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शिवाजी विद्यापीठ, कोल्हापूर ४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४, २६०९४८७
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Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SU/BOS/Sci & Tech/ 533 **Date: 04/09/2025**

To,

The Principal / Director,
All Concerned Affiliated Colleges / Institutions,
Shivaji University, Kolhapur.

Subject: Regarding revised syllabus of **B. Tech. Part - IV (Sem– VII - VIII)** degree **Programme (CBCS)** under the Faculty of Science and Technology.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, (Nature of Question paper and equivalence) of B. Tech. Part - IV (Sem - VII & VIII) degree **Programme (CBCS)** under the Faculty of Science & Technology.

No.	Course Syllabus
1	Electronics & Computer Science
2	Artificial Intelligence & Data Science

This Syllabus, shall be implemented from the academic year **2025-26** onwards. A soft copy containing the syllabus is attached herewith and it is available on university website **www.unishivaji.ac.in NEP-2020@suk (Online Syllabus)**

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October/ November 2025 & March / April 2026. These chances are available for repeater students, if any

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dr. S. M. Kubal
Dy. Registrar

Encl. : As above.

Copy to: For Information and necessary action.

1	The I/c Dean, Faculty of Science & Technology	7	Appointment Section A & B
2	Director, Board of Examinations & Evaluation	8	Affiliation Section (T.1) (T.2)
3	The Chairpersan, Respective Board of Studies	9	P.G.Admission Section,
4	OE 4 Exam Section,	10	Computer Centre,/IT Cell
5	Eligibility Section,	11	Internal Quality Assorance Cell (IQAC)
6	P.G Seminar Section		

FINAL YEAR CSE (ARTIFICIAL INTELLIGENCE & DATA SCIENCE)
CBCS PATTERN

Semester VII

Sr No	Course/Subject /Title	TEACHING SCHEME									EXAMINATION SCHEME										
		Theory			Tutorial			Practical			Theory				Practical			Term Work			
		Credits	No of Lecture	Hours	credits	No of Hours	Hours	credits	No of Hours	Hours	mode	Marks	Total Marks	min	Hours	MAX	MIN	Hours	MAX	MIN	
1	PCC-AIDS-701 Deep Learning	4	4	4				1	2	2	CIE	30	100	12	AS PER BOS GUIDELINES	50	20	AS PER BOS GUIDELINES	25	10	
											ESE	70		28							
2	PCC-AIDS-702 Natural Language Processing	3	3	3				1	2	2	CIE	30	100	12					25	10	
											ESE	70		28							
3	PCC-AIDS-703 Business Analytics	3	3	3	1	1	1				CIE	30	100	12					25	10	
											ESE	70		28							
4	PCC-AIDS-704 Mobile App Development	3	3	3				2	4	4						50	20		50	20	
5	Professional Core Elective I	3	3	3	1	1	1				CIE	30	100	12					25	10	
											ESE	70		28							
6	PW-AIDS-708 Project Phase I							2	4	4						100	40		50	20	
	Total	**16**	**16**	**16**	**2**	**2**	**2**	**6**	**12**	**12**			**400**			**200**	**80**		**200**	**80**	

CIE: Continuous Internal Evaluation ESE: End Semester Examination	**Professional Core Elective I:** PCE-AIDS-705: Mobile Ad-hoc Network PCE-AIDS-706: Cyber Security PCE-AIDS-707: Robotics System	PCC: Professional Core Course PCE: Professional Core Elective OCE: Open Elective Course HM: Humanities and Management PW: Domain Specific Mini Project

FINAL YEAR CSE (ARTIFICIAL INTELLIGENCE & DATA SCIENCE)
CBCS PATTERN

Semester VIII

		TEACHING SCHEME								EXAMINATION SCHEME									
Sr No	**Course/Subject /Title**	Theory			Tutorial			Practical			Theory				Practical			Term Work	
		Credits	No of Lecture	Hours	credits	No of Hours	Hours	credits	No of Hours	Hours	mode	Marks	Total Marks	min	Hours	MAX	MIN	Hours	MAX	MIN
1	PCC-AIDS-801 Computer Vision	3	3	3				1	2	2	CIE	30	100	12	AS PER BOS GUIDELINES	50	20	AS PER BOS GUIDELINES	25	10
											ESE	70		28						
2	PCC-AIDS-802 Cloud Computing	4	4	4							CIE	30	100	12					25	10
											ESE	70		28						
3	Professional Core Elective II	3	3	3	1	1	1				CIE	30	100	12					25	10
											ESE	70		28						
4	Professional Core Elective III	3	3	3	1	1	1				CIE	30	100	12					25	10
											ESE	70		28						
5	PCC-AIDS-809 UI/UX Design	3	3	3				2	4	4						50	20		50	20
6	PW-AIDS-810 Project Phase II							2	4	4						100	40		50	20
	Total	**16**	**16**	**16**	**2**	**2**	**2**	**5**	**10**	**10**			**400**			**200**	**80**		**200**	**80**

Professional Core Elective II: PCE-AIDS-803: Project Management PCE-AIDS-804: Software Testing PCE-AIDS-805: Data Warehousing and Data Mining	**Professional Core Elective III:** PCE-AIDS-806: AI in Healthcare PCE-AIDS-807: Generative AI PCE-AIDS-808: Industry 4.0	PCC: Professional Core Course PCE: Professional Core Elective OCE: Open Elective Course HM: Humanities and Management PW: Domain Specific Mini Project CIE: Continuous Internal Evaluation ESE: End Semester Examination

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VII
DEEP LEARNING

TEACHINGSCHEME	EXAMINATION SCHEME
Theory:4Hrs./Week	**ESE:**70 **CIE:** 30
Tutorial:--	**Termwork:**25Marks
Practical:2 Hr. / Week	**Practical :**50 Marks
Course Code: PCC-AIDS-701	**Credits:** 5

Course Outcomes:

Upon successful completion of this course, the student will be able to –

CO1. **Describe** basic concepts of artificial intelligence and deep learning.

CO2. **Apply** different hyper parameter tuning techniques.

CO3. **Design** and train CNN model for image classification.

CO4. **Analyze** sequence modeling techniques used in deep learning.

CO5. **Build** and monitor advanced deep learning models using the Keras Functional API, callbacks, and Tensor Board.

CO6. **Implement** generative deep learning techniques such as text generation with LSTM.

Unit No	Content	No. of lectures
01	**Introduction to Deep Learning** Overview of deep learning and its applications: Introduction to Deep Learning, A brief history, Need of Deep Learning, Applications of Deep Learning, Neural networks and their Architecture: ANN Intuition, Components of NN Architecture, Types of NN-Supervised - ANN, CNN, RNN, Unsupervised - SOM, AE, BM, Activation functions and their properties: Sigmoid, Hyperbolic Tangent (tanh) Function, Rectified Linear Unit (ReLU), Leaky ReLU, Softmax Practice exercises and discussions: Building ANN for Business Problem.	**08**
02	**Feed forward Neural Networks and Optimization** Multilayer perceptron (MLP):Architecture of MLP with Feedforward, Error Functions-Mean Squared Error (MSE), Binary Cross-Entropy, Categorical Cross-Entropy (CCE), Backpropagation algorithm: Difficulty of Training Deep Neural Networks Regularization techniques: Early Stopping, Drop Out,Optimization algorithms: Adagrad, Adam, Practice exercises and discussions:: Greedy layer wise training. **Hyperparameters:** Learning rate, No of iterations, hidden layers, hidden units, choice of activation function, momentum, mini batch size, Overfitting and underfitting, regularization	**08**
03	**Convolution Neural Networks (CNN)** Introduction to CNN, CNN Architecture basic, The convolutional operation, The max pooling operation, Training a convnet from scratch on a small dataset, Using pre-trained convnet, Visualizing what convnet learn, Convolution operation, pooling, flattening, ReLU Layer, Pooling, Flattening, Softmax and Cross Entropy, Transfer learning with CNNs, Practice exercises and discussions: image classification using CNNs	**08**

04	**Recurrent Neural Networks (RNNs) and NLP**	**06**
	Basics of sequence modeling, RNN architectures (LSTM, GRU), Applications of RNNs in NLP, Word embeddings and attention mechanisms, Practice exercises and discussions: sentiment analysis using RNNs	
05	**Advanced Deep Learning Best Practices**	**06**
	Going beyond the sequential model: The Keras functional API, Inspecting and monitoring deep learning models using Keras callbacks and Tensor Board, Getting the most out of your models	
06	**Generative Deep Learning**	**06**
	Text generation with LSTM, Deep Dream, Neural Style Transfer, Generating images with variational auto encoders, Introduction to generative adversarial network.	

