SHRI GURU RAM RAI UNIVERSITY

[Est. By Govt. Of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s (2f) of UGC Act 1956]

SYLLABUS OF COURSE WORK

FOR

DOCTOR OF PHILOSOPHY(Ph.D.)

IN COMPUTER SCIENCE

SCHOOL OF ENGINEERING & TECHNOLOGY

(w.e.f. 2025-2026)

Program outcome

- Provide students with knowledge, general competence, and analytical skills in Research Methodology and Research & Publication Ethics.
- Build their foundation for research in Computer Science.
- Provide hands-on experience to carry out research work in Computer Science as well as interdisciplinary areas
- Offer expertise, resources, and services to the community.
- Knowledge and understanding of ethical standards in proposing, executing, and communicating scientific research.
- Ability to conduct independent research.
- Proficiency with fundamental knowledge in several specialized areas of research and expertise in at least one area of research
- Ability to communicate concepts and results to a technical audience in the form of conference papers, journal papers, and/or oral presentations

Programme Specific Outcome

- Equip themselves with ethical issues related to Research and Publication.
- Build a strong foundation for future research work in a systematic manner by applying notions of Research Methodology.
- Gain ability to apply knowledge of Computer Science to research in real-world issues.
- Get familiar with current research trends in various core areas of Computer Science like ANN, NLP, Cloud Computing, Digital Image Processing, Big Data, Al, Cryptography, Software Engineering etc.

No	Course No.	Subject	L:T:P	Credit	Total Marks	Minimum marks to be scored for successful completion
1	PRMC 101	Research Methodology	2:1:2	4	80	As per the University/ UGC Guideline
2	RPEC 102	Research Publication & Ethics	1:1:0	2	40	
3	PCSC 102	Advanced Concept in Computer Science(core)	2:1:2	4	80	
4		Research Area Elective (Anyone)	2:1:2	4	80	
	PCSE103.1	Advance Machine Learning				
	PCSE103.2	Deep Learning				
	PCSE103.3	Natural Language Processing (NLP)				
	PCSE103.4	Big Data Analytics				
	PCSE103.5	Internet of Things				
	PCSE103.6	Cyber Security				
	PCSE103.7	Advanced Software Engineering				
	PCSE103.9	Advanced Network Technologies				
	PCSE103.10	Advanced Data Structure and Algorithm				
	PCSE103.11	Advanced Concept in Image Processing				
	PCSE103.12	Cloud Computing				
	PCSE103.13	Advanced Database Management System				
5	PCSF107	Field work workshop/ Seminar	1:2:2	4	80	
				18	360	

Course code:	PRMC 101				
Course Name:	Research Methodology				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C -Credit

Course Objectives: The objectives of this course are

- Understand some basic concepts of research and its methodologies
- Identify appropriate research topics
- Select and define appropriate research problem and parameters
- Organize and conduct research in a more appropriate manner.

Course Contents

UNIT I - Concept & Types of Research

Meaning and importance of research, Types of research, selection and formulation of research problem, Research Design, Classification, classification of research, Pure and applied research, exploring or formulative research, descriptive research, diagnostic research/ study, evaluation research/ studies, action research, experimental research, Historical research.

UNIT II - Methods Research

General Survey of various Methods including Survey Method, Interdisciplinary Method, Case Study Method, Sampling Method, Observation Method, Interview Method, Schedule Method, Questionnaire Method, Documentary Method, Library Method, Historical Method and Scientific Method. Characteristic Features of Scientific Method; Empirical Verifiable, Cumulative, Self - Correcting, Deterministic, Ethical & Ideological neutrality (Value Free).

UNIT Ill - Data Collection and Data Analysis

Collection, Objectives and Classification of Data, Aims, Methods and Objects of Tabulation of Data, Forms and Processes of Interpretation and Presentation of Data, Primary, Secondary and Tertiary Data, Construction and adaptation of instruments, administration of questions and tests, Data organization in SPSS & Excel, Graphical representation of data, Testing of Hypothesis: Logical and Statistical Techniques.

UNIT IV - Report Writing

Locating Information on a Topic of Interest, Acquiring Copies of Articles of Interest, The Nature of Scientific Variables, Conceptual Versus Operational Definitions of Variables, Levels of Measurement, Various Paradigms, The Basic Format for a Research Report, Identification of the Parts of a Research Report, Citation and Referencing Styles, Essentials of Report Writing, Aids for Writing Good Research Report.

References:

1) Bagchi, Kanak Kanti (2007) Research Methodology in Sciences: A Practical Guide, Delhi, Abijeet Publications.
2) Kothari, C.R (2004) Research Methodology: An Introduction, Delhi, New Age.
3) Cooper, R. Donakd and Pamela S. Schindler (2003) Business Research Methods, Delhi, Tata McGraw- Hill.
4) Flyvbjerg, Bent (2001) Making Social Science Matter: Why Social Inquiry Fails and How it can Succeed Again, United Kingdom, Cambridge University Press.
5) Goodde and Hatte (1952) Methods in Social Research, New York, McGraw — Hill.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	To develop the understanding of the basic framework of research process
CO2	To develop an understanding of various research designs and techniques.
CO3	To identify various sources of information for literature review and data collection.
CO4	To develop an understanding of the ethical dimensions of conducting applied research
CO5	Appreciate the components of scholarly writing and evaluate its quality

Course code:	RPEC-102				
Course Name:	Research & Publication Ethics (Compulsory)				
Semester /Year:					
		L	T	P	C
		1	1	0	2

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: The objectives of this course are

- To understand the philosophy of science and ethics, research integrity and publication ethics. To identify research misconduct and predatory publications.
- To understand indexing and citation databases, open access publications, research metrics (citations, h-index, impact Factor, etc.). To understand the usage of plagiarism tools.

