GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR
(Established by State Legislature Act 17 of 1995)
'A+' Grade, NAAC Accredited State Govt. University

2424
Dated 13/11/24

Acad./AC-III/BOS&R-6/2024/ 7393
Dated: 12/11/24

To

The Controller of Examinations
GJUS&T, Hisar.

Sub: **Approval of scheme of examination and syllabi of B.Tech. CSE (Artificial Intelligence & Machine Learning) – 7th and 8th semester for the batch 2021 being run by University Teaching Department.**

Sir,

I am directed to inform you that the Vice-Chancellor, on the recommendations of Dean, Faculty of Engineering & Technology on dated 07.11.2024, is pleased to approve the scheme of examinations and syllabi of B.Tech. CSE (Artificial Intelligence & Machine Learning) – 7th and 8th semester for the batch 2021 being run by University Teaching Department, under Section 11(5) of the University Act, 1995 in anticipation of approval of the Academic Council.

A copy of the scheme of examinations & syllabi of above said course is enclosed herewith.

You are therefore, requested to take further necessary action accordingly.

Yours faithfully

DA: As above

12/11/24
Assistant Registrar (Academic)
for Registrar

Endst. No. Acad./AC-III/BOS&R-6/2024/ 7394-97 Dated: 12/11/24

A copy of the above is forwarded to the following for information and necessary action:-

1. Dean, Faculty of Engineering & Technology, GJUST, Hisar.
2. Chairperson, Department of Computer Science & Engineering, GJUST, Hisar. He is requested to get upload the scheme of examination & syllabi of above said course being run in University Teaching Department on the website of the University.
3. OSD to Vice-Chancellor (for kind information of the Vice-Chancellor), GJUST, Hisar
4. Secretary to Registrar (for kind information of the Registrar), GJUST, Hisar.

12/11/24
Assistant Registrar (Academic)
for Registrar

13/11/24
Sh. Ashwani to upload the same on website
A-1

Department of Computer Science & Engineering

GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR

"A+" Grade NAAC Accredited

Established by Haryana State Legislative Act No.17 of 1995 & Recognised by UGC Act 1956 u/s 12-B & 2(F)

Website: www.gjust.ac.in ***Ph. No: 01662-263173, 263154***

Acad/1625
24/10/24

No. CSE/2024/ 1628
Dated 24/10/24

To

A.R (Academic)
Guru Jambheshwar University of Sci. & Tech.,
Hisar.

Sub: Scheme and Syllabus of B.Tech CSE (AI&ML)

Please find enclosed herewith Scheme and Syllabus of B.Tech CSE (AI&ML) 7th & 8th Semester is attached duly approved by BOSR (copy attached).

24/10/24
CHAIRMAN

Urgent
Pls forward

24/10/24
D.S.C (Acad.) 24/X/24
Ac - III

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY
(Established by State Legislature Act 17 of 1995)
'A+' Grade NAAC Accredited

No.CSE/23/3039-305
Dated: 14/12/2023

Minutes of BOSR Meeting

A meeting of BOSR was held on 08.12.2023 at 11:30 am onwards in the conference room of the Department of CSE. The following were present:

Sr. No.	Name		Sr. No.	Name	
1	Prof. O. P. Sangwan	In Chair	7.	Prof. Jyoti	Member
2	Prof. Saroj	Member	8.	Prof. Jaswinder Singh	Member
3	Prof. Yogesh Chabba	Member	9.	Dr. Sunil Nandal	Member
4	Prof. Pardeep kr. Bhatia	Member	10.	Dr. Manoj Kumar	Member
5.	Prof. Rishi Pal	Member	11.	Prof. Khujan Singh, DDE	Special Invitee
6.	Prof. Sanjeev Khambra	Member	12.	Prof. Suchita Bhasin DCSA, KUK	External Member

Following decisions were taken unanimously:

1. BOSR considered the minutes of DRC meetings held on 06.07.2023, 31.10.2023 and 06.12.2023 and the same were approved.

2. The panels of examiners of PhD Research scholars namely Mr. Parveen (Reg. No.: 16018053), Mr. Vikas Chahar (Reg. No.: 17019016), and Mr. Vinod Prakash (Reg. No.200010090004) were drawn and approved.

3. Scheme and Syllabus of B.Tech. CSE (Artificial Intelligence & Machine Learning) fourth year (seventh & eight semesters) was discussed and approved.

4. As per resolution no 19 of the minutes of meeting of 60th meeting of Academic council held on 08.02.2023 to introduce the paper "Research Methodology" in all M.Tech Programmes. Matter was discussed and approved to introduce "Research Methodology "paper as one of compulsory subject in third Semester of M.Tech. (CSE) Programme w.e.f. the academic session 2023-24.

5. As per minutes of staff council meeting held on 13.10.2023, it was discussed and approved that the (i) Intake capacity of B.Tech. CSE (AI&ML) will be increased from 60 to 120 seats, and (ii) To start BCA Programme with intake capacity of 60 (instead of 30 seats), subject to the availability of the sufficient infrastructure provided by the University Administration, w.e.f. the Academic Session 2024-25.

6. As per the approval of Vice Chancellor vide notification No.:Endst No.DF-03/2023/208-216, dated 27.10.2023, the scheme of MCA programme in Open and Distance Learning (ODL) mode

remains the same for the academic session 2023-24 and onwards i.e. External -70%, Internal-30%.

7. As per minutes of staff council meeting held on 13.10.2023, eligibility criteria for admission to M.Tech (CSE) proposed as under:-

B.E/B.Tech or equivalent degree in Computer Science & Engineering / Computer Engineering / Information Technology / Electronics & Communication Engineering / Electronics Engineering/Electrical & Electronics Engineering / Electronics & Instrumentation Engineering/Electrical Engineering / relevant branch or Master of Computer Applications (MCA) or M.Sc.(Computer Science)/IT/Software or M.Sc. (Data Science) or M.Sc. (maths) or M.Sc.(Physics) from a recognized University/Institution with at least 55% marks in aggregate (52.25% marks for SC candidates of Haryana only), was discussed and approved w.e.f. the Academic Session 2024-25.

8. Minor modifications in the existing Scheme & Syllabus of MCA programme as per NBA guidelines were discussed and approved. Further, Chairperson (CSE) is authorized to make minor changes in the scheme & syllabus, if required.

9. Chairperson is authorized to rectify for any discrepancy if observed in panel of examiners for PhD Evaluation is consultation with concerned supervisor.

10. Chairperson (CSE) is also authorized to draw panel(s) of examiners for any left out Course/Programme/Dissertation/Project etc., if required.

Meeting ended with vote of thanks to the Chair.

Chairperson, BOSR

Cc to :

1. COE, GJUS&T, Hisar, along with Panel of Examiners.
2. OSD to VC (for kind information of Hon'ble Vice Chancellor), GJUS&T, Hisar.
3. Supdt. to Registrar (for kind information of Registrar), GJUS&T, Hisar.
4. Deputy Registrar (Academic) GJUS&T, Hisar, for further necessary action.
5. Deputy Registrar (Registration), GJUST&T, Hisar.
6. All the members of BOS&R

14/12/23

Chairperson, BOSR

SEMESTER VII

Sr. No.	Course Codes	Nomenclature of the Courses	Hours per week			Credits	Internal	External
			L	T	P			
1.	PCC-CSEAI401-T	Deep Learning	3	0	0	3	30	70
2.	PCC-CSEAI402-T	Cryptography and Network Security	3	0	0	3	30	70
3.	PEC-CSEAI401-T to PEC-CSEAI405-T	Professional Elective Course to be opted by students	3	0	0	3	30	70
4.	PEC-CSEAI406-T to PEC-CSEAI410-T	Professional Elective Course to be opted by students	3	0	0	3	30	70
5.	OEC-T	Open Elective Course be opted by students	3	0	0	3	30	70
6.	PCC-CSEAI401-P	Deep Learning Tools Lab. (Python Packages, Tensor Flow, Keras, Google Colab etc.)	0	0	4	2	50	50
7.	PROJ-CSEAI401	*Major Project Part I	0	0	4	2	50	50
8.	INT-CSEAI401	**Industrial Training				2	100	-
Total Credit						21		

*Major Project Part I will be evaluated by a committee of three internal examiners appointed by the chairperson.

**Industrial Training will be evaluated by internal examiners appointed by the chairperson.

List of Electives II

1. PEC-CSEAI401-T/ PEC-CSE401-T/ PEC-IT401-T: Software Project Management
2. PEC-CSEAI402-T/ PEC-CSE302-T/ PCC-IT401-T: Wireless and Mobile Communication
3. PEC-CSEAI403-T/ PCC-CSE401-T/ PCC-IT306-T: Compiler Design
4. PEC-CSEAI404-T:Data Visualization Techniques
5. PEC-CSEAI405-T/PEC-CSE410-T/ PEC-IT410-T: Software Defined Networks
6. Any one of the MOOC not studied earlier and of equal credits (3)

List of Elective III

1. PEC-CSEAI406-T/PEC-CSE408-T/ PEC-IT408-T: Digital Image Processing
2. PEC-CSEAI407-T: Reinforcement Learning
3. PEC-CSEAI408-T: Edge and Fog Computing
4. PEC-CSEAI409-T: Natural Language Processing
5. PEC-CSEAI410-T: Cognitive Systems
6. Any one of the MOOC not studied earlier and of equal credits (3)

SEMESTER VIII

Sr. No.	Course Codes	Nomenclature of the Courses	Hours per week			Credits	Internal	External
			L	T	P			
1.	PCC-CSEAI403-T	Big Data Analytics	3	0	0	3	30	70
2.	PEC-CSEAI411-T to PEC-CSEAI415-T	Professional Elective Course to be opted by students	3	0	0	3	30	70
3.	PEC-CSE416-T to PEC-CSE420-T	Professional Elective Course to be opted by students	3	0	0	3	30	70
4.	PCC-CSEAI403-P	Big Data Analytics Lab	0	0	4	2	50	50
5.	PROJ-CSEAI402	*Major Project Part II	0	0	8	4	50	50
Total Credit						15		

*Major Project Part II will be evaluated by internal examiner and external examiner appointed by Chairperson and COE respectively.

List of Electives IV

1. PEC-CSEAI411-T: Introduction to Robotics
2. PEC-CSEAI412-T/ PEC-CSE417-T/ PEC-IT406-T:Digital Forensics
3. PEC-CSEAI413-T: Social Network Analysis
4. PEC-CSEAI414-T: Computer Vision
5. PEC-CSEAI415-T: Pattern Recognition
6. Any one of the MOOC not studied earlier and of equal credits (3)

List of Electives V

1. PEC-CSEAI416-T: Quantum Computing
2. PEC-CSEAI417-T: Optimization Methods
3. PEC-CSEAI418-T: Blockchain Technology
4. PEC-CSEAI419-T: Introduction to Augmented and Virtual Reality
5. PEC-CSEAI420-T: Federated Learning
6. Any one of the MOOC not studied earlier and of equal credits (3)

Deep Learning

General Course Information

Course Code: PCC-CSEAI401-T Course Credits: 3 Type: Professional Core Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Linear Algebra, probability and information theory and machine learning

About the Course:

Deep learning has revolutionised the field of machine learning. Deep learning emphasises on learning complex, hierarchical feature representation from raw data. Deep learning algorithms have found tremendous amount of applications in machine learning applications. The course covers fundamental principles of deep learning and elaborates on building and optimizing these highly parameterized models. It involves learning about convolutional neural networks, recurrent and generative adaptive neural network models.

Course Outcomes: By the end of the course students will be able to:

CO1. **state** the basic and fundamental terms and concepts in deep learning.(LOTS: Level 1: Remember)
CO2. **demonstrate** the understanding of deep learning principals involving architecture, regularization and optimization, of neural nets, CNN, RNN and autoencoders (LOTS: Level 2: Understand)
CO3. **solve** problemspertaining machine learning involving deep learning solutions. (LOTS: Level 3: Apply)
CO4. **compare** various neural network architectures. (HOTS: Level 4: Analyse)
CO5. **evaluate** the performance and challenges for deep learning algorithms. (HOTS: Level 5: Evaluated)
CO6. **devise** new deep learning architectures, optimization techniques and algorithms. (HOTS: Level 6: Create)

Course contents

Unit I

Review of Machine Learning: Learning algorithms, Overfitting and Underfitting, Hyperparameters and validation set, Estimating bias and variance, Maximum likelihood estimation, Bayesian Statistics, Stochastic gradient descent, Building a machine learning algorithm, Challenges and motivation for deep learning.

Deep Feedforward Networks: Learning XOR, Gradient-based learning, Hidden units, Backpropagation and other differentiation algorithms.

Unit II

Regularization for Deep Learning: Parameter norm Penalties, Norm penalties as constrained Optimization, Regularization and under-constrained problems, Dataset augmentation, Noise robustness, Semi-supervised learning, Multi-task learning, Early stopping, Adversarial training.

Optimization for Training Deep Models: How learning differs from pure optimization, Challenges in neural network optimization, Basic algorithms for neural network optimization, Parameter initialization strategies, Algorithm with Adaptive Learning Rule, Optimization Strategies and Meta-algorithms.

Unit III

Convolutional Networks: The convolution operation, Motivation, Pooling, Convolution and pooling as an infinitely strong prior, Variants of basic convolution functions, Structured outputs and Data types, Efficient convolution algorithms.

Recurrent Networks: Recurrent neural networks, Bidirectional RNNs, Encoder-Decoder sequence to sequence architectures, Deep recurrent networks, Recursive Neural Networks, The challenge of long term dependencies, The Long Short-Term Memory RNNs.

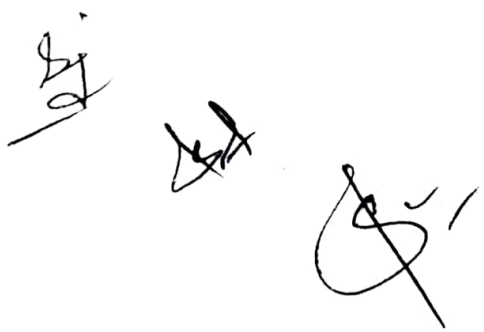
Unit IV

Autoencoders: Undercomplete autoencoders, Regularized autoencoders, Representational power, layer size and depth, stochastic encoders and decoders, Denoising autoencoders, Applications of autoencoders.

Deep Generative Models: Boltzmann Machines, Restricted Boltzmann machines, Deep belief networks, Deep Boltzmann machines, Boltzmann machine for real-valued data, Convolutional Boltzmann machine.

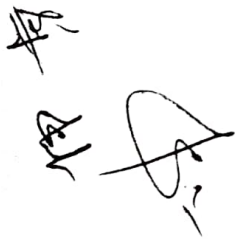
Text and References Books

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, *Deep Learning*, MIT press, 2017.
2. Charu C Aggarwal, *Neural Networks and Deep Learning: A text book*, Springer, 2018.
3. John D. Kelleher, Deep Learning, MIT press, 2019.
4. NithinBuduma, Nikhil Buduma and Joe Papa, Fundamentals of Deep Learning: Designing Next-Generation Machine Learning Algorithms, Second Edition, O'reilly, 2022.
5. Francois Chollet, Deep Learning with Python, Manning Publications, 2018.



CO-PO Articulation Matrix: Deep Learning (PCC-CSEAI401-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **State** the basic and fundamental terms and concepts in deep learning. (LOTS: Level 1: Remember)	1	1	-	-	-	-	-	-	-	-	-	-	-	3
CO2. **Demonstrate** the understanding of deep learning principals involving architecture, regularization and optimization, of neural nets, CNN, RNN and autoencoders. (LOTS: Level 2: Understand)	2	2	-	1	-	-	-	-	-	-	-	-	-	3
CO3. **Solve problems** pertaining machine learning involving deep learning solutions. (LOTS: Level 3: Apply)	3	3	-	2	1	-	-	-	-	-	-	-	1	3
CO4. **Compare** various neural network architectures. (HOTS: Level 4: Analyse)	3	3	-	3	2	-	-	-	-	-	-	-	2	3
CO5. **Evaluate** the performance and challenges for deep learning algorithms. (HOTS: Level 5: Evaluated)	3	3	-	3	3	-	-	-	-	-	-	-	2	3
CO6. **Devise** new deep learning architectures, optimization techniques and algorithms. (HOTS: Level 6: Create)	3	3	-	3	3	-	-	-	-	-	-	-	2	3
Level of Attainments PCC-CSEAI401-T														



Cryptography and Network Security

General Course Information

Course Code: PCC-CSEAI402-T Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Basic knowledge of Number systems, Complexity Theory, Computer Networks.

About the Course:

The aim of this course is to introduce the student to the areas of cryptography and cryptanalysis. This course develops a basic understanding of the algorithms used to protect users online and to understand some of the design choices behind these algorithms.

Course Outcomes: By the end of the course students will be able to:

- CO1. **describe** various cryptography terminology and cryptographic Algorithms.(LOTS: Level 1: Remember)
- CO2. **represent** security in terms of various techniques and algorithms. (LOTS: Level2: Understand)
- CO3. **apply** mathematical techniques to cryptography for solving problems related to security issue. (LOTS: Level 3: Apply)
- CO4. **identify** various types of attacks for their mitigation/proactive and reactive treatment. (HOTS: Level 4: Analyze)
- CO5. **judge** the security of an organization/institute by means of network security devices/models/controls. (HOTS: Level 5: Evaluate)
- CO6. **integrate** different types of securities under one environment and evaluate its performance.(HOTS: Level 6: Create)

Course Contents

Unit I

Computer & Network Security Concepts: Overview; Security Goals; Threats, Attacks, & Assets;

Vulnerabilities; Security Functional Requirements; Security Services; Security Mechanism; Secure Communications; Model for Network Security; The OSI Security Architecture.

Cryptographic Tools: Symmetric and Asymmetric Key Ciphers; Classical Encryption Techniques; Symmetric Ciphers: Confidentiality with Symmetric Encryption; One-Time Pads; User Authentication Methods; Block Cipher and Data Encryption Standard; Advanced Encryption Standard; RC2, RC4, RC5 & RC6; Block Cipher Operation; Random and Pseudo Random Numbers.

