EIGHTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours / Week	Credit	Full Marks
1	Program Elective – 4	PE CS 801/1	Distributed Systems	3	0	0	3	3	100
		PE CS 801/2	Mobile Computing						
		PE CS 801/ 4	Neural Network Architecture for Data Analysis						
2	Program Elective – 5	PE CS 802/1	Pattern Recognition	2	0	0	2	2	100
		PE CS 802/4	Applications of Artificial Intelligence in Healthcare						
		PE CS 802/5	Optimization Techniques						
3	Open Elective – 3	OE 803	Refer Annexure 3	3	0	0	3	3	100
4	Open Elective – 4	OE 804	Refer Annexure 4	2	0	0	2	2	100
5	Employment Enhancement Courses – 7	EEC 805	Project Work Final	0	0	12	12	6	200
6	Employment Enhancement Courses – 8	EEC 806	Seminar on Contemporary Engineering Topics - II	0	0	2	2	1	100
7	Online Course - 1	SW CS 807	SWAYAM Courses	0	0	0	0	1	100
				10	**0**	**14**	**24**	**18**	**800**

Distributed Systems

Course Code	PE CS 801/1
Course Title	Distributed Systems
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Database Management Systems
Course Category	Program Elective
Number of classes	36 hours

Course Outcome:

After completing this course, the student should be able to-

CO Number	CO Description	K-level
CO-1	Explain the trends in distributed systems.	K2
CO-2	Illustrate the reliability issues of distributed systems.	K2
CO-3	Apply remote method invocation and objects.	K3
CO-4	Design distributed systems.	K4

Course Content:

Module1: (8 hours)

Introduction - Distributed data processing; what is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts.
Distributed Database Management System Architecture - Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues.

Module2: (10 hours)

Design - Distributed Database Design Alternative design strategies; Distributed design issues; Fragmentation; Data allocation;
Semantics Data Control - View management; Data security; Semantic Integrity Control QUERY Processing Issues, Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data.

Module3: (10 hours)

Distributed Query Optimization - Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms;
Transaction Management - The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models;
Concurrency Control - Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management.

Module4: (8 hours)

Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols Algorithm; Parallel Database Systems - Parallel architectures; parallel query processing; Advanced Topics - Mobile Databases, Distributed Object Management, Multi-databases.

References / Suggested Learning Resources:

1. Principles of Distributed Database Systems, M.T. Ozsu and PValduriez, Prentice-Hall,1991.

2. Distributed Database Systems, D. Bell and J. Grimson, Addison- Wesley,1992.

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Mobile Computing

Course Code	PE CS 801/2
Course Title	Mobile Computing
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	--
Course Category	Program Elective
Number of classes	36 hours

Course Outcome:

After completing this course, the student should be able to -

CO Number	CO Description	K-level
CO-1	Explain Mobile Communication and next generation mobile computing system.	K2
CO-2	Explain network and transport layers of Mobile Communication.	K2
CO-3	Analyze IP and TCP layers of Mobile Communication.	K3
CO-4	Analyze various protocols of all layers for mobile and ad hoc wireless communication networks.	K3

Course Content:

Module 1: (8 Hours)

Basic history of Mobile Computing Architecture for mobile computing, Three tier architecture, design considerations for mobile computing, mobile computing through internet, Wireless network architecture, Applications, Security, Concerns and Standards, Benefits, Future. Evolution of mobile computing.

Module 2: (12 Hours)

Overview of Wireless n/w. and Technologies: Introduction, Different generations. Introduction to 1G, 2G, 3G and 4G, Bluetooth, Radio frequency identification (Rfid), Wireless Broadband, Mobile IP: Introduction, Advertisement, Registration, TCP connections, two level addressing, abstract mobility management model, performance issue, routing in mobile host, Adhoc networks, Mobile transport layer: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, transaction oriented TCP, IPv6 Wireless network topologies, Cell fundamentals and topologies, Global system for mobile communication, Global system for mobile communication, GSM architecture, GSM entities, call routing in GSM,PLMN interface, GSM addresses and identifiers, network aspects in GSM,GSM frequency allocation, authentication and security, Short message services, Mobile computing over SMS, SMS, value added services through SMS, accessing the SMS bearer, Security in wireless networks.

