CENTRAL UNIVERSITY OF PUNJAB, BATHINDA

Ph.D. in Computer Science and Technology

Session – 2020-22

Department of Computer Science & Technology

Programme Learning outcome

Course Structure of the Programme

Semester-I

Course Code	Course Title	Course Type	Credit Hours			
			L	T	P	Cr
CST.701	Research Methodology	Core	4	0	0	4
CST.702	Research Methodology Lab	Core	0	0	4	2
CST.751	Research And Publication Ethics(RPE)	Core	2	0	0	2
CST.703	Advanced Image Processing	*Opt any one of the courses along with the corresponding Lab. Student can also opt any Course (along with the lab) running in current semester of M.Tech with the due approval from guide.	4	0	0	4
CST.704	Software Metrics and Measurements					
CST.707	Quantum Cryptography					
CST.705	Advanced Image Processing Lab		0	0	4	2
CST.706	Software Metrics and Measurements Lab					
CST.709	Quantum Cryptography Lab					
Total Credits			**10**	**0**	**8**	**14**

Evaluation Criteria
As per UGC guidelines on adoption of CBCS.

Course Code: CST.701
Course Title: Research Methodology

L	T	P	Cr
4	0	0	4

Total Hours: 60

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

- To Formulate research plan, understand scientific literature, build hypothesis and test the results.
- To Develop skills to prepare the research papers and PhD thesis.
- To Use tools like SPSS, Latex and MS office for research work.

UNIT I **Hours: 15**

Research Aptitude: Meaning of Research, Objectives of Research, and Motivation in Research, Types of Research, Research Approaches, and Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is done.

Research Process: Reviewing the literature, Formulation of research problem, Nature and type of variables, Hypothesis - meaning, types, and development of hypothesis and its testing, Meaning & functions of Research Design.

UNIT II **Hours: 15**

Data Analysis: Sources, acquisition and interpretation of data, Quantitative and qualitative data, Graphical representation and mapping of data, Sensitivity Analysis with Data Tables, Optimization with EXCEL Solver, Summarizing Data with Histograms and Descriptive Statistics, Pivot Tables, Summarizing Data with database statistical functions, using correlation, Multiple Regression, Using Sampling to Analyze Data.

UNIT III **Hours: 15**

Scientific and Technical Writing: Role and importance of communication, Effective oral and written communication, Scientific writing, Preparing Research papers for journals, Seminars and Conferences, Technical report writing, Making R&D proposals, Dissertation/Thesis writing, Oral and poster presentation in meetings, seminars, group discussions, Use of modern aids; Making technical presentations.

Research and academic integrity: Plagiarism, copyright issues, ethics in research, and case studies.

UNIT IV **Hours: 15**

Use of Computers in Education and Research: Data analysis tools, e-Library, Search engines related to research, Research paper editing tools like Latex.

Transactional Modes: Lecture, E-tutorial, Self-Learning, lecture and demonstration.

Suggested Readings:

1. Kothari, C. R. (2014). Research methodology (s). New Age International (p)Limited. New Delhi.
2. Kauda J. (2012). Research Methodology: A Project Guide for University Students. Samfunds literature Publications.
3. Dharmapalan B. (2012). Scientific Research Methodology. Narosa Publishing House ISBN: 978-81-8487-180-7.

L	T	P	Cr
4	0	0	4

Code: CST. 707
Course Title: Quantum Cryptography

Total Hours: 60

Course Objectives:

The objective of this course is to:

- To provide fundamental concepts of quantum information processing and cryptography, and take the discussion forward to potentials offered, technological bottlenecks and the way forward.
- To expose the participants to the state-of-the-art in quantum computing and cryptography with its possible impact on the society.

Course Outcomes:

After completion of course, students would be able:

1. To understand the basic concepts and terminologies in quantum information processing and quantum cryptography.
2. To work in the field of quantum information processing and quantum cryptography, and to design efficient quantum algorithms to solve different computing problems.
3. To design new or modify existing quantum cryptographic algorithms for secure key distribution and communications.
4. To grasp the working principle of a quantum computer and understand the impact of noise in real world implementations.
5. To understand some of the long-standing issues in quantum computing, and way forward in Noise-Intermediate-Scale-Quantum and Post Quantum Cryptography era.
6. To understand the current scenario in Google, IBM, D-wave, IonQ etc.

UNIT I **12 Hours**

Basics of Quantum Information and Linear Algebra: Why Quantum Computing, Classical to quantum mechanics,Hilber space, bases and linear independence, operators and matrices, Hermitian and Unitary operators, measurements in quantum mechanics, Einstein-Podolsky-Rosen paradox

UNIT II **14 Hours**

Introduction to quantum information: Qubits and quantum gates, quantum circuits, density operators, pure and mixed states, Bloch sphere, Bell states,

information and entropy, von-Neumann entropy and trace distance, fidelity, No-cloning Theorem

UNIT III **17 Hours**

Entanglement and Nonlocality: Quantum entanglement, bi-partite and multiqubit systems, Bell-type inequalities and nonlocality, entanglement classes and measures, quantum parallelism, Deutsch-Jozsa algorithm.