TEXT BOOKS:

1. Deep Learning (Adaptive Computation and Machine Learning series) by Ian Goodfellow (Author),Yoshua Bengio (Author), Aaron Courville (Author)

REFERENCEBOOKS:

1. Deep Learning by Ian Good fellow, Yoshua Bengio, Aaron Courville MIT Press Book publication.

SUPPLEMENTARY READING:

1. https://www.coursera.org/specializations/deep-learning
2. http://alvarestech.com/temp/deep/Deep%20Learning%20by%20Ian%20Goodfellow,%20Yoshua%20Bengio,%20Aaron%20Courville%20(z-lib.org).pdf
3. https://www.udemy.com/course/tensorflow-developer

TERM WORK:

1. 25 marks for performance in practical and experiments as part of continuous evaluation.
2. It should consist of minimum 10 experiments based on following topics. The Continuous Internal Evaluation (CIE) is based on regular practical performance and final internal practical oral examination.

LIST OF EXPERIMENTS:

1. Installing of Anaconda or Miniconda and working with Tensorflow and Keras
2. Introduction and working with Google Colab for using GPUs and TPUs for large projects
3. Developing simple perceptron (single layer neural network)
4. Developing simple multilayer neural network for different tasks
5. Designing and developing basic CNN for given task
6. Using transfer learning in CNN
7. Designing and developing simple RNN for given task
8. Designing and developing RNN with LSTM for given task
9. Designing and developing RNN with GRU for given task
10. Designing and developing model for Text generation using LSTM
11. Designing and developing model for Neural style transfer
12. Designing and developing model for generating images.

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VII
NATURAL LANGUAGE PROCESSING

TEACHING SCHEME	EXAMINATION SCHEME
Theory: 3 Hrs. / Week	**ESE:** 70 **CIE:** 30
Tutorial: --	**Term work:** 25 Marks
Practical: 2 Hr. / Week	**Practical :** --
Course Code: PCC-AIDS-702	**Credits:** 4

Course Outcomes:

Upon successful completion of this course, the student will be able to –

CO1. Apply foundational NLP techniques to process and analyze textual data.

CO2. Understand the principles of N-gram language models.

CO3. Describe key concepts in lexical and vector semantics for evaluating semantic similarity.

CO4. Evaluate the accuracy and performance of part-of-speech and named entity recognition systems.

CO5. Describe the principles of machine translation.

CO6. Analyze the architecture and effectiveness of attention-based models and pretrained transformers.

Unit No	Content	No. of lectures
01	**Introduction to NLP** What is Natural Language Processing? Origins of NLP, Language and Knowledge, The Challenges of NLP, Regular Expressions, Words, Corpora, Text Normalization, Minimum Edit Distance.	**06**
02	**N-Gram Language Models** N-Grams, Evaluating Language Models, Generalization and Zeros, Smoothing, Kneser-Ney Smoothing, Huge Language Models and Stupid Backoff, Advanced: Perplexity's Relation to Entropy.	**06**
03	**Vector Semantics and Embeddings** Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Pointwise Mutual Information (PMI) Applications of the TF-IDF or PPMI vector models, Word2vec, Visualizing Embeddings, Semantic properties of embeddings, Bias and Embeddings, Evaluating Vector Models.	**06**
04	**Sequential labeling and language modeling** English Word Classes, Part-of-Speech Tagging, Named Entities and Named Entity Tagging, HMM Part-of-Speech Tagging, Conditional Random Fields (CRFs), Evaluation of Named Entity Recognition.	**06**

05	**Machine Translation**	**06**

Machine Translation: Language Divergences and Typology, Machine Translation using Encoder Decoder, Details of the Encoder-Decoder Model, Translating in Low-Resource Situations, MT Evaluation, Bias and Ethical Issues.

06	**Attention and Transformer**	**06**

What is attention? Sequence-to-sequence with attention, Transformer and self-attention, Transformer-based language models, Transfer learning with pretrained language models, BERT, Other pretrained language models, Case study, Sentiment analysis with BERT

TEXT BOOKS:

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing an Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition

REFERENCE BOOKS:

1. Steven Bird, Ewan Klein, and Edward Loper, "Natural Language Processing with Python–Analyzing Text with the Natural Language Toolkit", O'Reilly.
2. Masato Hagiwara, “Real-World Natural Language Processing”, Manning Publications, 2021

SUPPLEMENTARY READING:

1. https://www.nltk.org/book/
2. https://web.stanford.edu/~jurafsky/slp3/

TERM WORK:

1. 25 marks for performance in practical and experiments as part of continuous evaluation.
2. It should consist of minimum 10 experiments based on following topics. The Continuous Internal Evaluation (CIE) is based on regular practical performance and final internal practical oral examination.

LIST OF EXPERIMENTS:

1. Demonstration of stemming and lemmatization
2. Demonstrate the tokenization and stop words removal.
3. Write a python program to build N-grams from the text.
4. Implement N-gram model to predict the next word in the sentence.
5. Demonstration of stemming and lemmatization
6. Demonstration of parts-of-speech tagging
7. Demonstration of document classification using TF-IDF
8. Demonstration of named entity recognition
9. Demonstration of sentiment analysis
10. Implement Naïve Bays classifier for text classification
11. Implement Word Sense Disambiguation algorithm
12. Learn Word2Vec word embedding from the given corpus and perform various operations.
13. Implement the machine translation application of NLP where it needs to train a machine translation model for a language with limited parallel corpora. Investigate and incorporate techniques to improve performance in low-resource scenarios.
14. Demonstrate Sentiment Analysis using BERT.

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VII
BUSINESS ANALYTICS

TEACHINGSCHEME	EXAMINATION SCHEME
Theory:3Hrs./Week	**ESE:**70 **CIE:** 30
Tutorial:-- 1Hrs./Week	**Termwork:**25Marks
Practical:	**Practical :--**
Course Code: PCC-AIDS-703	**Credits:** 4

Course Outcomes:

Upon successful completion of this course, the student will be able to –

CO1. **Explain** the foundations and scope of business analytics and its role in data-driven decision-making.

CO2. **Explain** key descriptive statistical measures including measures of location, dispersion, shape, and association.

CO3. **Apply** trendlines and regression analysis to model relationships between variables and predict future outcomes.

CO4. **Perform** text categorization and sentiment analysis using standard tools and methods.

CO5. **Explain** the principles and components of linear and integer optimization models used in decision-making.

CO6. **Describe** how analytics can be applied across various business domains such as finance, marketing, HR, supply chain, healthcare, and cyber security.

Unit No	Content	No. of lectures
01	**Introduction to Business Analytics** Foundations of Business Analytics, Decision making, Introduction to Business Analytics, Models in Business Analytics, Problem solving with analytics, Big data, Stages of analytics (descriptive, predictive, prescriptive).	**06**
02	**Predictive Analytics** Trendlines and Regression Analysis, Forecasting Techniques, Introduction to Data Mining, Spreadsheet Modeling and Analysis, Monte Carlo Simulation and Risk Analysis.	**06**
03	**Descriptive Analytics** Descriptive Statistical Measures: measures of location, dispersion, shape and association. Visualizing and Exploring Data: Overview, Tables, Charts, Advanced data visualization, data dashboards	**06**
04	**Textual Analytics** Simple Linear Regression models; Confidence & Prediction intervals; Multiple Linear Regression; Interpretation of Regression Coefficients; heteroscedasticity; multi-collinearity. Basics of textual data analysis, significance, application, and challenges. Introduction to Textual Analysis using R. Methods and Techniques of textual analysis: Text Mining, Categorization and Sentiment Analysis	**06**

05	**Optimizations**	**06**

Going beyond the sequential model: The Keras functional API, Inspecting and monitoring deep learning models using Keras callbacks and Tensor Board, Getting the most out of your models

06	**Business Analytics Applications**	**06**

Application of Analytics in Finance, Marketing, Human Resource Management, Supply Chain, Healthcare, social media and Cyber Space.