Module 3: (6 Hours)

General packet radio service (GPRS): GPRS and packet data network, GPRS network architecture, GPRS network operation, data services in GPRS, Applications of GPRS, Billing and charging in GPRS.

Module 4: (10 Hours)

Wireless Application Protocol (WAP): WAP, MMS, GPRS application CDMA and 3G Spread-spectrum Technology, CDMA versus GSM, Wireless data, third generation networks, applications in 3G Wireless LAN, Wireless LAN advantages, IEEE 802.11 standards, Wireless LAN architecture, Mobility in Wireless LAN, Deploying Wireless LAN, Deploying Wireless LAN, Mobile ad hoc networks and sensor networks, wireless LAN security, WiFi v/s 3G Voice over Internet protocol and convergence, Voice over IP, H.323 framework for voice over IP, SIP, comparison between H.323 ad SIP, Real time protocols, convergence technologies, call routing, call routing, voice over IP applications, IMS, Mobile VoIP, 13 30 Security issues in mobile Information security, security techniques and algorithms, security framework for mobile environment.

Suggested books:

1. Mobile Computing, Raj Kamal by Oxford
2. Wireless Communications & Networks, Second Edition, William Stallings by Pearson
3. Mobile Computing Theory and Practice-Kumkum Garg-Pearson
4. TCP/IP Protocol Suite by Behrouz A Forouzan, Third Edition, TMH

Suggested reference books:

1. Mobile Computing Technology, Applications and service creation, Asoke K Telukder, Roopa R Yavagal by TMH.
2. V.K. Garg, J.E. Wilkes, “Principle and Application of GSM”, Pearson Education, 5th edition, 2008.
3. V.K. Garg, “IS-95 CDMA & CDMA 2000”, Pearson Education, 4th edition, 2009.
4. T.S. Rappaport, “Wireless Communications Principles and Practice”, 2nd edition, PHI, 2002.
5. William C.Y. Lee, “Mobile Cellular Telecommunications Analog and Digital Systems”, 2nd edition, TMH, 1995.
6. Asha Mehrotra, “A GSM system Engineering” Artech House Publishers Bosten,London,1997

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Neural Network Architecture for Data Analysis

Course Code	PE CS 801/4
Course Title	Neural Network Architecture for Data Analysis
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Neural Network
Course Category	Program Elective
Number of classes	36 hours

Course Outcome:

After completing this course, the student should be able to -

CO Number	CO Description	K-level
CO-1	Understand the various kinds of neural network architectures and the various techniques and tricks involved in training them effectively	K2
CO-2	Understand the computational challenges involved in training neural networks	K2
CO-3	Compare the performance of different neural network designs	K2
CO-4	Design a suitable neural network for a given machine learning task	K3

Course Content:

Module 1: (9 Hours)

Introduction to neural networks - What is Neural Network, Model of Artificial Neuron, Learning rules and various activation functions. Deep neural networks, MLP architecture, forward and backward propagation, automatic differentiation, loss functions, regularization. Neural Network, Fuzzy logic, Genetic Algorithm.

Module 2: (9 Hours)

Types of Neural Networks - Dense neural networks, Convolutional neural networks (CNN): LeNet-5, Alex Net, Inception, Resnet, Recurrent neural networks (RNN), LSTMs, GRU, Graph neural networks (GNN).

Module 3: (9 Hours)

Neural Network Architecture - Single layer Feed-forward networks. Multilayer Feed-forward networks. Recurrent Networks. Cluster Structure, Vector Quantization, Classical ART Network, Simplified ART Architecture, ART1 and ART2 Architecture and algorithms, Applications, Sensitivities of ordering of data.