Course Contents

UNIT I-Philosophy and Ethics

Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition moral philosophy, nature of moral judgements and reactions.

UNIT II-Scientific Conduct

Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts: Falsification and Plagiarism (FFP), Redundant publication: duplicate and overlapping publication, salami slicing, Selective reporting and misrepresentation of data.

UNIT III-Publication Ethics

Publication ethics: definition, introduction and importance, best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types, violation of publication ethics, authorship and contributor ship, Identification of publication misconduct, complaints and appeals, Predatory publishers and journals practice.
publishers

UNIT IV-Open Access Publishing

Open access publications and initiatives, SHERPA / RoMEO online resource to check publisher copyright and self-archiving policies, Software tools to identify predatory publications developed by SPPU, Journal finder / journal suggestion tools viz. JANE, Elsevier journal Finder, Springer, Journal Suggester, etc.

UNIT V-Publication Misconduct

Group Discussion, Subject specific ethical issues, FFP, authorship, Conflicts of interest, Complaints and appeals: examples and fraud from India and abroad. Software tools, Use of plagiarism software like Turnitin, Urkund and other open-source software tools.

UNIT VI-Databases and Research Metrics

Databases, indexing databases, Citation databases: Web of Science, scopus, etc., Research Metrics, Impact factor of journal as per journal Citation report, SNP, SJR, IPP, Cite score, Metrics: h-index, g index, altmetrics.

UNIT VII- Technical writing with LATEX

Introduction to Latex, Create Latex files, Create and typeset a simple Latex document, Creating basic documents, Adding basic information to the document, Title, author and date commands, Using packages, Defining new environments, Enumerate and itemize environments, Including a picture, Highlighted text, Elementary mathematical typesetting, Math mode, Align, equation, and cases, Math alphabets, Mathematical Symbols, Mathematical structure.

References:

1) Bird, A. (2006). Philosophy of Science. Routledge.
2) MacIntyre, Alasdair (1967) A Short History of Ethics. London.
3) P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978- 9387480865
4) National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academies Press.
5) Resnik, D. B. (2011). What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10. Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis /index.cfrn
6) Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. https://doi.org/10.1038/489 1 79a
7) Indian National Science Academy (INSA), Ethics in Science Education, Research and Govemance(2019).

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	To develop the understanding of Research Ethics, Publications, misconduct and plagiarism.
CO2	To develop Intellectual honesty and research integrity.
CO3	To identify various sources of information for data bases and research matrices.
CO4	To develop an understanding of the Open access publications and initiatives.
CO5	Appreciate the components of scholarly writing and evaluate its quality

Course code:	PCSC-102				
Course Name:	Advance Concepts in computer science				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: The objectives of this course are

- To learn about the advancements and recent innovations in computer science.
- To understand the concepts of parallel computing, cloud computing, internet of things, blockchain etc.
- To learn the applications of new technologies like Blockchain, Machine learning in real world.
- To learn and evolve new dimensions of research and advancements.
- To develop a scientific, know-how of the technologies and concepts that are being evolved in recent scenario.

Course Contents

UNIT-I

Parallel Computing: Evolution of Computer Architecture – Dimensions of Scalability – Parallel Computer Models – Basic Concepts of Clustering –Scalable Design Principles – Parallel Programming Overview – Processes, Tasks and Threads – Parallelism Issues – Interaction / Communication Issues –Semantic Issues in Parallel Programs.

UNIT-II

Cloud Computing: Definition, private, public and hybrid cloud .Cloud types; Cloud Computing model, laaS, PaaS, SaaS, Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility :Benefits and challenges to Cloud architecture .Application availability, performance, security and disaster recovery; next generation Cloud Applications .Difference between mainframe computing, distributed computing, cloud computing, grid computing, and green computing .Limitation of cloud computing, Issues on cloud computing.

UNIT- III

Internet of Things: Internet of Things Definition: Definition and characteristics of IoT, concepts behind the Internet of Things. Internet of Everything, industrial IoT, smartness in IoT, IoT paradigm, smart objects; Reference Architecture: IoT -architecture, reference model and architecture, IoT reference model, IoT reference architecture, functional view, information view, deployment and operational view, other relevant architectural view.

UNIT-IV

Introduction to Machine Learning and Artificial Intelligence: Overview of Machine Learning; Definition, Components of a learning problem, Applications, choosing a Model Representation, Types of learning: Supervised Learning, Unsupervised Learning, Semi-supervised learning, Reinforcement Learning, Inductive Learning or Prediction.

UNIT-V

Block Chain: Definition, Evolution of Bit Coin, Crypto Currency, Advantages of Block chain, Hyperledger, Ethereum, Security Issues in Block Chain, Distributed Ledger Technology, Consensus Algorithm, Proof of Work.

References:

1) Parallel Computing Architecture: A Hardware/Software Approach, David E. Culler and Jaswinder Pal Singh, Morgan Kaufman, 1999.
2) Advanced Computer Architecture, Kai Hwang, Tata McGraw-Hill, New Delhi, 2003.
3) Cloud Computing: Principles and paradigms, Buyya K, R., Broberg J. and Goscinski M. A., MIT Press, 2011.
4) Puttini R. and Mahmood Z., Cloud Computing: Concepts, Technology & Architecture, Service Tech press. 2013.
5) Internet of Things: Architectures, Protocols and Standards, Simone Cirani, Gianluigi Ferrari, Marco Picone and Luca Veltri, Wiley Publishers, 2018
6) The Internet of Things: From Data to Insight, Carolina Fortuna, John Davies, Wiley Publishers, 2020
7) Introduction to Machine learning, Nils J. Nilsson, Nils Johan Nilsson, Morgan Kaufmann Publishers 1998.
8) Machine learning for dummies, IBM Limited, by Judith Hurwitz and Daniel Kirsch, 2019.
9) Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Gold feder, Princeton University Press, 2016.
10) Blockchain For Dummies, Tiana Laurence, Wiley, 2019.

