Government College of Engineering
Chhatrapati Sambhajinagar
(An Autonomous Institute of Government of Maharashtra)

Curriculum for M. Tech. in Computer Science & Engineering
(NEP Compliant)

(With Effect from Academic Year 2026-27)

Dr. Vikul Pawar
Head CSE

Dr. Anil Karwankar
Dean Academics

M.Tech. Computer Science & Engineering Curriculum
With effect from Academic Year 2026-2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Vision of the Institute

To be globally recognized leader in technical education through industry integration and societal wellbeing.

Mission of the Institute

1. To build career-ready graduates through multidisciplinary learning and industry-sync curricula.
2. To promote ecosystem for cutting-edge research, patents, publications, IPR, innovation, technology transfer and entrepreneurship.
3. To be a premier trusted partner of government allied bodies, industries, and society.

Vision of the Department

To nurture technically proficient, socially responsible, and industry-ready computer professionals and researchers.

Mission of the Department

1. To foster strong foundational and advanced knowledge in computer science through industry-driven curricula.
2. To cultivate an ethical, innovative, and research-oriented academic environment that promotes collaboration, leadership, and holistic development.
3. To promote lifelong learning and professional adaptability through industry-relevant skills and experiential learning.

Program Educational Objective(s)

After graduation and few years of graduation, the Computer Science & Engineering graduates would

PEO 1: Technical Expertise: Implement fundamental domain knowledge of core courses for developing effective computing solutions by incorporating creativity and logical reasoning.

PEO 2: Successful Career: Deliver professional services with updated technologies in computer science based career.

PEO 3: Soft Skills: Develop leadership skills and incorporate ethics, team work with effective communication & time management in the profession.

PEO 4: Life Long Learning: Conduct research among computing professionals as per market needs.

Program Outcome(s)

After graduation Students will be able to

PO1: Apply knowledge of mathematics, science and algorithm in solving complex Computer engineering problems.
PO2: Generate solutions by conducting experiments and applying techniques to analyze and interpret data.
PO3: Design component, or processes to meet the needs within realistic constraints.
PO4: Identify, formulate, and solve Software Engineering, Networking and Data Mining problems.
PO5: Comprehend professional and ethical responsibility in computing profession.

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PO6: Express effective communication skills.
PO7: Participate in global, economic, environmental, and societal context.
PO8: Recognize the need for, and an ability to engage in life-long learning.
PO9: Knowledge of contemporary issues and emerging developments in computing profession.
PO10: Utilize the techniques, skills and modern computer Engineering tools, Software and techniques necessary for Engineering practice.
PO11: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
PO12: Design research problems and conduct research in computing environment.

M. Tech. Programme Components

<table>
<tr><th colspan="2">Components</th><th>Total Credits</th></tr>
<tr><td>Programme Core Course (PCC)</td><td>Program Courses</td><td>20</td></tr>
<tr><td>Programme Elective Course (PEC)</td><td>Program Electives</td><td>10</td></tr>
<tr><td>Open Elective (OEC) other than a particular program</td><td>Open Electives</td><td>02</td></tr>
<tr><td>Vocational and Skill Enhancement Course (VSE)</td><td>Skill Courses</td><td>02</td></tr>
<tr><td>Ability Enhancement Course (AEC) Technical Presentation</td><td rowspan="3">Humanities Social Science and Management (HSSM)</td><td>02</td></tr>
<tr><td>Entrepreneurship / Economics/ Management Courses (EEM)</td><td>02</td></tr>
<tr><td>Indian Knowledge System (IKS)</td><td>02</td></tr>
<tr><td>Research Methodology (RMC)</td><td rowspan="2">Experiential Learning Courses</td><td>02</td></tr>
<tr><td>Dissertation / Project / Internship (DIS/INT)</td><td>20</td></tr>
<tr><td>Co-curricular Courses (CCC)</td><td>Liberal Learning Courses</td><td>Audit</td></tr>
<tr><td colspan="2">Total Credits</td><td>62</td></tr>
</table>

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GENERAL COURSE STRUCTURE & THEME

Government College of Engineering, Chhtrapati Sambhajinag
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Teaching and Evaluation Scheme from Academic Year 2026-27 as per NEP - 2020
M. Tech. Program in Computer Science & Engineering

Semester – I

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	PCC	CSPCC5001	Advanced Data Structures	4	0	0	**4**	20	20	60	**100**
2.	PCC	CSPCC5102	Advanced Machine Learning	3	0	0	**3**	20	20	60	**100**
3.	PCC	CSPCC5103	Lab- Advanced Machine Learning	0	0	2	**1**	-	25	-	**25**
4.	PEC	CSPEC5001-3	Programme Elective Course - I	3	0	0	**3**	20	20	60	**100**
5.	PEC	CSPEC5004-6	Programme Elective Course - II	3	0	0	**3**	20	20	60	**100**
6.	AEC	CSAES5101	Seminar			4	**2**		50		**50**
7.	ELC	CSELC5111	Research Methodology	2	0	0	**2**	10	10	30	**50**
8.	CC	INCCC5001	Yoga/Club	-	-	2	**-**	-	-	-	**-**
Total				15	0	8	**18**	90	165	270	525