TEXT BOOKS:

1. James, E.R. (2017). Business Analytics. UK: Pearson Education Limited.
2. Camm, J.D., Cochran, J.J., Fry, M.J., Ohlmann, J.W., Anderson, D.R. (2015),
3. Essentials of Business Analytics, Cengage Learning, Second Edition. Prasad, R. N., Acharya, S. (2011), Fundamentals of Business Analytics, Wiley.
4. Schniederjans, M.J., Schniederjans, D.G., Starkey, C.M. (2014), Business Analytics Principles, Concepts and Applications, Pearson.

REFERENCEBOOKS:

1. Liebowitz, J. (2013), Business Analytics: An Introduction, Auerbach Publications.
2. Hardoon, D.R., and Shmueli, G. (2016), Getting Started with Business Analytics, CRC Press, Taylor & Francis.
3. Rao, P.H. (2014), Business Analytics: An Application Focus, Prentice Hall India.
4. Sharma, J.K., Khatua, P.K. (2012), Business Statistics, Pearson.

SUPPLEMENTARY READING:

1. https://www.lpude.in/SLMs/Master%20of%20Computer%20Applications/Sem_4/DEMGN801_BUSINESS_ANALYTICS.pdf
2. https://www.coursera.org/learn/business-analysis-fundamentals
3. https://online.hbs.edu/courses/business-analytics

TERM WORK:

3. Minimum 8 tutorials to be performed on 6 topics.

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VII
MOBILE APP DEVELOPMENT

TEACHING SCHEME	EXAMINATION SCHEME
Theory: 3 Hrs. / Week	**ESE:** -- **CIE:** --
Tutorial: --	**Term work:** 50 Marks
Practical: 4 Hr. / Week	**Practical :** 50 Marks
Course Code: PCC-AIDS-704	**Credits:** 3

Course Outcomes:
Upon successful completion of this course, the student will be able to –

CO1. Understand Android architecture, versions, and development environment for app creation.
CO2. Design UI with layouts and use intents for communication in Android apps.
CO3. Use input controls, handle events, and manage dialogs in Android apps.
CO4. Explain fundamental concepts of Mobile application Development.
CO5. Design user interface for Mobile application.
CO6. Develop Mobile application using appropriate platform.

Unit No	Content	No. of lectures
01	**Android Overview**	**07**
	Overview of Android, History, Android Versions, Android OS stack: Linux kernel, Native Libraries/DVM, Application Framework, Applications, Fragments, Process and Threads**.** Android Development Environment: Introduction to Android SDK, Android Emulator, Creating a Project, Project Directory Structure, DDMS, Logging in Android (Logcat),Android Manifest File, Permissions.	
02	**Intents and Layouts**	**05**
	XML, Android View Hierarchies, Linear Layouts, Relative Layout, Table Layout, Frame Layout Sliding, Using Padding and Margins with Layouts. What Is Intent? Android Intent Messaging via Intent Objects, Types of Intents, Sending Intents (Telephony, SMS).	
03	**Input Controls, Input Events, Dialogs**	**05**
	Buttons, Text Fields, Checkboxes, Radio Buttons, Toggle Buttons, Spinners, Event Listeners, Event Handlers, Touch Mode, Handling Focus, Dialogs: Alerts, Popups, Toasts	
04	**iOS Basics**	**05**
	Introduction, XCode, iOS Simulator, Interface Builder, Understanding XCode, Accessing UI, Buttons,Views, Image Views, Switch and Text Field, Introduction, Print and comments, Variables and Primitives, Operators, Break, Control Flow, Collections, Dice Generator	

05 Intermediate UI **04**

Introduction, Outlets and Constraints, Stack Views, Hard Coding Outlets, Segmented Controls, Break, View controller, Date Picker View, Picker View, Slides.

06 Login UI **06**

Introduction, starting New App, Three Main components, Segmented Control, Text fields, Outlets in Code, Break, Login or Register Function, Revealing the Password, Constraints, User Notification

TEXT BOOKS:

1. Beginning Android application development by - Wei-Mag Lee
2. Learning Android by Marko Gargenta Publisher - W. Jason Gilmore,O'Reilly Media
3. Android Apps for Absolute Beginners - Wallace Jackson,SECOND EDITION
4. Swift: A Step-by-Step Guide for Absolute Beginners by Daniel Bell
5. 5. T1, “Android Wireless Application Development” - Lauren Darcey and Shane Conder,Pearson Education,2nd ed.

REFERENCE BOOKS:

1. Application Development by Reto Meier Publisher: Wiley India
2. Android in Action Third Edition by W.Frank Ableson, Robi Sen, Chris King, C. Enrique Ortiz
3. Swift for Beginners (Develop and Design) by Boisy G. Pitre

TERM WORK:

1. Minimum of 12 Experiments to be performed from the list given below.
2. 25 marks for performance in practical and experiments as part of continuous evaluation
3. 25 marks for Practical Test and oral to be conducted.

LIST OF EXPERIMENTS:

01. Installation of Android SDK, emulator.
02. Creating simple project and study of android project structure and installing apk on mobile device/tablet, configuring mobile device/tablet in Android Studio with developer options and running app directly on mobile device/tablet.
03. Write a program to use of different layouts.
04. Write a program to study Intents for switching between activities.
05. Write a program to use of Intents for SMS and Telephony.
06. Write a program to study and demonstrate Broadcast Receiver.
07. Program to demonstrate Buttons, Text Fields, Checkboxes, Radio Buttons, and Toggle Buttons with their events handler.
08. Program to demonstrate Spinners, Touch Mode, Alerts, Popups, and Toasts with their events handler.
09. Introduction to XCode, iOS Simulator and Interface Builder
10. Program for Accessing UI Outlets, Buttons, Views and Image Views
11. Write a Program Intermediate UI using Swift-Outlets, Constraints, View controller and Data
12. Program to demonstrate Date Picker View, Picker View and Sliders
13. Create an iOS Application using Login Function, Register Function, Revealing password and User Notifications
14. Create an iOS Application using Scroll Views, Table views and Reusable Views

B. Tech CSE (Artificial Intelligence & Data Science) SEM – VII

MOBILE AD-HOC NETWORK

(Professional Core Elective I)

TEACHING SCHEME	EXAMINATION SCHEME
Theory: 3 Hrs. / Week	**ESE:** 70 **CIE:** 30
Tutorial: --	**Term work:** 25 Marks
Practical:	**Practical :** --
Course Code: PCC-AIDS-705	**Credits:** 3

Course Outcomes:

Upon successful completion of this course, the student will be able to –

CO1: Explain issues and design goals in Ad Hoc wireless networks.

CO2: Explain and classify various routing protocols in Ad Hoc wireless networks.

CO3: Describe design issues and classify transport layer protocols and security protocols in Ad Hoc wireless Networks.

CO4: Explain the fundamental concepts, unique constraints, and design challenges Associated with wireless sensor networks.

CO5: Describe challenges and routing protocols in sensor networks.