UNIT IV **17 Hours**

Applications and Quantum Cryptography: Teleportation, dense coding, entanglement swapping, quantum key distribution, quantum cryptographic protocols.

Quantum Noise and Operation: Environments and quantum operations, examples of noisy channels, effect of noise on entanglement and efficiency of communication protocols.

Transactional Modes:

- Lecture cum Demonstration
- Peer Learning/Teaching
- E-tutorial
- Self-Learning

Suggested Readings:

1. Griffiths, D. J. (2016). Introduction to Quantum Mechanics, Reprint edition, United Sates: Pearson Prentice Hall.
2. Bouwmeester, D., Ekert, A., and Zeilinger, A. (2000). The Physics of Quantum Information. Reprint edition. Springer Berlin Heidelberg.
3. Nielsen, M. A., and Chuang, I. L., (2010). Quantum Computation and Quantum Information. New Delhi: Cambridge University Press.

Course Code: CST.702
Course Title: Research Methodology - Lab

L	T	P	Cr
0	0	4	2

Course Outcomes:

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

- To Use data analysis tools.
- To Analyze the research results using data analysis tools.

The Laboratory assignments for this lab will include the assignments from the paper CST-701: Based on MS office, Latex and SPSS.

Lab Assignments will be based on topics studied in CST.701

Suggested Readings:

1. Lab Manual

Course Code: CST.751
Course Title: Research and Publication Ethics (RPE)

L	T	P	Cr
2	0	0	2

Total Hours: 30

Course Outcomes:
After completion of this course, students will be able:

- To Gain a deep knowledge about research misconduct and predatorypublications.
- To Learn indexing and citation databases, open access publications,research metrics.
- To Execute various plagiarism tools for plagiarism check.

UNIT I **7 Hours**

Philosophy, Ethics and Scientific Conduct

1. Introduction to philosophy: definition, nature and scoope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions.
3. Ethics with respect to science and research
4. Intellectual honest and research integrity
5. Scientific misconducts: falsification, fabrication, and plagiarism.
6. Redundant publications: duplicate and overlapping publications, salami slicing
7. Selective reporting and misrepresentation of data.

UNIT II **8 Hours**

Publication Ethics

1. Publication ethics: definition, introduction and importance
2. Best practices/standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributor ship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

UNIT III **8 Hours**

Open Access Publishing

1. Open access publications and initiatives
2. SHERPA/RoME0 online resource to check publisher copyright and self-archiving policies.
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.
5. Group Discussions
   a) Subject specific ethical issues, FFP, authorship
   b) Conflicts of interest
   c) Complaints and appeals: examples and fraud from India and abroad

6. Software tools
Use of plagiarism software like Turnitin, Urkund and other open source software tools.

UNIT IV **7Hours**

Databases and Research Metrics

A. Databases

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics

Impact Factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score. Metrics: h-index, g index, i10 index, altmetrics

Transactional Modes: Lecture ,Case Studies, E-tutorial, Self-Learning

Suggested Readings:

1. Melville, S., and Goddard, W. (1996). Research methodology: An introduction for science & engineering students.South Africa: Juta Academic.

L	T	P	Cr
4	0	0	4

Course Code: CST.703
Course Title: Advance Image Processing

Total Hours: 60

Course Outcomes:

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

- To Discuss the concepts of digital image processing
- To Explain, analyse and implement algorithms for advanced image analysis.
- To Design solutions for complex image processing problems like image retrieval.

UNIT I **15 Hours**

Recognition of image patterns: Introduction to pattern classification, supervised and unsupervised pattern classification, introduction to neural networks as pattern classifiers. Texture and shape analysis: primitives in textures, classification of textures, gray level co-occurrence matrix, texture spectrum.

UNIT II **15 Hours**

Introduction to shape analysis (landmark points, polygon as shape descriptor, dominant points in shape description, curvature and its role in shape determination, polygonal approximation for shape analysis), active contour model, shape distortion and normalization, contour-based shape descriptor, region based shape descriptors.

UNIT III **15 Hours**

Fuzzy set theory in image processing: introduction to fuzzy set theory (fuzzification, basic terms and operations, image as a fuzzy set, selection of the membership function), need for fuzzy image processing, fuzzy methods of contrast enhancement, fuzzy spatial filter for noise removal, smoothing algorithm.

UNIT IV **15 Hours**

Fuzzy approaches to pixel classification (fuzzy c-means algorithm)

Content based image retrieval: introduction, fundamental steps in image retrieval, image features for retrieval, fuzzy similarity measure in an image retrieval System.