Unit II

Asymmetric Ciphers: Public Key Cryptography and RSA; Diffie-Hellman Key Exchange; Elliptic Curve Cryptography.

Cryptographic Data integrity: Cryptographic Hash Functions and Applications; Message Authentication Codes; Digital signatures & Schemes; Hashing & Signing; Message Digests; Digital Signature Standard; Birthday attacks on Signatures.

Key Management and Distribution: Symmetric Key Distribution using Symmetric Encryption & Asymmetric Encryption; Distribution of Public Keys; X.509 Certificates; Public Key Infrastructure.

Unit III

User Authentication Protocols: Remote User Authentication Principles; Remote User Authentication using Symmetric & Asymmetric Encryption; Kerberos.

Network Security: Threats & Attacks; Denial-of Service; Distributed Denial-of-Service; Cryptography in Network Security: Network & Browser Encryption, Onion Routing, IP Security protocol Suite (IPSec), Virtual Private Networks; Firewalls: Design & Types, Personal Firewalls, Network Address Translation (NAT); Intrusion Detection and Prevention Systems.

IP Security: Overview; IP Security Policy; Encapsulating Security Payload; Combining Security Associations; Internet Key Exchange.

Unit IV

Transport-Level Security: Web Security: Issues & Threats; Secure Naming; Secure Socket layer (SSL); Transport Layer Security (TLS); HTTPS; Secure Shell(SSH).

Wireless Network Security: Vulnerabilities in Wireless Networks; IEEE 802.11 Wireless LAN Securities; Wireless Application Protocol Overview; Wireless Transport Layer Security; WEP & WPA.

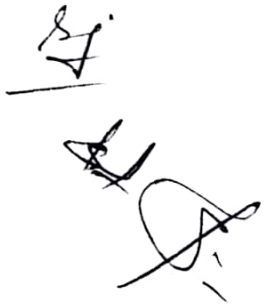
Electronic-mail Security: E-Mail Attacks; Pretty Good Privacy (PGP); Privacy Enhanced Mail (PEM); S/MIME; DomainKeys Identified Mail (DKIM).

Text and Reference Books and Links:

1. William Stallings, *Cryptography and Network security-Principles and Practices*, Pearson Education, Ninth Indian Reprint 2005.
2. Charlie Kaufman , *Network Security : Private communication in Public World*, Prentice-Hall International, Inc. April 2008.
3. Roberta Bragg, Mark Rhodes-Ousley, Keith Strassberg, *The Complete Reference Network Security*, McGraw hill Education, 2004.
4. Charles P. Fleeger, *Security in Computing*, 2nd Edition, Prentice Hall International Inc., 1996.
5. Atul Kahate, *Cryptography and Network Security*, McGraw Hill Education; Third edition, 2017

CO-PO Articulation Matrix:Cryptography and Network SecurityCourse (PCC-CSEAI402-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Describe** cryptography terminology and cryptographic Algorithms.(LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2. **Represent** security in terms of various techniques and algorithms. (LOTS: Level2: Understand)	2	1	-	-	-	-	-	-	-	-	-	-	1	2
CO3. **Apply** mathematical techniques to cryptography for solving problems related to security issue. (LOTS: Level 3: Apply)	3	2	1	1	-	-	-	-	-	-	-	-	2	3
CO4. **Identify** various types of attacks for their mitigation/proactive and reactive treatment. (HOTS: Level 4: Analyze)	3	2	2	2	-	-	-	-	-	-	-	-	2	3
CO5. **Judge** the security of an organization/institute by means of network security devices/models/controls. (HOTS: Level 5: Evaluate)	3	2	2	2	-	-	-	-	-	-	-	-	2	3
CO6. **Integrate** different types of securities under one environment and evaluate its performance.(HOTS: Level 6: Create)	3	3	3	3	-	-	-	-	-	-	-	-	2	3
Level of Attainments PCC-CSEAI402-T					-	-	-	-	-	-	-	-		



Software Project Management

General Course Information

Course Code: PEC-CSEAI401-T/ PEC-CSE401-T/ PEC-IT401-T Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Preliminary knowledge of Software Engineering.

About the Course:

The course involves training students in software project management and project planning. It focuses on the need for careful planning, monitoring and control for delivering quality projects in time. Besides this student learn to measure the success of a project in meeting its objectives.

Course Outcomes: By the end of the course studentswill be able to:

CO1. **outline** basic concepts related to stepwise project planning.(LOTS: Level 1: Remember)
CO2. **demonstrate** the knowledge about Quality Control, Standard and Risk Management. (LOTS: Level 2: Understand)
CO3. **illustrate** the Activity Planning, and Resource Allocation Process. (LOTS: Level 2: Understand)
CO4. **apply** the concept of team structure and organization structure. (LOTS: Level 3: Apply)
CO5. **compare**various Project Evaluation and Estimation Techniques. (HOTS: Level 4: Analyse)
CO6. **plan** activities necessary for completing the software projectssuccessfully. (HOTS: Level 6: Create)

Course Contents

Unit I

Introduction to Software Project Management(SPM): Definition of Software Project, Software Project Vs Other types of projects, activities covered by SPM, categorizing software projects, project as system, management control, Requirement specification, Information and control in organization, project management lifecycle.

Stepwise Project Planning: Introduction, selecting a project, identifying project scope and objectives, identifying project infrastructure, analysing project characteristics, identifying the project products and activities, estimate efforts for each activity, identifying activity risk, allocate resources, review/publicize plan.

Unit II

Project Evaluation and Estimation: Cost-Benefit analysis, cash flow forecasting, cost benefit evaluation techniques, Selection of an appropriate project, choosing technologies, choice of process models, rapid application

development, waterfall model, V process model and spiral model, Albrecht function point analysis.

Activity Planning: Objectives of activity planning, project schedule, projects and activities, sequencing and scheduling activities, network planning model.

Unit III

Risk Management: Introduction, the nature of risk, managing risk, risk identification, risk analysis, reducing the risks, evaluating risks to schedule, calculating z-values.

Resource Allocation: Introduction, the nature of resources, identifying resource requirements, scheduling resources, creating critical paths.

Unit IV

Managing Contracts and People: Introduction, types of contract, stages in contract placement, terms of contract, contract management, acceptance, managing people and organizing teams: Introduction,understanding organization behaviour: a back ground, selecting the right person for job, instruction in best methods, motivation, working in groups, becoming a team, decision making, leadership, organization structures.

Software Quality: Introduction, theplace of software quality inproject planning, the importance of software quality, defining software quality, McCall's software quality factors, product versus process quality management, external standards, techniques to enhance software quality.

Text and Reference Books:

1. Bob Hughes and Mike Cotterell, *Software Project Management*, Sixth Edition,TMH, 2018.
2. Walker Royce , *Software Project Management*, , Addison Wesley, 1998.
3. Pankaj Jalote, *Software Project Management in Practice*, Pearson, 2002.
4. Ramesh, *Managing Global Software Projects*, TMH, 2005.

CO-PO Articulation Matrix: Software Project Management Course (PEC-CSEAI401-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Outline** basic concepts related to stepwise project planning. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2. **Demonstrate** the knowledge about Quality Control, Standard and Risk Management. (LOTS: Level 2: Understand)	1		-	-	-	-	-	-	-	-	-	-	2	-
CO3. **Illustrate** the Activity Planning, and Resource Allocation Process. (LOTS: Level 2: Understand)	1	-	-	-	2	-	-	-	-	-	-	-	3	-
CO4. **Apply** the concept of team structure and organization structure. (LOTS: Level 3: Apply)	2	2	-	-	2	-	-	-	2	-	-	-	3	-
CO5. **Compare** various Project Evaluation and Estimation Techniques. (HOTS: Level 4: Analyse)	2	2	2	2	2	-	-	-	-	-	2	-	3	-
CO6. **Plan** activities necessary for completing the software projects successfully. (HOTS: Level 6: Create)	3	3	_	3	3	-	-	-	-	2	3	2	3	-
Level of Attainments PEC-CSEAI401-T														

Wireless and Mobile Communication

General Course Information

Course Code: PEC-CSEA1402-T/ PEC-CSE302-T/ PCC-IT401-T Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites:

Basic knowledge of computer networks, Network Architecture and reference model, High Speed Network technologies, Ethernet, TCP/IP architecture.

About the course:

This course attunes the students with mobile and wireless communication using the Networking infrastructure of organizations/institutes. Students learn to analyse Networks' Architecture for wireless communication and the protocols for various layers in the Wireless Networks, technologies used and application arena of Wireless Networks.

Course Outcomes: At the end of this course studentswill be able to:

CO1. **recall** different mobile and wireless communication concepts. (LOTS: Level 1: Remember)

CO2. **explain**working of different Mobile Communication Technologies used now a days. (LOTS: Level 2: Understand)

CO3. **demonstrate**application of different mobile protocols for different Mobile and Wireless Communication Technologies. (LOTS: Level 2: Understand)

CO4. **analyze**the performance of different Mobile Communication technologies in different scenarios / situations. (HOTS: Level 4: Analyse)

CO5. **design** a mobile network for any city/state/country using combination of different Mobile Technologies. (HOTS: Level 6: Create)

Course Contents

Unit I

Mobile Communication: Wireless Transmission--- Frequencies, signals, antennas, signal propagation, multiplexing, modulation, spread spectrum, cellular system. Specialized MAC, SDMA, FDMA, TDMA- fixed TDM, classical ALOHA, slotted ALOHA, CSMA, DAMA, PRMA, reservation TDMA. Collision avoidance, polling inhibit sense multiple access. CDMA, GSM- mobile services, architecture, radio interface, protocol, localization, calling, handover, security, new data services, Introduction to WLL.

Unit II

Wireless LAN IEEE 802.11-System and protocol architecture, physical layer. Frame format.

Bluetooth--- Protocol architecture, Frame format

WiMAX – Layered Protocol architecture, frame types, format, Applications

Introduction to LTE, LTE advanced, VoLTE

Unit III

Mobile network Layer. Mobile IP- goals, assumption, requirement, entities, terminology, IP packet delivery, Agent advertisement and discovery, registration, tunneling, encapsulation, optimization , reverse tunneling, IPV6. DHCP. Adhoc Networks—routing , Destination Sequence Distance Vector, dynamic source routing, hierarchical algorithm, alternative metric.

Unit IV

Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP fast retransmission/ recovery, transmission/time out freezing, selective retransmission, Transaction oriented TCP

Text and Reference Books:

1. Jochen Schiller, *Mobile Communication*, 2nd Edition, Pearson,2009
2. Andrew S Tanenbaum, *Computer Networks*, 5th Edition, Pearson 2013
3. William C Y Lee, *Mobile Communication Engineering: Theory and Applications*, 2nd Edition, McGraw Hill, 1997.

CO-PO Articulation Matrix: Wireless and Mobile Communication Course (PEC-CSEAI402-T)

Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**Recall** different mobile and wireless communication concepts (LOTS Level 1 Remember)	1	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	**Explain** working of different Mobile Communication Technologies used now a days (LOTS Level 2 Understand)	1	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	**Demonstrate** application of different mobile protocols for differeht Mobile and Wireless Communication Technologies (LOTS Level 2 Understand)	1	1	-	-	-	-	-	-	-	-	-	-	-	3
CO4	**Analyze** the performance of different Mobile Communication technologies in different scenarios situations (HOTS Level 4 Analyse)	2	2	2	2	2	-	-	-	-	-	-	-	-	3
CO5	**Design** a mobile network for any city/state/country using combination of different Mobile Technologies (HOTS Level 6 Create)	3	3	3	3	3	-	-	-	-	-	2	2	-	3
	Level of Attainments PEC-CSEAI402-T														

Compiler Design

General Course Information

Course Code: PEC-CSEAI403-T
PCC-CSE401-T
PCC-IT306-T

Course Credits: 3

Type: Professional Elective

Contact Hours: 3 hours/week

Mode: Lectures (L)

Examination Duration: 3 hours

Course Assessment Methods:

Max. Marks: 100 (Internal: 30; External: 70)

Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks).

The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Brief knowledge of programming languages, Data Structure, and Algorithm Design.

About the Course:

Compilers have become part and parcel of today's computer systems. These are responsible for making the user's computing requirements, specified as a piece of program, understandable to the underlying machine. These tools work as interface between the entities of two different domains - the human being and the machine. The actual process involved in this transformation is quite complex. Compiler design covers basic translation mechanism and, error detection and recovery. It includes lexical, syntax, and semantic analysis as front end, and code generation and optimization as back-end.

Course Outcomes: By the end of the course studentswill be able to:

CO1. **state** principles of compiler design. (LOTS: Level 1: Remember)
CO2. **illustrate** the essential phases for automatically converting source code into object code. (LOTS: Level 2: Understand)
CO3. **apply** lexical analysis, syntax analysis and code optimization techniques for solving problems. (LOTS: Level 3: Apply)
CO4. **analyse** a parse tree and a givenBNF grammar. (LOTS: Level 4: Analyse)
CO5. **compare and contrast** syntax-oriented translation schemes (HOTS: Level 5: Evaluate)
CO6. **design** a lexical analyser from the specification of alanguage's lexical rules.(HOTS: Level 6: Create)

Course Contents

Unit 1

Introduction To Compilers: Compilers and translators, need of translators, structure of compiler its different

phases, Compiler construction tools.

Lexical Analysis: Role of lexical analyzer, design of lexical analyzer, regular expressions, Specification and recognition of tokens, input buffering, A language specifying lexical analyzer. Finite automata, conversion from regular expression to finite automata, and vice versa, minimizing number of states of DFA, Implementation of lexical analyzer.

Unit II

Syntax Analysis: Role of parsers, context free grammars, definition of parsing. Parsing Technique: Shift- reduce parsing, operator precedence parsing, top-down parsing, predictive parsing.

Unit III

LR parsers, SLR, LALR and Canonical LR parser. Syntax Directed Translations: Syntax directed definition, construction of syntax trees, syntax directed translation scheme, implementation of syntax directed translation, three address code, quadruples and triples.

Unit IV

Symbol Table & Error Detection and Recovery: Symbol tables, its contents and data structure for symbol tables; trees, arrays, linked lists, hash tables. Errors, lexical phase error, syntactic phase error, semantic error.

Code Optimization & Code Generation: Code generation, forms of objects code, machine dependent code, optimization, register allocation for temporary and user defined variables.

Text and Reference Books:

1. Alfread V. AHO, Ravi Sethiand J.D. Ullman, *Compilers Principle, Techniques and Tools*, Addison Wesley, 2007.
2. Tremblay and Sorenson, *Theory and practice of compiler writing*, Mc. Graw Hill, 1985.
3. Dhamdare, *System software*, MGH, 1986.
4. Alfred V. Aho, Jeffrey D. Ullman, *Principles of Compiler Design*, Narosa Publication, 2002.

CO-PO Articulation Matrix: Compiler Design Course (PEC-CSEAI403-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **State** principles of compiler design. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2. **Illustrate** the essential phases for automatically converting source code into object code. (LOTS: Level 2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3. **Apply** lexical analysis, syntax analysis and code optimization techniques for solving problems. (LOTS: Level 3: Apply)	2	1	-	-	-	-	-	-	-	-	-	-	3	-
CO4. **Analyse** a parse tree and a given BNF grammar. (LOTS: Level 4: Analyse)	3	2	1	-	2	-	-	-	-	-	-	-	3	-
CO5. **Compare and contrast** syntax-oriented translation schemes (HOTS: Level 5: Evaluate)	2	2	1	-	2	-	-	-	-	-	-	-	3	-
CO6. **Design** a lexical analyser from the specification of a language's lexical rules. (HOTS: Level 6: Create)	3	3	2	2	3	-	-	-	-	-	-	-	3	-
Level of Attainments PEC-CSEAI-403-T														

Data Visualization Techniques

General Course Information

Course Code: PEC-CSEAI404-T Course Credits: 3 Type: Professional Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Basics ofdata handling techniques, graphs and plots.

About the Course:

This course focuses on building creative and technicdl skills to transform data into visual reports for engendering a shared understanding. Students will learn to use software to organize, and visualize data, with an emphasis on applying design principles ofproducing clear, elegant graphs and dashboards that capture the essence of an insight, message, or recommendation distilled from the data.

Course Outcomes: By the end of the course students will be able to:

- CO1. **define**the key concepts and terms behind data visualization.(LOTS: Level 1: Remember)
- CO2. **explain** the methods for visualizing data using various tools. (LOTS: Level 2: Understand)
- CO3. **apply** visualization methods for different data domains. (LOTS: Level 3: Apply)
- CO4. **suggest** appropriate data visualization tools for domain specific applications. (HOTS: Level 4: Analyze)
- CO5. **evaluate** information visualization systems and other forms of visual presentation for their effectiveness. (HOTS: Level 5: Evaluate)
- CO6. **design** and build data visualization systems. (HOTS: Level 6: Create)

Course Contents

Unit I

Introduction to Data Visualization: Definition, methodology, sevenstages of data visualization, Data visualizationtools, Visualizing Data: Mapping data onto aesthetics, Visualizing amounts,Visualizing Distributions: Histograms and density Plots, Visualizing Propositions: Visualizing associations among two or more quantitative variables, Visualizing Time Series and otherFunctions of an independent variable, trends, Visualizing geospatial data.

Unit II

Interactive Data Visualization: Introduction to D3, Fundamental Technology: The Web, HTML, DOM, CSS, JavaScript, SVG. D3 setup, generatingpage elements, Bindingdata, Drawing with data, Scales: Domains andranges,Normalization, Creating a scale, Scaling the scatter plot, other methods and other scales; Axes, Modernizing the chart,Update the data, Transition, Updates, Interactivity.

Unit III

D3 Based Reusable Chart Library: Setup and deployment, Generate Chart, Customize Chart: Additional axis, Show axis labels,Change chart type, Format values, size, color, padding, tooltip; Use APIs: Load and unload, Show and hide, Focus, Transform, Groups, Grid, regions, Flow,Revert, Toggle, Legend, Sub chart, Zoom, Resize; Customize Style, Building Real time and live updating animated graphs withC3.