CO6: Explain sensor networks infrastructure management and sensor tasking and control Techniques

Unit No	Content	No. of lectures
01	**Introduction**	06
	Cellular and Ad Hoc wireless networks, Applications, Issues in Ad-Hoc wireless networks, MAC Protocols for ad hoc wireless networks – Introduction, Issues in designing MAC protocol, Design goals of MAC protocol, Classification of MAC Protocols, Contention based protocols.	
02	**Routing protocols for ad hoc wireless networks**	06
	Introduction, Issues in designing a routing protocol for ad hoc wireless networks, Classification of routing protocols, Table driven, on-demand Hybrid routing protocols, Issues in designing a multicast routing protocol, Operation of multicast routing/ protocols, An architecture reference model for multicast routing protocols, Classification of multicast routing protocols.	
03	**Transport layer and security protocols for ad hoc wireless networks**	06
	Introduction, Design issues and goals, Classification of transport layer solutions, TCP over ad hoc wireless Networks, Security in ad hoc wireless networks, Network security Requirements, Issues and challenges in security provisioning, Network security attacks, Key management, Secure routing.	
04	**Introduction to Sensor Networks**	06
	Unique Constraints and Challenges, Advantages of Sensor Networks, Sensor Network Applications, Medium Access Control, The S-MAC Protocol, IEEE 802.15.Standard and ZigBee: General Issues	

05 Routing Protocol for Sensor Network **07**

Geographic, Energy-Aware Routing , Unicast Geographic Routing, Routing on a Curve , Energy-Minimizing Broadcast , Energy-Aware Routing to a Region , Attribute-Based Routing , Directed Diffusion , Rumor Routing , Geographic Hash Tables

06 Sensor Network Infrastructure Establishment **05**

Topology Control, Clustering , Time Synchronization , Clocks and Communication Delays, Interval Methods, Reference Broadcasts, Localization and Localization Services, Ranging Techniques, Range-Based Localization Algorithms

TEXT BOOKS:

1. C. Siva Ram Murthy and B. S. Manoj – "Ad Hoc Wireless Networks: Architectures and Protocols"
2. Charles E. Perkins – "Ad Hoc Networking"
3. Stefano Basagni, Marco Conti, Silvia Giordano, Ivan Stojmenovic – "Mobile Ad Hoc Networking: The Cutting Edge Directions"

REFERENCE BOOKS:

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad-hoc networking, Wiley-IEEE press, 2004.
2. Mohammad Ilyas, The handbook of ad-hoc wireless networks, CRC press, 2002.
3. T. Camp, J. Boleng, and V. Davies " A Survey of Mobility Models for Ad-hoc Network"
4. Research, "Wireless Commun, and Mobile Comp.. Special Issue on Mobile Ad-hoc Networking Research, Trends and Applications, Vol. 2, no. 5, 2002, pp. 483 – 502.
5. A survey of integrating IP mobility protocols and Mobile Ad-hoc networks, Fekri M. bduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, no: 12007.

TERM WORK:

25 marks for Assignments based on each unit as part of continuous evaluation.

B. Tech CSE (Artificial Intelligence & Data Science) SEM – VII

CYBER SECURITY

(Professional Core Elective I)

TEACHING SCHEME	EXAMINATION SCHEME
Theory: 3 Hrs. / Week	**ESE:** 70 **CIE:** 30
Tutorial: --	**Term work:** 25 Marks
Practical:	**Practical : --**
Course Code: PCC-AIDS-706	**Credits:** 3

Course Outcomes:

Upon successful completion of this course, the student will be able to –

CO1: Understand Cyber Security Concept.

CO2: Explain core security principles, including confidentiality, integrity, and defense-in-depth strategies.

CO3: Identify different types of cyber frauds, including identity theft, online scams, phishing and financial Fraud.

CO4: Analyze methods such as phishing, social engineering, password cracking, and Privilege escalation.

CO5: Implement firewalls, intrusion detection/prevention systems (IDS/IPS), VPNs, and secure network protocols.

CO6: Examine global cyber security regulations and their role in securing digital Infrastructure.

Unit No	Content	No. of lectures
01	**Cyber Security Fundamentals**	**06**
	Array: Representation of arrays, Applications of arrays, sparse matrix and its representation Stack: Stack-Definitions & Concepts, Operations On Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression And Their Compilation, Recursion, and Tower of Hanoi Queue: Representation Of Queue, Operations On Queue, Circular Queue, Priority Queue, and Array representation of Priority Queue, Double Ended Queue, and Applications of Queue.	
02	**Computer and Network Security**	**06**
	Introduction to Computer Security - Introduction, How Seriously Should You Take Threats to Network Security?, Identifying Types of Threats, Basic Security Terminology, Concepts and Approaches, Online Security Resources Networks and the Internet : Introduction, Network Basics, How the Internet Works, Basic Network Utilities , Advanced Network Communications Topics	
03	**Cyber Frauds, DoS, Viruses**	**06**

Cyber Stalking, Fraud, and Abuse: Introduction, How Internet Fraud Works, Identity Theft, Cyber Stalking, Protecting Yourself Against Cyber Crime. Denial of Service Attacks: Introduction, DoS, Illustrating an Attack, Malware: Introduction, Viruses, Trojan Horses, and The Buffer-Overflow Attack. The Sasses Virus/Buffer Overflow, Spyware, Other Forms of Malware, Detecting and Eliminating Viruses and Spyware, Unit

04 Techniques Used by Hackers **06**

Introduction, Basic Terminology, The Reconnaissance Phase, Actual Attacks, Malware Creation, Penetration Testing

05 Computer Security Technology **06**

Introduction, Virus Scanners, Firewalls, Antispyware, IDS, Digital Certificates, SSL/TLS, Virtual Private Networks, Wi-Fi Security

06 I.T. ACT **06**

Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, I.T. Act

TEXT BOOKS:

1. Computer Security Fundamentals - Chuck Easttom , Pearson ,third edition.

REFERENCE BOOKS:

1. Jason Luttgens, Matthew Pepe, Kevin Mandia, Incident Response & Computer Forensics, McGrawHill Osborne Media, 3 rd edition , 2014.
2. Keith J. Jones, Richard Bejtlich, Curtis W. Rose, Real Digital Forensics: Computer Security and Incident Response, Paperback – Import, 2005.
3. John Sammons, The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics Paperback, February 24, 2012.
4. Hacking Exposed: Network Security Secrets & Solutions, Stuart McClure, Joel Scambray and George Kurtz, McGraw-Hill, 2005.
5. Network intrusion alert: an ethical hacking guide to intrusion detection, Ankit Fadia, Manu Zacharia, Thomson Course Technology PTR, 2007.
6. Ethical Hacking, Thomas Mathew, OSB Publisher, 2003.
7. Hacking Exposed: Network Security Secrets & Solutions, Stuart McClure, Joel

TERM WORK:

25 marks for Assignments based on each unit as part of continuous evaluation.

B. Tech CSE (Artificial Intelligence & Data Science) SEM – VII
ROBOTICS SYSTEM

(Professional Core Elective I)

TEACHING SCHEME	EXAMINATION SCHEME
Theory: 3 Hrs. / Week	**ESE:** 70 **CIE:** 30
Tutorial: --	**Term work:** 25 Marks
Practical:	**Practical :** --
Course Code: PCC-AIDS-707	**Credits:** 3

Course Outcomes:

Upon successful completion of this course, the student will be able to –

CO1: Define the structure and components of robotic systems, including sensors, actuators, and Controllers.

CO2: Apply forward and inverse kinematics for robotic arms.

CO3: Analyze trajectory generation and motion planning techniques.

CO4: Explain various path planning techniques.

CO5: Explain dynamics and control in robotics industries.

CO6: Understand the role of actuators in robotic systems, classify various types of Actuators.

Unit No	Content	No. of lectures
01	**INTRODUCTION TO ROBOTICS**	06
	Definition and history of robotics, Applications of robots: industrial, medical, service, military, Classification and types of robots (based on geometry, function, and intelligence), Components of a Robotic System- Actuators: electric motors (servo, stepper, DC), pneumatics, hydraulics, Sensors: proximity, ultrasonic, IR, vision, tactileQueue.	
02	**DIRECT AND INVERSE KINEMATICS**	07
	Mathematical representation of Robots - Position and orientation – Homogeneous transformation-Various joints- Representation using the Denavit Hattenberg parameters -Degrees of freedom-Direct kinematics Inverse kinematics- SCARA robots- Solvability – Solution methods-Closed form solution.	
03	**MANIPULATOR DIFFERENTIAL MOTION AND STATICS**	06
	Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance.	
04	**PATH PLANNING**	06
	Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning	

05 DYNAMICS AND CONTROL **06**

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler Formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.

