressions for lexical analysis. Use different compiler tools like LEX and YACC 3.Design Lexical analyser for given language using C and LEX /YACC tools 4.Identify and validate different tokens for given high level language code. 5.Design and analyse top down and bottom up parsers. 6.Generate intermediate code and machine code from the given code forms. 7.Apply ethical principles like timeliness and adhere to the rules of the laboratory

Module	Content	LO mapped	Hrs / lab
1	Implementation of two pass assembler.	LO1, LO7	02
2	Design and implement a lexical analyzer for given language, the lexical analyzer should ignore redundant spaces, tabs and new lines.	LO1, LO7	02
3	Implementation of Lexical Analyzer using Lex Tool.	LO2, LO7	02
4	Generate YACC specification for a few syntactic categories. a) Program to recognize a valid arithmetic expression that uses operator +, – , * and /. b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits. c) Implementation of Calculator using LEX and YACC d) Convert the BNF rules into YACC form and write code to generate abstract syntax tree	LO3, LO7	02
5	Write program to find ε – closure of all states of any given NFA with ε transition.	LO4, LO7	02
6	Write program to find First and Follow of any given grammar.	LO4, LO7	02
7	Construct a Shift Reduce Parser for a given language	LO5, LO7	02
8	Develop an operator precedence parser for a given language.	LO5, LO7	02

9	Implement Intermediate code generation for simple expressions.	**LO6, LO7**	**02**
10	Generate machine code from the intermediate code forms	**LO6, LO7**	**02**

Term work:

1. Term work should consist of minimum 10 experiments
2. Journal must include at least 2 assignments.
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 CEL602 and CEC602

Lab Code	Lab Name	Credits (P+TUT)
CEL602	Deep Learning Lab	1- 0

Lab Prerequisite:	1. Machine Learning 2. Basic Mathematics and Statistics Concepts
Lab Objectives:	1. To design and analyze the concept of Deep Neural Network through various applications 2. To implement Convolution Neural Network and Recurrent Neural Network 3. To implement Deep Neural Network and layered learning approach 4. Apply various deep learning techniques to design efficient algorithms for real-world applications.
Lab Outcomes (LOs):	**At the end of the course, the student will be able to** 1. Explore Deep learning libraries and implement deep learning model 2. Build and train Convolution Neural Network 3. Build and train Recurrent Neural Network 4. Demonstrate regularization and optimization schemes in deep learning 5. Apply the deep neural network concepts in developing real world applications 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 of XOR Gate using Backpropagation in Neural Networks.	**LO1, LO6**	**02**
2.	To explore all major deep learning libraries, e.g., TensorFlow, Keras, MXNet, JAX, and Hugging Face Transformers.	**LO1, LO6**	**02**
3.	To design and implement a Neural Network using Keras API. a) To design a Neural Network using Keras api. b)To plot the model and its subsequent layers(along with the input and output dimensions of each layer) using vis_utils.	**LO1, LO6**	**02**
4.	a) To design and implement a CNN for Multiclass Object classification on image data. b) Classification of digits from 0 to 9 using keras API and training using layers of Conv2D, Maxpooling, Dropout etc.	**LO2, LO4, LO6**	**02**
5.	To design and implement simple RNN layer for Binary Classification on text data.	**LO3, LO6**	**02**
6.	a) To design and implement RNN(Recurrent Neural Network) by using LSTM layer for Multiclass Classification on text data b) To design and implement a RNN(Recurrent Neural Network) by using GRU layer for Multiclass Classification on text data.	**LO3, LO4, LO6**	**02**
7.	Implement Generative Adversarial network	**LO5, LO6**	**02**
8.	Implement an **Encoder–Decoder architecture using LSTM** for Machine Translation.	**LO5, LO6**	**02**
9	Implement a **Transformer-based text classification model** to automatically categorize news articles into predefined topics such as politics, sports, technology, and business.	**LO5, LO6**	**02**

10.	Deployment of Deep Learning models using Docker	**LO5** **LO6**	**02**

Term work:

1. Term work should consist of minimum 8 experiments.
2. Journal must include at least 2 assignments on content of theory and practical of "Deep Learning".
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, Assignment: 05-marks)**

Oral Exam

Oral examination will be based on theory and practical syllabus.