Programme Elective Course – I	**Programme Elective Course – II**
1. CSPEC5001 Advanced Cloud Computing 2. CSPEC5102 Advanced Computer Network 3. CSPEC5003 Soft Computing	1. CSPEC5004 Intelligent Systems 2. CSPEC5005 Distributed Computing Systems 3. CSPEC5006 Internet of Things with Raspberry Pi

Semester – II

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Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	PCC	CSPCC 5011	Advanced Data Mining	**4**	0	0	**4**	20	20	60	**100**
2.	PCC	CSPCC 5112	Recommender Systems	**4**	0	0	**4**	20	20	60	**100**
3.	PCC	CSPC C5113	Computer Vision	3	0	0	**3**	20	20	60	**100**
4.	PCC	CSPC C5014	Lab- Computer Vision	0	0	2	**1**	-	25	-	**25**
5.	PEC	CSPEC 5107,5 110,11	Programme Elective Course - III	4	0	0	**4**	20	20	60	**100**
6.	VSEC	CSVS E5101	Mini Project	0	0	4	**2**	-	25	25	**50**
7.	OE	CSOE C5102	Open Elective – I*	2	0	0	**2**	20	20	60	**100**
Total				**17**	**0**	**6**	**20**	**100**	**150**	**325**	**575**

Programme Elective Course – III
1. CSPEC5110 Big Data Analytics
2. CSPEC5107 Speech and Natural Language Processing
3. CSPEC5111 High Performance Computing

Open Elective – I*
1. CSOEC5002 Professional Ethics and Cyber Laws

*** Equivalent online courses (NPTEL/SWAYAM/MOOC/COURSERA/OTHERS) will be approved by BoS Chairman**

List of Open Electives I to be offered in PG Semester II (First Year)

Sr. No.	Course code	Open Elective Course	Course offering Department
1	AMOEC5001	Basics of Finite Element Analysis	Applied Mechanics
2	CSOEC5102	Professional Ethics & Cyber Law (Not for CSE PG Students)	CSE
3	CEOEC6103	Disaster Management	Civil
4	MEOEC6104	Additive Manufacturing (Not for Mechanical PG Students)	Mechanical
5	EEOEC5101	Data Science for Engineering Applications (Not for Electrical PG Students)	Electrical
6	ECOEC5007	Artificial Intelligence of Things	E&TC

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Semester – III

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	IKS	INIKS 6001 Vedic	Vedic Approach to Mathematics	2	0	0	**2**	10	10	30	**50**
2.	HSSM		Economics / Management Course	2	0	0	**2**	10	10	30	**50**
3.	ELC	CSDI S6101	Dissertation – I	0	0	20	**10**	-	100	100	**200**
Total				4	0	20	**14**	20	120	160	300

List of Humanities –II to be offered in PG Semester – III NEP Compliant Curriculum

Sr. No.	Course code	Humanities Course	Course offering Department
1	MEEEM6101	Entrepreneurship Skills	Mechanical
2	ECEEM6004	AI Governance and Ethics	E&TC
3	MEEEM6103	Industrial Management	Mechanical
4	CEIKS6001	Ancient Water management Practices	Civil

Semester – IV

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	ELC	CSDIS 6102	Dissertation – II/OJT	-	-	20	**10**	-	100	100	200
Total				**0**	**0**	**20**	**10**	**0**	**100**	**100**	**200**

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CSPCC5001	Advanced Data Structures	
Teaching Scheme	**Examination Scheme**	
Lectures: 04 hrs./ week	**ISE I**	**20 Marks**
Credits:04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Description: Data structures play a central role in modern computer science. In addition, data structures are essential building blocks in obtaining efficient algorithms. This course covers advanced data structures.

Course Outcomes

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

CO1	Understand the implementation of symbol table using hashing techniques.
CO2	Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
CO3	Develop algorithms for text processing applications.
CO4	Identify suitable data structures and develop algorithms for computational geometryproblems.
CO5	Understand the implementation of symbol table using hashing techniques.

Detailed Syllabus:

Unit 1	**Dictionaries:** Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. **Hashing:** Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.
Unit 2	**String algorithms:** Rabin karp algorithm, finger search trees, fibonacii heap ers
Unit 3	**Trees:** Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees
Unit 4	**Text Processing:** Sting Operations, Brute-Force Pattern Matching, The Boyer- Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.
Unit 5	**Computational Geometry:** One-Dimensional Range Searching, Two-Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees**.**

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Text/References:

1. Suman Shah, Shailendra shukla Advance data structures Theory and Applications Ist edition Chapman and Hall ,2019.
2. Peter bras Advance Data Structures, Cambridge University Press, revised Edition 2019
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
4. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

3 - High 2 – Medium 1 –Low

Course outcome	Program Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3						1	1	1			2	1	
CO2	2	3						1	1	1			2	1	
CO3	2	3						1	1	1			2	2	
CO4	2	2	1					2	3	2		1	2	2	
CO5	2	2	1					2	3	2		1	3	3	2

Assessment:
ISE I : In semester evaluations 20 marks, each will be based on Class Test
ISE II:. Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