Module 4: **(9 Hours)**

Introduction about Fuzzy set theory - Fuzzy versus Crisp, Crisp and fuzzy sets, Crisp and Fuzzy relations. Fuzzy Systems: Crisp Logic, Predicate Logic, Fuzzy logic, Fuzzy rule-based system, Defuzzification Methods, Applications.

Suggested books:

1. Dive into deep learning, Aston Zhang, Z. Lipton, M Li and Alex Smola, Open-source book
2. Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems, Aurelien Geron, O'Reilly 2019.
3. Introduction to Machine Learning, by Jeeva Jose, Khanna Book Publishing, 2020.
4. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.
5. Neural Networks,Fuzzy Logic and Genetic Algorithms, by S. Rajasekaran and G.A. Vijayalakshmi Pai.
6. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
7. Build_Neural_Network_With_MS_Excel_sample by Joe choong.

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Pattern Recognition

Course Code	PE CS 802/1
Course Title	Pattern Recognition
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Nil
Course Category	Program Elective
Number of classes	26 hours

Course Outcome:

After completing this course, the student should be able to-

CO Number	CO Description	K-level
CO-1	Explain supervised and unsupervised pattern classifiers	K2
CO-2	Classify the data and identify the patterns	K3
CO-3	Apply different feature extraction techniques.	K3
CO-4	Utilize Hidden Markov model and SVM in pattern recognition.	K3

Course Content:

Module 1: **(6 Hours)**

Pattern Classifier - Overview of Pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach– Pattern classification by distance functions – Minimum distance pattern classifier- Fisher Linear Discriminant.

Module 2: **(8 Hours)**

Classification - Bayes decision rule, Error probability, Error rate, Minimum distance classifier, MahalaNobis distance; K-NN Classifier, Linear discriminant functions and Non-linear decision

boundaries.
Clustering for unsupervised learning and classification–Clustering concept – C Means algorithm – Hierarchical clustering – Graph theoretic approach to pattern Clustering – Validity of Clusters Clustering: Different distance functions and similarity measures.

Module 3: (6 Hours)

Feature Extraction and Structural Pattern Recognition - Principle component analysis, independent component analysis, Linear discriminant analysis, Feature selection through functional approximation.
Feature selection: Problem statement and Uses, Probabilistic separability-based criterion functions, interclass distance-based criterion functions, Branch and bound algorithm, sequential forward/backward selection algorithms.

Module 4: (6 Hours)

Hidden Markov Models and Support Vector Machine - State Machines – Hidden Markov Models – Training – Classification – Support vector Machine – Feature Selection-obtaining the optimal hyperplane.

References / Suggested Learning Resources:

1. Andrew Webb,"Statistical Pattern Recognition", Arnold publishers, London, 1999
2. C.M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
3. M. Narasimha Murthyand V. Susheela Devi, "Pattern Recognition", Springer 2011.
4. Menahem Friedman, Abraham Kandel, "Introduction to Pattern Recognition Statistical, Structural, Neural and Fuzzy Logic Approaches", World Scientific publishing Co. Ltd, 2000.
5. Robert J. Schalkoff, "Pattern Recognition Statistical, Structural and Neural Approaches", John Wiley & Sons Inc., New York, 1992.
6. R.O. Duda, P.E. Hart and D.G. Stork, "Pattern Classification", John Wiley, 2001
7. S. Theodoridis and K. Koutroumbas, "Pattern Recognition", 4th Ed., Academic Press, 2009
8. R.O. Duda, P.E. Hart and D.G. Stork, Pattern Classification, John Wiley, 2002.
9. C.M. Bishop, Neural Networks and Pattern Recognition, Oxford University Press (Indian Edition), 2003.

