

SIKKIM UNIVERSITY

(A Central University Established by an Act of Parliament of India, 2007)

**LEARNING OUTCOME - BASED
CURRICULUM**

Ph.D. IN COMPUTER APPLICATIONS

(With effect from Academic Session 2023-24)



DEPARTMENT OF COMPUTER APPLICATIONS

SIKKIM UNIVERISTY

6TH MILE, TADONG - 737102

GANGTOK, SIKKIM, INDIA

1. Preamble

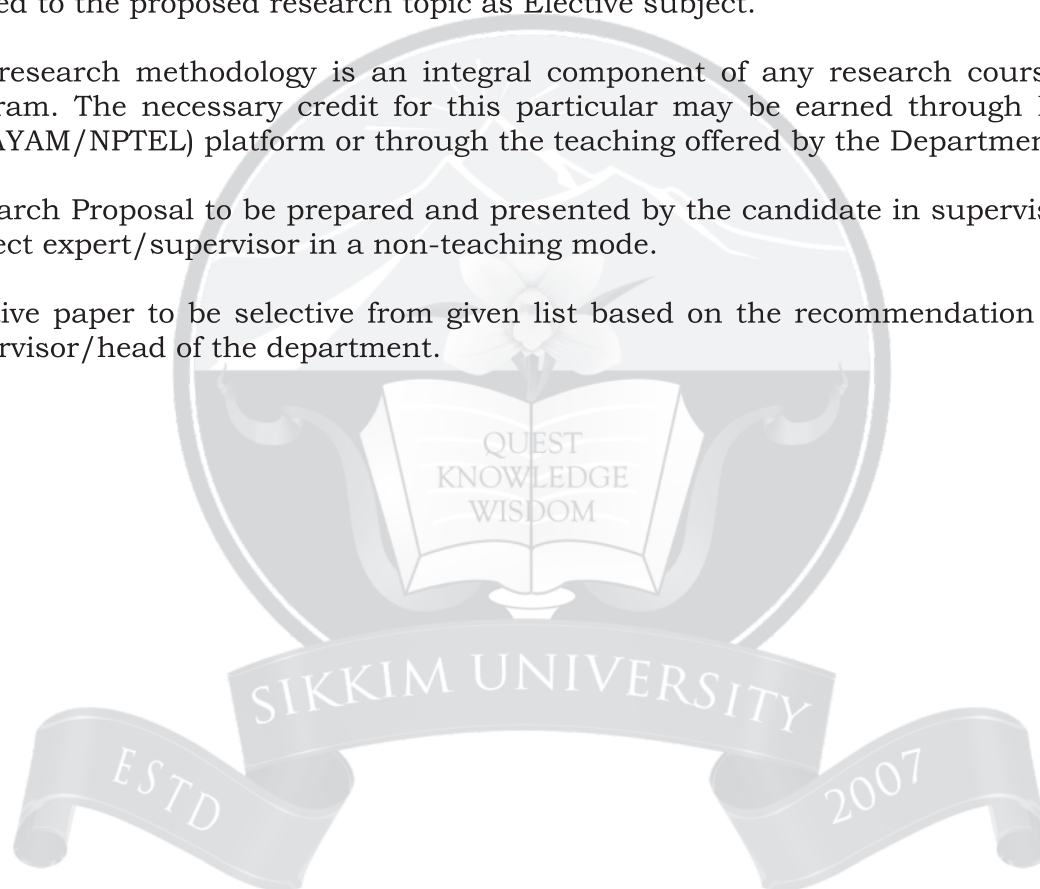
The six-months mandatory course work program is a pre-requisite for the enrolled Ph.D. students, aims to prepare them to start research activities. The course involves the activities associated with scientific research, particularly in the area of Computer Science. It introduces the essential aspects of designing, supporting, and conducting a research project. Those who successfully complete the course will be able to produce a well-developed research proposal, select an appropriate methodology with which to conduct the research, defend the methodology, understand the various tasks required to carry out the research, to find the resources needed to guide them through the research process and the documentation of its findings.

The course-work contains four subjects: Research Methodology, Research and Publication Ethics (RPE) in Computer Science, Proposal Preparation, and one paper related to the proposed research topic as Elective subject.