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	Describe the evolution in new advances in computer science.
CO2	Learn the concepts of Advance computing and to identify problems related to specific research area.
CO3	Understand and analyse the concepts and advances in Cloud Computing, , IoT, Blockchain, Machine Learning etc.
CO4	Understand and analyse the concepts and advances in Parallel Computing
CO5	Understand and analyse the concepts and advances in Blockchain, Machine Learning.

Course code:	PCSE-103.1				
Course Name:	Advanced Machine Learning				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: The objectives of this course are

- To gain knowledge in the areas of Machine Learning.
- To understand algorithms for analysing data.
- To learn advanced algorithms for analytics.

Course Contents

UNIT I-Types of Learning

Definition of learning systems, Goals and applications of machine learning - Types of learning: Supervised learning, Unsupervised learning, Reinforcement Learning. Overview ofclassification: setup, training, test, validation dataset, over fitting.

UNIT II- Classification Algorithms

Issues regarding classification and prediction, Bayesian Classification, Classification by back propagation, Classification based on concepts from association rule mining, Other Classification Methods, Classification accuracy.

UNIT III- Decision Trees

Introduction to Decision trees –Splitting approaches in decision tree - Classification by decision tree induction – Tree pruning methods (Cost complexity pruning - Chi square pruning) – Issues in decision trees –Extended Decision Trees (fuzzy decision trees)

UNIT IV- Clustering Algorithms

Distance Measures – Similarity Functions – Error measures – K-Means algorithm – Fuzzy CMeans algorithm– Hierarchical clustering algorithm– Mixture of Gaussian algorithm– Expectation & Maximization approach – Probabilistic clustering algorithms

UNIT V- Text Analytics

Introduction - Text mining operations -Border increment text mining algorithm - Preprocessing techniques – Feature selection using dimensionality reduction – Support Vector Machine (SVM) – Foundations of NLP.

References:

1) EthemAlpaydin, Introduction to Machine Learning, Third edition, The MIT Press Cambridge.

2) Tom M Mitchell, Machine Learning, McGraw Hill Education
3) Jiawei Han and Micheline Kamber, —Data Mining: Concepts and Techniques‖, Morgan Kaufmann Publishers, 3rd ed, 2010.
4) LiorRokach and OdedMaimon, —Data Mining and Knowledge Discovery Handbook‖, Springer, 2nd edition, 2010.
5) Ronen Feldman and James Sanger, —The Text Mining Handbook: Advanced Approaches in Analysing Unstructured Data‖, Cambridge University Press, 2006.

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	Describe the evolution and new advancements in Machine Learning.
CO2	Learn the concepts of Machine learning and to identify problems related to specific research area.
CO3	To gain knowledge in the areas of Machine Learning.
CO4	To understand algorithms for analysing data.
CO5	To learn advanced algorithms for analytics

Course code:	PCSE-103.2				
Course Name:	Deep Learning				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: The objectives of this course are

- To enable graduates to excel professionally by adapting to the dynamic needs of the industry, academia and research in the field of Information Technology.
- To enable graduates to practice and promote information technologies for societal needs
- To enable graduates to contribute to advancement of information technology by means of research and lifelong learning.

Course Contents

UNIT I- Introduction

Introduction to machine learning- Linear models (SVMs and Perceptron's, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

UNIT II-Deep Networks

History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets Deep Vs Shallow Networks Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning.

UNIT III- Dimensionality Reduction

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet-Training a Convnet: weights initialization, batch normalization, hyperparameter optimization

UNIT IV- Optimization and Generalization

Optimization in deep learning–non-convex optimization for deep networks-Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks-Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

UNIT V- Case Study and Applications

ImageNet, Detection-Audio Wave Net Natural Language Processing, Word2Vec - Joint Detection, Bio Informatics, Face Recognition, Scene Understanding, Gathering Image Captions.

References

1) Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson, 2016
2) Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.
3) https://www.deeplearningbook.org/lecture_slides.html.

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	Describe the evolution and new advancements in Deep Learning.
CO2	Learn the concepts of Deep learning and to identify problems related to specific research area.
CO3	To gain knowledge in the areas of Deep Learning.
CO4	To understand the applications of Deep Learning.
CO5	To learn advanced algorithms for optimization and generalization.

Course code:	PCSE-103.3				
Course Name:	Natural Language Processing				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: The objectives of this course are

- To learn the basics of Natural Language Processing.
- To apply the techniques of Natural Language Processing.
- To understand the role of sentence semantics and pragmatics.

Course Contents

UNIT I

Words – Structure (spellcheck, morphology using FSTs) – Words - Semantics (Basic ideas in Lexical Semantics, WordNet and WordNet based similarity measures, Distributional measures of similarity, Concept Mining using Latent Semantic Analysis) – Words - Semantics (Word Sense Disambiguation; supervised, unsupervised and semi-supervised approaches) – Words - Parts of Speech Tagging

UNIT II

Sentences: Basic ideas in compositional semantics, Classical Parsing (Bottom up, top down, Dynamic Programming: CYK parser) - Sentences: Parsing using Probabilistic Context Free Grammars and EM based approaches for learning PCFG parameters - Language Modelling (basic ideas, smoothing techniques) - Machine Translation (rule based techniques, Statistical Machine Translation (SMT), parameter learning in SMT (IBM models) using EM) - Information Extraction: Introduction to Named Entity Recognition and Relation Extraction

UNIT III

Natural Language Generation: the potential of using ML for NLG - Additional topics: Advanced Language Modelling (including LDA), other applications like summarization, question answering

UNIT IV

Lexical functional grammar, LFG and Indian languages, Tree Adjoining Grammar, Comparing TAG and PG. Automatic parsing: rules based and statistical. Introduction to some other NLP applications, depending on availability of time.