1. Quiz
2. Assignments
3. Question and answer
4. PowerPoint presentation

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	10	05	10
K2	Understand	05	05	10
K3	Apply	05	05	10
K4	Analyze	00	02	10
K5	Evaluate	00	03	10
K6	Create	00	00	10
Total Marks 100		20	20	60

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Assessment table:

Assessment Tool	**K1, K2**	**K3,K4,K5,K6**
	CO1,CO2,CO3	CO3, CO4,CO5
ISE I (20 Marks)	10	10
ISE II (20 Marks)	10	10
ESE Assessment (60 Marks)	20	40
Total Marks 100	40	60

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CSPCC5102: Advanced Machine Learning

Teaching Scheme		Evaluation Scheme	
Lectures	**3 Hrs/Week**	**ISE I**	**20 Marks**
Tutorial	**-**	**ISE II**	**20 Marks**
Total Credits	**3**	**ESE**	**60 Marks**

Course Description: Machine learning is a branch of computer science that uses algorithms to imitate the way in which humans learn. It uses statistical methods to train algorithms and make predictions. Machine learning is one of the most in-demand Data Science skills, which allows data scientists to increase the accuracy of predictions of algorithms.

Course Outcomes:

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

	Course Outcomes
CO1	Understand the characteristics of machine learning strategies
CO2	Apply various supervised & unsupervised learning methods to real life problems
CO3	Apply advanced ensebled learning models for handling unknown pattern
CO4	Identify and integrate more than one technique to enhance the performance of learning
CO5	Explain the principles of emerging machine learning techniques, including Transformer architectures, attention mechanisms, and Large Language Models (LLMs).

Detailed Syllabus:

Unit 1	Introduction, Examples of Various Learning Paradigms, Perspectives and Issues, Version Spaces, Finite and Infinite Hypothesis Spaces. Classification and Regression Trees, Regression: Linear Regression, Multiple Linear Regression, Logistic Regression, Support vector machine, Naïve Bayes Algorithm
Unit 2	Clustering,Hierarchical Clustering: AGNES, DIANA, Partitional: K-means clustering, K-Mode Clustering, Expectation Maximization, Gaussian Mixture Models,Generative Models (mixture models and latent factor models), Spectral Clustering, Fuzzy C-Means Clustering, Mean Shift Clustering
Unit 3	Ensemble Learning Model Combination Schemes, Voting Methods Bagging, Random Forest, Extra Trees (Extremely Randomized Trees) Boosting, AdaBoost, Gradient Boosting, XGBoost, CatBoost
Unit 4	Learning Theory, Introduction to Reinforcement Learning, Bandit algorithms – UCB, PAC Learning, VC Dimension, Federated Learning, Explainable and Responsible AI
Unit 5	Emerging Machine Learning Techniques, Transformer Architecture and Attention Mechanism, Large Language Models (LLMs): Architecture and Applications, Prompt Engineering and In-Context Learning Retrieval-Augmented Generation (RAG), Transfer Learning and Fine-Tuning

Text and Reference Books:

1. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Prentice Hall of India, Third Edition.
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning",

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MIT Press,.
3. Charu C .Aggarwal,"Data Classification Algorithms and Applications",CRCPress,.
4. Charu C. Aggarwal, "DATA CLUSTERING Algorithms and Applications", CRC Press, 2014.
5. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press,
6. Jiawei Han and Micheline Kambers and Jian Pei,"DataMining Concepts andTechniques",3rd edition, Morgan Kaufman Publications, .

Web Resources:

NPTEL course : Machine Learning :https://onlinecourses.nptel.ac.in/noc20_cs74/preview
Reinforcement Learning :https://onlinecourses.nptel.ac.in/noc20_cs74/preview

Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	1	2							2			1			
CO2	2	2	1	3				1	1	2		2	1	2	
CO3	2	2	1	3				1	2	2		3	1	2	1
CO4	2	2	1	2			2	1	1	2		3	2	3	1
CO5		2	1	2			2	1	3	2		3	3	3	1

3 - High 2 – Medium 1 –Low

Assessment:
ISE I: In semester evaluations (ISE I) of 20 marks, each will be based on Class Test
ISE II: Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

1. Quiz
2. Assignments
3. Question and answer
4. PowerPoint presentation

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**End Semester Examination**
K1	Remember	05	00	12
K2	Understand	10	10	12
K3	Apply	05	10	12
K4	Analyze	00	00	12
K5	Evaluate	00	00	12
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table:

Assessment Tool	**K1, K2**	**K3,K4,K5**
	CO1,CO2	CO3, CO4,CO5
ISE I (20 Marks)	10	10

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ISE II (20 Marks)	10	10
ESE Assessment (60 Marks)	24	36
Total Marks 100	44	56

Special Instructions if any: Nil

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CSPCC5103: Lab Advanced Machine Learning

Teaching Scheme		Evaluation Scheme	
Practical	**2Hrs/Week**	**ISE I**	
Tutorial	**-**	**ISE II(Term Work)**	**25 Marks**
Total Credits	**1**	**ESE**	**-**

Course Outcomes:

After completion of this course students will be able to:

Course Outcomes	
CO1	Learn to perform classification tasks using a python programming.
CO2	Learn to perform clustering tasks using a python programming.
CO3	Demonstrate the working of algorithms ensemble algorithms
CO4	Exercise the RL techniques with varied input values for different parameters.