The research methodology is an integral component of any research coursework program. The necessary credit for this particular may be earned through MOOC (SWAYAM/NPTEL) platform or through the teaching offered by the Department.

Research Proposal to be prepared and presented by the candidate in supervision of subject expert/supervisor in a non-teaching mode.

Elective paper to be selective from given list based on the recommendation of the supervisor/head of the department.



2. Programme Outcomes (POs) for Ph. D

Programme Outcomes (POs)	
PO1	Inclusive Computational Knowledge: Research Students will be able to acquire the complete exposure and full understanding to the theories and practices suitable to their research.
PO2	Problem Identification and Analysis: Through presentations, and discussions, research students will be able to identify and analyze problems and in so doing articulate the key requirements based on their rational thinking ability and by reviewing different available literatures.
PO3	Planning, Design and Development of Solutions: Research scholar will be able to apply a substantial specialised skills in order to act unconventionally in the planning of research. Further, the research scholar will be capable of designing innovative methodologies and applying the same for any given requirement considering the societal as well as environmental aspects.
PO4	Investigations of Complex Computing Problems: Through continuous experiments and research, research students will be able to accomplish investigations to examine and construe data of complex applications to determine valid solutions.
PO5	Usage of Contemporary Tool and Models: Research students will be able to identify, choose and apply current techniques and modern tools that suit the computing requirements.
PO6	Research skills and Professional ethics: Research students by practicing proactive, self-critical and self-reflective approach based on research will be able to enhance their research skills essential to function competently as an individual and as a leader in multidisciplinary research works thereby fulfilling the given task. Further, students will be capable of understanding the professional, security, social, ethical issues that are mandatory to survive in a society.
PO7	Communication Efficacy: Through individual / group presentations, discussions, Brainstorming activities and collaborative concept mapping, research students with their sturdy communication skills will be able to communicate effectively across multidisciplinary teams to achieve a common goal. Further, the students will be capable of presenting and defending original research outcomes.
PO8	Innovations and Employments: Research students will be able to establish a culture that focus on Innovation and in addition critically and ingeniously evaluate current scenario, research and scholarships in their respective discipline thereby paving a way for employment opportunities in future by inculcating the knowledge achieved so far. Also, research scholar will be able to work in collaboration with the stakeholders to advance and exchange research knowledge to influence and benefit society as well as economy as a whole.