UNIT V

Some applications of machine learning in NLP such as Shallow Discourse Parsing. Statistical machine translation.

References:

1) Jurafsky Dan and Martin James H. "Speech and Language Processing",3rd Edition, 2018.
2) Jurafsky D. and Martin J. H., "Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", 2nd Edition, Upper Saddle River, NJ: Prentice-Hall, 2008.

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	Students will be able to understand Natural Language Processing.
CO2	Application of a probabilistic model of defining language and techniques.
CO3	Analyse semantics and discourse differentiation from an NLP perspective
CO4	Understand the mathematical and linguistic foundations underlying approaches to the above areas in NLP (measured by problem sets and quizzes).
CO5	Design, implement and test algorithms for NLP problems (measured by problem sets).

Course code:	PCSE-103.4				
Course Name:	Big Data Analytics				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: The objectives of this course are

- Fundamentals of Big data
- Fundamental of Map Reduce
- Information Management and Data Privacy and Ethics

Course Contents

UNIT I

Introduction: Big data and its importance, a flood of mythic "start-up" proportions, big data is more than merely big why now? A convergence of key trends, a wider variety of data, the expanding universe of unstructured data, industry examples of big data: Digital marketing and the online world, the right approach, cross channel lifecycle marketing.

UNIT II

Big Data Technology: The elephant in the room: Hadoop's parallel world, old vs. new approaches. Data discovery: Work the way people's minds work, open-source technology for big data analytics, the cloud and big data, predictive analytics moves into the limelight, a brief history of Hadoop, Apache Hadoop and the Hadoop ecosystem.

MapReduce: Analysing the data with Hadoop, map and reduce, java MapReduce, scaling out, data flow, combiner functions, running a distributed MapReduce job, Hadoop streaming, the had oop distributed file system, the design of HDFS, HDFS concepts, blocks, name nodes and data nodes, HDFS federation, HDFS high, availability, the command, line interface, basic file system operations, had oop file systems.

UNIT III

Information Management: The big data foundation, big data computing platforms, big data computation, more on big data storage, big data computational limitations, big data emerging technologies. Business analytics: The last mile in data analysis, geospatial intelligence will make your life better, consumption of analytics, from creation to consumption. Visualizing: How to make it consumable? Organizations are using data

UNIT IV

Data Privacy and Ethics: The privacy landscape, preferences, personalization, and relationships, rights and responsibility, playing in a global sandbox, conscientious and

conscious responsibility, privacy may be the wrong focus can data be anonymized? balancing for counter intelligence.

References

1) Michael Minelli, Michele Chambers, Big Data,Big Analytics, Wiley Publications, 2013
2) Tom White, Hadoop: The Definitive Guide, 3/e, O'Reilly Publications, 2012.
3) Bill Franks Taming, The Big Data Tidal Wave, 1/e, Wiley, 2012.
4) Frank J. Ohlhorst, Big Data Analytics, 1/e, Wiley, 2012

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	Remember and understand the basic concepts/Principles of big data analytics.
CO2	Analyse the various concepts to understand them through case studies.
CO3	Apply the knowledge in understanding practical problems.
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course.

Course code:	PCSE-103.5				
Course Name:	Internet of Things				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: **The objectives of this course are**

- To Understand the Architectural Overview of IoT.
- Understand the vision of IoT from a global context.
- Understand the application of IoT.
- Determine the Market perspective of IoT.

Course Contents

UNIT I

Introduction: The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

UNIT II

IOT Architecture: IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoTarchitecture outline, standards considerations. M2M and IoT Technology.

Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business Processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.

UNIT-III

IOT Layers Protocols: PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART,Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT.

UNIT IV

Internet of things privacy, security and governance: Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.

References:

1) Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1stEdition, Academic Press, 2014.
2) VijayMadisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
3) Peter Waher, "Learning Internet of Things", PACKT publishing,BIRMINGHAM – MUMBAI
4) Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet ofThings", ISBN 978-3642-19156-5 e-ISBN 978-3-642-19157-2,Springer.

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	Remember and understand the basic concepts/Principles of internet of things.
CO2	Analyse the Various Concepts to understand them through case studies.
CO3	Apply the knowledge in understanding practical problems.
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course.

Course code:	PCSE-103.6				
Course Name:	Cyber Security				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: The objectives of this course are

- Explain the objectives of cyber security
- Explain the importance and application of each of confidentiality, integrity, authentication and availability
- Understand various cryptographic algorithms.
- Understand the basic categories of threats to computers and networks
- Describe public-key cryptosystem.
- Describe the enhancements made to IPv4 by IPSec
- Understand Intrusions and intrusion detection
- Discuss the fundamental ideas of public-key cryptography.
- Generate and distribute a PGP key pair and use the PGP package to send an encrypted e-mail message.

Course Contents

UNIT I

Classical Encryption Techniques: Cryptography, cryptanalysis, Security attacks, services & mechanisms, Symmetric Cipher Model, Substitution Techniques, Transportation Techniques, Cyber threats and their defence (Phishing Defensive measures), web-based attacks, SQL injection & Defence techniques, Buffer overflow & format string vulnerabilities, TCP session hijacking (ARP attacks, route table modification) UDP hijacking (man-in-the-middle attacks).