06 ROBOTIC ACTUATION AND DRIVE SYSTEMS **06**

Role of actuators in robotic systems, Classification of actuators: electric, hydraulic, pneumatic, smart materials, Selection criteria: torque, speed, weight, efficiency, cost, control complexity, Electric Actuators- DC motors (brushed and brushless), Stepper motors, Servo motors.

TEXT BOOKS:

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2017.
2. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. Mikell P Groover, Mitchell Weiss, Roger N Nagel, Nicholas Odrey, Ashish Dutta "Industrial Robotics (SIE): Technology, Programming and Applications, McGraw Hill Education India, 2012

REFERENCE BOOKS:

8. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
9. K. K.Appu Kuttan, Robotics, I K International, 2007.
10. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
11. R.D.Klafter, T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.
12. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers,Chennai, 1998.
1. S.Ghoshal, " Embedded Systems & Robotics" – Projects using the 8051 Microcontroller", Cengage Learning, 2009.

TERM WORK:

25 marks for Assignments based on each unit as part of continuous evaluation.

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VII
PROJECT PHASE I

TEACHING SCHEME	EXAMINATION SCHEME
Theory: --	**ESE:** -- **CIE**: --
Tutorial: --	**Term work:** 50 Marks
Practical: 4 Hrs. /Week	**Practical :** 100 Mark
Course Code: PW-AIDS-708	**Credits:** 2

Pre-requisites: Software Engineering, Mini Project.

Course Objectives

1. Identify the area of project work
2. Recognize the need and ability to engage in lifelong learning
3. Function effectively on teams and to communicate effectively
4. Able to prepare the technical report

Course Outcomes:

Upon successful completion of this course, the students will be able to:

CO1. Identify the problem statement through literature survey for project work.
CO2. Identify requirement analysis like functional and technical requirements for the project
CO3. Develop design strategy for the project work.
CO4. Develop presentation and interpersonal communication skills through project work
CO5. Prepare the technical report consisting of Requirement specification, Analysis and Design of Project

Content:

1. The project work is to be carried out in two semesters of Final Year CSE (Artificial Intelligence & Data Science).
2. The project should be undertaken preferably by group of 4-5 students who will jointly work and implement the project in the two semesters.
3. In Semester VII, the group will select a project with the approval of the Guide (staff member) and submit the Name of the project with a synopsis of the proposed work of not more than 02 to 08 pages before second week of August in the academic year.
4. The group is expected to complete detailed system design, analysis, data flow design, procurement of hardware and/or software, implementation of a few modules of the proposed work at the end of semester –VIII as a part of the term work submission in the form of a joint report.
5. The term work assessment will be done jointly by teachers appointed by Head of the Department.
6. The oral examination will be conducted by an internal and external examiner
7. Project work should be continually evaluated based on the contributions of the group members, originality of the work, innovations brought in, research and developmental efforts, depth and applicability, etc.
8. Two mid-term evaluations should be done, which includes presentations and demos of the work done

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VIII
COMPUTER VISION

TEACHING SCHEME	EXAMINATION SCHEME
Theory: 3 Hrs. / Week	**ESE:** 70 **CIE:** 30
Tutorial: --	**Term work:** 25 marks
Practical: 2 Hr. / Week	**Practical :** 50 Marks
Course Code: PCC-AIDS-801	**Credits:** 4

Course Outcomes:

Upon successful completion of this course, the student will be able to –

CO1. Understand basic knowledge, theories and methods in image processing and computer vision.
CO2. Implement basic and some advanced image processing techniques in OpenCV.
CO3. Apply 2D a feature-based based image alignment, segmentation and motion estimations
CO4. Apply 3D image reconstruction techniques.
CO5. Design and **Develop** innovative image processing and computer vision applications.
CO6. Apply Transfer Learning architectures to real-world video processing tasks.

Unit No	Content	No. of lectures
01	**Introduction To Image Formation and Processing** Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighbourhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.	**06**
02	**Feature Detection, Matching and Segmentation** Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods	**06**
03	**Feature-Based Alignment & Motion Estimation** 2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.	**06**
04	**3D Reconstruction** Shape from X - Active range finding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedos.	**06**

05 Image-Based Rendering and Recognition **06**

View interpolation Layered depth images - Light fields and Lumi graphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

06 Video Analytics **06**

Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem- RestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architecture- Improvement in Inception v2-Video analytics-RestNet and Inception v3.

TEXT BOOKS:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCE BOOKS:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

TERM WORK:

1. 25 marks for performance in practical and experiments as part of continuous evaluation.
2. 25 marks for Practical Test and oral / Project to be conducted at the end of semester before POE.
3. It should consist of minimum 15 experiments based on following topics. The Continuous Internal Evaluation (CIE) is based on regular practical performance and final internal practical oral examination.

LIST OF EXPERIMENTS:

1. OpenCV Installation and working with Python
2. Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour
3. analysis, Bolb detection
4. Image Annotation – Drawing lines, text circle, rectangle, ellipse on images
5. Image Enhancement - Understanding Color spaces, color space conversion, Histogram equalization, Convolution, Image smoothing, Gradients, Edge Detection
6. Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching, cloning, Feature matching-based image alignment
7. Image segmentation using Graphcut / Grabcut
8. Camera Calibration with circular grid
9. Pose Estimation
10. 3D Reconstruction – Creating Depth map from stereo images
11. Object Detection and Tracking using Kalman Filter, Camshift
12. Develop a program to implement Object Detection and Recognition
13. Develop a program for motion analysis using moving edges, and apply it to your image sequences.
14. Develop a program for Facial Detection and Recognition
15. Write a program for event detection in video surveillance system

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VII
CLOUD COMPUTING

TEACHING SCHEME	EXAMINATION SCHEME
Theory: 4 Hrs. / Week	**ESE:** --70 **CIE:** --30
Tutorial: --	**Term work:** 25 Marks
Practical: --	**Practical : --**
Course Code: PCC-AIDS-802	**Credits:** 4

Course Outcomes:
Upon successful completion of this course, the student will be able to –

CO1. Understand the benefits and challenges of cloud computing, including scalability, security, and latency issues.

CO2. Describe cloud computing models (SaaS, PaaS, IaaS) and deployment types (public, private, hybrid).

CO3. Collaboratively research on the state of the art (and open problems)in cloud computing.

CO4. Identify problems, and explain, analyze, and evaluate various cloud computing solutions.

CO5. Choose the appropriate technologies, algorithms, and approaches for the related issues.

CO6. Display new ideas and innovations in cloud computing.

Unit No	Content	No. of lectures
01	**Introduction to Cloud Computing**	**07**
	Introduction to Cloud Computing, Cloud service providers. Properties, Characteristics& Disadvantages of Cloud Computing, Benefits of Cloud Computing. Overview of computing paradigm: Recent trends in Computing - Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing.	
02	**Cloud Computing Architecture**	**07**
	Cloud computing stack - Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used. Service Models (XaaS) - Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS). Deployment Models, Public cloud, Privatecloud, Hybrid cloud, Community cloud	
03	**Virtualization**	**07**
	Introduction and benefits, Implementation Levels of Virtualization, Virtualization at the OS Level, Virtualization Structure, Virtualization Mechanism, XenVirtualization Architecture, Binary Translation with Full Virtualization, Paravirtualization, Open-Source Virtualization Technology, Virtualization of CPU, Memory and I/O Devices	

04 Types of Services **07**

Infrastructure as a Service (IaaS): Introduction to IaaS – IaaS definition, Introduction to virtualization, Hypervisors. storage as a service, Data storage incloud computing (storage as a service).

Platform as a Service (PaaS): Introduction to PaaS - What is PaaS, Service Oriented Architecture (SOA). Cloud Platform and Management - computation, storage

Software as a Service (SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS, Case Study on SaaS

05 Service Management in Cloud Computing **07**

Service Level Agreements (SLAs), Comparing Scaling Hardware: Traditional vs. Cloud, Database & Data Stores in Cloud, Large Scale Data Processing.