List of the Experiments:
The student shall perform minimum ten experiments of the following using Python

Sr. No.	Title of the Experiments	Skill / Knowledge Level	CO	Marks for ISE
Level: Basic (all)				
1	Implement Linear regression	S1	CO1	02
2	Implement Logistic Regression	S2	CO2	02
3	Implement EM algorithm	S2	CO2	02
4	Implement Naïve Bayes Classification	S2	CO1	03
5	Implement Random forest Algorithm	S2	CO1	03
Level: Moderate (all)				
6	Implement bagging algorithm	S2	CO3	02
7	Implement LLM based algorithm	S2	CO2	02
8	Implement hierarchical clustering using python	S2	CO2	02
9	Implement boosting algorithm	S2	CO3	02
Level: Complex (all)				
10	Implement reinforced learning to solve any problem .	S3	CO4	03
11	Develop RAG	S2	CO4	02

Assessment:

ISEII: In-Semester Evaluation of 25 marks based on performance of students in practical hours, practical assignments completed, and timely submission.

Assessment Table:

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Assessment Tool	S1	S2, S3
	CO1	CO2,C03, CO4
ISE II (25 Marks)	03	22

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	End Semester Examination
S1	Imitation	03
S2	Manipulation	19
S3	Precision	03
S4	Articulation	00
S5	Naturalizatio n	00
Total Marks		25

Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	1	1	1	2	1		1	2	1	2		1	1	2	1
CO2	2	3	1	1	1		1	2	1	2		1	1	2	1
CO3	3	3	1	2	1		1	2	1	2		2	1		1
CO4	3	3	1	3	1		1	2	1	2		2			1

3 – High 2 – Medium 1- Low

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Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**ISE1**	**20 Marks**
Tutorial		**ISE II**	**20 Marks**
Total Credits	**3**	**ESE**	**60 Marks**

Course description:
Developments in cloud computing technology are transforming the way we live and work. This course will equip students with specialist knowledge in this fast-growing field and allow to explore a range of advanced topics in cloud computing like: Exploring different cloud computing platforms, virtualization, VDC architecture, etc

Course Outcomes:
After successful completion the course, students will be able to:

	Course Outcomes
CO1	To install cloud computing environments.
CO2	To study a survey on cloud building blocks and technologies.
CO3	To perform cloud computing admin and programming using open source tools.
CO4	Identify real time cloud applications in different scenarios appropriate to society
CO5	To study Cloud security aspects

Detailed Syllabus:

Unit 1	Introduction, Roots of Cloud Computing: From mainframe to Cloud, Benefits of Cloud Computing SOA, Web services, Web 2.0, Mashups, Grid computing, Utility computing, Hardware virtualization, Essentials of Cloud characteristics, Challenges, Cloud economics, Role of Networks in Cloud Computing: Cloud types and service models, Cloud computing platforms : Openstack, Opennimbus, Eucalyptus Primary Cloud Service models, Cloud Services brokerage, Primary cloud deployment models, cloud computing reference model, The greenfield and brownfield deployment options
Unit 2	Introduction, Characteristics of Virutalized environments, Taxonomy of Virtualization techniques, Pros and Cons of Virtualization, Technology examples: Xen, KVM, Vmware, Microsoft Hyper-V Infrastructure as Service, best-of breed cloud infrastructure components, cloud ready converged infrastructure, Virtual machine provisioning and migration services, Anatomy of Cloud infrastructure, Distributed management of virtual infrastructure, scheduling techniques, SLA Commitment
Unit 3	Storage system architecture, Big data, Virtualize data centre(VDC) architecture, VDC Environment, server, storage, networking, desktop and application virtualization techniques and benefits, Virtual Machine Components and Process of converting physical to VMs, Block and file level storage virtualization, Virtual Provisioning, and automated storage tiering, VLAN, VSAN and benifits, Network traffic management techniques in VDC, Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo. Features and comparisons among GFS,HDFS.

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Unit 4	Introduction and architecture for federated cloud computing, Performance prediction for HPC on Cloud. SLA management: Types of SLA, Life cycle of SLA, Traditional approaches of SLA. service catalog, service ordering process, management and functional interfaces of services , cloud portal and its functions, cloud interface standards along with SOAP and REST, system integration and work-flow modeling, cloud service life-cycle phases: service planning, service creation, service operation, and service termination Control layer, its functions and benefits,element and unified manager, software defined approach and techniques for managing IT resources
Unit 5	Introduction, Global Risk and Compliance aspects in cloud environments and key security terminologies, Technologies for Data security, Data security risk, Cloud computing and identity, Digital identity and access management, Content level security, Security-As-A-Cloud Service .