UNIT II

Block Ciphers, Symmetric Key Cryptography & Asymmetric Key Cryptography: Traditional Block Cipher Structure, DES, Triple DES, Block Cipher Design Principles, AES-Structure, Transformation functions, Key Expansion, Blowfish, IDEA, Block Cipher Modes of Operations. Public Key Cryptography: Principles, public key cryptography algorithms, RSA Algorithms, Diffie Hellman Key Exchange, Elliptic Curve Cryptography

UNIT III

Cryptographic Hash Functions & Digital Signatures: Message authentication and Hash Functions, Authentication Requirements and Functions, Message Authentication, Hash Functions and MACs Hash and MAC Algorithms SHA-512, HMAC, Digital Signatures, NIST Digital Signature Algorithm. Key management & distribution. User Authentication: Remote user authentication principles, Kerberos

UNIT IV

Transport Level Security: Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Shell (SSH) Electronic Mail Security: Pretty Good Privacy (PGP) and S/MIME. IP Security: IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management. Firewalls: Need for Fire wall, Types of Firewalls, Firewall Designing principle

References:

1) Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 6th Edition
2) Introduction to Computer Networks & Cyber Security, ChwanHwa Wu, J.David Irwin, CRC press
3) Hack Proofing your Network, Russell, Kaminsky, Forest Puppy, Wiley Dreamtech.
4) Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	Remember and understand the basic concepts/Principles of information security.
CO2	Analyse the Various Concepts to understand them through case studies. .
CO3	Apply the knowledge in understanding practical problems.,
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course.

Course code:	PCSE-103.7				
Course Name:	Advanced Software Engineering				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: The objectives of this course are

- Knowledge of basic SW engineering methods and practices, and their appropriate application.
- Describe software engineering layered technology and Process framework.
- A general understanding of software process models such as the waterfall and evolutionary
- models.
- Understanding of software requirements and the SRS documents.
- Understanding of the role of project management including planning, scheduling, risk
- management, etc.
- Describe data models, object models, context models and behavioural models.
- Understanding of different software architectural styles.
- Understanding of implementation issues such as modularity and coding standards.

Course Contents

UNIT- I

Introduction to Software Engineering: The evolving role of software, Changing Nature of Software, legacy software, Software myths. A Generic view of process: Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), Process patterns, process assessment, personal and team process models.

Process models: The waterfall model, Incremental process models, Evolutionary process models, specialized process models, The Unified process. Software Requirements: Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document. Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.

UNIT- II

Role of Software Design: The nature of the design process; transferring design knowledge; constraints upon the design process and product, recording design decisions, designing with others, context for design, economic factors, assessing design qualities, quality attributes of the design product, assessing the design process.

Transferring Design Knowledge-Representing abstract ideas; design viewpoints, the architecture concept, design methods, design patterns, Design representations, and rationale for design methods. Design Processes and Strategies: The role of strategy in design methods, describing the design process –The D Matrix, design by top-down decomposition, design by composition and organizational influences upon design.

UNIT- III

Designing with objects and components: Designing with objects: design practices for object-oriented paradigm, Object- oriented frame works, Hierarchal object-oriented design process and heuristics, the fusion method, the unified process. Component – based design: The component concept, designing with components, designing components, COTS, Performing User interface design-The Golden rules, Interface analysis and design models, user and task analysis, analysis of display content and work environment, applying interface design steps, user interface design issues, design evaluation.

UNIT- IV

Project Management and Metrics: Project Management: The management spectrum: people, product, process and project, W5HH principle, critical practices. Metrics for Process and Projects: Process metrics, project metrics, size-oriented metrics, function oriented metrics, Object-oriented and use-case metrics, metrics for software quality, integrating metrics within the software process. Project Scheduling and Risk Management: Project Scheduling: Basic concepts, project scheduling, defining a task set and task network, timeline Charts, tracking the schedule, tracking the progress for an OO project, Earned value analysis.

References:

1) Software design, David Budgen, second edition, Pearson education, 2003.
2) Software Engineering: A practitioner's Approach, Roger S Pressman, seventh edition Mc-Graw Hill International Edition, 2009.
3) Software Engineering, Ian Sommerville, seventh edition, Pearson education,2004.
4) Software Project Management, Bob Hughes & Mike Cotterell, fourth edition,Tata McGraw Hill,2006
5) The art of Project management, Scott Berkun, O'Reilly, 2005.

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	Appreciate the engineering nature of software development.
CO2	Describe key activities in software development and the role of modelling.
CO3	Explain key concepts in software development such as risk and quality.
CO4	Explain the basics of an object-oriented approach to software development.
CO5	Describe a simple workflow for interacting with the published literature.

Course code:	PCSE-103.8				
Course Name:	Advanced Database Concepts				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: The objectives of this course are

- To understand the advanced concepts of database in large scale analytics.
- Derive data maintenance, change schema, database update and Benchmark Object Databases.
- To understand the open issues in database technologies.

Course Contents

UNIT I- Parallel and Distributed Databases

Inter and Intra Query Parallelism – Architecture – Query evaluation – Optimization – Distributed Architecture – Storage – Catalog Management – Query Processing - Transactions – Recovery - Largescale Data Analytics in the Internet Context – Map Reduce Paradigm - run-time system for supporting scalable and fault-tolerant execution - paradigms: PigLatin and Hive and parallel databases versus Map Reduce

UNIT II- Active Databases, Temporal and Object Databases

Syntax and Semantics (Starburst, Oracle, DB2) – Taxonomy – Applications – Integrity Management – Workflow Management – Business Rules – Design Principles – Properties – Rule Modularization – Rule Debugging – IDEA methodology – Open Problems. Overview – Data types – Associating Facts – Temporal Query Language – TSQL2 – Time Ontology – Language Constructs – Architecture – Temporal Support – Object Database and Change Management – Change of Schema – Implementing Database Updates in O2 – Benchmark Database Updates – Performance Evaluation.