Unit IV

Introduction to Tableau: Environment Setup, Navigation, File & Data Types; TA SOURCE: Custom data view, ExtractingData, Fields operations, editingmeta data, Data joining, Data blending; Worksheets.
Basic and Advanced Charts in Tableau: Bar chart, Line chart, Pie chart, Scatter plot, Bubble chart, Gantt chart, Histograms,Waterfall charts. Dashboard, Formatting, Forecasting, Trend Lines.

Text and Reference Books and Links:

1. Ben Fry, *Visualizing Data: Exploring and Explaining Data with the Processing Environment*, O'Reilly, 1st Edition, 2008.
2. Scott Murray, *Interactive data visualization for the web: An Introduction to Designing with D3*, O'Reilly, 2nd Edition, 2017.
3. Joshua N. Milligan, *Learning Tableau 2019: Tools for Business Intelligence, data prep, and visual analytics*, Packt Publishing Limited, 2019.
4. Claus O. Wilke, *Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures*, O.Reilly, 2019.
5. Ritchie S. King, *Visual Storytelling with D3: An Introduction to Data Visualization in JavaScript, Addison-wesley Data and Analytics*, 2014.
6. Elijah Meeks, *D3.js in Action: Data visualization with JavaScript*, Second Edition, Manning Publications, 2017.
7. Lindy Ryan, *Visual Data Storytelling with Tableau*, 1st Edition, Pearson, 2018.
8. Cole NussbaumerKnaflic, *Storytelling with Data: A Data Visualization Guide for Business Professionals*, Wiley, 2015.

CO-PO Articulation Matrix: Data Visualization (PEC-CSEAI404-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Define** the key concepts and terms behind data visualization. (LOTS: Level 1: Remember)	1	-	-	-	1	-	-	-	-	-	-	-	-	1
CO2. **Explain** the methods for visualizing data using various tools. (LOTS: Level 2: Understand)	1	-	-	-	2	-	-	-	-	-	-	-	-	2
CO3. **Apply** visualization methods/tools for different data domains. (LOTS: Level 3: Apply)	2	1	-	1	3	-	-	-	-	-	-	-	-	3
CO4. **Suggest** appropriate data visualization tools for domain specific applications. (HOTS: Level 4: Analyze)	2	2	1	2	3	-	-	-	-	-	-	-	-	3
CO5. **Evaluate** information visualization systems and other forms of visual presentation for their effectiveness. (HOTS: Level 5: Evaluate)	2	2	1	2	3	-	-	-	-	-	-	-	-	3
CO6. **Design** and build data visualization systems. (HOTS: Level 6: Create)	3	3	2	3	3	-	-	-	-	-	-	-	-	3
Level of Attainments PEC-CSEAI404-T														

Software Defined Networks

General Course Information

Course Code: PEC-CSEAI405-T/ PEC-CSE410-T/ PEC-IT410-T Course Credits: 3 Type: Professional Elective Contact Hours: 3 hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Programming in C/C++/Java

About the Course:

Software Defined Networks is a result of improvement of flexibility of Network Control. To make the Networks Programmable it was deemed necessary to separate the Control Plane from the Data Plane. SDN Controllers are inserted into the Network to realize Network Virtualization. OpenFlow protocol and Mininet framework are used to design SDN. This Course is considered as a necessary addition in the Curriculum of B. Tech. (CSE/IT) from professional point of view.

Course Outcomes: By the end of the course students will be able to:

CO1. **outline** Software Defined Networks and its various components. (LOTS: Level 1: Remember)
CO2. **explain** techniques to make the Network Programmable for better flexibility. (LOTS: Level 2: Understand)
CO3. **use** modern tools to implement SDN Controllers in a Network scenario. (LOTS: Level 3: Apply)
CO4. **breakdown** Virtual Networks into its components for controlling of networks. (HOTS: Level 4: Analyse)
CO5. **compare** and **contrast** the working of SDN through various protocols. (HOTS: Level 5: Evaluate)
CO6. **generate** SDN using Application Programming Interface and compute its performance for a given scenario. (HOTS: Level 6: Create)

Course Contents

Unit I

Introduction: The need for Programmable Networks, Evolution of Software Defined Networks, Software Defined Networks' Architecture and Design, Traditional Switch Architecture, Centralized and decentralized Control Plane and Data Plane, IETF SDN framework, Scalability (Service provider Networks, ISP Automation), Reliability (QoS and Service Availability), Consistency (Configuration management and Access Control violations).

Unit II

Openflow and Software Defined Networks Controllers: Control and Data Plane Separation, Evolution of Openflow, SDN Controllers(POX, floodlight, openDayLight), Applicability of Openflow protocols in SDN Controllers, scalable Programming for SDN Controllers.

Unit III

Network Virtualization: Virtual Network, Abstraction of physical Network, Components of Virtual Network (Virtual Switch, Bridge, Host-virtual adapter, NAT device, DHCP server, Network Adapter), Network as a Service (NaaS), Network Virtual Machine.

Unit IV

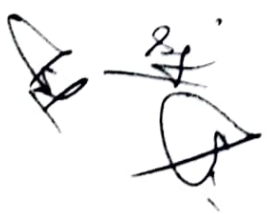
Software Defined Networks Programming: Programming Software Defined Networks, Northbound Application Programming Interface, Current Languages and tools, Network Functions Virtualization, Software Defined Networks implementation and Applications, Bandwidth Calendaring- Data Center Orchestration, Mininet. Use-cases(Network Access Control, Virtual Customer Edge, Data center Optimization), Latest trends in SDN.

Text and Reference Books:

1. Paul Goransson and Chuck Black, *Software Defined Networks: A Comprehensive Approach*, First Edition, Morgan Kaufmann, 2014.
2. Thomas D.Nadeau, Ken Gray, *Software Defined Networks*, O'Reilly Media, 2013.
3. SiamakAzodolmolky, *Software Defined Networking with Openflow, Packt Publishing*, 2013.
4. Kingston Smiler, *Openflow Cookbook*, Packt Publishing, 2015.
5. Doug Marschke, Jeff Doyle, PeteMoyer, *Software Defined Networking: Anatomy of Openflow*, Volume-I, Lulu Publishing Services, 2015.

CO-PO Articulation Matrix: Software Defined Networks Course (PEC-CSEAI405-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Outline** Software Defined Networks and its various components. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2. **Explain** techniques to make the Network Programmable for better flexibility. (LOTS: Level 2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3. **Use** of modern tools to implement SDN Controllers in a Network scenario. (LOTS: Level 3: Apply)	2	2	2	2	3	-	-	-	-	-	-	-	-	3
CO4. **Breakdown** Virtual Networks into its components for controlling of networks. (HOTS: Level 4: Analyse)	3	2	2	3	3	-	-	-	-	-	-	-	-	3
CO5. **Compare** and **contrast** the working of SDN through various protocols. (HOTS: Level 5: Evaluate)	3	3	2	3	3	-	-	-	-	-	-	-	-	3
CO6. **Generate** SDN using Application Programming Interface and compute its performance for a given scenario. (HOTS: Level 6: Create)	3	3	2	2	3	-	-	-	-	-	-	-	-	3
Level of Attainments PEC-CSEAI-405-T														



Digital Image Processing

General Course Information

Course Code: PEC-CSEAI406-T/ PEC-CSE408-T/ PEC-IT408-T Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: knowledge of basic linear algebra, basic probability theory, basic programming techniques, and Fourier Transforms.

About the Course:

Digital Image Processing is a Professional Elective course that provides a theoretical foundation of digital image processing concepts. This course provides a mathematical foundation for digital manipulation of images, image acquisition, pre-processing, enhancement, segmentation and compression. Students learn algorithms that perform basic image processing operations (e.g., histogram processing, noise removal and image enhancement and restoration).Algorithms for image analysis (e.g., image compression, image segmentation and image representation) are explained.

Course Outcomes: By the end of the course students will be able to:

CO1. **State** concepts related to image acquisition and processing. (LOTS: Level 1: Remember)
CO2. **illustrate** the principles and methods in image processing. (LOTS: Level 2: Understand)
CO3. **apply** mathematical functions for digital manipulation of images such as image acquisition, pre-processing, segmentation, compression and representation. (LOTS: Level 3: Apply)
CO4. **compare** various image processing techniques. (HOTS: Level 4: Analyse)
CO5. **assess** the various image processing techniques for a given problem.*(HOTS: Level 5: Evaluate)
CO6. **design** and implement algorithms for digital image processing operations such as histogram equalization, filtering, enhancement, restoration and denoising, segmentation, compression. (HOTS: Level 6: Create)

Course contents

Unit I

Introduction and fundamental to digital image processing: What is digital image processing, Origin of digitalimage processing, Examples that use digital image processing, Fundamental steps in digital image processing, Components of digital image processing system, Image sensing and acquisition, Image sampling, Quantization and

representation, Basic relationship between pixels. Image enhancement in spatial domain and frequency domain: Background, Basic gray level transformation,
Histogram processing, Basics of spatial filtering, Smoothing and sharpening spatial and the frequency domain filters.

Unit II

Image Restoration: Image degradation/restoration Process, Noise models, Restoration in presence of noise, Inverse filtering, Minimum mean square filtering, Geometric mean filter, Geometric transformations.Color Image Processing: Color fundamentals, Color models, Basics of full color image processing, Colortransformations.

Unit III

Image Compression: Fundamentals, Image compression models, Error free compression, Lossy compression
Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region based segmentation.

Unit IV

Representation, Description and Recognition: Representation-chain codes, polygonal approximation and skeletons, Boundary descriptors-simple descriptors, shape numbers,.Regional descriptors- simple, topological descriptors.
Recognition: Pattern and Pattern classes.

Text and Reference Books:

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Pearson Education,Ed, 2001.
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Pearson Education, PHI, 2001.
3. Tinku Acharya and Ajoy K. Ray, *Image Processing-Principles and Applications*, John Wiley & Sons,
4. Inc., 2005.
5. Chanda and D. Dutta Majumdar, *Digital Image Processing and Analysis*, PHI, 2003.
6. Milan Sonka, Vaclav Hlavac, Roger Boyle, *Image Processing, Analysis, and Machine Vision*, 2nd edition, PWS Publishing Company, Thomson Learning, 1999.

CO-PO Articulation Matrix: Digital Image Processing Course (PEC-CSEA1406-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **State** concepts related to image acquisition and processing. (LOTS: Level 1: Remember)	1	3	-	-	-	-	-	-	-	-	-	-	-	1
CO2. **Illustrate** the principles and methods in image processing. (LOTS: Level 2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3. **Apply** mathematical functions for digital manipulation of images such as image acquisition, pre-processing, segmentation, compression and representation. (LOTS: Level 3: Apply)	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO4. **Compare** various image processing techniques. (HOTS: Level 4: Analyse)	2	3	2	2	-	-	-	-	-	-	-	-	-	3
CO5. **Assess** the various image processing techniques for a given problem. (HOTS: Level 5: Evaluate)	3	3	2	2	-	-	-	-	-	-	-	-	-	3
CO6. **Design** and implement algorithms for digital image processing operations such as histogram equalization, filtering, enhancement, restoration and denoising, segmentation, compression. (HOTS: Level 6: Create)	3	3	2	3	3	-	-	-	-	-	-	2	-	3
Level of Attainments PEC-CSEA1406-T														

Reinforcement Learning

General Course Information

Course Code: PEC-CSEAI407-T Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Pre-requisites: Probability and linear algebra, python programming, data structures and algorithms, artificial intelligence, machine learning.

About the Course:

Reinforcement learning is a paradigm that aims to model the trial-and-error learning process that is needed in many problem situations where explicit instructive signals are not available. The goal of the course is to introduce the basic foundations of reinforcement learning, model-based learning, temporal difference learning and ensemble learning.

Course Outcomes: By the end of the course students will be able to:

- CO1. **describe** the relevance of reinforcement learning and how does it complement other ML techniques.(LOTS: Level 1: Remember)
- CO2. **discussthe** challenges in learning from dynamic environment with minimal data and how reinforcement learning overcome these challenges. (LOTS: Level 2: Understand)
- CO3. **apply** various reinforcement and ensemble learning algorithms. (LOTS: Level 3: Apply)
- CO4. **analyze** the performance of various reinforcement and ensemble learning methods. (HOTS: Level 4: Analyze)
- CO5. **Interpret** the results of reinforcement and ensemble learning algorithms. (HOTS: Level 5: Evaluate)
- CO6. **design** reinforcement learning algorithms for addressing novel problems. (HOTS: Level 6: Create)

Course Contents

Unit I

Introduction: Reinforcement Learning, Elements of Reinforcement Learning, Limitations and Scope, relationship to dynamic programming.

Multi-armed Bandits: A k-armed Bandit Problem, Action-value Methods, The 10-armed Testbed,Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandit Algorithms

Unit II

Finite Markov Decision Processes: The Agent–Environment Interface, Goals and Rewards, Reward models (infinite discounted, total, finite horizon, and average), Returns and Episodes, Policies and Value Functions, Optimal Policies and Optimal Value Functions
Dynamic Programming: Policy Evaluation (Prediction), Policy Improvement, Policy Iteration, Value Iteration
Monte Carlo Methods: Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control

Unit III

Temporal-Difference Learning: TD Prediction, Advantages of TD Prediction Methods, Optimality of TD (0), Sarsa, Q-learning, Expected Sarsa , Maximization Bias and Double Learning
n-step Bootstrapping: n-step TD Prediction, n-step Sarsa, n-step Off Policy Learning, The n-step Tree Backup Algorithm, A Unifying Algorithm: n-step Q(σ)

Unit IV

Policy Gradient Methods: Policy Approximation and Advantages, Policy Gradient Theorem, Monte Carlo Policy Gradient, Reinforce with Baseline,Actor–Critic Methods, Policy Gradient for Continuing Problems
Applications and case studies: TD-Gammon, Samuel's Checkers Player, Watson's Daily-Double Wagering, Optimizing Memory Control, Mastering the Game of Go, Personalized Web Services, Reinforcement learning in robotics

Text and Reference Books and Links:

1. Sutton and Barto, *Reinforcement Learning: An Introduction*, The MIT Press Cambridge, Massachusetts London, England, 2015.
2. Zhou andZhi-Hua,*Ensemble Methods: Foundations and Algorithms*, Chapman & Hall/CRC, 2012
3. CsabaSzepesvari, *Algorithms for Reinforcement Learning*, Morgan & Claypool, UnitedStates,2010.
4. Tesauro, *Temporal Difference Learning and TD-Gammon*, Communications of the Association for Computing Machinery, 1995.
5. Dimitri P. Bertsekas, Reinforcement *Learning and Optimal Control*, 1st Edition, Athena Scientific, 2019.

CO-PO Articulation Matrix: Reinforcement Learning (PEC-CSEAI407-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Describe** the relevance of reinforcement learning and how does it complement other ML techniques. (LOTS: Level 1: Remember)	1	1	1	1	-	-	-	-	-	-	-	-	-	1
CO2. **Discuss** the challenges in learning from dynamic environment with minimal data and how reinforcement learning overcome these challenges. (LOTS: Level 2: Understand)	2	2	2	1	-	-	-	-	-	-	-	-	-	2
CO3. **Apply** various reinforcement and ensemble learning algorithms. (LOTS: Level 3: Apply)	3	3	2	2	-	-	-	-	-	-	-	-	-	3
CO4. **Analyze** the performance of various reinforcement and ensemble learning methods.(HOTS: Level 4: Analyze)	3	3	2	3	-	-	-	-	-	-	-	-	-	3
CO5. **Interpret** the results of reinforcement and ensemble learning algorithms. (HOTS: Level 5: Evaluate)	3	3	2	3	-	-	-	-	-	-	-	-	-	3
CO6. **Design** reinforcement learning algorithms for addressing novel problems. (HOTS: Level 6: Create)	3	3	2	3	-	-	-	-	-	-	-	-	-	3
Level of Attainments PEC-CSEAI407-T														

Edge and Fog Computing

General Course Information

Course Code: PEC-CSEAI408-T Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Basics of Cloud Computing and Internet of Things.

About the Course:

Responding to the ever-increasing bandwidth demands of the IoT, Fog and Edge computing concepts have been developed to collect, analyze, and process data more efficiently than traditional cloud architecture. This course will provide the design concepts, frameworks, and applications in Fog and Edge computing.

Course Outcomes: By the end of the course students will be able to:

CO1. **recall**the basic principles, architectures of edge and fog computing.(LOTS: Level 1: Remember)
CO2. **discuss** the storage and computation in edge and fog computing paradigm. (LOTS: Level 2: Understand)
CO3. **realize** the improved performance of Internet of things by exploring the edge and fog computing paradigm. (LOTS: Level 3: Apply)
CO4. **analyze** the performance of the applications developed using fog architecture.(HOTS: Level 4: Analyze)
CO5. **design** and implement Internet of Everything (IoE) applications through fog computing architecture. (HOTS: Level 6: Create)

Course Contents

Unit I

Introduction of Edge and Fog Computing: Internet of Things (IoT) and New computing paradigms, Emergence of edge computing, Fog computing: A platform for Internet of Things and analytics, Legal aspects of operating IoT applications in the fog.

Edge Architecture: Multi-Tier cloud computing framework; Data services with clouds at home; Leveraging mobile devices to provide cloud service at the edge; Fast, scalable and secure onloading of edge functions.

Unit II

Integrating IoT + Fog + Cloud Infrastructures: System modeling and research Challenges, Management and Orchestration of network slices in 5G, Fog, Edge, and Clouds
System Design: Optimization problems in fog and edge computing, Middleware for fog and edge Computing: Design issues, A Lightweight container middleware for edge cloud architectures

Unit III

Data Processing: Data management in fog computing, Predictive analysis to support fog application deployment, using machine learning for protecting the security and privacy of Internet of Things (IoT) systems, fog Computing realization for Big data analytics.