Text and Reference Books:

1. RajkumarBuyya, "Cloud computing principles and paradigms", Wiley
2. Gautam Shroff, Enterprise Cloud Computing, Cambridge
3. Handbook of Cloud Computing, Springer Publication
4. RajkumarBuyya, "Mastering Cloud computing", McGraw Hill
5.Tim Mather, Subra K, ShahidL.,Cloud Security and Privacy, Oreilly, ISBN-13 978-81-8404-815-5
6. Dr. Kumar Saurabh,"Cloud Computing", Wiley Publication
7. Greg Schulr,"Cloud and virtual data storage networking",CRC Press
8. Barrie Sosinsky,"Cloud Computing", Wiley India
9. Kailash Jayaswal, " Cloud computing", Black Book, Dreamtech Press
10. Anthony T. Velte, Cloud Computing: A Practical Approach, Tata McGraw Hill, 2009, ISBN: 070683514
11. Richard Hill, Guide to Cloud Computing: Principals and Practices, Springer ISBN-10: 1447146026

Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS O 1**	**PS O 2**	**PS O 3**
CO1	1	1	2					1			2				
CO2	1	1						1		2	2	1			
CO3		2	3	3				2	1	3		1		2	1
CO4			2					2	1	3		1	1	2	1
CO5			2	3	3			2	1	3		1	1		1

3 - High 2 – Medium 1 –Low

Assessment:

ISE I: In semester evaluation (ISE I) of 20 marks, will be based on Class Test.

ISE II: Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

1. Quiz
2. Assignments
3. Question and answer

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4. PowerPoint presentation

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**End Semester Examination**
K1	Remember	10	05	15
K2	Understand	05	05	15
K3	Apply	05	05	15
K4	Analyze	00	05	10
K5	Evaluate	00	00	05
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table:

Assessment Tool	**K1, K2**	**K3,K4,K5**
	CO1,CO2	CO3
ISE I (20 Marks)	10	10
ISE II (20 Marks)	10	10
ESE Assessment (60 Marks)	30	30
Total Marks 100	50	50

Special Instructions if any: Nil

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CSPEC5102 Advanced Computer Network			
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**ISE I**	**20 Marks**
		ISE II	**20 Marks**
Total Credits	**3**	**End-Semester Examination**	**60 Marks**

Course description:

This course discusses the terminology and concepts of the Advance computer network. Subject also discuss the concepts of protocols, network interfaces, and design/performance issues in local area networks and wide area networks, students will be familiar with Network Management and Services. This subject distinguishes between secret and public cryptography. At the end this course assist identify issues in networking technologies.

Course Outcomes:

CO1: To comprehend the advanced computer network knowledge.
CO2: Analyze and implement routing algorithms.
CO3: Evaluate the performances of computer networks
CO4: Design the network protocols using network simulators.
CO5: Discover the knowledge in the field of Software Defined Network.

UNIT 1	Introduction: Brief history of Computer Networks, Network Layer, Transport Layer, and Applications Layer: HTTP and other protocols, Layering abstraction. Network architecture and protocols, Packet switching, Internetworking protocols	
UNIT 2	Addressing, IP versions, routing, Routing in the Internet: Intra and inter domain routing; Unicast Routing Protocols : RIP, OSPF, BGP, Socket programming. Path Vector Routing. Link State Routing.	
UNIT 3	Network Management and Services : SNMP : Concept, Management components, Multi-media over Internet : RTP, RSVP, IP Multicasting, VOIP	
UNIT 4	Cryptography, Enterprise Network Security : DMZ, NAT, Proxy	
UNIT 5	Storage and Networking, Software Defined Networks, Open Stack Networking, Neutron.	

References:

1. B. A. Forouzan , “TCP/IP Protocol Suite”, Tata McGraw Hill edition, Third Edition.
2. N. Olifer V. Olifer, “Computer Networks: Principles, Technologies and Protocols for Network
   design”, Wiley India Edition (1st Edition).
3. Marc Farley, Building Storage Networks , Tata McGraw Hill
4. Thomas D N Adeau and Ken Grey, Software Defined Networking, O'Reilly, 2013
5. SDN and NFV Simplified SDN and NFV Simplified Jim Doherty Copyright © 2016 Pearson Education, Inc. ISBN-13: 978-0-13-430640-7

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6. S. Tanenbaum , "Computer Networks", Pearson Education, Fourth Edition.

NPTEL Course Link: https://onlinecourses.nptel.ac.in/noc23_cs35/preview

Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1			1					3	2					
CO2	1	2	2	3					1						
CO3	1	2		3				1	2				1	2	1
CO4	1	2	3	2	1	1	1	1		2		1		3	1
CO5	1	1			1			1	1			1	3		1

3 - High 2 – Medium 1 –Low

Assessment:

ISE I: In semester evaluations (ISE I) of 20 marks, each will be based on Class Test

ISE II: Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

5. Quiz
6. Assignments
7. Question and answer
8. PowerPoint presentation

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	12
K3	Apply	05	10	12
K4	Analyze	05	00	12
K5	Evaluate	00	00	12
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table:

Assessment Tool	K1, K2	K3,K4,K5
	CO1,CO2	CO3, CO4,CO5
ISE I (20 Marks)	10	10
ISE II (20 Marks)	10	10
ESE Assessment (60 Marks)	24	36
Total Marks 100	44	56

Special Instructions if any: Nil

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Teaching Scheme		Evaluation Scheme	
Lectures	**3 Hrs/Week**	**ISEI**	**20 Marks**
Tutorial	**-**	**ISEII**	**20 Marks**
Total Credits	**3**	**ESE**	**60 Marks**

Course Description:
Soft computing is an emerging approach to computing which parallel the remarkable ability of the human mind to reason and learn in an environment of uncertainty and imprecision. soft computing is the only solution when we don't have any mathematical modelling of problem solving (i.e., algorithm), need a solution to a complex problem in real time, easy to adapt with changed scenario and can be implemented with parallel computing. It has enormous applications in many application areas such as medical diagnosis, computer vision, hand written character recondition, pattern recognition, machine intelligence, weather forecasting, network optimization, etc.