Cloud Security: Infrastructure Security - Network level security, Host level security, Application-level security. Data security and Storage - Data privacy and security Issues, Authentication in cloud computing

06 Case study on Open Source and Commercial Clouds **05**

Amazon EC2, Google Compute Engine, Microsoft Azure, Cloud foundry

TEXT BOOKS:

1. Cloud Computing for Dummies - Judith Hurwitz, R. Bloor, M.Kanfman, F.Halper,WileyIndia Edition Unit - I, II, IV, V
2. Cloud Computing Black Book - Jayaswal, Kallakurchi, Houde, Shah, DreamtechPress Unit - III
3. Cloud Security - Ronald Krutz and Russell Dean Vines, Wiley-India Unit- V

REFERENCE BOOKS:

1. Google Apps - Scott Granneman, Pearson
2. Cloud Security & Privacy - Tim Mather, S.Kumaraswammy, S.Latif, SPD, O'REILLY
3. Cloud Computing: Principles and Paradigms - Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley India
4. Cloud Computing: A Practical Approach - Anthony T.Velte, et.al, McGraw Hill
5. Cloud Computing for Dummies - Judith Hurwitz, Marcia Kaufman, Fern Halper,Robin Bloor, Wiley Publication
6. Cloud Computing Bible - Barrie Sosinsky, Wiley India
7. Cloud Computing - Michael Miller, Que Publishing

TERM WORK:

1. Minimum of 10 Tutorials to be done.
2. It should include the demonstration and use of the Tools /Techniques

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VIII
PROJECT MANAGEMENT

(Professional Core Elective II)

TEACHING SCHEME	EXAMINATION SCHEME
Theory: 3 Hrs. / Week	**ESE:** 70 **CIE:** 30
Tutorial: 1 Hrs. / Week	**Term work:** 25 Marks
Practical: --	**Practical : --**
Course Code: PCE-AIDS-803	**Credits:** 4

Course Outcomes:

Upon successful completion of this course, the student will be able to –

CO1. Apply project management concepts and techniques to an IT project

CO2. Identify issues that could lead to IT project success or failure.

CO3. Explain project management in terms of the software development process.

CO4. Describe the responsibilities of IT project managers.

CO5. Apply project management concepts through working in a group as team leader.

Unit No	Content	No. of lectures
01	**Introduction** Defining of Software Development Process - Process - Tailoring the Process - Improving the process discipline - Need for implementing discipline. Software Production Process - Identify the Software Model - Software Process Models: Waterfall Model, Prototyping Model, RAD Model, Incremental Model, Spiral Model, Component Assembly Model - Software Life Cycle.	06
02	**Software Development** Software Development Team - Three Vital Aspects of Software Project Management - The Team - Meaning of Leadership - Communicating in Harmony - Personality traits - Project Organizations. Project Planning: Top-Down and Bottom-Up Planning - Types of Activity - Project Duration: Schedule Monitoring Tools - Gantt Chart, PERT Chart, Critical Path.	06
03	**Project Review** Tracking Meetings - Recovery plans - Schedule Work & Escalation Meetings. Project Engineering: Product Requirements - Understanding the Customer Problem to solve - Initial Investigation, Strategies for determining information requirements, Information gathering Tools - Product Objectives.	06
04	**Problem Solving** Product Specifications - Defining the Final Product - Data Flow Diagram, Data Dictionary, Structured English, Decision Trees, Decision Tables - Feasibility Study. Software Testing: Test Plan - Development Testing: Verification and Validation - General Testing Methods: White Box and Black Box Testing - Unit Testing - System Integration Testing - Validation Testing - System testing.	06

05 Software Quality **06**

Software Quality - Quality Measures - FURPS - Software Quality Assurance - Software Reviews - Format Technical Review (FTR) Formal Approaches to SQA - Software Reliability - Introduction to SQA - The Software Quality Assurance Plan - Formal approaches to SQA - Clean room Methodology.

TEXT BOOKS:

1. B. Hughes, M. Cotterell, Rajib Mall, Software Project Management, McGraw Hill, 2015
2. R. Walker, Software Project Management, Pearson, 2003

REFERENCE BOOKS:

1. R. H. Thayer, Software Engineering Project management, IEEE CS Press, 1988
2. R. Pressman, Software Engineering: A Practitioner's approach, McGraw Hill, 2005

SUPPLEMENTARY READING:

1. https://onlinecourses.nptel.ac.in/noc19_cs70/preview

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VIII
SOFTWARE TESTING (Professional Core Elective II)

TEACHING SCHEME	EXAMINATION SCHEME
Theory:3Hrs./Week	**ESE:**70 **CIE:** 30
Tutorial: 1Hrs./Week	**Termwork:**25Marks
Practical: --	**Practical :** --
Course Code: PCC-AIDS-804	**Credits:** 4

Course Outcomes:

Upon successful completion of this course, the student will be able to –

CO1. Understand fundamental component of software life cycle

CO2. Understand different software verification method

CO3. Select and prioritize test cases for regression testing using appropriate techniques.

CO4. Apply and use the modern software testing tools

CO5. Describe the seven-step software testing process

CO6. Explore newer software project assessment methods

Unit No	Content	No. of lectures
01	**Introduction** Introduction **:**Some Software Failures, Testing Process, Some Terminologies, Limitations of Testing, The V Shaped software life cycle model	**04**
02	**Software Verification** Software Verification: Verification Methods, SRS document verification, SDD document verification, Source code reviews, User documentation verification, Software project audit. Creating test cases from SRS and Use cases: Use Case Diagram and Use Cases, Generation of test cases from use cases, Guidelines for generating validity checks, strategies for data validity, Database testing	**08**
03	**Regression Testing** Regression Testing**:** What is regression testing?, Regression Test cases selection, Reducing the number of test cases, Risk analysis, Code coverage, prioritization techniques, Object oriented testing: What is Object orientation?, What is object oriented testing?, Path testing, State based testing, Class testing.	**06**
04	**Software Testing** Software Testing Tools**:** Selecting and Installing Software Testing tools, Automation and Testing Tools, Load Runner, Win runner and Rational Testing Tools,Silk test, Java Testing Tools	**06**

05 Testing Process **06**

Testing Process **:** Seven Step Testing Process – I: Overview of the Software Testing Process,Organizing ofTesting, Developing the Test Plan, Verification Testing, Validation Testing.

06 Testing Web applications **06**

Testing Web applications**:** What is web testing? functional testing, UI testing, Usability testing, configurations and compatibility testing, security testing, performance testing, database testing, post deployment testing, web metrics. Automated Test data generation**:** Automated Test Data generation, Approaches to test data generation, Test data generation tools

TEXT BOOKS:

1. Yogesh Singh, Software Testing, Cambridge University Press, First Edition, 2021, Units I, II, III, VI.
2. William E. Perry, Effective Methods for Software Testing (Chapters 4, 6, 7, 8, 9, 10), Wiley India, Third Edition, 2009, Units IV, V.
3. Naresh Chauhan, Software Testing – Principles and Practices (Chapter 12), Oxford University Press, 2010, Unit IV.

REFERENCEBOOKS:

1. Aditya P. Mathur, Foundations of Software Testing, Pearson, Second Edition.
2. Ron Patton, Software Testing, Pearson (SAMS), Second Edition.
3. Mordechai Ben Menachem, Garry S. Marliss, Software Quality, BS Publications.

SUPPLEMENTARY READING:

1. https://malenezi.github.io/malenezi/SE401/Books/Software-Testing-A-Craftsman-s-Approach-Fourth-Edition-Paul-C-Jorgensen.pdf

TERM WORK:

Minimum of 10 Tutorials to be done from the list given below.

It should include the demonstration and use of the Tools /Techniques

Guidelines for tutorials:

It should consist of 8-10 assignments based on the following topics:

1. Software Testing Process, its need and limitations
2. Verification at different phases of SDLC for particular case study (SRS document verification, SDD document verification, Source code reviews, User documentation verification, Software project audit etc.)
3. Creating test cases from SRS and Use cases for particular case study
4. Generation of validity checks for particular case study
5. Regression testing with Test cases selection / Regression testing with reducing the number of test cases / Regression testing with code coverage prioritization techniques
6. Generation of test cases using Path testing/ State based testing/Class testing for particular case Study
7. Measurement in Software Engineering
8. Software Metrics: Object oriented Metrics used in testing
9. Calculation of Software Quality attributes using different prediction models
10. Measurement of Internal / External Product Attributes.