UNIT III-Spatial, Text and Multimedia Databases

Traditional Indexing Methods (Secondary Keys, Spatial Access Methods) – Text Retrieval – Multimedia Indexing – 1D Time Series – 2d Colour images – Sub pattern Matching – Open Issues – Uncertainties

UNIT IV Complex Queries and Reasoning

Logic of Query Languages – Relational Calculi – Recursive rules – Syntax and semantics of Data log – Fix point semantics – Implementation Rules and Recursion – Rule rewriting methods – Compilation and Optimization – Recursive Queries in SQL – Open issues. Introduction to Big data analytics and No-SQL

References:

1) Ramakrishnan, Gehrke, "Database Management System", Tata McGraw Hill Publications.
2) Carlo Zaniolo, Stefano Ceri "Advanced Database Systems", Morgan Kauffmann Publishers.
3) VLDB Journal.
4) Elmaski & Navathe -Fundamentals of Database Systems, 4th Edition, Pearson Education
5) Database Systems, Thomas Connolly, Carolyn Begg
6) Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2002.

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	Remember and understand the basic concepts/Principles of advanced database systems.
CO2	Analyse the Various Concepts to understand them through case studies.
CO3	Apply the knowledge in understanding practical problems.
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course.

Course code:	PCSE-103.9				
Course Name:	Advanced Network Technologies				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: The objectives of this course are

- Build an understanding of the fundamental concepts of computer networking.
- Familiarize the student with the basic taxonomy and terminology of the computer
- networking area.
- Introduce the student to advanced networking concepts, preparing the student for entry
- Advanced courses in computer networking.
- Allow the student to gain expertise in some specific areas of networking such as the design
- and maintenance of individual networks

Course Contents

UNIT-I

Computer Networks and the Internet: What is the Internet, The Network edge, The Network core, Access Networks and Physical media, ISPs and Internet Backbones, Delay and Loss in Packet-Switched Networks, History of Computer Networking and the Internet Foundation of Networking, Protocols: 5 layer TCP/IP Model, 7-Layer OSI Model, Internet Protocols and Addressing, Equal-Sized Packets Model. ATM - Networking Devices: Multiplexers, Modems and Internet Access Devices, Switching and Routing Devices, Router Structure.

UNIT-II

The Link Layer and Local Area Networks: Link Layer: Introduction and Services, Error-Detection and Error-Correction techniques, Multiple Access Protocols, Link Layer Addressing, Ethernet, Interconnections: Hubs and Switches, PPP: The Point-to-Point Protocol, Link Virtualization. Routing and Internetworking: Network–Layer Routing, Least-Cost-Path algorithms, Non-Least-Cost- Path algorithms, Intradomain Routing Protocols, Interdomain Routing Protocols, Congestion Control at Network Layer

UNIT-III

Logical Addressing: IPv4 Addresses, IPv6 Addresses. Internet Protocol: Internetworking, IPv4, IPv6,Transition from IPv4 to IPv6 – Multicasting Techniques and Protocols: Basic Definitions and Techniques, Intradomain Multicast Protocols, Interdomain Multicast Protocols, Node-Level Multicast algorithms - Transport and End-to-End Protocols: Transport Layer, Transmission Control Protocol(TCP), User Datagram Protocol (UDP), Mobile Transport Protocols, TCP Congestion

Control –Application Layer: Principles of Network Applications, The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, Domain Name System (DNS), P2P File Sharing, Socket Programming with TCP and UDP, Building a Simple Web Server

UNIT-IV

Wireless Networks and Mobile IP: Infrastructure of Wireless Networks, Wireless LAN Technologies, IEEE 802.11 Wireless Standard, Cellular Networks, Mobile IP, Wireless Mesh Networks (WMNs). Optical Networks and WDM Systems: Overview of Optical Networks, Basic Optical Networking Devices, Large-Scale Optical Switches, Optical Routers, Wavelength Allocation in Networks, Case Study: An All-Optical Switch VPNs, Tunneling and Overlay Networks Virtual Private Networks (VPNs), Multiprotocol Label Switching (MPLS), Overlay Networks – VoIP and Multimedia Networking: Overview of IP Telephony, VoIP Signaling Protocols, Real-Time Media Transport Protocols, Distributed Multimedia Networking, Stream Control Transmission Protocol - Mobile A-Hoc Networks: Overview of Wireless Ad-Hoc Networks, Routing in Ad-Hoc Networks, Routing Protocols for Ad-Hoc Networks – Wireless Sensor Networks: Sensor Networks and Protocol Structures, Communication Energy Model, Clustering Protocols, Routing Protocols

References:

1) Data Communication & Networking, B.A. Forouzan.
2) Computer Networks, A.S. Tanenbaum, Prentice Hall, 1992, 3rd edition
3) Data & Computer Communication, William Stallings, McMillan Publishing Co.
4) Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, Keith W.Ross, Third Edition, Pearson Education, 2007
5) Data Communications, Fred Halsall, Pearson Education

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	Independently understand basic computer network technology.
CO2	Understand and explain Data Communications System and its components.
CO3	Identify the different types of network topologies and protocols.
CO4	Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
CO5	Identify the different types of network devices and their functions within a network

Course code:	PCSE-103.10				
Course Name:	Advanced Data Structure and Algorithm				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: **The objectives of this course are**

- To impart the basic concepts of data structures and algorithms.
- To acquaint the student with the basics of the various data structures
- This course also gives insight into the various algorithm design techniques

Course Contents

UNIT I

Introduction To Data Structures: Data Structures: Definition- Time & Space Complexity - Arrays: Representation of arrays, Applications of arrays, sparse matrix and its representation - Linear list: Singly linked list implementation, insertion, deletion and searching operations on linear list - Circular linked list: implementation, Double linked list implementation, insertion, deletion and searching operations.