Course Outcomes:
After successful completion the course, students will be able to:

	Course Outcomes
CO1	Identify and describe soft computing techniques and their roles in building intelligent machines
CO2	Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering
CO3	Apply genetic algorithms to combinatorial optimization problems
CO4	Evaluate and compare solutions by various soft computing approaches for a given problem.

Detailed Syllabus:

Unit 1	**INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS:** Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics.
Unit 2	**NEURAL NETWORKS:** Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks
Unit 3	**FUZZY LOGIC:** Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.
Unit 4	**Matlab/Python Lib:** Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic
Unit 5	**Introduction to genetic algorithm,** operators in genetic algorithm –Coding – selection – cross over – mutation, Stopping condition for Genetic algorithm flow, Genetic-neuro hybrid systems, Genetic-Fuzzy rule based systems Recent Trends in deep learning, various classifiers,. Implementation of recently proposed soft computing techniques.

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Text and Reference Books:

1. Robert J. Schalkoff, "Artificial Neural Networks" -MGH
2. S.R.Jang,C.T.sun , "Neuro Fuzzy and Soft Computing ",E.Mizutani-Person
3. S.N.Sivanandam,S.N.Deepa,"Principles of Soft Computing",Second Edition, Wiley India Edition
4. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro: "Fuzzy and Soft Computing ", Prentice:Hall of India, 2003.
5. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic:Theory and Applications", Prentice Hall, 1995.

Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	2	1				1	1		2	2	1	1	
CO2	3	1						2	2	2	2	2	1	1	
CO3	3	2	3	3				2	2			3	2	2	1
CO4	3	3						3	3			3	1	2	1

3 - High 2 – Medium 1 –Low

Assessment:

ISE I : In semester evaluations (ISE I) of 20 marks, each will be based on Class Test I .

ISE II: Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

1. Quiz
2. Assignments
3. Question and answer
4. PowerPoint presentation

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	05	15
K2	Understand	05	05	15
K3	Apply	05	05	15
K4	Analyze	05	05	10
K5	Evaluate	00	00	05
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table

Assessment Tool	K1, K2	K3
	CO1,CO2	CO3, CO4
ISE I (20 Marks)	10	10
ISE II (20 Marks)	10	10
ESE Assessment (60 Marks)	24	36
Total Marks 100	44	56

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Special Instructions if any: Nil

CSPEC5004 : Intelligent Systems			
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**ISE I**	**20 Marks**
		ISE II	**20 Marks**
Total Credits	**3**	**End-Semester Examination**	**60 Marks**

Course Description:

This course discusses the terminology and concepts of intelligent Systems. This subject elaborates the concepts of Inference systems and rule based system. Students will be familiar with handling uncertainty in intelligent systems and also will be familiar with symbolic learning. Students will learn the genetic algorithm.

Course Outcomes Expected:

After Completing the course student will be able to

CO1: To understand the fundamentals of Intelligent system.
CO2: Analyze and apply the rule-based system for maintaining consistency.
CO3: Apply the fuzzy logic conception.
CO4: Design the optimization algorithm using search space searching.
CO5: Discover the knowledge of Genetic algorithm for optimization.

UNIT 1	Introduction: Intelligent Systems, A Spectrum of Intelligent Behavior, Knowledge-Based Systems, The Knowledge Base, Deduction, Abduction, and Induction, The Inference Engine, Declarative and Procedural Programming, Expert Systems, Knowledge Acquisition, Search, Computational Intelligence, Integration with Other Software.
UNIT 2	Rule-Based Systems: Rules and Facts, A Rule-Based System for Boiler Control, Rule Examination and Rule Firing, Maintaining Consistency, The Closed-World Assumption, Use of Local Variables within Rules, Forward Chaining (a Data-Driven Strategy), A Hybrid Strategy, Explanation Facilities,
UNIT 3	Handling Uncertainty: Uncertainty, Review of Probability, Probabilistic Reasoning, Bayesian Network, Inferencein Bayesian Network. Agents, Objects, and Frames: Birds of a Feather: Agents, Objects, and Frames, Intelligent Agents, Agent Architectures, Multiagent Systems, Swarm Intelligence, Objects and Agents.
UNIT 4	Symbolic Learning: Introduction, Learning by Induction, Case-Based Reasoning (CBR), Single-Candidate Optimization Algorithms: Optimization, The Search Space, Searching the Parameter Space, Hill-Climbing and Gradient Descent Algorithms.
UNIT 5	Genetic Algorithms for Optimization: Introduction, The Basic GA, Selection,

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	Elitism, Multiobjective Optimization, Gray Code, Variable Length Chromosomes, Building Block Hypothesis, Selecting GA Parameters, Monitoring Evolution, Finding Multiple Optima, Genetic Programming.