Transactional Modes: Lecture and demonstration, Flipped Learning, Peer Learning/Teaching.

Suggested Readings:

1. Acharya, T. and Ray A.K. (2005). Image processing principles and applications, 2005, United States: Wiley Blackwell.
2. Gonzalez, R.C. and Woods, R.E. (2009). Digital Image Processing. New Delhi: Person Education.

Course Code: CST.704
Course Title: Software Metrics and Measurements

L	T	P	Cr
4	0	0	4

Total Hours:60

Course Outcomes:

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

- To Apply software testing knowledge, verification & validation and engineering methods.
- To Design and conduct a software test process for a quality software test.
- To Identify various software testing problems, and solve these problems by designing and selecting software metrics models, testing criteria, strategies, and methods.

UNIT I **15 Hours**

Overview of Software Metrics: Measurement in Software Engineering, Scope of Software Metrics, Measurement and Models Meaningfulness in measurement, Measurement quality, Measurement process, Scale, Measurement validation, Object-oriented measurements,

Goal based framework for software measurement: Software measure classification, Goal-Question-Metrics (GQM) and Goal-Question-Indicator-Metrics (GQIM), Applications of GQM and GQIM.

UNIT II **15 Hours**

Empirical Investigation: Software engineering investigation, Investigation principles, Investigation techniques, Planning Formal experiments, Case Studies for Empirical investigations.

Object–oriented metrics: Object-Oriented measurement concepts, Basic metrics for OO systems, OO analysis and design metrics, Metrics for productivity measurement, Metrics for OO software quality.

UNIT III **15 Hours**

Measuring Internal Product attributes: Software Size, Length, reuse, Functionality, Complexity, Software structural measurement, Control flow structure, Cyclomatic Complexity, Data flow and data structure attributes Architectural measurement.

Measuring External Product attributes: Software Quality Measurements, Aspectes of Quality Measurements, Maintainability Measurements, Usability and Security Measurements.

UNIT IV **15 Hours**

Measuring software Reliability: Concepts and definitions, Software reliability models and metrics, Fundamentals of software reliability engineering (SRE), Reliability management model.

Transactional Modes:

- Lecture cum Demonstration
- Peer Learning/Teaching
- E-tutorial
- Self-Learning

Suggested Readings:

1. Norman E. Fenton, S. L. P fleeger. (1998). Software Metrics: A Rigorous and Practical Approach. International Thomson Computer Press.
2. Stephen H. Kan. (2002). Metrics and Models in Software Quality Engineering. New Delhi: Addison-Wesley Professional.
3. BasuAnirban. (2015). Software Quality Assurance, Testing and Metrics.New Delhi: Prentice Hall India Learning Private Limited.
4. Robert B. Grady. (1992). Practical Software Metrics for Project Management and Process Improvement. New Delhi: Prentice Hall.
5. Katrina D. M. (2002). Applied Statistics for Software Managers. New Delhi: Prentice Hall PTR.

Course Code: CST.705
Course Title: Advanced Image Processing Lab

L	T	P	Cr
0	0	4	2

Learning Outcomes:

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

- To Understand the concepts of image recognition and analysis.
- To Implement some techniques and analyze the result.
- To Use tools like Matlab and Python

Lab Assignments will be based on topics studied in Subject
The Laboratory assignments for this lab will include the assignments from the paper CST-703: Based on Image feature extraction, fuzzy image processing, and image classification.

Suggested Readings:
1. Lab Manual

Course Code: CST.706
Course Title: Software Metrics and Measurements-Lab

L	T	P	Cr
0	0	4	2

Course Outcomes:
The Laboratory assignments for this lab will include the assignments from the paper CST-704

Lab Assignments will be based on topics studied in Subject

Suggested Readings:
1. Lab Manual

Code: CST. 709
Course Title: Quantum Cryptography Lab

L	T	P	Cr
0	0	4	2

Course Outcomes:
At the end of the course the student will be able to:
- To simulate qubits, multi-qubit pure and mixed quantum states, the celebrated Bell states and density matrices associated with entangled systems.
- To simulate quantum circuits composed of single and multi-qubit quantum gates.
- To simulate different measures of entanglement and nonlocality in pure and mixed two and three-qubit states.
- To simulate different noisy channels to analyse the effect of noise on entanglement and efficiency of a protocol.
- To Simulate different quantum information processing protocols such as teleportation, dense coding, and Secret Sharing.

Lab Assignments will be based on topics studied in Subject
The Laboratory assignments for this lab will include the assignments from the paper CST-708: Based on Qubit, Quantum Gates, Density Matrix, Entanglement, Quantum Algorithms, and Applications- Teleportation, dense coding, entanglement swapping, and quantum key distribution.

Suggested Readings:
1. Lab Manual