Unit IV

Applications and Case Studies: Fog computing realization for big data analytics, exploiting fog computing in health monitoring, Smart surveillance video stream processing at the edge for real-time human objects tracking, Fog computing model for evolving smart transportation applications.

Text and Reference Books and Links:

1. R. Buyya and S.N. Srirama,*Fogand Edge Computing: Principles and Paradigms*, Wiley-Blackwell, 2019.
2. Ajit Singh, *Edge Computing: Simply in Depth*, Amazon LLC, 2019.
3. Cao,Jie, Zhang, Quan, Shi, and Weisong,*Edge Computing: A Primer, Pearson Education*, Springer, 2018.
4. Assad Abbas, Samee U. Khan, Albert Y. Zomaya,*Fog Computing – Theory and Practice*, John Wiley & Sons, 2020.
5. Zaigham Mahmood, *Fog Computing: Concepts, Frameworks and Technologies*,Springer, 2018.
6. Amir M. Rahmani, PasiLiljeberg, Preden, and Axel Jantsch, *Fog Computing in the Internet of Things - Intelligence at the Edge*, Springer International Publishing, 2018.

CO-PO Articulation Matrix: Edge and Fog Computing (PEC-CSEAI408-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Recall** the basic principles, architectures of edge and fog computing. (LOTS: Level 1: Remember)	1	1	-	-	-	-	-	-	-	-	-	-	-	1
CO2. **Discuss** the storage and computation in edge and fog computing paradigm. (LOTS: Level 2: Understand)	2	2	-	-	-	-	-	-	-	-	-	-	-	1
CO3. **Realize** the improved performance of Internet of things by exploring the edge and fog computing paradigm. (LOTS: Level 3: Apply)	3	2	1	1	-	-	-	-	-	-	-	-	-	2
CO4. **Analyze** the performance of the applications developed using fog architecture. (HOTS: Level 4: Analyze)	3	2	2	2	-	-	-	-	-	-	-	-	-	3
CO5. **Design** and implement Internet of Everything (IoE) applications through fog computing architecture. (HOTS: Level 6: Create)	3	3	3	3	-	-	-	-	-	-	-	-	-	3
Level of Attainments PEC-CSEAI408-T														

Natural Language Processing

General Course Information

Course Code: PEC-CSEA409-T Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Basic of machine learning and data mining

About the Course:

Natural Language processing (NLP) has a wide scope of application sentiment analysis, opinion mining, chatbots, summarization and question answering. This objective of course is to give exposure to students about basic tasks and principles in natural language processing. The course covers pre-processing of text, language models and sentiment analysis using Bayesian and Logistic regression frameworks.

Course Outcomes: By the end of the course students will be able to:

- CO1. **define**the basic vocabulary and terminology used in NLP. (LOTS: Level 1: Remember)
- CO2. **describe** regular expressions, text processing, N-grams, sentiment analysis, NLP applications and challenges. (LOTS: Level 2: Understand)
- CO3. **solve** problems pertaining to NLP tasks. (LOTS: Level 3: Apply)
- CO4. **compare** the various language models and NLP algorithms. (LOTS: Level 4: Analyse)
- CO5. **evaluate** language models andNLP algorithms. (HOTS: Level 5: Evaluate)

Course Contents

Unit I

Introduction to NLP, Ambiguity, Models and Algorithms, Language thought and understanding, Historical perspective and Latest developments in NLP.
Regular expressions: Basic regular expression patterns, Disjunction, grouping and precedence, Examples, Advanced operators, Regular expression substitution, Finite state automata, Formal languages, Non-deterministic FSAs, Using NFSAs to accept strings, Regular languages and FSAs.
Text Processing and Tokenisation: English morphology, Finite-state morphological parsing, Building a finite state lexicon, Finite state transducers, FSTs for morphological parsing, Combining FST lexicon and rules, Lexicon-free FSTs.

Unit II

Words and sentence tokenization, detecting and correcting spelling errors, Words, Corpora, Text normalization, Minimum edit distance.
N-Grams: Counting words in corpora, Simple N-grams, Training and test sets, Evaluating language models, Smoothing, advanced topics in language modelling.
Vector Semantics and Embeddings: Lexical semantics, Vector semantics, Words and vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in vector, Pointwise mutual information, Applications of TF-IDF, Word2vec, Visualizing embeddings, Semantic properties of embeddings, Bias and embeddings, Evaluating vector models.

Unit III

Naïve Bayesian and Sentiment Classification: Training the Naïve Bayes classifier, Optimizing for sentiment analysis, Naïve Bayes as a language model, Evaluation, test set and cross-validation, Statistical significance testing. Classification with logistic regression, Multinomial logistic regression, Learning in logistic regression, The cross-entropy loss function, Regularization, Learning in multimodal logistic regression, Interpreting models.

Unit IV

NLP Applications: Machine Translation: Machine translation using Encoder-Decoder, Details of Encoder-Decoder model, Machine Translation evaluation, Biases and ethical issues, Text classification for sentiment analysis.
Question answering and Information Retrieval: Information retrieval, IR-based factoid question answering, Entity linking, Knowledge based question answering, Using language models to do question answering, Classic QA models, Evaluation of Factoid answers.

Text and Reference Books:

1. Daniel Jurafsky and James H. Martin, *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*, 2nd Edition, Prentice Hall, Second Edition, 2009.
2. Dan Jurafsky and James Martin, *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*, 3rd Edition, 2023.
3. Yoav Goldberg, *Neural Network Methods for Natural Language Processing*, Morgan and Claypool, 2017.
4. Chris Manning and Hinrich Schütze,*Foundations of Statistical Natural Language Processing*, MIT Press, Cambridge, MA, 1999.
5. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit, O'Reilly, 2009,http://www.nltk.org/book/.
6. Dipanjan Sarkar, Text Analytics with Python, Springer, 2016, https://link-springer-com.proxy.uchicago.edu/book/10.1007%2F978-1-4842-2388-8.

CO-PO Articulation Matrix: Natural Language Processing (PEC-CSEAI409-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1 **Define** the basic vocabulary and terminology used in NLP. (LOTS: Level 1: Remember)	1	1	-	-	-	-	-	-	-	-	-	-	-	3
CO2 **Describe** regular expressions, text processing, N-grams, sentiment analysis, NLP applications and challenges. (LOTS: Level 2: Understand)	2	2	1	1	-	-	-	-	-	-	-	-	1	3
CO3 **Solve** problems pertaining to NLP tasks. (LOTS: Level 3: Apply)	3	2	2	2	-	-	-	-	-	-	-	-	2	3
CO4 **Compare** the various language models and NLP algorithms. (LOTS: Level 4: Analyse)	3	3	2	2	-	-	-	-	-	-	-	-	2	3
CO5 **Evaluate** language models andNLP algorithms. (HOTS: Level 5: Evaluate)	3	3-	2	2	-	-	-	-	-	-	-	-	3	3
Level of Attainments PEC-CSEAI409-T														

Cognitive Systems

General Course Information

Course Code: PEC-CSEAI410-T/ Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Background in basic computer science, programming and artificial intelligence.

About the Course

This course covers introduction to the basic concepts of cognitive science and systems, hypotheses, models, methods, issues and debates in cognitive science. The course encompasses the historical perspective and current debates on cognitive systems and ethical issues involved in the domain. Since the course is multi-disciplinary and situated at the cross-section of Artificial Intelligence, Machine learning, Psychology, Philosophy, and Linguistics, it involve quite a few readings to understand the issues around cognitive science. Overall, it needs an open and inquisitive mind.

Course Outcomes: By the end of the course students will be able to:

- CO1. **define** the basic vocabulary and terms of cognitive science and systems. (LOTS: Level 1: Remember)
- CO2. **describe** the fundamentals of cognitive concepts such as perception, knowledge representation, reasoning, decision making, cognitive architectures, natural language processing etc. (LOTS: Level 2: Understanding)
- CO3. **apply** techniques of knowledge representation and reasoning to model and solveproblems in cognitive systems(LOTS: Level 3: Apply)
- CO4. **identify** emerging trends and future directions in cognitive systems for staying informed about advancements and potential opportunities in the field.(LOTS: Level 3: Apply)
- CO5. **analyze** the historical perspectives and advancements in cognitive systems, recognizing their impact on various fields and applications. (HOTS: Level 4: Analyse).
- CO6. **review** criticallythe current debates on cognitive science and on applying cognitive systems. (HOTS: Level 5: Evaluate).

Course Contents

Unit I

Overview of Cognitive Systems, Historical perspective on cognitive systems, Perception and sensing, Knowledge Representation and reasoning: Logic, rules, concepts,analogies, images, connections, Cognitive architectures.

Unit II

The interdisciplinary nature of cognitive science, cognitive science and integration challenge, Information processing models of the mind- Physical symbols systems and language of thought, Applying symbolic paradigm, Neural Networks and distributed information processing, neural network model of cognitive process, Challenges

and applications of cognitive systems

Unit III

Language and Communication in Cognitive Systems: Introduction to natural language processing, Syntax and semantics in NLP, Language understanding and generation, Dialog systems, Sentiment analysis and opinion mining.

Unit IV

Cognitive Systems in Practice: Cognitive systems in health care, Intelligent Virtual Assistants, Cognitive systems in robotics and autonomous systems, Ethical and social implications of cognitive systems, Future trends and applications.

Text and Reference Books:

1. Paul Thagard, *MIND. An Introduction to Cognitive Science*, MIT Press, Second edition, 2005
2. José Luis Bermúdez, *cognitive science. An Introduction to the Science of the Mind*, Second Ed., Cambridge University Press, 2014.
3. RichardG.M. Morris, Lionel Tarassenko and Michael Kenward, *Cognitive Systems - Information Processing Meets Brain Science*, Elsevier, 2006.
4. Frank C. Keil, (Eds.), *The MIT Encyclopaedia of the Cognitive Sciences*, MIT Press, 1999.
5. Jay Friedenberg, Gordon Silverman, Cognitive Science: *An Introduction to the Study of Mind*, Sage Publications, 2006.

CO-PO Articulation Matrix: Cognitive Systems (PEC-CSEAI410-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. **Define** the basic vocabulary and terms of cognitive science and systems. (LOTS: Level 1: Remember)	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2. **Describe** the fundamentals of cognitive concepts such as perception, knowledge representation, reasoning, decision making, cognitive architectures, natural language processing etc. (LOTS: Level 2: Understanding)	1	2	-	-	-	1	-	-	-	-	-	-	-	1	2
CO3. **Apply** techniques of knowledge representation and reasoning to model and solve problems in cognitive systems. (LOTS: Level 3: Apply)	1	2	1	-	-	2	-	-	-	-	-	-	-	2	3
CO4. **Identify** emerging trends and future directions in cognitive systems for staying informed about advancements and potential opportunities in the field. (LOTS: Level 3: Apply)	2	2	2	-	-	2	-	-	-	-	-	-	-	2	3
CO5. **Analyze** the historical perspectives and advancements in cognitive systems, recognizing their social and cultural impact on various fields and applications. (HOTS: Level 4: Analyse)	2	3	3	-	-	3	-	-	-	-	-	-	1	-	3
CO6. **Review** critically the current debates on cognitive science and on applying cognitive systems. (HOTS: Level 5: Evaluate)	2	3	-	-	-	-	-	-	-	-	-	-	1	-	3
Level of Attainments PEC-CSEAI410-T															

Deep Learning Tools Lab.

General Course Information

Course Code: PCC-CSEAI401-P Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods :** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Introduction to deep learning concepts and techniques

About the Course:
This is a lab course for hands on practice of deep learning techniques such as simple neural network, CNN,

RNN, Transfer Learning using Keras, TensorFlow and PyTorch. The students will solve and compare various techniques for classification problems.

Course Outcomes: By the end of the course students will be able to:

- CO1. **implement** deep learning algorithms for solving simple and medium size classification problems using modern deep learning tools such as Keras, TensorFlow, PyTorch etc. (LOTS: Level 3: Apply)
- CO2. **analyse** the impact of parameter setting/tuning and activation functions on the resulting solutions. (LOTS: Level 4: Analyse)
- CO3. **evaluate** the performance deep learning algorithms on various problems. (LOTS: Level 5: Evaluate)
- CO4. **create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create).
- CO5. **demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

List of experiments/assignments:

1. Install deep learning frameworks like Keras, TensorFlow and PyTorch.
2. Build a feedforward NN to classify Iris dataset using Keras. Experiment with different activation functions and compare the impact on the performance of the NN.
3. Implement a feedforward neural network from scratch using NumPy. Train the NN on any synthetic/real world dataset to perform binary classification. Experiment with different activation functions and compare the performance of the NN.
4. Create a neural network to classify handwritten digits using MNIST handwritten digits dataset.
5. Implement a CNN architecture to classify handwritten digits from MNIST dataset. Visualize filters and feature maps from different layers to understand learnt features.
6. Implement a CNN architecture for image classification on the CIFAR-10 dataset or any other dataset. Analyse the effect of varying hyperparameters such as filter size, stride and, pooling method. Visualise the intermediate layer outputs and discuss the feature learned by different layers.
7. Build an RNN model to perform sentiment analysis on Movie reviews (e.g., IMDB dataset)
8. Implement a character-level RNN to generate text sequences.
9. Fine-tune a pre-trained CNN (e.g., VGG16, ResNet) on any image dataset of your choice for classification. Compare the performance of fine-tuned model with training a CNN from scratch.
10. Implement the YOLO object detection algorithm to detect objects in images.
11. Choose a suitable problem from domain such as healthcare, finance, robotics, surveillance etc. and design deep learning solution using appropriate frameworks and tools.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix: Deep Learning Tools Lab. (PCC-CSEAI401-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Implement deep learning algorithms** for solving simple and medium size classification problems using modern deep learning tools such as Keras, TensorFlow, PyTorch etc. (LOTS: Level 3: Apply)	2	3	2	2	3	-	-	-	-	-	-	-	-	3
CO2. **Analyse** the impact of **parameter** setting/tuning and activation functions on the resulting solutions. (LOTS: Level 4: Analyse)	3	3	-	2	3	-	-	-	-	-	-	-	-	3
CO3. **Evaluate** the performance deep learning algorithms on various problems. (LOTS: Level 5: Evaluate)	3	3	-	3	3	-	-	-	-	-	-	-	-	3
CO4. **Create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create).	3	3	-	3	3	-	-	-	-	3	-	-	-	3
CO5. **Demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)	-	-	-	-	-	-	-	3	3	-	-	3	-	-
Level of Attainments: PCC-CSEAI401-P														

Major Project Part I

General Course Information

Course Code: PROJ-CSEAI401 Course Credits: 4 Mode: Self learning under the guidance of faculty members. Contact hours: 8 hours/week	**Course Assessment Method (100)** An internal evaluation is done by a committee of two teachers constituted by the Chairperson of the Department. The criteria for evaluation are given below. 1. Literature review: 20 2. Problem formulation: 20 3. Basic knowledge of the tools:20 4. Organisation and presentation of synopsis: 20 5. Level of Ethics followed: 20

About the major project Part I:

Students start working on their project work in seventh semester. Students do the background research for identifying appropriate problems, methodology and tools for their respective project works to be culminated in eighth semester. They prepare a synopsis of the project work to be carried out. At the end of seventh semester, each student is required to prepare a synopsis in the format provided and present it in front of a committee constituted by the Chairperson of the Department. Students can carry out projects in groups of two. In case of group project, the size of the problem should be significant, and members of the group must specify their individual contribution.

Course Outcomes: After doing Major Project Part I students will be able to:

CO1. **evaluate** criticallythe existing solutions and methodologies through reviewing literature. (HOTS: Level 5: Evaluate)
CO2. **formulate** suitable AI and ML problems to be addressed. (HOTS: Level 6: Create)
CO3. **identify** tentative modern AI and ML tools to solve the problem. (HOTS: Level 4: Analyse)
CO4. **organise** and communicate (written and oral) ideas effectively. (HOTS: Level 6: Create)
CO5. **develop** methodologies that meet ethical, societal and legal considerations. (HOTS: Level 6: Create)

Note: The project for the students of B.Tech. CSE (AIML) must involve components of Artificial Intelligence and Machine Learning. A simple website development or simple database applications will not be accepted toward the project work. Therefore, the students are advised to select appropriate topic for their projects in consultation with their guides.

CO-PO Articulation Matrix:Major Project Part 1(PROJ-CSEAI401)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO1	PSO2
CO1. **Evaluate** critically the existing solutions and methodologies through reviewing literature. (HOTS: Level 5: Evaluate)	2	3	3	3	-	-	-	-	-	-	-	3	-	-	3
CO2. **Formulate** suitable AI and ML problems to be addressed. (HOTS: Level 6: Create)	2	3	3	3	-	-	-	-	-	-	-	-	-	-	3
CO3. **Identify** tentative AI and ML modern tools to solve the problem. (HOTS: Level 4: Analyse)	2	_	2	_	3	-	-	-	-	-	-	2	-	-	3
CO4. **Organise** and communicate (written and oral) ideas effectively. (HOTS: Level 6: Create)	-	-	-	-	-	-	-	-	-	3	3	-	-	-	3
CO5. **Develop** methodologies that meet ethical, societal and legal considerations. (HOTS: Level 6: Create)	-	-	-	-	-	3	-	3	3	-	-	3	-	-	3
Level of Attainments PROJ-CSEAI401															

Industrial Training

General Course Information

Course Code: INT-CSEAI301 Course Credits: 1 Mode: Industrial Training /Internship	**Course Assessment Methods (100 Marks)** An internal evaluation is done by a faculty member appointed by the Chairperson of the Department. Significance and originality of the problem addressed and the solution provided: 20 Knowledge of the problem domain and tool used (VIVA-VOCE):25 Report Writing: 20 Judgement of the skill learnt and system developed: 20 Level of ethics followed: 15

About the Industrial training:
Students do an Industrial Training of **4 to 6 weeks after fourth semester. They are expected to learn novel skills** and develop some software application during the training period.