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Applications of Artificial Intelligence in Healthcare

Course Code	PE CS 802/4
Course Title	Applications of Artificial Intelligence in Healthcare
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Artificial Intelligence, Image Processing
Course Category	Program Elective
Number of classes	26 hours

Course Outcome:

After completing this course, the student should be able to-

CO Number	CO Description	K-level
CO-1	Gain broad knowledge of opportunities for AI in healthcare	K2
CO-2	Understand data techniques in healthcare data analysis along with image analysis	K2
CO-3	Understand applications and challenges across the design, implementation and management of intelligent systems and healthcare data networks	K2
CO-4	Apply cutting edge machine learning algorithms for health record analysis and multi-modal data	K3

Course Content:

Module 1: (6 Hours)

Overview of techniques and applications of Artificial Intelligence, Introduction to data generated inside and outside health system: Images, Electronic Health Records, Wearables and other sensors; social media etc.

Module 2: (7 Hours)

Medical image analysis without AI, AI for medical image analysis and imaging, Medical image and video analysis: X-Ray, CT-Scan, Ultrasound; Segmentation, Classification, Vision Models.

Module 3: (6 Hours)

Electronic Health Records and their analysis; Genomics; Multi-modal data; AI for data analytics and data mining, Future applications and techniques.

Module 4: (7 Hours)

Epidemics; Interpretability, Fairness, and Ethics; Ethical and data protection issues in AI-based solutions; Innovation and entrepreneurship for AI in health care; Design and deployment of AI solutions in health care: stakeholder's views.

Suggested Learning Resources:

1. Deep Learning in Healthcare, Paradigms and Applications, Chen, Yen-Wei, Jain, Lakhmi C., Springer 2020.
2. Artificial Intelligence in Healthcare, Adam Bohr, Kaveh Memarzadeh, Academic Press, 2020.
3. M.C. Trivedi, A classical approach to Artificial Intelligence, Khanna Book Publishing Company, 2020.
4. Machine Learning, Deep Learning, Rajiv Chopra, Khanna Publishing, 2021.

References:

- List of contemporary research papers prescribed by the instructor.

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Optimization Techniques

Course Code	PE CS 802/5
Course Title	Optimization Techniques
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Soft Computing
Course Category	Program Elective
Number of classes	26 hours

Course Outcome:

After completing this course, the student should be able to-

CO Number	CO Description	K-level
CO-1	Understand basic theoretical principles for optimization models and its solution.	K2
CO-2	Learn the unified and exact mathematical basis as well as the general principles of various soft computing techniques.	K2
CO-3	Apply detailed theoretical and practical aspects of intelligent modelling, optimization and control of linear and non-linear systems.	K3
CO-4	Implement important optimization methods using MATLAB.	K3

Course Content:

Module 1: (7 Hours)

Optimization and its engineering applications, Design vector and constraints, Constraint surface, Objective function, Classification of Optimization Problems, Engineering application of Optimization, Statement of an Optimization problem, Optimal Problem formulation.

Module 2: (7 Hours)

Optimization algorithms for solving unconstrained optimization problems, Gradient based method; Cauchy's steepest descent method, Newton's method, Optimization algorithms for solving constrained optimization problems, direct methods, penalty function methods, steepest descent method, Engineering applications of constrained and unconstrained algorithms.

Module 3: (6 Hours)

Classical Optimization Techniques - Single variable optimization, Constrained and unconstrained multi-variable optimization, direct substitution method, Lagrange's method of multipliers, Karush-Kuhn-Tucker conditions.

Module 4: (6 Hours)

Modern methods of Optimization: Genetic Algorithms, Simulated Annealing, Ant colony optimization, Tabu search, Neural-Network based Optimization, Fuzzy optimization techniques – Applications. Use of MATLAB to solve optimization problems.

References / Suggested Learning Resources:

1. Engineering Optimization Theory and Practice, S.S. Rao, New Age International (P) Ltd, Publishers.
2. Kalyanmoy Deb Multi-objective optimization using evolutionary algorithms, John Wiley Publications.
3. Jasbir S. Arora Introduction to Optimum Design McGraw Hill Publication.