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VIII
DATA WAREHOUSING AND DATA MINING
(Professional Core Elective II)

TEACHING SCHEME	EXAMINATION SCHEME
Theory: 3 Hrs. /Week	**ESE:** 70 **CIE**: -- 30
Tutorial: 1 Hr. /Week	**Term work:** 25 Marks
Practical: --	**Practical :** --
Course Code: PCE-AIDS-805	**Credits:** 4

Course Outcomes:

Upon successful completion of this course, the student will be able to –

CO1. Design data warehouse architecture for various Problems.
CO2. Understand the Architecture of a Data Mining system.
CO3. Describe various dimensional modeling techniques and schema types used in data warehousing.
CO4. Apply clustering algorithms and data mining techniques across different domains.

Unit No	Content	No of lectures
01	**Data Warehousing – Introduction and Design** Overview and Concepts: Data Warehousing Components, Building a Data Warehouse, Data Warehouse Architecture, Infrastructure and Metadata. Data Design and Data Representation: Principles of Dimensional Modeling, Data Extraction, Transformation and Loading, Data Quality, Online Analytical Processing (OLAP)–OLAP and Multidimensional Data Analysis.	06
02	**Dimensional Modeling and Schema** Dimensional Modeling- Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition - Process Architecture- Types of Data Base Parallelism – Datawarehouse Tools	06
03	**Data Mining – Pre-processing** Steps in Data mining process, Data Mining Functionalities, Architecture of a Typical Data Mining Systems, Classification of Data Mining Systems, Knowledge Discovery in Databases (KDD), KDD Process, Data Preprocessing, Data Cleaning, Data Transformation, Data Compression and Dimension Reduction, Principal Component Analysis, Binning Methods.	06
04	**Data Mining Techniques** Association Rule Mining, Classification and Prediction: Efficient and Scalable Frequent Itemset Mining Methods, Mining, Various Kinds of Association Rules, Association Rules, Market Basket Analysis, Apriori Algorithm, Tree Based Algorithms. Classification by Decision Tree Introduction, Bayesian Classification, Rule Based Classification, Classification by Back propagation, Support Vector Machines, Lazy Learners, Prediction Techniques, Regression Models.	06

05 Clustering & Introduction to Web Mining **06**

Data Mining Algorithms: Clustering. Partitioned Algorithms, Hierarchical Algorithms, Density Based, Algorithms, Grid Based Algorithms, Web Content Mining, Web Structure Mining, Web Usage Mining, Spatial Mining, Multimedia Data Mining, Text Mining.

TEXT BOOKS:

1. J. Han and M. Kamber, “Data Mining Tools and Techniques”, Morgan Kaufmann Publishers.
2. M.H. Dunham, “Data Mining Introductory and Advanced Topics”, Pearson Education.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “Introduction to Data Mining”, Pearson Education.

REFERENCE BOOKS:

1. Prabhu, “Data warehousing- concepts, Techniques, Products and Applications”, Prentice Hall of India.
2. Alex Berson and Stephen J. Smith, “Data Warehousing, Data Mining & OLAP”, Tata McGraw Hill Edition, Tenth Reprint.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “Introduction to Data Mining”, Pearson Education.

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VII
AI IN HEALTHCARE
(Professional Core Elective III)

TEACHING SCHEME	EXAMINATION SCHEME
Theory: 3 Hrs. / Week	**ESE:** --70 **CIE:** --30
Tutorial: --1 Hrs. / Week	**Term work:** 25 Marks
Practical: --	**Practical : --**
Course Code: PCE-AIDS-806	**Credits:** 3

Course Outcomes:
Upon successful completion of this course, the student will be able to –
CO1. Outline the importance of Artificial intelligence and its evolution
CO2. Apply the uninformed and informed search algorithms
CO3. Explain machine learning in healthcare
CO4. Explain Deep learning in healthcare
CO5. Summarize robotics knowledge in healthcare
CO6. Outline the IOT for healthcare systems.

Unit No	Content	No. of lectures
01	**Introduction To AI** History of AI before 90s History of AI after 90s, Definition of AI. Goal of AI, Types of AI, Applications of AI.	04
02	**Uninformed and informed searching algorithms** Depth first search. Depth limited search ,iterative Deepening DFS, breadth first search., Best first search , A*Search,A0*Search Beyond Classical Search Algorithms Hill Climbing, Beam search, Genetic algorithm ,N-Queens Problem.	06
03	**Machine learning in Healthcare** Introduction to Machine learning ,Supervised vs. Unsupervised learning ,Regression, classification and clustering techniques ,healthcare applications of ML algorithms ,Disease Prediction (e.g. Diabetes ,heart disease).Predicting patient outcome (e,g hospital readmission rates).Risk prediction and management.	06
04	**Deep learning in Healthcare** Introduction to neural networks and deep learning, Architecture of artificial neural networks(ANNs).Activation functions. Backpropagation and optimization techniques. Application of deep learning in healthcare Image recognition :medical image classifications (X-rays ,CT scans ,MRI) Time series data for patient monitoring (e.g ECG ,heart rate) Early diagnosis and predictive modelling.**Software as a Service**	06

05	**Robotics in healthcare**	**07**
	History of robot in healthcare, Types of robots in healthcare , Types of robotics in healthcare, The challenges of robotics in healthcare, The application of robotics in healthcare	
06	**Internet of things (IOT) in healthcare systems**	**07**
	The internet of healthcare things (IoHT) work, Factors affecting IoT healthcare application, Simple health care system Architecture, Benefits of IoT in healthcare challenges in healthcare.	

TEXT BOOKS:

1. Artificial Intelligence in healthcare applications and management by Boris Galitsky and Saveli Goldberg
2. Applications of artificial intelligence in the health care sector

REFERENCE BOOKS:

1. Stuart J Russell and peter norvig ,Artificial intelligence A modern Approach, Prentice Hall, Pearson
2. Lavika Goel, Artificial intelligence :concepts and applications Willey

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VII
GENERATIVE AI
(Professional Core Elective III)

TEACHING SCHEME	EXAMINATION SCHEME
Theory: 3 Hrs. / Week	**ESE:** --70 **CIE:** --30
Tutorial: 1 Hr. / Week	**Term work:** 25 Marks
Practical: --	**Practical :** --
Course Code: PCC-AIDS-807	**Credits:** 3

Pre-requisite

Prior knowledge of Calculus, Linear Algebra, Probability Theory, and Python programming
Course Outcomes

Course Outcomes:

Upon successful completion of this course, the student will be able to –

CO1. Understand the evolution of AI and the significance of Deep Learning.
CO2. Apply various Neural Network architectures for tasks like image recognition and sequence modeling.
CO3. Analyse data preprocessing and training techniques for neural networks.
CO4. Understand large language models' architecture and pre-training techniques.
CO5. Design practical solutions using advanced neural networks for diverse applications. .

Unit No	Content	No. of lectures
01	**Foundations of AI and Neural Networks:** History and evolution of AI/ML, Deep learning revolution, Transfer learning, History of Neural Natural Language Processing, Structure of Artificial Neural Networks, Steps in Training an Artificial Neural Network, Parameters and Hyper parameters, Backpropagation.	08
02	**Advanced Neural Network Architectures:** Introduction to advanced architectures, Introduction to Generative AI Models: Generative Adversarial Networks (GANs), Variation Auto encoders (VAEs), Transformers, Attention Mechanism in detail Long Short-Term Memory Networks (LSTMs)	08
03	**Data Preprocessing** Probability and Statistics, Data Preprocessing Techniques, Model Training Techniques	08
04	**Introduction to Large Language Models :** Overview of Generative AI and Large Language Models. Basics of attention mechanisms and Transformer architecture. Pre-training techniques and transfer learning	08

05	**Generative AI Applications**	**05**

Applications in Various Fields : Art and Creativity, Image and Video Generation, Text Generation,Music Composition, Healthcare Finance.Real-world use cases and challenges in deploying generative AI models

TEXT BOOKS:

1. “Generative AI for everyone: Understanding the essentials and applications of this breakthrough technology". Altaf Rehmani .
2. "Introduction to Generative AI” , Numa Dhamani, Kindle Edition, 2024.
3. "Neural Networks and Deep Learning: A Textbook" by Charu C. Aggarwal.
4. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville

REFERENCE BOOKS:

1. . "Generative Adversarial Networks Cookbook: Over 100 recipes to build generative models using Python, TensorFlow, and Keras" by Josh Kalin.
2. “Generative AI in Software Development: Beyond the Limitations of Traditional Coding” Jesse Sprinter, 2024.