After doing training students will be able to:

CO1. **review** the existing systems for their strengths and weaknesses. (HOTS: Level 4: Analyse)
CO2. **address** novel problems in an original and innovative manner (HOTS: Level 6: Create)
CO3. **select and apply** modern engineering tools. (LOTS: Level 3: Apply)
CO4. **evaluate** the system developed critically with respect to the requirement analysis and other similar systems. (HOTS: Level 5: Evaluate)
CO5. **prepare** training report by organising ideas in an effective manner.
CO6. **follow** ethical practices while doing the training and writing report. (LOTS: Level 3: Apply)

Note: The Industrial training/Internship must be carried out preferably in the domain of AI and ML.

CO-PO Articulation Matrix:Industrial Training (INT-CSEAI301)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO1	PSO2
CO1. **Address** novel problems in an original manner using latest skills (HOTS: Level 6: Create)	3	3	3	2	-	1	-	-	2	-	1	-	-	-	-
CO2. **Select and apply** modern engineering tools. (LOTS: Level 3: Apply)	2	-	-	-	3	-	-	-	3	-	-	-	-	-	-
CO3. **Prepare** training report by organising ideas in an effective manner.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4. **Engage** in lifelong learning. (HOTS: Level 6: Create)	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO5. **Apply** ethical practices while doing the training and writing report. (LOTS: Level 3: Apply	-	-	-	-	-	-	-	3	-	3	-	-	-	-	-
Level of Attainments INT-CSEAI301															

Big Data Analytics

General Course Information

Course Code: PCC-CSEAI403-T/ Course Credits: 3 Type: Professional Core Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Statistics, Data Analytics and data mining

About the course:
This course aims to equip the student with emerging field of big data analytics. Students achieve this through developing understanding of Big data analytics techniques and principles in typical real world scenarios. The course teaches students to understand as well as apply data analytics to big data projects.

After doing training students will be able to:

CO1. **outline** the basic terminology of big data analytics. (LOTS: Level 1: Remember)
CO2. **describe**big data analytics techniques,MapReduce, Hadoop environment, processing data in distributed file systems, applications of big data analytics etc. (LOTS: Level 2: Understanding)
CO3. **apply**big data techniques and tools to address the problems in big data domain. (LOTS: Level 3: Apply)
CO4. **analyze** the big data techniques and tools for different scenarios. (HOTS: Level 4: Analyse).
CO5. **interpret** the outcomes/results of big data algorithms. (HOTS: Level 5: Evaluate).
CO6. **design complete** frameworkto address big data problems. (HOTS: Level 6: Create).

Course Contents

Unit-I

Introduction: Overview of Big data, Characteristics of big data.

MapReduce: Distributed File System, MapReduce, and Algorithm using MapReduce.

MapReduce using Hadoop: A weather dataset example, Analyzing data with UNIX tool, Analysing data with Hadoop, Scaling out, Hadoop streaming and Hadoop pipes.

Unit-II

Hadoop distributed file system: The Design of HDFS, HDFS Concepts, The Command-Line Interface, Hadoop File systems, The Java Interface, Data Flow, Parallel Copying with distcp, Hadoop Archives.

CO-PO Articulation Matrix: Big Analytics (PCC-CSEAI 403-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **outline** the basic terminology of big data analytics. (LOTS: Level 1: Remember)	1	1	1	-	-	-	-	-	-	-	-	-	-	3
CO2. **describe** big data analytics techniques, MapReduce, Hadoop environment, processing data in distributed file systems, applications of big data analytics etc. (LOTS: Level 2: Understanding)	2	2	2	-	1	-	-	-	-	-	-	-	-	3
CO3. **apply** big data techniques and tools to address the problems in big data domain. (LOTS: Level 3: Apply)	2	2	2	-	-	-	-	-	-	-	-	-	1	3
CO4. **analyze** the big data techniques and tools for different scenarios. (HOTS: Level 4: Analyse).	3	3	3	1	2	-	-	-	-	-	-	-	2	3
CO5. **interpret** the outcomes/results of big data algorithms. (HOTS: Level 5: Evaluate).	3	3	3	2	-	-	-	-	-	-	-	-	2	3
CO6. **design complete** frameworkto address big data problems. (HOTS: Level 6: Create).	3	3	3	3	3	-	-	-	-	-	-	-	3	3
Level of Attainments PCC-CSEAI403-T														

Unit-III

The stream data model, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting ones in a window, decaying windows.

Unit-IV

Pig: Installing and Running Pig: execution type, running pig programs, grunt, Pig Latin editors, An example in Pig Latin, generating examples, Comparing with databases, Pig Latin structure, statement, expression, types, schemas, function and macros.

Hive: Installing Hive, Hive shell, Hive example illustrating use of hive, running hive, hive services, the metastore, Comparing Hive with traditional databases.

Hbase: Hbasics, Concepts: Whirlwind Tour of Data Model, Implementation; Installation, Hbase versus RDBMS

Text and Reference Books:

1. Tom White, "Hadoop: The Definitive Guide", 3rd Edition, O"reilly, 2012
2. Anand Rajaraman and Jefrey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.
3. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015
4. Zikopoulos, Paul, and Chris Eaton. Understanding big data: Analytics for enterprise class hadoop and streaming data. McGraw-Hill Osborne Media, 2011.
5. Big Data, Black Book: Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization, DT Editorial Services
6. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
7. Fundamentals of Business Analytics by R.N. Prasad, Seema Acharya, Wiley.
8. Buyya, Rajkumar, Rodrigo N. Calheiros, and Amir Vahid Dastjerdi, eds. Big data: principles and paradigms. Morgan Kaufmann, 2016.

Introduction to Robotics

General Course Information

Course Code: PEC-CSEAI411-T Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Basics of digital electronics, programming

About the Course:

This course offers a comprehensive understanding of robotics, automation, and their applications in various industries. The course includes basic principles, practical implementations, and the integration of automation technologies into robotic systems. Students will gain hands-on experience with industry-standard tools and software, fostering the development of skills crucial for careers in the rapidly evolving field of robotics and automation.

After doing training students will be able to:

CO1. **define** fundamental vocabulary and concepts of robotics including kinematics, dynamics, control theory, robot architectures, PLCs, Sensors, actuators etc. (LOTS: Level 1: Remember)
CO2. **describe** process of industrial automation, common components such as PLCs sensors and actuators, programming automation systems, decision making and control algorithms, ethical and social issues involves in robotics etc. (LOTS: Level 2: Understanding)
CO3. **apply** robotics fundamentals, programming techniques and algorithms to solve robotics problems. (LOTS: Level 3: Apply)
CO4. **analyze** basic robotics systems. (HOTS: Level 4: Analyse).
CO5. **design** simple robotic systems. (HOTS: Level 6: Create).

Course Contents

Unit I

Introduction to Robotics and Automation, Historical development and milestones, types and classification of robots, Robot components-sensors, actuators, controllers. Robot kinematics and dynamics, Robot architecture and control systems
Robotics Perception and Sensing: Robotics perception-vision, proximity, and other sensors, sensor fusion and environmental awareness, Case studies on real applications.

Unit II

Robot Decision Making and Control: Introduction to decision making algorithms, control methods in robotics, Programming basics for robot control,
Fundamentals of Industrial Automation: Overview of industrial automation, Introduction to Programmable Logic Controls, Role of sensors and actuators in industry settings, Basics of PLC programming, Logic operations and ladder logic, Industrial communication protocols, Integration of automation systems using protocols.

Unit III

Advanced Robot Control: Advanced control techniques in robotics, Path planning and optimization, Robot simulation and modelling.

Robot Programming and Software: Programming language for robotics, Software development for robot applications, Introduction to ROS.

Unit IV

Robot Learning and Adaptation: Machine leaning in robotics, Adaptive learning algorithms, applications of learning in robotics systems

Ethical Considerations in Robotics: Ethical issues in robotics automation, social impact and responsibility, discussion on current ethical dilemmas and case studies

Integration of robotic systems with automation, Challenges and solutions in system integration.

Text and Reference Books and Links:

1. Nicolaus Correl, Bradley Hayes, Christoffer Heckman and Alessandro Roncone, *Mechanisms, Sensors, Actuators and Algorithms*, MIT press, 2022.
2. A.K. Gupta, *Industrial Automation and Robotics: An Introduction*, Mercury Learning and Information, 2017
3. Alok Mani Tripathi, *Learning Robotic Process Automation*, Packt Publishing Ltd., 2018
4. Gerardus Blokdyk, Robotic Process Automation A Complete Guide, 2020.

CO-PO Articulation Matrix: Introduction to Robotics (PEC-CSEAI411-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **Define** fundamental vocabulary and concepts of robotics including kinematics, dynamics, control theory, robot architectures, PLCs, Sensors, actuators etc. (LOTS: Level 1: Remember)	1	-	1	-	-	-	-	-	-	-	-	-	1	3
CO2. **describe** process of industrial automation, common components such as PLCs sensors and actuators, programming automation systems, decision making and control algorithms, ethical and social issues involves in robotics etc. (LOTS: Level 2: Understanding)	2	1	3	1	-	3	2	2	-	-	-	-	2	3
CO3. **apply** robotics fundamentals, programming techniques and algorithms to solve robotics problems. (LOTS: Level 3: Apply)	3	2	2	2	2	-	-	-	-	-	-	-	2	3
CO4. **Analyze** basic robotics systems. (HOTS: Level 4: Analyse).	3	2	3	2	2	-	-	-	-	-	-	-	2	3
CO5. **Design** simple robotic systems. (HOTS: Level 6: Create).	3	3	3	3	2	-	-	-	-	-	-	-	2	3
Level of Attainments PEC-CSEAI411-T														

Digital Forensics

General Course Information

Course Code: PEC-CSE/AI412-T/ PEC-CSE417-T/ PEC-IT406-T Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: working knowledge of Windows/Macintosh/Linux, Network security.

About the Course:
The course on Digital Forensics is an inevitable study in this information era. Computer crimes are on a hike by the hackers and cyber criminals. The need to recover the deleted, hidden and corrupted files on Windows/Macintosh/Linux platforms give an opportunity to offer digital forensics automating features. This will give students a chance to study laws of court against computer crimes committed intentionally or inadvertently.

Course outcomes: By the end of the course studentswill be able to:

- CO1. **determine** the hardware and operating system requirements for digital forensics.(LOTS: Level 1: Remember)
- CO2. **represent** digital forensics by organization of data and metadata in computer systems.(LOTS: Level 2: Understand)
- CO3. **analyze** file recovery and hidden file extraction techniques. (HOTS: Level 4: Analyze)
- CO4. **identify** various types of forensics in the arena of information technology. (HOTS: Level 4:Analyze)
- CO5. **critic** the computer crimes by studying the security Laws and legal Landscape around the world.(HOTS: Level 5: Evaluate)
- CO6. **integrate** security of computer systems with digital forensics and evaluate its performance. (HOTS: Level 6: create)

Course content

Unit I

Introduction to Digital Forensics: digital crimes, digital investigation, evidence, extraction, preservation etc.; overview of hardware and operating systems: structure of storage media/devices, Windows/Macintosh/Linux-registry, boot process, disk and file system analysis, data acquisition of physical storage devices.

Unit II

Data recovery: identifying hidden data, recovering deleted files, digital evidence controls: uncovering attacks that evade detection by event viewer, task manager and other windows GUI tools, disk imaging, recovering swap files, temporary and cache files; automating analysis and extending capabilities.

Unit III

Network Forensics: collecting and analyzing network-based evidence, reconstructing web browsing, email activity, intrusion detection, tracking offenders, windows registry changes, etc., Mobile Network forensics: introduction, investigations, collecting evidences, where to seek digital data for further investigations; Email and database forensics; memory acquisition.

Unit IV

Computer crime and legal issues: intellectual property, privacy issues, criminal justice system for forensic, audit/investigative situations and digital crime scene, investigative procedure/standards for extraction, preservation and deposition of legal evidence in a court of law.

Text and Reference Books:

1. Thomas J Holt , Adam M Bossler, Kathryn C Seigfried-Spellar, *Cybercrime and Digital Forensics: An Introduction*, Routledge, 2015.
2. Cory Altheide and Harlan Carvey,*Digital Forensics with Open Source Tools*, Elsevier publication, April 2011.
3. B. Nelson, A. Phillips, F. Enfinger, C. Steuart, *Guide to Computer Forensics and Investigations* 4th edition, Thomson, 2009.
4. Michael Hale Ligh, Andrew Case, Jamie Levy, AAron Walters, *The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory*,july 2014.

CO-PO Articulation Matrix Digital Forensics Course (PEC-CSEAI412-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. **Determine** the hardware and operating system requirements for digital forensics. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2. **Represent** digital forensics by organization of data and metadata in computer systems. (LOTS: Level 2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3. **Analyze** file recovery and hidden file extraction techniques. (HOTS: Level 4: Analyze)	2	2	-	-	3	-	-	-	-	-	-	-	-	3	-
CO4. **Identify** various types of forensics in the arena of information technology. (HOTS: Level 4:Analyze)	2	2	2	2	3	-	-	-	-	-	-	-	-	3	2
CO5. **Critic** the computer crimes by studying the security Laws and legal Landscape around the world. .(HOTS: Level 5: Evaluate)	3	3	3	3	-	3	-	3	-	3	-	-	-	3	-
CO6. **Integrate** security of computer systems with digital forensics and evaluate its performance. (HOTS: Level 6: create)	3	3	2	3	3	-	-	-	-	-	-	-	-	3	-
Level of Attainments PEC-CSEAI412-T															

Social Network Analysis

General Course Information

Course Code: PCC-CSEAI413-T Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Background knowledge of statistics, data analysis techniques and scripting tools are useful.

About the Course:
This course introduces concepts and theories of social network analyses. Application areas include human behavior, community and trend detection, sentiment analysis, and development and visualize social network results.

Course outcomes: By the end of the course studentswill be able to:

- CO1. **recall** the terminology associated with network science and analysis. (LOTS: Level 1: Remember)
- CO2. **describe**concepts and algorithms of social network analysis. (LOTS: Level 2: Understand)
- CO3. **apply**social network techniques to address the issues in the domain. (HOTS: Level 4: Apply)
- CO4. **analyze** the challenges forsocial network algorithms and privacy issues. (HOTS: Level 4:Analyze)
- CO5. **judge** the performance of various social network algorithms.(HOTS: Level 5: Evaluate)
- CO6. **create** novel techniques for social network analysis. (HOTS: Level 6: create)

Course content

Unit I

Introduction to network science, Descriptive network analysis, mathematical models of networks, Introduction to semantic web and limitations, Development of semantic web, Emergence of the Social Web, Social network analysis,Expansion of social network analysis, Key concepts and measures in network analysis, E-sources for network analysis,E-discussion networks, Blogs and online communities, Web-based networks, Applications of Social Network Analysis.

Unit II

Extracting process of web community from a series of web archive,detecting communities in social networks, Definition of community,evaluating communities, Methods for community detection and mining, Applications of community in mining algorithms, Tools for detecting communities, social network infrastructures, Decentralized online social networks,Multi-Relational characterization of dynamic social network communities.

Unit III

Understanding and predicting human behaviour for social communities, User data management, Inference and Distribution,enabling new human experiences, Reality mining,Concept of context, Awareness and Privacy in online social networks, Trust in online environment, Trust models based on subjective logic, Trust network analysis, Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.

Unit IV

Graph theory, Centrality, Clustering, Node-Edge Diagrams, Matrix representation,visualizing online social networks, Visualizing social networks with matrix-based representations, Matrix and Node-Link Diagrams, Hybrid representations, Applications, Cover networks, Community welfare, Collaboration networks.

Text Books and References:

1. J. Golbeck, ***Analyzing the social web***, First edition.Morgan Kaufmann, Elsevier, 2013.
2. B. Furht, Ed., ***Handbook of Social Network Technologies and Applications***. New York,Springer US, 2010.
3. P. J. Carrington, J. Scott, and S. Wasserman, "Models and Methods in Social: Network Analysis," 2005.
4. M. Tsvetovat and A. Kouznetsov, "Social Network Analysis for Startups".
5. S. Wasserman and K. Faust, *Social network analysis: methods and applications*. in Structural analysis in the social sciences, Cambridge, New York: Cambridge University Press, 1994.
6. J. G. Breslin, A. Passant, and S. Decker, *The Social Semantic Web*. Berlin, Heidelberg: 2009.
7. G. Xu, Y. Zhang, and L. Li, *Web Mining and Social Networking: Techniques and Applications*. Boston, MA: Springer US, 2011.

Computer Vision

General Course Information

Course Code: PEC-CSEAI414-T Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Linear algebra, Calculus, and. Basics of programming using python.

About the Course

Computer Vision includes methods of acquiring, processing, analysing and understanding digital images and gaining insights from them. This course includes introduction to computer vision as a new advancement in technology. We start from understanding the concepts of images, colors, 2D-3D images. Then we understand about image formation, image processing, technologies used for image classification and application of computer vision.

Course Outcomes: By the end of the course students will be able to:

CO1. **outline** the basicsof computer vision and image processing domain. (LOTS: Level 1: Remember)
CO2. **describe** the fundamental concepts of image processing, sampling, image smoothing, filtering and transformations etc.(LOTS: Level 2: Understanding)
CO3. **Solveproblems** usingimageprocessing and computer vision techniques. (LOTS: Level 3: Apply)
CO4. **analyze**computer vision, image processing and deep learning algorithms for diverse applications. (HOTS: Level 4: Analyse).
CO5. **Design** complete solutions by synthesising your knowledge from computer vision, machine learning and image processing.

Course Contents

Unit-1

Introduction to Computer Vision: Basics of computer vision, its history and applications, Imaging and Image representation: sensing light, reflection and shading, optics, Imaging devices(Digital Camera), Image Formation: 2D transformations, 3D transformations, 3D rotations, 3D to 2D projections.

Unit-II

Image Processing: Need of image processing, pixel transforms, color transforms, histogram equalization, Linear filtering: separable filtering, examples of linear filtering, band pass and steerable filters, Non-linear filtering, binary image classification, Fourier transformation, 2D Fourier transformation and applications, Wavelets transformation, Geometric Transformation. Sampling and Aliasing, image smoothing.