4. An introduction to Optimization by Edwin P K Chong, Stainslaw Zak.
5. Nonlinear Programming by Dimitri Bertsekas.

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Project Work Final

Course Code	EEC 805
Course Title	Project Work Final
Number of Credits	6 (L: 0, T: 0, P: 12)
Prerequisites	Nil
Course Category	Employment Enhancement Courses (EEC)
Number of classes	130 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Demonstrate a sound technical knowledge of their selected project topic	K2
CO-2	Demonstrate the knowledge, skills and attitudes of a professional engineer	K2
CO-3	Develop the skill of working in a Team	K3
CO-4	Develop the skill of effective communication with engineers and the community at large in written an oral forms	K3
CO-5	Design engineering solutions to complex problems utilizing a systematic approach	K6
CO-6	Design the solution of an engineering project involving latest tools and techniques	K6

Course Content:

The project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following -

1. Develop sound knowledge about the domain of the project work.
2. Perform detailed study about various components of a project.
3. Learn to be an important member of a team for successful execution of a project work.
4. Study about methodologies and professional way of documentation and communication related to project work.
5. Develop idea about problem formulation, finding the solution of a complex engineering problem.
6. Develop project report as per the suggested format to communicate the findings of the project work.
7. Acquire the skill of effective oral communication to the fellow engineers and people in the society at large.
8. Develop knowledge of how to organize, scope, plan, do and act within a project thesis.

9. Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
10. Demonstrate the implementation of a project work.

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Seminar on Contemporary Engineering Topics – II

Course Code	EEC 806
Course Title	Seminar on Contemporary Engineering Topics – II
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Nil
Course Category	Employment Enhancement Courses (EEC)
Number of classes	24 hours

Course Outcome:
After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Identify contemporary topics in respective branch of engineering	K3
CO-2	Develop report writing and presentation making skill	K3
CO-3	Present the topic so prepared among audience using suitable aid	K3
CO-4	Survey literature to understand insight of the selected topic	K4

Course Content:

Each student shall -

1. Identify a topic of current relevance in his/her branch of engineering,
2. Get approval of the faculty concerned/HOD,
3. Collect sufficient literature on the selected topic, study it thoroughly (literature survey),
4. Prepare their own report and presentation slides,
5. Present in the class among fellow students and faculty members.

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SWAYAM Courses

Course Code	SW CS 807
Course Title	SWAYAM Courses
Number of Credits	1 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Online Course (SW)
Number of classes	-

Course Outcome:
After completion of the courses, students will be able to:

CO Number	CO Description	K-level
CO-1	Make use of digital learning platform to enhance knowledge and skill beyond the prescribed curriculum structure	K3
CO-2	Utilize the opportunity to learn from best faculty in the Country for professional development	K3
CO-3	Develop the skill of lifelong self-learning and become future ready	K3
CO-4	Take part in proctored examination system to prepare oneself for similar future challenges	K4

Courses Content:

SWAYAM (Study Webs of Active-learning for Young Aspiring Minds); India Chapter of Massive Open Online Courses. SWAYAM is an indigenous developed IT platform, initiated by Government of India, which is instrumental for self-actualization providing opportunities for a life-long learning. Learner can choose from hundreds of courses, virtually every course that is taught at the university/college/school level and these shall be offered by best of the teachers in India and elsewhere. Student having registered a course, having submitting the Assignments as per requirements of the course, shall at the end of each course, be assessed through a proctored examination. A student having successfully completed the course shall get a Certificate.

Each student has to undergo and qualify at least two relevant SWAYAM or equivalent courses (to be certified by concerned HOD) with certification during the entire course of B. Tech. program. The Head of the departments will approve the relevancy of a SWAYAM or equivalent course for respective branch of engineering.

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