References:

1. Adrian A. Hopgood, "Intelligent Systems for Engineers and Scientists", 3rd Edition CRC Press, ISBN: 9781498783798.
2. George A. Anastassiou, "Intelligent Systems II Complete Approximation by Neural Network Operators".

NPTEL Course Link: https://nptel.ac.in/courses/108104049

Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1				1	1				3	2					
CO2	1	1			1			1	1	3					
CO3	1	3	1	1				1		1			1	2	1
CO4	1	2	3	2				1		2		1		3	1
CO5				2	1		1		3	1			1		1

3 - High 2 – Medium 1 –Low

Assessment:

ISE I: In semester evaluations (ISE I) of 20 marks, each will be based on Class Test

ISE II: Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

9. Quiz
10. Assignments
11. Question and answer
12. PowerPoint presentation

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	12
K3	Apply	05	10	12
K4	Analyze	05	00	12
K5	Evaluate	00	00	12
K6	Create	00	00	00
Total Marks 100		20	20	60

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Assessment table:

Assessment Tool	**K1, K2**	**K3,K4,K5**
	CO1,CO2	CO3, CO4,CO5
ISE I (20 Marks)	10	10
ISE II (20 Marks)	10	10
ESE Assessment (60 Marks)	24	36
Total Marks 100	44	56

Special Instructions if any: Nil

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Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**ISE I**	**20 Marks**
Tutorial	**-**	**ISE II**	**20 Marks**
Total Credits	**3**	**ESE**	**60 Marks**

Course Description:

Distributed computing is the method of making multiple computers work together to solve a common problem. It makes a computer network appear as a powerful single computer that provides large-scale resources to deal with complex challenges. This course introduces distributed Computing Systems architecture and the concepts of distributed file system. It explores communication in distributed system along with communication protocols.

Course Outcomes:

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

	Course Outcomes
CO1	To understand the basics of Computing Systems and its functionalities
CO2	To study distributed Computing system concepts agreement protocols and Create models for distributed Computing systems.
CO3	To learn basics of agreement problem along with its solution
CO4	To learn concurrency control and properties of transaction in Distributed Computing systems.
CO5	Apply different techniques learned in the distributed Computing system

Detailed Syllabus:

Unit 1	**Introduction**: Introduction to Distributed Computing Systems, System Models, and Issues in Designing a Distributed Operating System, Examples of distributed systems.
Unit 2	Features of Message Passing System, Synchronization and Buffering, Introduction to RPC and its models, Transparency of RPC, Implementation Mechanism, Stub Generation and RPC Messages, Server Management, Call Semantics, Communication Protocols and Client Server Binding.
Unit 3	Introduction, Design and implementation of DSM system. Granularity and Consistency Model, Advantages of DSM, Clock Synchronization, Event Ordering, Mutual exclusion, Deadlock, Election Algorithms.
Unit 4	Task Assignment Approach, Load Balancing Approach, Load Sharing Approach, Process Migration and Threads.
Unit 5	File Models, File Accessing Models, File Sharing Semantics, File Caching Schemes, File Replication, Atomic Transactions, Cryptography, Authentication, Access control and Digital Signatures.

Text and Reference Books:

1. Pradeep. K. Sinha: "Distributed Operating Systems: Concepts and Design**"**, PHI, 2007.
2. George Coulouris, Jean Dollimore, Tim Kindberg: "Distributed Systems", Concept and Design, 3rd Edition, Pearson Education, 2005.

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3. A.D. Kshem kalyani, M. Singhal, "Distributed Computing: Principles, Algorithms, and Systems", ISBN: 9780521189842, paperback edition, Cambridge University Press, 4. MarchHagitAttiya, Jennifer Welch , "Distributed Computing: Fundamentals, Simulations, and Advanced Topics",Wiley

Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	1	1	1						1	2		1			
CO2	1	1	2					1	1	2		2			
CO3	2	1	2					1	2	2		2			
CO4	1	1	2					2	3	2		2		1	
CO5	1	1	3					2	3	3	1	3	2	1	1

3 - High 2 – Medium 1 –Low

Assessment:
ISE I: In semester evaluations (ISE I) of 20 marks, each will be based on Class Test

ISE II: Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

1.Quiz
2. Assignments
3.Question and answer
4. PowerPoint presentation

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	10	10	12
K3	Apply	05	10	12
K4	Analyze	00	00	12
K5	Evaluate	00	00	12
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table:

Assessment Tool	**K1, K2**	**K3,K4,K5**
	CO1,CO2	CO3, CO4,CO5
ISE I (20 Marks)	10	10
ISE II (20 Marks)	10	10
ESE Assessment (60 Marks)	24	36
Total Marks 100	44	56

Special Instructions if any: Nil

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CSPEC5006 **:** Internet of Things & Raspberry Pi

Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**ISE I**	**20 Marks**
Tutorial	**-**	**ISE II**	**20 Marks**
Total Credits	**3**	**ESE**	**60 Marks**

Course Description: Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defense sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT.