CO-PO Articulation Matrix: Social Network Analysis (PEC-CSEAI413-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Recall** the terminology associated with network science and analysis. (LOTS: Level 1: Remember)	1	-	-	1	-	-	-	-	-	-	-	-	-	1
CO2. **Describe** concepts and algorithms of social network analysis. (LOTS: Level 2: Understand)	2	1	1	1	-	-	-	-	-	-	-	-	1	2
CO3. **Apply** social network techniques to address the issues in the domain. (HOTS: Level 3: Apply)	3	2	2	2	-	-	-	-	-	-	-	-	2	2
CO4. **Analyze** the challenges for social network algorithms and privacy issues. (HOTS: Level 4:Analyze)	3	2	3	2	-	-	-	-	-	-	-	-	1	3
CO5. **Judge** the performance of various social network algorithms. (HOTS: Level 5: Evaluate)	3	2	2	2	-	-	-	-	-	-	-	-	2	3
CO6. **Create** novel techniques for social network analysis. (HOTS: Level 6: create)	3	3	3	3	-	-	-	-	-	-	-	-	-	3
Level of Attainments PEC-CSEAI413-T														

Unit III

Edge detection: Edges and gradient based edge detectors, Differentiation and noise, Feature extractions: finding patterns, normalized correlation, human vision, the visual pathway and a model for early spatial vision.

Textures: analysis of textures, shape for textures and applications.

Unit IV

Introduction to Deep Learning: Supervised Learning, Unsupervised learning, Neural networks: Convolutional Neural networks, network architecture, visualizing weights and activation function, applications of convolutional neural network, 3D NN, recurrent NN, generative models.

Applications of Computer Vision: Image classification: Feature based methods, Face recognition, Object detection: face detection, general object detection, Image segmentation: instance segmentation, medical image diagnosis, retail and e-commerce, autonomous driving and augmented reality.

Text and Reference Books:

1. Richard Szeliski, Computer vision: Algorithms and applications, springer 2nd edition, 2022.
2. Forsyth and Pounce, Computer Vision: A modern approach, Pearson 2nd edition, 2011.
3. Shaprio, Linda G., Stockman, George C., Computer Vision, Pearson 1st edition, 2001.

CO-PO Articulation Matrix: Computer Vision (PEC-CSEAI414-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **outline** the basics of computer vision and image processing domain. (LOTS: Level 1: Remember)	1	1	1	-	-	-	-	-	-	-	-	-	1	3
CO2. **describe** the fundamental concepts of image processing, sampling, image smoothing, filtering and transformations etc.(LOTS: Level 2: Understanding)	2	2	2	-	-	-	-	-	-	-	-	-	2	3
CO3. **Solve problems** usingimageprocessing and computer vision techniques. (LOTS: Level 3: Apply)	3	2	2	1	-	-	-	-	-	-	-	-	2	3
CO4. **analyze**computer vision, image processing and deep learning algorithms for diverse applications. (HOTS: Level 4: Analyse).	3	3	3	2	-	-	-	-	-	-	-	-	2	3
CO5. **Design** complete solutions by synthesising your knowledge from computer vision, machine learning and image processing	3	3	3	3	-	-	-	-	-	-	-	-	3	3
Level of Attainments PEC-CSEAI414-T														

Pattern Recognition

General Course Information

Course Code: PEC-CSEAI415-T Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Data mining, data analytics.

About the Course:

Course Outcomes: By the end of the course studentswill be able to:

- CO1. **State** the introductory fundamentals of pattern recognition, Maximum Likelihood and Bayesian Parameter estimation, Linear discriminant functions. (LOTS: Level 1: Remember)
- CO2. **Describe** various types of pattern recognition concepts and techniques. (LOTS: Level 2: Understand)
- CO3. **Find** solutions for pattern recognition problems. (LOTS: Level 3: Apply)
- CO4. **Analyze**classification problems probabilistically and estimate classifier performance. (HOTS: Level 4: Analyse)
- CO5. **Evaluate**the performance of pattern recognition algorithms. (HOTS: Level 5: Evaluate)
- CO6. **Design** algorithms and pattern recognition systems. (HOTS: Level 6: Design)

Course Content

Unit I

Introduction - Basic concepts, Applications, Fundamental problems in pattern Recognition system design, Design concepts and methodologies, The Design Cycle, Learning and Adaptation., Examples of Automatic Pattern recognition systems, Simple pattern recognition model, Decision and Distance Functions - Linear and generalized decision functions, Pattern space and weight space, Geometrical properties, implementations of decision functions, Minimum-distance pattern classifications. Bayes Decision Theory: Bayes Decision Theory, Minimum Error rate Classification.

- **Unit II**

Maximum Likelihood and Bayesian Parameter Estimation: Maximum Likelihood Estimation, Bayesian Estimation, Bayesian Parameter Estimation, Gaussian Case and General Theory. Hidden Markov models; Non Parametric Techniques: Density Estimation, Parzen Windows, K- Nearest Neighbor Estimation, Nearest Neighbour rule, Metrics and Nearest Neighbour Classification, Fuzzy Classification, k-Means Clustering, Self-Organizing Maps. Non Parametric Decision Making - Introduction, histogram, kernel and window estimation,. Adaptive decision boundaries, adaptive discriminate functions, Minimum squared error Discriminate functions.

Unit III

Linear Discriminant Functions: Linear Discriminant Functions and Decision Surfaces, Generalized Discriminant Functions, The two-category linearly separable case, Minimizing the perceptron criterion function, relaxation procedures, non- separable behaviour, Minimum Squared- Error procedures. Support vector machines, Algorithm-independent machine learning-Bias and Variance, Bootstrapping-Adaboost Algorithm, Boosting, Bagging

Unit IV

Syntactic Pattern Recognition & Application of Pattern Recognition: Introduction, concepts from formal language theory, formulation of syntactic pattern recognition problem, syntactic pattern description, recognition grammars, automata as pattern recognizers, Application of pattern recognition techniques in bio-metric, facial recognition, IRIS scan, Finger prints, etc..

Text and Reference Books:

1. R. O. Duda, P. E. Hart and D. G. Stork, Pattern classification, John Wiley & Sons, 2002.
2. C. M. Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995.
3. V. N. Vapnik, The Nature of Statistical Learning Theory, Springer, 2000.
4. N. Cristianini and J. Shawe-Taylor, An Introduction to Support Vector Machines, Cambridge University Press, 2000.

CO-PO Articulation Matrix: Pattern Recognition (PEC-CSEAI415-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **State** the introductory fundamentals of pattern recognition, Maximum Likelihood and Bayesian Parameter estimation, Linear discriminant functions. (LOTS: Level 1: Remember)	1	1	1	-	-	-	-	-	-	-	-	-	1	3
CO2. **Describe** various types of pattern recognition concepts and techniques. (LOTS: Level 2: Understand)	2	2	2	-	-	-	-	-	-	-	-	-	2	3
CO3. **Find** solutions for pattern recognition problems. (LOTS: Level 3: Apply)	2	2	2	1	-	-	-	-	-	-	-	-	2	3
CO4. **Analyze**classification problems probabilistically and estimate classifier performance. (HOTS: Level 4: Analyse)	3	3	3	2	-	-	-	-	-	-	-	-	2	3
CO5. **Evaluate** the performance of pattern recognition algorithms. (HOTS: Level 5: Evaluate)	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO6. **Design** algorithms and pattern recognition systems. (HOTS: Level 6: Design)	3	3	3	3									3	3
Level of Attainments PEC-CSEAI415-T														

Quantum Computing

General Course Information

Course Code: PCC-CSEAI416-T Course Credits: 3 Type: Professional Elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Linear algebra and preferably basics of quantum mechanics.

About the Course

Quantum computing can be used to compute the answers to certain problems much faster than any classical system or computer can. This course provides a concise introduction to quantum computing from a computer science perspective. Initially we delve into the basics of linear algebra, complex vector space and quantum mechanics required for the course. Subsequently, we take up on quantum gates, circuits and algorithms, error correcting codes etc.

Course Outcomes: By the end of the course students will be able to:

- CO1. **define** the basic principles of linear algebra, quantum mechanics quantum gates, quantum circuits and the related quantum computing concepts. (LOTS: Level 1: Remember)
- CO2. **describe** the fundamental concepts of qubits, quantum gates, and quantum circuits, quantum entanglement, quantum search algorithms and quantum error correction codes etc.(LOTS: Level 2: Understanding)
- CO3. **applythe** principles of quantum computing to solve problemsthat cannot be solved by classical computing. (LOTS: Level 3: Apply)
- CO4. **illustrate** the importance of quantum error correction techniques in building reliable quantum computing systems. (LOTS: Level 3: Apply
- CO5. **analyzequantum** algorithms, including their applications and advantages over classical algorithms. (HOTS: Level 4: Analyse).

Course Contents

Unit-1

Review of Linear Algebra: Bases and linear independence, Linear operators and matrices, The Pauli matrices, Inner product, Eigenvectors and eigen values, Adjoint and Hermitian operators, Tensor products, Operator functions, The polar and singular value decomposition.

Introductory Quantum Mechanics: Basic principles of quantum mechanics, State space, quantum measurements, distinguishing quantum states, projective measurements, POVM measurements, phase, composite systems, Superdense coding, The density operator, The Schmidt decomposition and purifications, EPR and Bell inequality.

Unit-II

Quantum Computing Fundamentals: Qubits, Single qubit gates, Multiple qubitgates, quantum circuits, qubit copying circuit, quantum measurement and quantum state collapse, Bell states, quantum parallelism and superposition, quantum teleportation. classical computation on a quantum computer, The Deutch-Jozsa algorithm.

Unit –III

Quantum Circuits: Quantum algorithms, Single qubit operations, Controlled operations, Measurements, universal quantum gates, two level unitary gates, single qubit and CNOT gates, A discrete set of universal operations, The quantum simulation illustrative example, quantum fourier transform, quantum search algorithms: Grover's Algorithm, Quantum Factoring: Shor's Algorithm.

Unit– IV

Quantum Information and Quantum Error Correction: Quantum Entanglement, Classical noise and Markov process, quantum operations, examples of quantum noise and quantum operations, quantum teleportation and superdense coding.

Quantum Error Correction: The three-qubit flip code, three qubit phase flip code, The Shor code, theory of quantum error correction,fault-tolerant quantum computing,quantum cryptography.

Text and Reference Books:

1. Michael A. Nielsen and Isaac L. Chuang, *Quantum Computation and Quantum, Information*, Cambridge University Press, 2000.
2. Noson S. Yanofsky and Mirco A. Mannucci, *Quantum Computing for Computer Scientists*, Cambridge University Press, 2008.
3. Eleanor Rieffel and Wolfgang Polak, *Quantum computing: A gentle introduction*, MIT Press, 2014.
4. N. David Mermin, Quantum computer science: An introduction, Cambridge Univ. Press, 2007.

CO-PO Articulation Matrix: Quantum Computing (PEC-CSEAI416-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. **Define** the basic principles of linear algebra, quantum mechanics quantum gates, quantum circuits and the related quantum computing concepts.(LOTS: Level 1: Remember)	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2. **Describe** the fundamental concepts of qubits, quantum gates, and quantum circuits, quantum entanglement, quantum search algorithms and quantum error correction codes etc. (LOTS: Level 2: Understanding)	2	2	-	-	-	-	-	-	-	-	-	-	-	1	2
CO3. **Apply**the principles of quantum computing to solve problemsthat cannot be solved by classical computing. (LOTS: Level 3: Apply)	3	3	1	1	-	-	-	-	-	-	-	-	-	2	2
CO4.**Illustrate** the importance of quantum error correction techniques in building reliable quantum computing systems. (LOTS: Level 3: Apply)	3	3	2	2	-	-	-	-	-	-	-	-	-	2	2
CO5.**Analyze**quantum algorithms, including their applications and advantages over classical algorithms. (HOTS: Level 4: Analyse).	3	3	3	3	-	-	-	-	-	-	-	-	1	3	3
Level of Attainments PEC-CSEAI416-T															

Optimization Methods

General Course Information:

Course Code: PCC-CSEAI417 Course Credits: 3 Type: Professional Elective Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester *examination*, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Prerequisite: Background in differential calculus and basic maths.

About the Course

This course introduces the basic concepts of optimization methods as an important segment of Operation Research. These methods use the concepts of maximization or minimization of parameters to find the solution of problem. The course focuses on the mathematical modelling of real-life problems using optimization methods. The course encompasses on linear programming problems, Integer linear programming problems, Transportation problems, Assignment problems. Moreover, this course also covers the project management techniques, resource allocation and queueing theory concepts.

Course Outcomes: By the end of the course students will be able to:

- CO1. **define** the basic terms related to linear programming problems, integer programming problems, transportation and assignment problems, project management techniques and queueing systems. (LOTS: Level 1: Remember)
- CO2. **formulate** linear programming problems, integer programming problems, transportation and assignment problems. (LOTS: Level 2: Understanding)
- CO3. **apply** techniques of linear programming problems, integer programming problems, transportation and assignment problems to obtain optimal solutions. (LOTS: Level 3: Apply)
- CO4. **select**an appropriate method to solve optimizationand queuing theory problems. (LOTS: Level 4: Analyse)
- CO5. **Optimize** the allocation of resources using project management techniques like PERT/CPM.(HOTS: Level 5: Evaluate)
- CO6. **model** real-world problems using various concepts of optimization methods. (LOTS: Level 6: Create)

Course Contents

Unit-1

Introduction to linear and non-linear programming problems, formulation of LPP, Graphical solution, Standard and matrix form of LPP, Assumptions in LPP, Limitations, application and advantages of LPP, solution of LPP by Simplex method, Two phase method, Big-M method, disadvantages of Big-M method over Two phase method, Degeneracy problem, Special cases: Alternative solutions, Unbounded solutions, Non-existing solutions.

Unit-II

Revised simplex method, Duality in linear programming: concept of duality, Primal-Dual problems, general rules for converting any primal to its dual, Dual simplex method, advantages of Dual simplex method over Simplex method, difference between simplex and Dual simplex method, Integer linear programming: Importance of Integer programming problems, Gomory's cutting plane method, Branch and bound method.

Unit-III

Transportation problems: Finding an initial basic feasible solution by Northwest corner rule, Least cost rule, Vogel's approximation method, degeneracy, optimality test, MODI method, stepping stone method, Assignment problems: Hungarian method for assignment problem, unbalanced assignment problems.

Unit-IV

Project management by PERT-CPM: Applications of PERT/CPM techniques, basic steps in PERT/CPM techniques, Network diagram representation, rules for drawing network diagram, Time estimates and critical path in network analysis, Project evaluation and review technique, resource allocation, Queueing theory: Queueing system, queueing problem, transient and steady states, traffic intensity, probability distributions in queueing systems, Kendall's notation for queueing models, (M | M | 1) : (∞ | FCFS): Birth and death model, General erlang queueing model (birth-death process), (M | M | 1) : (∞ | SIRO) model, (M | M | 1) : (N | FCFS) model.

Text and Reference Books:

1. Hamdy A. Taha, *Operations Research: An Introduction*, Pearson, Tenth edition, 2017.
2. S. D. Sharma, *Operations Research: Theory*,Methods and Applications,2020th edition., Kedar Nath Ram Nath & Co., 2014.
3. Wayne L. Winston, *Operations Research: Applications and Algorithms,* Thomson, Fourth edition, 2004.
4. P. K. Gupta and D. S. Hira, *Operations Research,* 2017th edition, S. Chand & Co Ltd., 2017.

CO-PO Articulation Matrix: Optimization Methods(PCC-CSEAI417-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Define** the basic terms related to linear programming problems, integer programmingproblems, transportation and assignment problems, project management techniques and queueing systems. (LOTS: Level 1: Remember)	1	1	-	1	-	-	-	-	-	-	-	-	1	1
CO2. **Formulate** linear programming problems, integer programming problems, transportation and assignment problems. (LOTS: Level 2: Understanding)	2	2	-	2	-	-	-	-	-	-	-	-	2	2
CO3. **Apply** techniques of linear programming problems, integer programming problems, transportation and assignment problems to obtain optimal solutions. (LOTS: Level 3: Apply)	3	3	-	3	-	-	-	-	-	-	-	-	2	3
CO4. **Select** an appropriate method to solve optimization and queuing theory problems. (LOTS: Level 4: Analyse)	3	3	-	3	-	-	-	-	-	-	-	-	3	3
CO5. **Optimize** the allocation of resources using project management techniques like PERT/CPM.(HOTS: Level 5: Evaluate)	3	3	-	3	-	-	-	-	-	-	-	-	3	3
CO6. **Model** real-world problems using various concepts of optimization methods. (LOTS: Level 6: Create)	3	3	-	3	-	-	-	-	-	-	-	-	3	3
Level of Attainments PCC-CSEAI417-T														

Blockchain Technology

General Course Information

Course Code: PEC-CSEAI418-T/ Course Credits: 3 Type: Professional elective Contact Hours: 3hours/week Mode: Lectures (L) Examination Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Basics of Cryptographic Hash Functions

About the Course:

This course provides a broad overview of the essential concepts of blockchain technology by initially exploring the Bitcoin protocol followed by the Ethereum protocol to lay the foundation necessary for developing applications.

Course Outcomes: By the end of the course students will be able to:

- CO1. **describe** the basic concepts and technology used for blockchain.(LOTS: Level 1: Remember)
- CO2. **explain** the primitives of the distributed computing and cryptography related to blockchain. (LOTS: Level 2: Understand)
- CO3. **illustrate** the concepts of Bitcoin and their usage. (LOTS: Level 2: Understand)
- CO4. **apply** security features in blockchain technologies. (LOTS: Level 3: Apply)
- CO5. **identify** challenges in smart contract in real world applications.(HOTS: Level 4: Analyse)
- CO6. **devise** Ethereum block chain contract. (HOTS: Level 6: Create)

Course Contents

Unit I

Overview of Blockchain Technology: Defining Blockchain and Distributed Ledger, Blockchain properties decentralized, transparent, immutable and secure. Blockchain applications. Types of blockchain: Public, private, and consortium based blockchain, when to use, and when not to use blockchain, History of blockchain.