3. Course Coding Scheme**3.1 Adopted Course Code**

CA-ABCD

3.2 Acronym used in Course Code

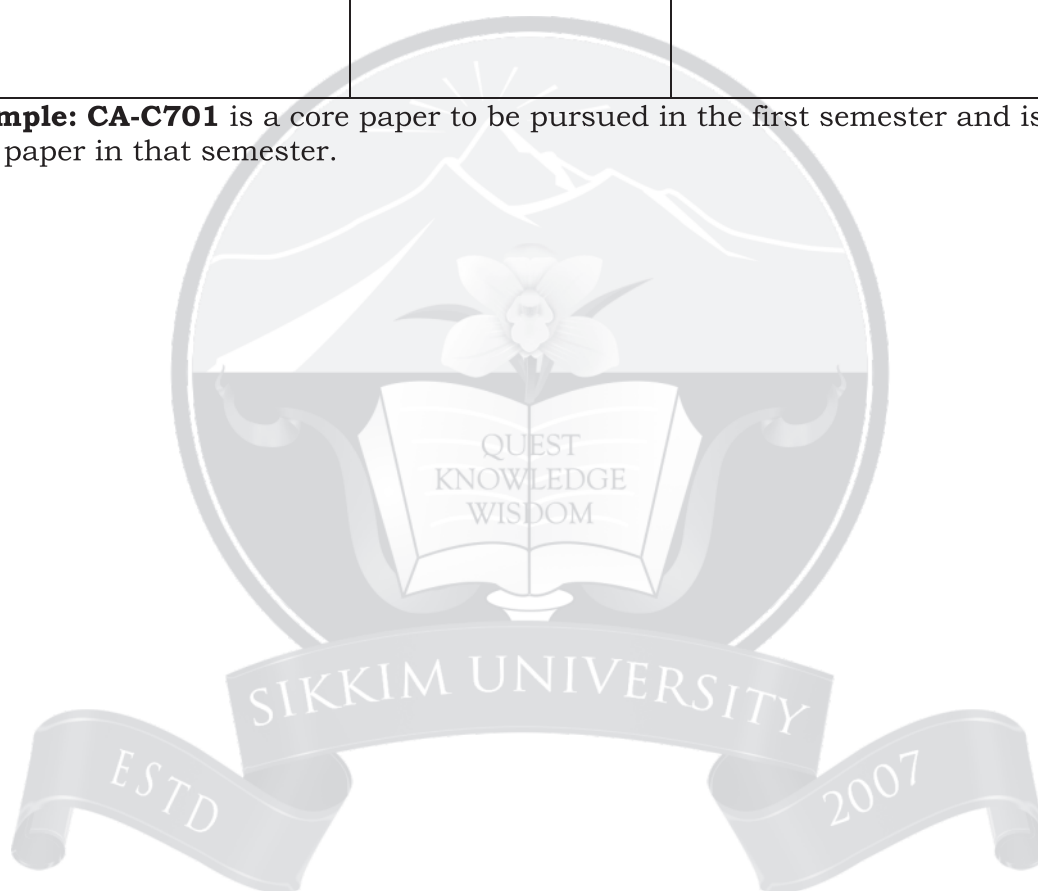
CA – Computer Applications

3.3 Coding for the Papers

Four characters Alpha-Numeric code is used as Paper Code:

A	B	CD
C -Core Subject S - Seminar E -Elective	Level: 7	Paper Code: 01-49

Example: CA-C701 is a core paper to be pursued in the first semester and is the first paper in that semester.



4. Programme Structure**4.1 Total Credits: 14****4.2 Structure of the curriculum****4.3 Course Layout for PhD Programme (Year 2023 Onwards)**

SEMESTER I						
Subject Code	Subject Name	L	T	P	Total Marks	Credit
CA-C701	Research Methodology in Computer Science*	4	0	0	100	4
CA-C702	Research and Publication Ethics (RPE) in Computer Science	1	0	1	50	2
CA-S703	Research Proposal Preparation & Presentation	0	0	4	100	4
CA-E7XX	Elective	4	0	0	100	4
Total					400	14

* The necessary credit for the course may be earned through online SWAYAM/NPTEL.



4.4 Mapping of Courses with Program Outcomes (POs)

Semester	Course Code	Course Name	Program Outcomes (POs)								
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	
I	CA-PHD-C101	Research Methodology in Computer Science	✓						✓	✓	✓
	CA-PHD-C102	Research and Publication Ethics (RPE) in Computer Science	✓	✓	✓	✓			✓	✓	✓
	CA-PHD-S102	Research Proposal Preparation & Presentation		✓	✓	✓			✓	✓	✓
	CA-PHD-E1XX	Elective	✓							✓	✓

**PhD
CA-C701**

Research Methodology in Computer Science

Semester: First Semester Course Level: 700 Total Marks: 100
L+T+P: 3+1+0 = 4 Credits Lecture:45 Hrs+Tutorial:15 Hrs+ Practical 0 Hrs

COURSE LEARNING OUTCOMES:

Upon completion of this course students should be able to do the following:

CLO1: Understand and comprehend the basics of research methodology and applying them in their research initiatives.

CLO2: Understand the importance of research publications and its types.

CLO3: Understand the importance of research design, its types and help them to select an appropriate research design.

CLO4: Formulate sound research problems identifying its constituents with well-defined objectives.

CLO5: Deploy appropriate review technique for deriving knowledge of the accomplishments and the areas open for research.

CLO6: Document various aspects of research using tools like latex.

CLO7: Promote ethical research.

CLO8: Identify and implement software tools to identify predatory publications and plagiarism check.

CLO9: Verify the correctness of numerous indexing and citation databases and as well gain knowledge about the various research metrics such as -index, g index, i10 index, etc.,

Unit-I: Introduction and Types of Research

- Introduction: Research and its importance, Objectives and motivation of research, Steps in scientific research.
- Types of Research: Types, Research process and steps in it, Hypothesis, Research proposals and aspects.

Unit-II: Research Design, Tools of research, and Formulating research problems

- Research Design: Need, Problem definition, research design concepts, research design process, errors in research. Tools of research: Resources, Measurements for Computer Science research, Statistics, Data analysis tools.
- Formulating research problems: Finding a problem, stating the problem, identifying subproblems.