Lab Code	Lab Name	Credits (P)
CEDLL6031	**Quantitative Analysis Lab**	**01**
Lab Prerequisite:	Python Programming.	
Lab Objectives:	1. Understand the types of data and its collection methods 2. Learn the data visualization techniques 3. Learn the regression and testing techniques	
Lab Outcomes (LOs):	**At the end of the lab, students will be able to:** 1. Identify different data collection methods 2. Analyze data visualizations using various graphical representations and calculate statistical errors 3. Apply linear regression methods to model and analyze relationships between variables 4. Apply multiple regression analysis and compute partial and multiple correlation coefficient 5. Conduct statistical inference and hypothesis tests and use the results to make data-driven decisions 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory	

Content:

Data collection methods, data representation techniques, simple and multiple regression analysis and different hypothesis testing using Python/R language

Lab No.	Experiment Title	LO mapped	Hrs/ Lab
1.	Case Study: Data collection methods and its analysis.	**LO1, LO6**	**02**
2.	Data Visualization: Use primary or secondary data to create various visualizations using data visualization tool (e.g., bar charts, pie chart, histograms, scatter plots etc).	**LO2, LO6**	**02**
3.	A. Implementation of Probability Sampling Techniques using a sample data set and compute statistical errors B. Implementation of Non-Probability Sampling Techniques using a sample data set and compute statistical errors	**LO2, LO6**	**02**
4.	A. Implement different methods of correlation and understand their applications a. Scatter diagram method b. Graphic method c. Karl Pearson's Coefficient of Correlation B. Implement Simple Linear Regression Analysis and Evaluate the Model performance.	**LO3, LO6**	**02**
5.	Computation of Partial and Multiple Correlation Coefficients for Multivariate Data Analysis	**LO4, LO6**	**02**
6.	A. Apply Multiple Regression Analysis based on normal equation for the least square regression B. Implement Multiple Regression Analysis with Deviations Taken from Actual Means	**LO4, LO6**	**02**
7.	To estimate population parameters using **Method of Moments** and **Maximum Likelihood Estimation** and to study **properties**	**LO5, LO6**	**02**

	of point estimators.		
8.	Demonstrate of One-Tailed and Two-Tailed t-Tests in Hypothesis Testing	**LO5, LO6**	**02**
9.	Perform Z-tests for large samples and interpret the test results	**LO5, LO6**	**02**
10.	Perform an end-to-end statistical analysis on a real-world dataset, covering statistical concepts and techniques.	**LO1 to LO6**	**02**

Term work:

1. Term work should consist of 10 experiments.
2. Journal must include at least 2 assignments
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/ Practical

Oral examination will be based on theory and practical syllabus

Lab Code	Lab Name	Credits (P+TUT)
CEDLL6032	Multimedia Systems Lab	1- 0

Lab Prerequisite:	• Computer Fundamentals • Basics of Computer Graphics • Fundamental knowledge of programming (C / Python / HTML)
Lab Objectives:	1. To understand the basic concepts, elements, and architecture of multimedia systems. 2. To study various multimedia components such as text, image, audio, and video. 3. To analyse and implement compression techniques for different multimedia data. 4. To understand multimedia communication and networking concepts. 5. To apply multimedia security techniques in real-world applications.
Lab Outcomes (LOs):	At the end of the course, the student will be able to: 1. Identify the fundamentals and architecture of multimedia systems. 2. Analyze different multimedia file formats and representations. 3. Implement basic compression techniques for text, image, audio, and video. 4. Demonstrate multimedia communication and streaming concepts. 5. Apply security techniques in multimedia environments. 6. Follow ethical principles such as discipline, punctuality, and proper laboratory practices.