Introduction to computing models and P2P networking: Centralized, Decentralized and Distributed Systems, Decentralization vs distributed, P2P systems, propertied of P2P systems, P2P communication architecture. P2P network applications: File sharing, P2P network for Blockchain

Unit II

Foundational Concepts in Blockchain Data Structure: Cryptographic Hash Functions, Digital Signatures, Public Keys as Identities, Hash Pointers and Hash chain and Merkel tree, Consensus mechanisms

Blockchain Characteristics: Decentralized Identity management, Transactions, incentivizing and mining Distributed Consensus (PoW), Cryptocurrency as the first blockchain application. Mechanics of Bitcoin, Bitcoin Scripts, Storing and Using Bitcoins, Mining in Bitcoin

Unit III

Consensus Mechanisms: Proof of storage, proof of stake, proof of deposit, proof of burn, proof of activity algorithms for adjusting difficulty and retargeting. Limitations of Bitcoin, alternative cryptocurrencies.
Smart Contracts and Ethereum: Purpose and types of smart contracts, Introduction to Ethereum, bitcoin vs Ethereum stack. P2P network in Ethereum, consensus in Ethereum, scripts in Ethereum, Smart contracts (Ethereum Virtual Machine). Developing and executing smart contracts in Ethereum. State and data structure in Ethereum.

Unit IV

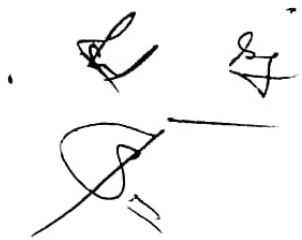
Private and Consortium based Blockchain Hyperledger: Need for the consortium. Hyperledger stack, Multi-chain blockchain, Innovation in Hyperledger, smart contracts, and distributed applications in Hyperledger.
Case studies/ Enabling Technologies and applications: Application of blockchain in privacy and security, IoT and smart cities, Business and Industry, Data management, e-Governance.

Text and Reference Books and Links:

1. Imran Bashir, *Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained*, Packt Publishing, 2018
2. Daniel Drescher, *Block Chain Basics*, Apress; 1stedition, 2017.
3. Josh Thompsons, *Block Chain: The Block Chain for Beginners- Guide to Blockchain Technology and Leveraging Blockchain Programming*, Createspace Independent Pub, 2017.
4. Pethuru Raj, Kavita Saini, ChellammalSurianarayanan, *Blockchain Technology and Applications*, CRC Press, 2021.
5. Raj K., *Foundation of Blockchain: The pathway to cryptocurrency and decentralized blockchain application*, 1st ed. Packt Publishing Ltd, 2019.
6. S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, *Blockchain Technology: Cryptocurrency and Applications*, Oxford University Press, 2019
7. Melanie Swan, *Blockchain: Blueprint for a New Economy*, O'Reilly, 2015.
8. Amit Dua, *Blockchain Technology and Applications: A systematic and Practical approach*, Amazon LLC, 2022

CO-PO Articulation Matrix: Block chain Technology(PCC-CSEAI418-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Describe** the basic concepts and technology used for blockchain. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2. **Explain** the primitives of the distributed computing and cryptography related to blockchain. (LOTS: Level 2: Understand)	2	1	-	-	-	-	-	-	-	-	-	-	-	2
CO3. **Illustrate** the concepts of Bitcoin and their usage. (LOTS: Level 2: Understand)	2	1	-	-	-	-	-	-	-	-	-	-	-	2
CO4. **Apply** security features in blockchain technologies. (LOTS: Level 3: Apply)	2	2	-	1	-	-	-	-	-	-	-	-	-	3
CO5. **Identify** challenges in smart contract in real world applications. (HOTS: Level 4: Analyse)	3	3	1	2	-	-	-	-	-	-	-	-	-	3
CO6. **Devise** Ethereum block chain contract. (HOTS: Level 6: Create)	3	3	2	2	-	-	-	-	-	-	-	-	-	3
Level of Attainments PEC-CSEAI418-T														



Introduction to Augmented and Virtual Reality

General Course Information

Course Code: PEC-CSEAI419-T

Course Credits: 3

Type: Professional Elective

Contact Hours: 3hours/week

Mode: Lectures (L)

Examination Duration: 3 hours

Course Assessment Methods:
Max. Marks: 100 (Internal: 30; External: 70)

Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks).

The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Pre-requisites: Augmented and Virtual reality basic.

About the Course

The objective of this course is to provide a foundation to the fast growing field of Augmented Reality and Virtual Reality. This course provides brief introduction to Augmented Reality and Virtual Reality, AR and VR software development. In this course, students will learn about VR modelling, 3D interactions, 3D user interfaces, Strategies for Designing and Developing 3D UIs etc.

Course Outcomes: By the end of the course students will be able to:

CO1. **define** the concepts pertaining to augmented reality and virtual reality, AR and VR techniques etc. (LOTS: Level 1: Remember)

CO2. **describe** the fundamental principles applications and challenges of augmented and visual reality, VR modelling, 3D interaction UIs etc. (LOTS: Level 2: Understand)

CO3. **find** solutions to real world problems involving the use of augmented and virtual reality. (LOTS: Level 3: Apply)

CO4. **analyse** the techniques available in the domain of augmented and virtual reality. (LOTS: Level 4: Analyse)

CO5. **comment** on the outcomes of the augmented and virtual reality solutions. (LOTS: Level 5: Evaluate)

Course Contents

Unit-I

Introduction to Augmented Reality (AR):Definition and Scope of AR, History of Augmented Reality, Displays (Multimodal Displays, Spatial Display Model, and Visual Displays), Merits and demerits of AR. Applications of AR, Challenges in AR

Unit-II

Introduction to Virtual Reality (VR):Definition and Scope of VR, Types of VR, Characteristics of VR, Components of VR system, Designing & Building VR Systems,Benefits of VR, Limitations of VR environments, Key hardware requirements for VR, Difference between VR and AR

Unit-III

AR software development :AR software, Camera parameters and camera calibration, Marker-based augmented reality, AR Toolkit.

VR software development : Challenges in VR software development, Master/slave and Client/server architectures, Cluster rendering, Game Engines and available sdk to develop VR applications for different hardware (HTC VIVE, Oculus, Google VR).

Unit-IV

VR Modeling: Geometric modeling, Kinematic, Physical and Behavior modeling, Selection and Manipulation during 3D Interaction, Travel and Wayfinding in Virtual Environments, Strategies for Designing and Developing 3D UIs, Evaluation of 3D User Interfaces, Traditional and Emerging VR/AR applications

Text and Reference Books:

1. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition.Wiley-IEEE Press, 2003/2006.
2. *D.A. Bowman* et al., "3D User Interfaces: Theory and Practice", Addison Wesley.
3. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
4. GJ Kim, "Designing VR Systems: The Structured Approach", Springer, 2005.

CO-PO Articulation Matrix: Introduction to Augmented and Virtual Reality (PEC-CSEAI419-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Define** the concepts pertaining to augmented reality and virtual reality, AR and VR techniques etc. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2. **Describe** the fundamental principles applications and challenges of augmented and visual reality, VR modelling, 3D interaction UIs etc. (LOTS: Level 2: Understand)	2	-	1	-	-	-	-	-	-	-	-	-	-	2
CO3. **Find** solutions to real world problems involving the use of augmented and virtual reality. (LOTS: Level 3: Apply)	2	1	2	1	-	-	-	-	-	-	-	-	-	3
CO4. **Analyse** the techniques available in the domain of augmented and virtual reality. (LOTS: Level 4: Analyse)	3	2	2	2	-	-	-	-	-	-	-	-	-	3
CO5. **Comment** on the outcomes of the augmented and virtual reality solutions. (LOTS: Level 5: Evaluate)	3	3	2	3	-	-	-	-	-	-	-	-	-	3
Level of Attainments PEC-CSEAI419-T														

Federated Learning

General Course Information:

Course Code: PEC-CSEAI420-T Course Credits: 3 Type: Professional Elective Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods:** **Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any of the two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. The remaining eight questions are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt five questions in all, one compulsory and any other four questions by selecting one from each unit.

Prerequisite: Machine Learning and proficiency in Python

About the Course

The machine learning applications are spread around many fields such as health care, financial, marketing agriculture, and space organisations. The machine learning algorithms, specifically, deep learning techniques require millions of data tuples to achieve a reasonable acceptable performance. Very often the data required is not located at one place rather it is distributed across several locations or edge devices. One approach could be to gather all the data at cloud server, integrate it and then run machine learning algorithms. This approach is time consuming and not feasible due to data privacy issues. The solution is federated learning. The models are learnt with smaller size training data at the side of edge devices. These models are encrypted and sent to the cloud server for constructing the aggregated model. The aggregated model can be downloaded by the edge devices. This course aims to introduces the students with principles and algorithms for federated learning, relatively a novel area of research.

Course Outcomes: By the end of the course students will be able to:

- CO1. **define**the related terms and concepts of federated learning. (LOTS: Level 1: Remember)
- CO2. **describe**the federated learning's principles, significance, potential benefits, challenges, security, communication efficiency and optimizations issues. (LOTS: Level 2: Understanding)
- CO3. **apply**the federated learning algorithms and respective optimization techniques. (LOTS: Level 3: Apply)
- CO4. **analyze**issues regarding applications of federated learning, in domains such as healthcare, IoT, financeetc. and adapt federated learning to cater to domain-specific challenges. (HOTS: Level 4: Analyse).
- CO5. **evaluate** ongoing research and ethical issues for federated learning environments.(HOTS: Level 5: Evaluate)

Course Contents

Unit1

Overview of federated learning and its significance, comparing traditional centralized machine learning with federated learning, Privacy and security challenges in distributed learning.

Decentralized data sources: Types of decentralized data sources, Data heterogeneity and distribution challenges, Federated datasets and data representation.

Ethical and legal considerations: Fairness, bias and accountability in federated learning, regulatory compliance and data protection laws, ethical implications of decentralized machine learning.

Unit II

Privacy and Security in Federated Learning: Privacy preserving techniques (differential privacy, secure aggregation), Federated learning framework for privacy protection, Threat models and security models, adversary security models, Privacy preservation techniques.

Federated learning algorithms: Federated averaging and weighted averaging, communication-efficient optimization methods, model aggregation techniques, Privacy preserving decision trees, Privacy preserving DML schemes. Architecture of horizontal and vertical federated learning, Secure federated linear regression and tree boosting algorithms.

Unit III

Optimization techniques for federated learning: Federated stochastic gradient descent, federated meta-learning, Adaptive learning rate techniques.

Communication and bandwidth optimiz

ation: Model compression and quantization method, Bandwidth efficient communication protocols.

Unit IV

Applications of federated learning: Finance, Healthcare and medical applications, Internet of thing and edge computing.

Research trends and future directions: Current research challenges in federated learning, federated transfer learning (FTL), Federated transfer learning framework, The FTL training process, The FTL prediction process, Federated reinforcement learning: Policy, reward, value function, model of environment, RL example, reinforcement learning algorithms.

Text and Reference Books:

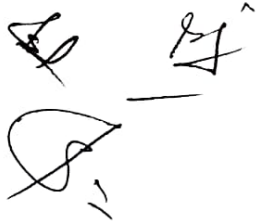
Yang Liu, Tianjian Chen, and Qiang Yang, Federated Learning: Theory and Practice, 2023.

Research papers:

1. Q. yang, et al., Federated Machine Learning: Concept and Applications, *ACM Trans. Intell. Syst. Technology*, Vol. 10, No. 2, 2019.
2. Li. Tian et al., Federated Learning: Challenges, Methods, and Future Directions, *IEEE Signal Processing Magazine*, Vol. 37, No. 3, 2020.
3. Jakub Konecnyet al., Federated Learning: Strategies for Improving Communication Efficiency, NIPS Workshop on Private Multi-Party Machine Learning, 2016.
4. H. Brendan McMahan et al., Communication-Efficient Learning of Deep Networks from Decentralized Data, *Proceedings of the 20th International Conference on Artificial Intelligence and Statistics*, Florida, USA, 2017.
5. Daniel Ramage et al., Federated Learning for Mobile Keyboard Prediction, *Google LLC*, Mountain View, CA, U.S.A., 2018.
6. M. Joshi et al., Federated Learning for Healthcare Domain - Pipeline, Applications and Challenges, *ACM Transactions on Computing for Healthcare*, Vol. 3, No. 4, 2022.
7. Li, Hao et al. Review on security of federated learning and its application in healthcare, *Future Generation Computer Systems*, Vol. 144, 2023.

CO-PO Articulation Matrix: Federated Learning(PEC-CSEAI420-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. **Define**the related terms and concepts of federated learning. (LOTS: Level 1: Remember)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2. **Describe**the federated learning's principles, significance, potential benefits, challenges, security, communication efficiency and optimizations issues. (LOTS: Level 2: Understanding)	2	1	-	-	-	1	-	1	-	-	-	-	-	-	2
CO3. **Apply**the federated learning algorithms and respective optimization techniques. (LOTS: Level 3: Apply)	3	2	-	1	-	-	-	-	-	-	-	-	-	-	3
CO4.**Analyze**issues regarding applications of federated learning, in domains such as healthcare, IoT, finance etc and adapt federated learning to cater to domain-specific challenges. (HOTS: Level 4: Analyse).	3	3	-	2	-	2	-	2	-	-	-	-	-	-	3
CO5.**Evaluate** ongoing research and ethical issues for federated learning environments.(HOTS: Level 5: Evaluate).	3	3	3	3	-	3	-	3	-	-	-	-	-	-	3
Level of Attainments PEC-CSEAI420-T															



Big Data Analytics Lab.

General Course Information

Course Code: PCC-CSEAI403-P Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods :** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Data Analytics, Big Data Analytics

About the Course:

The course familiarizes students with Hadoop distributions, configuring Hadoop and performing File management tasks. It also includes implementation of storage of big data using MongoDB,MapReduce programs for processing big data for various applications, andProcessing Large datasets using programming tools like PIG & HIVE in Hadoop ecosystem.

Course Outcomes: By the end of the lab course a student would be able to:

- **CO 1. configure** and install HDFS and apply big data analytics technique for solving big data problems. (LOTS: Level 3: Apply)
- **CO 2. select and compare** big data analytics algorithms and tools for address diverse big data problems. (HOTS: Level 4: Analyse)
- **CO 3. Interpret** the results of applying big data analytics techniques. (HOTS: Level 5: Interpret)
- **CO 4. create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create)
- **CO 5. demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

List of Experiments:

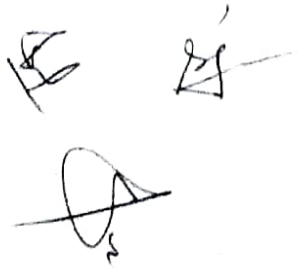
1. Install, configure and run Hadoop and Hadoop Distributed file System (HDFS).
2. Develop a MapReduce program to calculate the frequency of a given word in a given file.
3. Develop a MapReduce program to find the maximum temperature in each year.
4. Develop a MapReduce program to implement Matrix Multiplication.
5. Develop a MapReduce to analyze weather data set and print whether the day is shiny or cool day.
6. Develop a program to calculate the maximum recorded temperature yearwise for the weather dataset in Pig Latin.
7. Write queries to sort and aggregate the data in a table using HiveQL.
8. Develop a Java application to find the maximum temperature using Spark.
9. Implement NoSQL Database Operations: CRUD operations, Arrays using MongoDB.
10. Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB.
11. Implement clustering techniques using SPARK.
12. Implement an application that stores big data in MongoDB / Pig using Hadoop / R.

Note:

The actual experiments assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix: Big Data Analytics Lab. (PCC-CSEAI403-P)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14
CO1. **configure** and install HDFS and apply big data analytics technique for solving big data problems. (LOTS: Level 3: Apply)	2	3	2	2	3	-	-	-	-	-	-	-	-	3
CO2. **select and compare** big data analytics algorithms and tools for address diverse big data problems. (HOTS: Level 4: Analyse)	3	3	-	2	3	-	-	-	-	-	-	-	-	3
CO3. **Interpret** the results of applying big data analytics techniques. (HOTS: Level 5: Interpret)	3	3	-	3	3	-	-	-	-	-	-	-	-	3
CO4. **create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create).	3	3	-	3	3	-	-	-	-	3	-	-	-	3
CO5. **demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)	-	-	-	-	-	-	-	3	3	-	-	3	-	-
Level of Attainments: PCC-CSEAI403-P														



Major Project Part II

General Project Information

Course Code: PROJ-CSEA1402 Course Credits: 4 Mode: Self learning under the guidance of a faculty member.	**Course Assessment Methods (Internal evaluation: 30 marks; External Evaluation marks: 70)** Evaluation is done by the internal examiner (project guide) and external examiner appointed by the Controller of Examination. The criteria for evaluation are given below. 1. Review of literature related to problem domain: 15 2. Significance and originality of the solution presented: 15 3. Application of software engineering principles and project management: 15 4. Significance and scope of results: 20 5. Organisation and presentation of major project report: 20 6. Level of Ethics and societal issues covered: 15

About the major project part II:

Students continue working on their project work and they are required to complete it by the end of 8th semester. Students carry out implementation of their respective projects based on the problem identified, methodology and tools suggested in the synopsis prepared during seventh semester. They prepare the final project reports according to the format provided. At the end of eighth semester, each student is required to present his/her project work in front of internal project guide and external examiner appointed by the Controller of Examination.