Unit-III: Review, Research Planning and Documentation

- Review: Literature review, Reading a paper, Critique, Survey. Research Planning: The scientific methods, Research planning, Data analysis.
- Documentation: Characteristics and organization of a paper, writing effective paper, Prewriting considerations, thesis writing, formats of report writing, formats of publications in research journals.

Unit-IV: Latex and Ethics of Research

- Latex: Exposure to LaTeX, Installation, MikTeX, Tex-Editors, Creating reports and articles, Latex environments, Figures, Tables, BibTeX - reference manager, Camera Ready Preparation.

SUGGESTED TEACHING LEARNING STRATEGIES:

(These activities are only indicative; the Faculty member can innovate any)

- Problem solving.
- Group discussions.

ASSESSMENT FRAMEWORK:**Assessment****Formative Marks: 30****Summative Marks: 70****Written Modes**

Sessional,
Assignments

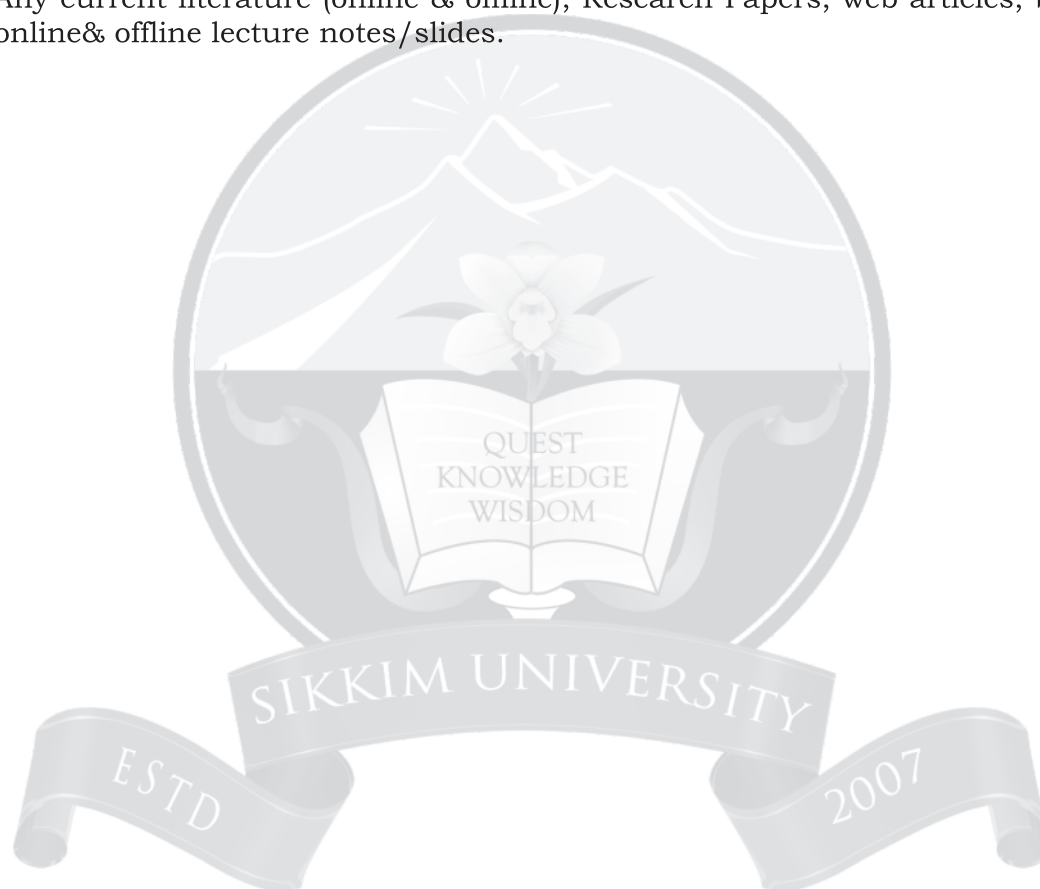
Semester-end examinations conducted by the university will be considered the mode of summative assessment.

Integrated Modes

Quiz, Presentation, Seminars,
Poster Presentations.

SUGGESTED READINGS:

- Any current literature (online & offline), Research Papers, web articles, blogs, online& offline lecture notes/slides.