UNIT II

STACKS and QUEUES: Operations, array and linked representations of stack, stack applications, infix to postfix conversion, postfix expression evaluation - Queues: operations on queues, array and linked representations - Circular Queue: operations, applications of queue

UNIT III

Trees & Graphs: Trees: Definitions and Concepts- Representation of binary tree, Binary tree traversals (Inorder, Postorder, preorder), Binary search trees in arrays– Heaps - AVL Trees – B Trees Graphs: Representation of Graphs- Types of graphs

UNIT IV

Introduction To Algorithms: Definition of Algorithms- Overview and importance of algorithms- pseudocode conventions, Asymptotic notations, practical complexities. Graph Applications: Breadth first traversal – Depth first traversal- -Single source shortest path – Minimal spanning trees – prim's and kruskal's algorithms

UNIT V

Divide And Conquer Algorithms: General Method – Binary Search- Quick Sort- Merge Sort. BACKTRACKING: General method, 8 Queens, Graph coloring, Hamiltonian cycle

References

1) Ellis Horowitz , Sartaj Sahni, Susan Anderson Freed, Second Edition ,"Fundamentals of Data in C", Universities Press
2) E. Horowitz, S. Sahni and S. Rajasekaran, Second Edition ,"Fundamentals ofComputer Algorithms "Universities Press.
3) Seymour Lipschutz ,"Data Structures with C", First Edition, Schaum's outline seriesin computers, Tata McGraw Hill.
4) R.Krishnamoorthy and G.Indirani Kumaravel, Data Structures using C, Tata McGraw-Hill – 2008.
5) A.K.Sharma, Data Structures using C , Pearson Education India,2011
6) G. Brassard and P. Bratley, "Fundamentals of Algorithms", PHI, New Delhi, 1997.
7) A.V. Aho, J.E. Hopcroft, J.D. Ullmann,, "The design and analysis of Computer Algorithms", Addison Wesley, Boston, 1974
8) Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	To introduce the concepts of Data structures and to understand simple linear data structures.
CO2	Learn the basics of stack data structure, its implementation and application
CO3	Use the appropriate data structure in context of solution of given problem and demonstrate a familiarity with major data structures
CO4	To introduce the basic concepts of algorithms
CO5	To give clear idea on algorithmic design paradigms like Divide and conquer and backtracking

Course code:	PCSE-103.11				
Course Name:	Advanced Concept in Image Processing				
Semester /Year:					
		L	T	P	C
		2	1'	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: The objectives of this course are

- Describe and explain basic principles of digital image processing.
- Design and implement algorithms that perform basic image processing (e.g., noise removal and
- image enhancement);
- Design and implement algorithms for advanced image analysis (e.g., image compression, image
- segmentation)
- Assess the performance of image processing algorithms and systems.

Course Contents

UNIT I- Digital Image Fundamentals and Transforms

Elements of visual perception: Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Image sampling and quantization, Basic relationship between pixels: Basic geometric transformations-Introduction to Fourier Transform and DFT: Properties of 2D Fourier Transform, FFT, Separable Image Transforms, Walsh – Hadamard – Discrete Cosine Transform, Haar, Slant – Karhunen – Loeve transforms. Perspective Projection, Spatial Domain Filtering, sampling and quantization.

UNIT II- Image Enhancement Techniques

Spatial Domain methods: Basic grey level transformation, Histogram equalization, Image subtraction, Image averaging, Spatial filtering: Smoothing, sharpening filters, Laplacian filters, Frequency domain filters: Smoothing, Sharpening filters, Homomorphic filtering.

UNIT III- Image Restoration and Image Compression

Model of Image Degradation/restoration process: Noise models, Inverse filtering, Least mean square filtering, Constrained least mean square filtering, Blind image restoration, Pseudo inverse, Singular value decomposition. Lossless compression: Variable length coding: LZW coding, Bit plane coding- predictive coding, DPCM.

Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG, MPEG, Basics of Vector quantization

UNIT IV- Image Segmentation and Representation

Edge detection: Thresholding, Region Based segmentation, Boundary representation: chair codes, Polygonal approximation, Boundary segments: boundary descriptors: Simple descriptors, Fourier descriptors, regional descriptors, Simple descriptors, Texture

References:

1) Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods. Publisher: Pearson Education.
2) Fundamentals of Digital Image Processing, By Anil K Jain
3) Digital Image Processing, By William K Pratt, John Willey (2001)
4) Image Processing Analysis and Machine Vision, By MillmanSonka, Vaclav hlavac, Roger Boyle, Broos/colic, Thompson Learniy (1999).
5) Digital Image Processing and Applications, By, B. Chanda, D. DuttaMagundar, Prentice Hall of India, 2000

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	Remember and understand the basic concepts/Principles of digital image processing.
CO2	Analyse the Various Concepts to understand them through case studies.
CO3	Apply the knowledge in understanding practical problems.
CO4	Execute/Create the Project or field assignment as per the knowledge gained in the course.