E-Sources:

1.https://elearn.nptel.ac.in/shop/iit-workshops/completed/leveraging-generative-ai-for-teaching-programming-courses/?v=c86ee0d9d7ed
2.https://elearn.nptel.ac.in/shop/iit-workshops/completed/introduction-to-language-models/?v=c86ee0d9d7ed

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VII
INDUSTRY 4.0
(Professional Core Elective III)

TEACHING SCHEME	EXAMINATION SCHEME
Theory: 3 Hrs. / Week	**ESE:** --70 **CIE:** --30
Tutorial: 1 Hr. / Week	**Term work:** 25 Marks
Practical: --	**Practical :** --
Course Code: PCC-AIDS-808	**Credits:** 3

Course Outcomes:

At the end of successful completion of course, the students will be able to—

CO1. Understand the main concepts and components of Industry 4.0,

CO2. Explain, the key concepts of Industry 4.0 in developing a technology roadmap.

CO3. Explain how Industry 4.0 technologies, like AI and IoT, can optimize manufacturing processes and improve product quality.

CO4. Illustrate the role of advanced technologies in enhancing industrial robotic in the Industry 4.0 era

Co5: Identify the role of Augmented Reality (AR) in Industry 4.0 and its industrial applications

CO6. Identify the security threats and vulnerabilities in IoT and industrial systems, and explain their potential impact on Industry 4.0 operations.

Unit No	Content	No. of lectures
01	**A Conceptual Framework for Industry 4.0:** Introduction Main Concepts and Components of Industry 4.0 ,State of Art , Supportive Technologies ,Proposed Framework for Industry 4.0 ,Business Models ,Key business model components of smart and connected products, IoT value creation layers and technologies	06
02	**Technology Roadmap for Industry4.0:** Introduction ,Proposed Framework for Technology Roadmap Strategy Phase, New Product and Process Development Phase	03
03	**Internet of Things and New Value Proposition.** Introduction, Internet of Things (IoTs), Examples for IoTs Value Creation in Different Industries. Smart Agriculture, Smart City. Smart Life—Wearable Technologies Smart Health. ,IoTs Value Creation Barriers: Standards, Security and Privacy Concerns. .Privacy Concerns, Standardization	06
04	**Advances in Robotics in the Era of Industry4.0:** Introduction Recent Technological Components of Robots Advanced Sensor Technologies Artificial Intelligence Internet of Robotic Things, Cloud Robotics. Cognitive Architecture for Cyber-Physical Robotics Industrial Robotic Applications Manufacturing Maintenance. Assembly	07

05	**The Role of Augmented Reality in the Age of Industry4.0** History of robot in healthcare, Types of robots in healthcare , Types of robotics in healthcare, The challenges of robotics in healthcare, The application of robotics in healthcare	**07**
06	**Internet of things (IOT) in healthcare systems** The internet of healthcare things (IoHT) work, Factors affecting IoT healthcare application, Simple health care system Architecture, Benefits of IoT in healthcare challenges in healthcare.	**07**

TEXT BOOKS:

1. Springer Series in Advanced Manufacturing Series editor Duc Truong Pham, University of Birmingham, Birmingham, UK
2. The Concept Industry 4.0: An Empirical Analysis of Technologies and Applications in Production Logistics By Christoph Jan Bartodziej
3. Industry 4.0: Entrepreneurship and Structural Change in the New Digital Landscape, By Springer

Reference Books:

1. Virtual and Rapid Manufacturing: Advanced Research in Virtual and Rapid Prototyping, By Bartolo, P J, Taylor and Francis
2. Rapid Manufacturing: An Industrial Revolution for a Digital Age By Hopkinson, N, Haque, R., and Dickens, P., Wiley
3.Make: 3D Printing By Anna Kaziunas France

ICT/MOOCs Reference

https://nptel.ac.in/courses/107101086/

https://nptel.ac.in/courses/106105195/

https://nptel.ac.in/courses/112104265

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VII
UI/UX DESIGN

TEACHING SCHEME	EXAMINATION SCHEME
Theory: 3 Hrs. / Week	**ESE:** -- **CIE:** --
Tutorial: --	**Term work:** 50 Marks
Practical: -- 4 Hrs. / Week	**Practical :** 50 Marks
Course Code: PCC-AIDS-809	**Credits:** 3

Course Outcomes:
Upon successful completion of this course, the student will be able to –
CO1. Build UI for user Applications
CO2. Evaluate UX design of any product or application
CO3. Demonstrate UX Skills in product development
CO4. Implement Sketching principles
CO5. Create Wireframe and Prototype

Unit No	Content	No. of lectures
01	**Foundations Of Design** UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy	06
02	**Foundations Of UI Design** Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides	05
03	**Foundations Of UX Design** Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals	07
04	**Wireframing, Prototyping and Testing** Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration 132	06
05	**Research, Designing, Ideating, &amp, Information Architecture**	07

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping -Information Architecture

TEXT BOOKS:

1. 1. Joel Marsh, “UX for Beginners”, O’Reilly , 2022
2. 2. Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021

REFERENCE BOOKS:

1. . Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020
2. 2. Steve Schoger, Adam Wathan “Refactoring UI”, 2018
3. 3. Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015
4. 4. https://www.nngroup.com/articles.
5. 5. https://www.interaction-design.org/literature.

TERM WORK:

1. Minimum of 10 Experimrnts to be done from the list given below.
2. It should include the demonstration and use of the Tools /Techniques

LIST OF EXPERIMENTS:

1 Designing a Responsive layout for an societal application
2. Exploring various UI Interaction Patterns
3. Developing an interface with proper UI Style Guides
4. Developing Wireflow diagram for application using open source software
5. Exploring various open source collaborative interface Platform
6. Hands on Design Thinking Process for a new product
7. Brainstorming feature for proposed product
8. Defining the Look and Feel of the new Project
9. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
10. Identify a customer problem to solve
11. Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping
12. Sketch, design with popular tool and build a prototype and perform usability testing and identify improvements

B. Tech CSE (Artificial Intelligence & Data Science) Sem – VIII
PROJECT PHASE II

TEACHING SCHEME	EXAMINATION SCHEME
Theory: --	**ESE:** -- **CIE**: --
Tutorial: --	**Term work:** 50 Marks
Practical: 4 Hrs. /Week	**Practical :** 100 Mark
Course Code: PW-AIDS-810	**Credits:** 2

Pre-requisites: Software Engineering, Mini Project.

Course Objectives

1. Students should learn to design and develop usable User Interface
2. Students should learn to analyze and apply emerging technologies in development of a project
3. Students should learn to test the modules in Project
4. Students should learn to demonstrate working of project

Course Outcomes:

Upon successful completion of this course, the students will be able to:

CO1. Design and **develop** usable User Interface
CO2. Analyze and **apply** emerging technologies in development of a project
CO3. Test the modules in Project
CO4. Demonstrate working of project

Contents

1. The group will continue to work on the project selected during the semester VII and submit the completed Project work to the department at the end of semester VIII as mentioned below.
    a. The workable project.
    b. The project report in the bound journal complete in all respect with the following: -
    c. Problem specifications
    d. System definition – requirement analysis.
    e. System design – dataflow diagrams, database design
    f. System implementation – algorithm, code documentation
    g. Test results and test report.
2. Project work should be continually evaluated based on the contributions of the group members, originality of the work, innovations brought in, research and developmental efforts, depth and applicability, etc.
3. Two mid-term evaluations should be done, which includes presentations and demos of the work done.