CA-C702**Research and Publication Ethics (RPE) in Computer Science****Semester: First Semester****Course Level: 700****Total Marks: 100****L+T+P: 1+0+1 = 2 Credits****Lecture:45 Hrs+Tutorial:15 Hrs+ Practical 0 Hrs****COURSE LEARNING OUTCOMES:**

On completing the course, the students will be able to:

CLO1: Get acquainted to and apply the rules, regulations, issues, options, and scientific resources of research ethics and apply the same to research

CLO2: Build a have a positive outlook towards continued learning and practice of research philosophy & ethics

CLO3: To acquire the culture of fair, honest and integrity in creation and communications of research motivations and its findings

CLO4: Encourage original contributions to advance academic, research and scholarship

CLO5: Avoid wasteful and duplicate publications

CLO6: Understand the purpose, necessity and value of ethical decision-making in research motivations

CLO7: Acquire and apply, knowledge & professional competence and attain expertise in Patents, Copyrights, and other forms of Intellectual Property Rights

Unit-I: Philosophy, Ethics and Scientific Conduct

- Introduction to Philosophy: definition, nature and Scope, Concept, Branches
- Ethics: definition, moral philosophy, nature of moral judgements and reaction
- Ethics with respect to science and research
- Intellectual honesty and research integrity
- Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
- Redundant publications: duplicate and overlapping publications, salami slicing
- Selective reporting and misrepresentation of data.

Unit-II: 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 behavior and vice versa, types
- Violation of publication ethics, authorship and contributor-ship
- Identification of publication misconduct, complaints and appeals
- Predatory publishers and journals

Unit-III: Practice - Open Access Publishing, Publication Misconduct, Databases and Research Metrics

- Open access publications and initiatives
- SHEERPA/RoMEO online resource to check publisher copyright & Self – archiving policies
- Software tool to identify predatory publications developed by SPP
- Journal finder /Journal suggestion tools viz. JANE., Elsevier journal Finder, Springer Journal Suggester, etc.

- Group Discussions
 - 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-IV: Practice - 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, SNIP, SJR, IPP, Cite Score
 - Metrics: h-index, g index, i10 index, altmetrics

SUGGESTED TEACHING LEARNING STRATEGIES:

(These activities are only indicative; the Faculty member can innovate any)

- Problem solving
- Group discussions

ASSESSMENT FRAMEWORK:

Assessment

Formative Marks: 30

Summative Marks: 70

Written Modes

Sessional, Quiz, Assignments

Semester-end examinations conducted by the

university will be considered the mode of summative assessment.

Integrated Modes

Presentation, Seminars, Poster Presentations.

SUGGESTED READINGS:

- Bird, A. (2006). Philosophy of Science. Routledge
- MacIntyre, Alasdair (1967) A Short History of Ethics. London
- P. Chaddah, (2018) Ethics in Competitive Research: Do not get Scooped; do not get Plagiarized, ISBN :978-9387480865
- 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.
- Resnik, D. B. (2011) What is ethics in research & why is it important. National institute of Environmental Health Science, 1-10 Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
- Beall, J. (2012) Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. <https://doi.org/10.1038/489179a>
- Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019), ISBN: 978-81-939482-1-7.
- https://www.insaindia.res.in/pdf/Ethics_Book.pdf
- Ray, P. P. (2022) A Guide to Research and Publication Ethics, New Delhi Publishers, ISBN: 978-93-91012-21-2