Lab No	Experiment Title	LO Mapped	Hrs/ Lab
0	Prerequisite – Introduction to Multimedia Software Tools	LO1	02
1	Study of Multimedia System Components, Elements and Applications	LO1, LO2	02
2	Study of Multimedia Hardware Devices and Storage Media	LO1, LO2	02
3	Text Representation and File Format Analysis (RTF, TIFF)	LO2	02
4	Implementation of Text Compression using Huffman Coding and RLE	LO3	02
5	Digital Image Representation and File Format Study (BMP, JPG)	LO2	02
6	Implementation of Image Compression using JPEG Algorithm	LO3	02
7	Audio Signal Representation and Audio File Format Analysis (WAV, MPEG)	LO3	02
8	Implementation of Audio Compression Techniques (PCM / DPCM)	LO3, LO4	02
9	Study of Digital Video Representation and MPEG Video Compression	LO4	02
10	Implementation of Image Steganography for Multimedia Security	LO5	02

Term work: Total Marks: 25

- Experiments: **20 Marks**
- Assignments: **05 Marks**

Assessment Scheme :

- Laboratory sessions to be conducted as **2 hours continuous theory + hands-on session**.
- Assessment will be based on:
  - Practical implementation
  - Viva-voce
  - Assignments and records
- Students must submit:
  - Experiment write-ups / programs
  - Screenshots of outputs wherever applicable
- A **cover page stating aims and objectives** must be attached and will be considered towards assessment.

Useful Links :

- https://nptel.ac.in/courses/117/105/117105081/
- http://www.cse.unsw.edu.au/~cs9519/
- https://vlabs.iitb.ac.in

Oral/ Practical :

Oral examination will be based on theory and practical syllabus

Lab Code	Lab Name	Credits (P+TUT)
CEDLL6033	**Infrastructure 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 symmetric, asymmetric, hashing, and digital signature techniques for secure communication. **2.**Demonstrate software vulnerabilities like buffer overflow, SQL injection, and XSS with their protections. **3.**Configure SSL/TLS, IPsec, IDS/IPS, firewalls, and packet analyzers to secure networks and wireless systems. **4.**Develop security policies, handle incidents, and mitigate common web and email security threats. **5.**Follow ethical practices while safely using security tools and performing experiments.

Lab No	Experiment Title	LO Mapped	Hrs/ Lab
0	Prerequisite:Linux commands, networking basics, installing tools (Kali/Ubuntu)	-	**02**
1	Implement classical ciphers: Diffie-Hellman ,Caesar, Vigenère, Playfair, etc.	**LO1**	**02**
2	Implement AES/DES encryption using Python/OpenSSL	**LO1**	**02**
3	Implement RSA: key generation, encryption, decryption, signatures	**LO1**	**02**
4	Perform hashing: MD5, SHA-1, SHA-256 using tools/scripts	**LO1**	**02**
5	Configure firewall using iptables / ufw	**LO3**	**02**
6	Install and configure IDS/IPS using Snort / Suricata	**LO3**	**02**
7	Use PGP/GPG for secure email communication	**LO1, LO4**	**02**
8	Demonstrate buffer overflow in controlled environment	**LO2, LO5**	**02**
9	Perform SQL Injection using DVWA/WebGoat	**LO2, LO5**	**02**

10	Perform XSS attacks and apply mitigation techniques	**LO2, LO4**	**02**
11	Analyze attacks using Wireshark: packet sniffing, ARP spoofing	**LO3,LO5**	**02**
12	Implement authentication mechanisms: password policy, MFA tools	**LO3, LO4**	**02**
13	Configure HTTPS using self-signed certificates (OpenSSL)	**LO1, LO3**	**02**
14	Cloud IAM demonstration (AWS Educate/Azure Student): access control	**LO3, LO4**	**02**
15	Design an organizational security policy using practical cryptography, secure communication, security controls, attack analysis, and mitigation techniques.	**LO4, LO5**	**02**