Course Outcomes: After doing major Project students will be able to:

CO1. **review** information critically for solving complex engineering problems. (HOTS: Level 4: Analyse)
CO2. **plan** the project according to principles of project management. (HOTS: Level 6: Create)
CO3. **devise** original solutions to complex engineering problems using modern engineering tools. (HOTS: Level 6: Create)
CO4. **justify** the outcomes of the project work. (HOTS: Level 5: Evaluate)
CO5. **organise** and communicate (written and oral) ideas effectively. (HOTS: Level 6: Create)
CO6. **develop** solutions that meet ethical, societal and legal considerations. (HOTS: Level 6: Create)

CO-PO Articulation Matrix Course (PROJ-CSEAI402)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1. **Review** information critically for solving complex engineering problems. (HOTS: Level 4: Analyse)	2	2	2	3	-	-	-	-	-	-	-	-	-	3
CO2. **Plan** the project according to principles of project management. (HOTS: Level 6: Create)	1	1	1	-	3	-	-	-	-	-	3	3	-	3
CO3. **Devise** original solutions to complex engineering problems using modern engineering tools. (HOTS: Level 6: Create)	3	2	3	3	3	2	-	-	-	-	-	-	-	3
CO4. **Justify** the outcomes of the project work. (HOTS: Level 5: Evaluate)	3	3	3	3	-	2	-	-	-	-	-	-	-	3
CO5. **Organise** and communicate (written and oral) ideas effectively. (HOTS: Level 6: Create)	-	-	-	-	-	-	-	-	-	3	3	-	-	3
CO6. **Develop** solutions that meet ethical, societal and legal considerations. (HOTS: Level 6: Create)	-	-	-	-	-	-	-	3	3	-	-	3	-	3
Level of Attainments PROJ-CSE402														

Guidelines for Preparing Industrial Training (INT-CSEAI301) Report

All the students are required to follow these guidelines for preparing their industrial training report.

General Guidelines

1. The industrial training report must include a declaration by the student that he/she has followed ethical practices while doing the industrial training work. Any violation of ethical practices will lead to rejection of the industrial training report. For instance, a plagiarized report or a readymade report purchased from market will be rejected straight away.
2. Industrial training work carried out in groups of two students must include the individual contribution of the students.
3. The industrial training report must be submitted to the internal guide in soft binding at least 7 days before the final submission so that he/she can suggest changes.

6.2.2 Formatting Instructions

The formatting instructions are given in Table below.

Formatting Instructions		
Sr. No.	Item	Formatting
1.	No. of pages	Minimum 20 and maximum 40
2.	Paper size	A4
3.	Font Type	Times New Roman
4.	Normal text size	12
5.	Page numbering	Place: Centre Bottom Type: Front material in Roman numbers
6.	Margins	Left margin: 3.75 cms (1.5 inch) Right, bottom, top= 2.5 cms (1 inch)
7.	References/Bibliography	IEEE format
8.	Binding	soft binding of good quality

Contents of the Industrial Training Report

The contents of the industrial training report should be organised as described below.

1. Declaration that the students has carried out his work on his own. It is his/her original creation, not plagiarised from any other source and due credit has been given to the source material used in the industrial training report through references and citations.
2. Acknowledgement
3. List of figures
4. List of Tables
5. List of Abbreviations
6. Contents

Contents in the Body of the industrial training report

The report must be written in English. The ideas must be organised in a clear and concise fashion.

S. No	Content	Tentative No. of pages
1.	Profile of the Company	At most 2 pages
2.	Introduction	2-4 pages
3.	Description of skills learned	4-6 pages
4.	Application developed (if any) based on skills learnt	10-18 pages
5.	Scope of the training/ Application developed	1 paragraph

The industrial training report should not no way exceed 40 pages and should be submitted in soft binding of good quality.

Format of the title page

The format of the title page is given is given on next page.

TITLE OF THE INDUSTRIAL TRAINING REPORT

(Write in Times New Roman, 16-point size, Bold and Centred and Uppercase font)

Training report submitted to
Guru Jambheshwar University of Science and Technology, Hisar
for the partial award of the degree

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 4 lines gap with 12 font size from the title of the project)

of

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 1 lines gap with 12 font size from the text above in three lines)

Bachelor of Technology
in Computer Science and Engineering

(Write in Times New Roman, 14-point size, Bold, Centred style after "***of***" after 1 line gap with 12 font size)

By

(Write in Times New Roman 12-point size, Bold, Italics, and Centred style after the name of the degree with 1 line gap with 12 font size)

Your Name (Enrolment

Number)

(Write in Times New Roman, 14-point size font, Bold, Centred style after1 line gap with 12 font from "***By***")

Department of Computer Science & Engineering GURU
JAMBHESHWAR UNIVERSITY OF SCIENCE AND
TECHNOLOGY, HISAR

Month, Year

(Write in Times New Roman, 14-point size font, Bold, Centred style, after 2 lines gap from logo)

Declaration to be submitted for training report

DECLARATION

I, *Your Name*, *Your Roll No.*, certify that the work contained in this industrial training report is original and has been carried by me in the ---------- company name. This work has not been submitted to any other institute for the award of any degree and I have followed the ethical practices and other guidelines provided by the Department of Computer Science and Engineering in preparing the industrial training report.

Signature

Name of Student

Registration Number

Department of Computer Science and Engineering

Guru Jambheshwar University of Science and Technology, Hisar

Signature

Supervisor

Designation

Department of Computer Science and Engineering

Guru Jambheshwar University of Science and Technology, Hisar

Evaluation of mini-project

The proforma for evaluating the mini-project using open source tools is given on the next page.

Department of Computer Science and Engineering
Guru Jambheshwar University of Science and Technology, Hisar-125001

Name of the Programme:_____

Semester:_____

Session:_____

Credits: 1

Total Marks: 100

Evaluation of Mini Project using Open Source Tools (PROJ-CSE402)

SR. No.	Roll. No.	Significance of the problem addressed CO1 (15)	Knowledge of the problem domain CO2 (15)	Knowledge of the techniques and tools used CO3 (15)	Quality of the solution provided CO4 (20)	Quality of the Report Writing CO5 (20)	Level of engagement with ethical practices and self-learning CO6 (15)	Total (100)
1								
2								
3								
.								
.								

Name of the examiner(s).

Signature of the Examiner(s)

Date:

Signature of Chairperson

Total Candidates

No. of Candidates Present.

No. of Candidates Absent

Guidelines for Preparing Mini-project report (PROJ-CSE402)

All the students are required to follow these guidelines for preparing their mini- project report.

Formatting Instructions

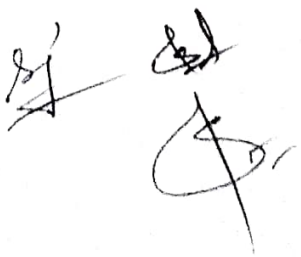
The formatting instructions are given in the table below.

Formatting Instructions		
Sr. No.	Item	Formatting
1.	Front Cover	Quality paper suitable for soft binding
2.	No. of pages	Minimum 20 and maximum 40 excluding the front material
3.	Paper size	A4
4.	Font Type	Times New Roman
5.	Chapter Heading Font	16
6.	Font of Sections and Subsections	14 and 12 in bold style
7.	Numbering style for sections and subsections; Do not use more than three levels.	2., 2.1 and 2.1.1
8.	Normal text size	12
9.	Figures and Tables must be numbered chapter-wise. Table headings on the top of the tables and Figure heading at the bottoms of the figures.	For example for chapter 2, Figures should be numbered as Fig. 2.1, Fig. 2.2 etc. and Tables as Table 2.1 and Table 2.2 etc.
10.	Page numbering	Place: Centre Bottom Type: Front material in Roman numbers Body of the report: in Arabic numerals. Pagination must start with first page of the first chapter and continue throughout the end of the report.
11.	Margins	Left margin: 3.75 cms (1.5 inch) Right, bottom, top= 2.5 cms (1 inch)
12	References/Bibliography	IEEE format
13	Binding	Soft binding of good quality

Contents of the Mini-Project Report

The contents of the report should be organised as described below.

7. The title page as per instructions.
8. Declaration that the student has carried out his work on his own. It is his/her original creation, not plagiarised from any other source and due credit has been given to the source material used in the report through references and citations.
9. Acknowledgement
10. List of figures
11. List of Tables



12. List of Abbreviations
13. Contents

14. Body of the Report

The report must be written in English. The ideas must be organised in a clear and concise fashion. Chapters must be tentatively organised as below.

Chapter 1. Introduction

This includes introduction to relevant area of mini-project, problem formulation, objectives of the mini-project, and structure of the project report.

Chapter 2. Requirement analysis, solution design framework of the mini-project work and tools used

Chapter 3. Outputs of the mini-project

References/Bibliography

Format of the Title page

The format for the title page of the mini-project using open source tools is given on next page.

TITLE OF THE MINI-PROJECT REPORT

(Write in Times New Roman, 16-point size, Bold and Centred and Uppercase font)

Mini-Project report submitted to
Guru Jambheshwar University of Science and Technology, Hisar
for the partial award of the degree

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 2 lines gap with 12 font size from the title of the project)

of

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 1 lines gap with 12 font size from the text above in three lines)

Bachelor of Technology
in Computer Science and Engineering

(Write in Times New Roman, 14-point size, Bold, Centred style after "*of*" after 1 line gap with 12 font size)

By

(Write in Times New Roman 12-point size, Bold, Italics, and Centred style after the name of the degree with 1 line gap with 12)

Your Name (Enrolment Number)

(Write in Times New Roman, 14-point size font, Bold, Centred style after 1 line gap with 12 font from "***By***")

Department of Computer Science & Engineering GURU JAMBHESHWAR UNIVERSITY OF SCIENCE AND
TECHNOLOGY, HISAR

Month, Year

(Write in Times New Roman, 14-point size font, Bold, Centred style, after 2 lines gap from logo with

Evaluation of Major Project Part-1

The students are required to do prepare a synopsis of the project work to be taken in the next semester. In this phase, they will look for an appropriate problem to be solved. They formulate the problem and search for appropriate modern tools. At the end of the Major Project Part-I, students submit and present their synopses. The proforma consisting of criteria on which students are evaluated is given on next page.

Department of Computer Science and Engineering

Guru Jambheshwar University of Science and Technology, Hisar-125001

Name of the Programme:_____

Credits: 4

Semester:_____

Total Marks: 100

Session:_____

Evaluation of Major Project Part I (PROJ-CSEAI401)

SR. No.	Roll. No.	Review of literature related to problem domain CO1 (20)	Significance and originality of the Problem Formulation CO2 (20)	Knowledge of the related tools CO3 (20)	Organisation and presentation of major project report CO4 (20)	Level of Ethics followed and societal issues covered CO5 (20)	Total Marks
1							
2							
3							

Name of the examiner (s):

Signature of the Examiner (s):

Date:

Signature of Chairperson

Total Candidates:

No. of Candidates Present:

No. of Candidates Absent:

Guidelines for preparing major project (PROJ-CSEA1401) synopsis

All the students are required to follow these guidelines for preparing their project synopsis.

General Guidelines

4. The student should follow ethical practices while doing the synopsis work. Any violation of ethical practices will lead to rejection of the synopsis. For instance, a plagiarized synopsis or a readymade synopsis purchased from market will be rejected straight away.
5. The synopsis must be submitted to the internal guide in soft binding at least 7 days before the presentation so that he/she can suggest changes.
6. Synopsis carried out in groups of two students must include the division of work.

Formatting Instructions

The formatting instructions are given in Table below.

Formatting Instructions		
Sr. No.	Item	Formatting
9.	No. of pages	Minimum 8 and maximum 10
10.	Paper size	A4
11.	Font Type	Times New Roman
12.	Normal text size	12
13.	Page numbering	Place: Centre Bottom
14.	Margins	Left margin: 3.75 cms (1.5 inch) Right, bottom, top= 2.5 cms (1 inch)
15.	References/Bibliography	IEEE format
16.	Binding	Soft binding of good quality

Contents of the Project Synopsis

The synopsis must be written in English. The ideas must be organised in a clear and concise fashion. Sections must be tentatively organised as below.

1. Contents Page
2. Introduction
3. Background Details and Literature Review
4. Problem Formulation and Objectives
5. Methodology and tools to be used
6. References/Bibliography

Signature

Name of Student

Registration Number

Department of Computer Science and Engineering

Guru Jambheshwar University of Science and Technology, Hisar

Signature

Supervisor

Designation

Department of Computer Science and Engineering

Guru Jambheshwar University of Science and Technology, Hisar

6.6.4 Format of Title Page

The format for the title page of the synopsis is given on next page

TITLE OF THE PROJECT SYNOPSIS

(Write in Times New Roman, 16-point size, Bold and Centred and Uppercase font)

Project synopsis submitted to
Guru Jambheshwar University of Science and Technology, Hisar
for the partial award of the degree

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 4 lines gap with 12 font size from the title of the project)

of

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 2 lines gap with 12 fontsize from the text above in three lines)

Bachelor of Technology
in Computer Science and Engineering

(Write in Times New Roman, 14-point size, Bold, Centredstyle after "*of*" after 2 lines gap with 12 font size)

by

(Write in Times New Roman 12-point size, Bold, Italics, and Centredstyle after the name of the degree with 2 lines gap with 12 font size)

Your Name
(Enrolment Number)

Supervisor Name
Designation

(Write in Times New Roman, 14-point size font, Bold, Centred style after 2 lines gap with 12 font from "*by*")

Department of Computer Science & Engineering GURU
JAMBHESHWAR UNIVERSITY OF SCIENCE AND
TECHNOLOGY, HISAR

Month, Year

(Write in Times New Roman, 14-point size font, Bold, Centredstyle, after 2 lines gap from logo)

Evaluation of Major Project-II

The major project is jointly evaluated by internal and external examiner. The proforma for evaluation of Major Project-II is given on the next page.

Department of Computer Science and Engineering
Guru Jambheshwar University of Science and Technology, Hisar-125001

Name of the Programme:_____

Semester:_____

Session:_____

Credits: 4

Total Marks: 100

Evaluation of Major Project II (PROJ-CSE403)

SR. No.	Roll. No.	Review of literature related to problem domain CO1 (15)	Application of principles of software engineering and project management CO2 (15)	Significance and originality of the solution presented CO3 (15)	Significance and Scope of the Results CO4 (20)	Organisation and presentation of major project report CO5 (20)	Level of Ethics followed and societal issues covered CO6 (15)
1							
2							
3							

Name of the external examiner:

Signature of the External Examiner:

Date:

Name of the internal examiner:

Signature of the internal Examiner:

Date:

Total Candidates:

No. of Candidates Present:

No. of Candidates Absent:

Guidelines for preparing Major Project (PROJ-CSE403) Report

All the students are required to follow these guidelines for preparing their final project report.

General Guidelines

1. The title of the project must be same as that of the title in the synopsis submitted at the end of seventh semester.
2. The report must include a declaration by the student that he/she has followed ethical practices while doing the project work. Any violation of ethical practices will lead to rejection of the report. For instance, a plagiarized report or a readymade report purchased from market will be rejected straight away.
3. Project works carried out in groups of two students must include the individual contribution of the students.
4. A CD of the project work should be included in closed pocket inside the back cover page. The CD must bear the name, registration number and title of the project.
5. The report must be submitted to the internal guide in soft binding at least 10 days before the final examination so that he/she can suggest changes before the report is presented to external examiner.

Formatting Instructions

The formatting instructions are given in Table below.

Formatting Instructions		
Sr. No.	Item	Formatting
1.	Front Cover	Dark Blue and contents in golden ink
2.	No. of pages	Minimum 40 and maximum 70 excluding front material
3.	Paper size	A4
4.	Font Type	Times New Roman
5.	Chapter Heading Font	16
6.	Font of Sections and Subsections	14 and 12 in bold style
7.	Numbering style for sections and subsections; Do not use more than three levels.	2., 2.1 and 2.1.1
8.	Normal text size	12
9.	Figures and Tables must be numbered chapter-wise. Table headings on the top of the tables and Figure heading at the bottoms of the figures.	For example for chapter 2, Figures should be numberd as Fig. 2.1, Fig. 2.2 etc. and Tables as Table 2.1 and Table 2,2 etc.
10.	Page numbering	Place: Centre Bottom Type: Front material in Roman numbers Body of the report: in Arabic numerals. Pagination must start with first page of the first chapter and continue throughout the end of the report.
11.	Margins	Left margin: 3.75 cms (1.5 inch) Right, bottom, top= 2.5 cms (1 inch)
12	References/Bibliography	IEEE format
13	Binding	Hard binding of good quality

Contents of the Project Report

The contents of the report should be organised as described below.

1. The first page in the report should be same as the cover page.
2. Declaration that the students has carried out his work on his own. It is his/her original creation, not plagiarised from any other source and due credit has been given to the source material used in the report through references and citations.
3. Acknowledgement
4. List of figures
5. List of Tables
6. List of Abbreviations
7. Contents

   Abstract (in Not more than 250 words)

   This answers the question what have you done? How have you done and brief indication about the results.
8. Body of the Report

   The report must be written in English. The ideas must be organised in a clear and concise fashion. Chapters must be tentatively organised as below.

   Chapter 1. Introduction

   This includes introduction to relevant area of project, problem formulation objectives of the project, and structure of the project report.

   Chapter 2. Background Details and Literature Review

   Chapter 3. Design or Framework of the project work

   Methodology, Data Flow Diagrams, Entity Modelling etc.

   Chapter 4. Discussion and Analysis of Results

   Discussion and comparison of results.

   Chapter 5. Conclusion and Future Scope

   This includes relevance and scope of the project work, and its extensions.

   References/Bibliography
9. Appendices

Declaration to be Submitted

The format of declaration to be included in the project report is given on next page.

Format of the Title Page

The format of the title page for the Major Project II is given on the next to next page

DECLARATION

I, *Your Name, Your Roll No* , certify that the work contained in this project report is original and has been carried by me under the guidance of my supervisor. This work has not been submitted to any other institute for the award of any degree or diploma and I have followed the ethical practices and other guidelines provided by the Department of Computer Science and Engineering in preparing the report. Whenever I have used materials (data, theoretical analysis, figures, and text) from other sources, I have given due credit to them by citing them in the text of the report and giving their details in the references. Further, I have taken permission from the copyright owners of the sources, whenever necessary.

Signature

Name of Student

Registration Number

Department of Computer Science and Engineering

Guru Jambheshwar University of Science and Technology, Hisar

Signature

Supervisor

Designation

Department of Computer Science and Engineering

Guru Jambheshwar University of Science and Technology, Hisar