CA-S703
Research Proposal Preparation & Presentation

Semester: First Semester

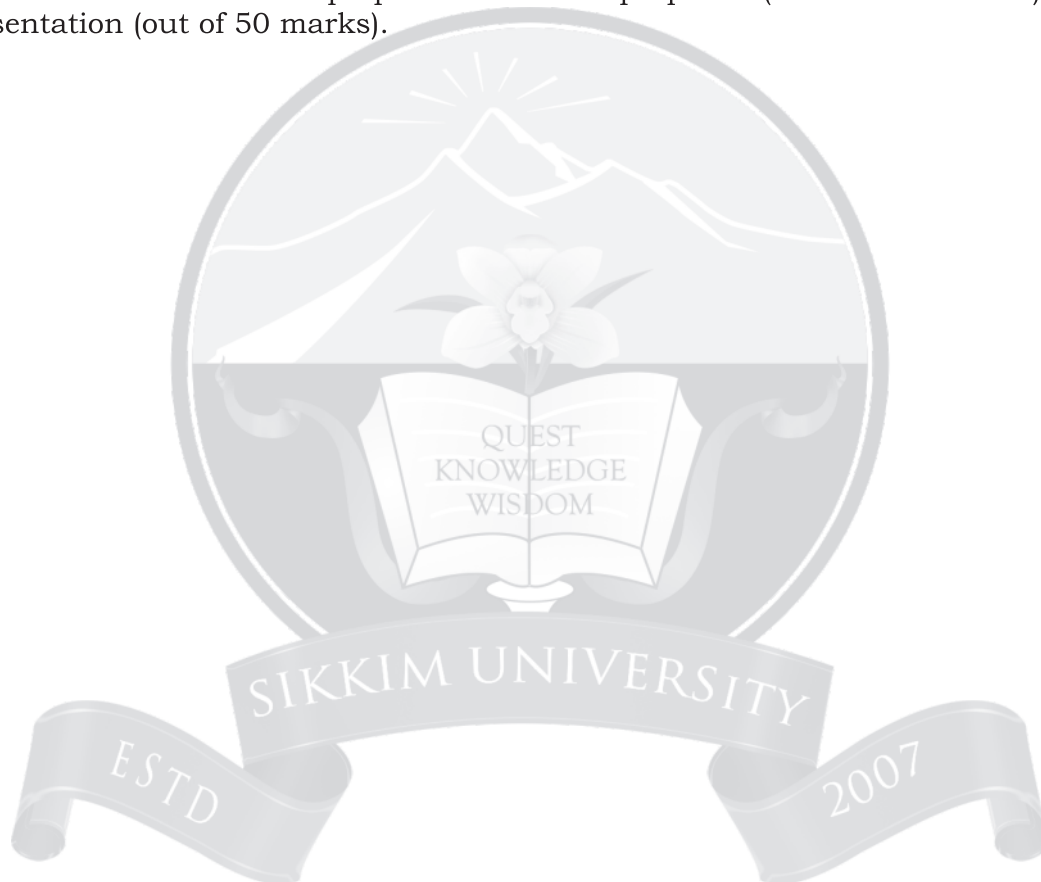
Course Level: 700

Total Marks: 100

L+T+P: 0+0+4 = 4 credits

Credits Lecture:60 Hrs

It is a 4-credit course to be undertaken by the candidate in a self-learning mode under the supervision of any prospective supervisor/subject expert. It involves literature review, state-of-the-art study, drawing motivation towards novel research ideas and write a research proposal based on the study. Candidate needs to present his proposal at the end of the semester in front of the appropriate Research Committee. There will be no sessional tests and no attendance requirement for this paper. The performance of the candidate will be evaluated based on the prepared research proposal (out of 50 marks) and presentation (out of 50 marks).



**CA-E7XX
Elective**

Semester: First Semester**Course Level: 700****Total Marks: 100****L+T+P: 3+1+0 = 4 Credits****Lecture:45 Hrs+Tutorial:15 Hrs+Practical:0 Hrs**

This course will be offered by the Department. The selection of the paper to be decided by the head/supervisor of the scholar. The detailed syllabus for each subject is a mere guideline. Concerned teacher may teach any essential and latest topic as he/she considers deem fit in addition to the listed topics. Students are encouraged and free to refer any current literature to get into any latest topic in a particular paper. List of Electives papers are given below:

Sl. No	Code	Name
1	CA-E704	Data Science
2	CA-E705	Machine Learning
3	CA-E706	Artificial Intelligence
4	CA-E707	Data Mining
5	CA-E708	Cryptography & Network Security
6	CA-E709	Cloud Computing
7	CA-E710	Internet of Things
8	CA-E711	Bioinformatics
9	CA-E712	Operation Research
10	CA-E713	Digital Image Processing
11	CA-E714	Cyber Security

The detailed content of the papers is same with the Elective-I in MCA course (2 Years) of the Department and available in Annexure-I in the 2-Year MCA syllabus. The above list will be updated time-to-time to accommodate new research related topics on the recommendation of the supervisors and after due approval by the University.