Term Work:

- Term work should consist of **10 experiments**.
  Journal must include at least 2 assignments based on theory and practical content. Final certification depends on satisfactory performance and securing minimum passing marks.
  Marks Distribution:
  Lab Performance: 20 marks
  Assignments: 5 marks

Course Code	Course Name	Credits (TH+P+TUT)
CEDLL6034	Artificial Intelligence & Soft Computing Lab	0-1-0

Prerequisite:	1. Algorithm 2. Discrete structure 3. Data structure
Course Objectives:	1. Introduce real-world AI applications through case studies, problem identification, and PEAS analysis. 2. Develop skills to formulate AI problems and apply suitable state-space models and search strategies. 3. Build foundational knowledge in representation methods, fuzzy logic, and fuzzy inference systems. 4. Provide students to evolutionary and swarm intelligence techniques like GA, PSO, and ACO for optimization
Lab Outcomes:	**At the end of the course, the students will be able to** 1. Analyze AI case studies, identify core problems, and describe them using PEAS and formal problem formulation. 2. Implement and compare search algorithms to reach goal states for given AI problem statements. 3. Design and implement knowledge representation schemes and construct a basic knowledge base for simple domains. 4. **Apply fuzzy logic** by implementing De-Morgan's law, creating membership functions, and designing fuzzy controllers for real-life systems. 5. **Implement and** evaluate optimization techniques such as Genetic Algorithms, Particle Swarm Optimization, and Ant Colony Optimization for benchmark problems. 6. Apply ethical principles like timeliness and adhere to the rule of the laboratory

Lab No	Experiment Title	LO mapped	Hrs/ Lab
1	Select a problem statement relevant to AI and design : 1.Identify the problem 2.PEAS Description 3.Problem formulation	**LO1, LO6**	**2**
2	To implement uninformed search algorithms to reach goal state	**LO2,LO6**	**2**
3	To implement informed search algorithms to reach goal state	**LO2, LO6**	**2**
4	To Implement Knowledge Representation and Create Knowledge Base	**LO3, LO6**	**2**
5	To implement a program to implement De-Morgan's law and to plot triangular, trapezoidal and bell shaped membership functions	**LO4, LO6**	**2**
6	To implement a program Using fuzzy toolbox to model tips value	**LO4, LO6**	**2**
7	To implement Fuzzy Controller system (Design an automobile or washing machine controller, etc. and implement)	**LO4,LO6**	**2**
8	To compare and implement different selection mechanism using genetic algorithm.	**LO5,LO6**	**2**

9	To implement Particles Swarm optimization.	**LO5,LO6**	**2**
10	To implement Ant colony optimization.	**LO5,LO6**	**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 by Aurélien Géron. 2. Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2, 3rd Edition By Sebastian Raschka,Vahid Mirjalili.		
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** based on theory and practical content. Final certification depends on satisfactory performance and securing minimum passing marks 3. Marks Distribution: **Lab Performance:** 20 marks. **Assignments:** 5 marks			
Oral/ Practical Oral examination will be based on Theory and Practical syllabus			

Course code	Course Name	Credits
CEPR64	**Project Based Learning - Major Project -A**	**3**

PBL Objectives:	1. To encourage students for knowledge acquisition and use latest technology. 2. To make students to develop presentation skills. 3. To use written communications to report and technical writing.
PBL Outcomes:	**Upon completion of the course, the learners will be able to:** 1. Review literature, Design solutions, components or processes for complex engineering problems on the basis of research knowledge. 2. Implement projects using modern tools which are useful to society. 3. Apply contextual knowledge to assess the public health/safety/societal/ environmental issues for sustainable development. 4. Document the work in project report and log book by referring reputed material. 5. Apply ethical principles and commit to professional ethics, responsibilities norms of the engineering practice and engage in independent and life-long learning. 6. Present their work in clear and effective manner with professional values like team work, time management and make financial arrangements .