Course code:	PCSE-103.12				
Course Name:	Cloud Computing				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: The objectives of this course are

- To provide students with the fundamentals and essentials of Cloud Computing.
- To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.
- To enable students exploring some important cloud computing driven commercial systems and applications.
- To expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

Course Contents

UNIT I

Distributed System Models and Enabling Technologies: Scalable Computing Over the Internet, Technologies for Network Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds, Performance, Security and Energy Efficiency.

UNIT II

Virtual Machines and Virtualization of Clusters and Data Centres: Implementation Levels of Virtualization, Virtualization Structure/Tools and Mechanisms, Virtualization of CPU/Memory and I/O devices, Virtual Clusters and Resource Management, Virtualization for Data Centre Automation.

UNIT III

Cloud Platform Architecture over Virtualized Datacentre's: Cloud Computing and Service Models, Data Centre Design and Interconnection Networks, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms: GAE, AWS and Azure, Inter-Cloud Resource Management.

UNIT IV

Cloud Security: Top concern for cloud users, Risks, Privacy Impact Assessment, Cloud Data Encryption, Security of Database Services, OS security, VM Security, Security Risks Posed by Shared Images and Management OS, XOAR, A Trusted Hypervisor, Mobile Devices and Cloud Security Cloud Security and Trust Management: Cloud Security Defence Strategies, Distributed

Intrusion/Anomaly Detection, Data and Software Protection Techniques, Reputation-Guided Protection of Data Centres.

UNIT V

Cloud Programming and Software Environments: Features of Cloud and Grid Platforms, Parallel and Distributed Computing Paradigms, Programming Support for Google App Engine, Programming on Amazon AWS and Microsoft, Emerging Cloud Software Environments.

References:

1) Barrie Sosinsky: "Cloud Computing Bible", Wiley-India, 2010
2) Rajkumar Buyya, James Broberg, Andrzej M. Goscinski: "Cloud Computing: Principles and Paradigms", Wiley, 2011
3) Nikos Antonopoulos, Lee Gillam: "Cloud Computing: Principles, Systems and Applications", Springer, 2012
4) Ronald L. Krutz, Russell Dean Vines: "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley-India, 2010
5) Tim Mather, Subra Kumara swamy, Shahed Latif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, O'Reilly Media, 2009.

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
CO2	Apply the fundamental concepts in datacentres to understand the trade-offs in power, efficiency and cost.
CO3	Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.
CO4	Analyse various cloud programming models and apply them to solve problems on the cloud.

Course code:	PCSE-103.13				
Course Name:	Advanced Database Management System				
Semester /Year:					
		L	T	P	C
		2	1	2	4

L - Lecture T -Tutorial P -Practical C - Credit

Course Objectives: The objectives of this course are

- To Understand the basic concepts and the applications of database systems
- To Master the basics of SQL and construct queries using SQL
- To understand the relational database design principles
- To become familiar with the basic issues of transaction processing and concurrency control
- To become familiar with database storage structures and access techniques

Course Contents

UNIT I

Data base System Applications, Purpose of Database Systems, View of Data – Data Abstraction Instances and Schemas – data Models – the ER Model – Relational Model – Other Models – Database Languages – DDL – DML – database Access for applications Programs – data base Users and Administrator – Transaction Management – data base Architecture – Storage Manager – the Query Processor. Data base design and ER diagrams – ER Model - Entities, Attributes and Entity sets – Relationships, ER Design Issues – Concept Design – Conceptual Design for University Enterprise. Introduction to the Relational Model – Structure – Database Schema, Keys – Schema Diagrams.

UNIT II

Relational Query Languages, Relational Operations. Relational Algebra – Selection and projection set operations – renaming – Joins – Division – Examples of Algebra overviews – Relational calculus – Tuple relational Calculus – Domain relational calculus. Overview of the SQL Query Language – Basic Structure of SQL Queries, Set Operations, Aggregate Functions – GROUPBY – HAVING, Nested Sub queries, Views, Triggers.

UNIT III

Normalization – Introduction, Non loss decomposition and functional dependencies, First, Second, and third normal forms – dependency preservation, Boyee/Codd normal form. Higher Normal Forms - Introduction, Multi-valued dependencies and Fourth normal form, Join dependencies and Fifth normal form

UNIT IV

Transaction Concept- Transaction State- Implementation of Atomicity and Durability – Concurrent – Executions – Serializability- Recoverability – Implementation of Isolation – Testing for serializability- Lock –Based Protocols – Timestamp Base Recoverability – Implementation of Isolation – Testing for serializability- Lock –Based Protocols – Timestamp Based Protocols- Validation- Based Protocols Multiple Granularity. Recovery and Atomicity – Log – Based Recovery – Recovery with Concurrent Transactions – Buffer Management – Failure with loss of nonvolatile storage-Advance Recovery systems- Remote Backup systems.

UNIT V

File organization: File organization – various kinds of indexes. Query Processing – Measures of query cost - Selection operation – Projection operation, - Join operation – set operation and aggregate operation – Relational Query Optimization – Transacting SQL queries – Estimating the cost – Equivalence Rules.

References

1) Data base System Concepts, Silberschatz, Korth, McGraw hill, Sixth Edition.(All UNITS except III)
2) Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition.
3) Fundamentals of Database Systems, Elmasri Navathe Pearson Education.
4) An Introduction to Database systems, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight Edition for UNIT III..

Course outcome (COs):

Upon successful completion of the course a student will be able to

CO1	Demonstrate the basic elements of a relational database management system
CO2	Ability to identify the data models for relevant problems
CO3	Ability to design entity relationship and convert entity relationship diagrams into RDBMS and formulate SQL queries on the respect data
CO4	Apply normalization for the development of application software's.