Project Guidelines:

1	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.
2	Project work must be carried out by the group of at least two students and maximum threeand must be original.
3	Students can certainly take ideas from anywhere, but be sure that they should evolve themin the unique way to suit their project requirements.
4	The project work can be undertaken in a research institute or organization/ company/anybusiness establishment.
5	Student must consult internal guide along with external guide (if any) in selection of topic.
6	Head of department and senior staff in the department will take decision regarding selectionof projects.
7	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. (Log book should be prepared by every group for maintaining weekly group.)
8	In case of industry projects, visit by internal guide will be preferred.

Project Report Format:

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

- Abstract
- Introduction
- Literature Survey
  - a) Survey Existing system
  - b) Limitation of the Existing system or research gap
  - c) Problem Statement and Objective
  - d) Scope
- Proposed System
  - a) Analysis/Framework/ Algorithm
  - b) Details of Hardware & Software
  - c) Design details
  - d) Methodology (your approach to solve the problem)
- Implementation Plan for next semester
- Conclusion
- References

Distribution of Term work marks for both semesters shall be as below:		**Marks**
1	Marks awarded by guide based on log book	5
2	Marks awarded by review committee for presentation	10
3	Quality of Project report	5
4	Effort taken by students ● Paper publish/Filling patent/creation of product/startup ● Idea/project/poster/TPP competition (National/international)	5
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.

Assessment criteria of Major Project

Major 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 managementStandard
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 VII and VIII), 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.	
Guidelines for Assessment of Major Project Practical/Oral Examination:	
1	Report should be prepared as per the standard format.
2	Major Project shall be assessed through a presentation and demonstration of working modelby 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 bythe head of Institution.
3	Project groups have to prepare a Conference paper/participate in project competition/ Technical paper presentation/ national international competitions etc.

Review / progress monitoring committee may consider points for assessment based on oneyear project as mentioned in general guidelines.

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:** AWS, Open Stack / Eucalyptus, etc	**LO2, LO6**	**02**
4	**Title:** Identity Management in Cloud **Concept:** Simulate identity management in your private cloud. **Technology:** AWS, Open Stack,etc	**LO3, LO6**	**02**
5	**Title:** Storage as a Service **Objective:** Explore Storage as a Service for remote file access using web interface. **Technology:** AWS, ownCloud,etc	**LO5, LO6**	**02**
6	**Title:** Cloud Security **Objective:** Understand security of web server and data directory. **Technology:** AWS, ownCloud, etc	**LO3, LO6**	**02**
7	**Title:** Platform as a Service **Objective:** Deploy web applications on commercial cloud. **Technology:** AWS, 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:** AWS, Ulteo	**LO5, LO6**	**02**
10	**Title:** Study the recent research paper on trend in cloud Computing. **Objective**: Understand the recent trends in cloud 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://onlinecourses.nptel.ac.in/noc26_cs55/course
3. https://www.coursera.org/specializations/cloud-computing
4. www.openstack.org
5. https://www.digitalocean.com/

Term Work:

The **Term Work** for the subject **Cloud Computing** shall carry a total of **50 marks**, distributed as follows:

- **Experiments – 20 Marks**
  Students are required to perform a **minimum of eight (8) laboratory experiments** based on Cloud Computing concepts. Evaluation shall be carried out based on regular performance in lab, conceptual understanding, correctness of implementation, and proper maintenance of laboratory records.
- **Mini Project – 15 Marks**
  Students shall undertake a mini project focused on a Cloud Computing application or use case. The assessment will be based on problem formulation, design and implementation, effective utilization of cloud services, documentation, and presentation.
- **AWS Certification – 15 Marks**
  Students are encouraged to complete a relevant **AWS Cloud certification** during the course duration. Marks will be awarded upon submission of valid certification or course completion evidence.