Course Outcomes:

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

	Course Outcomes
CO1	Identify applicability of IoT in given scenario
CO2	Illustate installation on IoT platform
CO3	Develop programs for Raspberry Pi
CO4	Develop web services
CO5	Apply Security to IoT App

Detailed Syllabus:

Unit 1	**What Is the Internet of Things (IoT)** Introduction to IOT,Introduction to the Internet of Things, Background, What is Internet of Things (IoT)?, Introduction to Embedded System, Embedded Boards, General Introduction to Arduino Boards, Are Mobile Phones IoT devices? IoT Platforms, Wearable Platform, Embedded Platforms, Cloud Platform for IoT, What IoT means for the developers
Unit 2	**IOT Platforms** Getting Started With Arduino Development Environment, Basics of Arduino C Program, Writing our First Arduino Program, Simple Blinking Program, Taking Input from Serial Port, Working With Digital Switches, Working with Sensors (Touch Switch Example), User Defined Functions, ArdOS – Installation, Working With ArdOS
Unit 3	**Introduction to Raspberry Pi with Raspbian OS** Raspberry Pi system specifications Ports, Pins and their uses , Raspberry Pi with Raspian OS, Setting Up Raspian OS, Configuring your Raspian, GUI - Lightweight X11 Desktop Environment" or in short LXDE, File system layout (Logical layout, Physical Layout) Installing and uninstalling software - Finding Software, Installing Software, Uninstalling Software, Upgrading Software, "Hello World" Programming on Raspberry Pi
Unit 4	**Web Service & Sensors** Creating a Web Service to be consumed by connected Devices via Internet, Working with Sensors like, proximity sensors, temperature sensor, image sensor, rfid sensor etc
Unit 5	**Securing IoT Apps**- Introduction to Wireless Hacking, Security Model and Threat Taxonomy for Internet of Things (IoT), Privacy Issues in Smart Devices, Introduction to Lightweight Symmetric Cryptosystem, Public Key Cryptography for IoT

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Text and Reference Books:

1. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley-Blackwell.
2. **Cuno** Pfister, "Getting started with the internet of things" , ISBN 9781449393571

Web Resources:

NPTEL course: **Introduction To Internet Of Things**
https://onlinecourses.nptel.ac.in/noc22_cs53/preview

Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1								2	2	1	2	2	1	1	
CO2								1	1	1	2			1	
CO3	2	2	1	2			2	1	2	3		2	2	2	1
CO4	2	2	1	2			2	2	3	3		3	3	2	1
CO5		1	1					2	3	1	2	2	3	2	3

3 - High 2 – Medium 1 –Low

Assessment:

ISE I: In semester evaluations (ISE I) of 20 marks, each will be based on Class Test

ISE II: Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

1. Quiz
2. Assignments
3. Question and answer
4. PowerPoint presentation

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	10	10	12
K3	Apply	05	10	12
K4	Analyze	00	00	12
K5	Evaluate	00	00	12
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table:

Assessment Tool	**K1, K2**	**K3,K4,K5**
	CO1,CO2	CO3, CO4,CO5
ISE I (20 Marks)	10	10
ISE II (20 Marks)	10	10
ESE Assessment (60 Marks)	24	36
Total Marks 100	44	56

Special Instructions if any: Nil

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CSAEC5101 **Seminar**		
TeachingScheme	**Examination Scheme**	
Practical:04Hrs. /Week	**ISEII**	**50 Marks**
Credit:02	**ESE**	

Course Objectives:

1. **Develop the ability to identify, review, and critically analyze** contemporary research literature in their chosen area of specialization.
2. **Enhance technical writing, presentation, and communication skills** through the preparation and delivery of a structured seminar.
3. **Prepare for dissertation research** by identifying research gaps, emerging trends, and potential future research directions while adhering to ethical research practices.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Conduct a comprehensive literature survey and critically analyze recent research in the chosen area of specialization.
CO2	Prepare and present a technical seminar report using appropriate research methodologies, academic writing standards, and presentation techniques.
CO3	Identify research gaps, evaluate emerging trends, and propose potential future research directions to support dissertation work.

Detailed description:

Course Description

1. The Seminar course is designed to develop students' research aptitude, critical thinking, technical communication, and presentation skills. Each student shall select a contemporary research topic related to their area of specialization in consultation with the assigned faculty supervisor. The selected topic should preferably align with the proposed dissertation work and focus on recent advancements, emerging technologies, or current research challenges.
2. Students are required to conduct a comprehensive literature survey using research articles published in reputed journals and conferences indexed in databases such as IEEE Xplore, ACM Digital Library, Springer, Elsevier, Scopus, and Web of Science. The literature review should critically analyze existing methodologies, compare their strengths and limitations, identify research trends, and highlight unresolved research problems or gaps.
3. Based on the literature survey, students shall prepare a well-structured seminar report that includes the introduction, motivation, objectives, detailed literature review, comparative analysis, research gap, future scope, and conclusion. The report must follow standard academic writing practices with appropriate citations and references while maintaining research ethics and avoiding plagiarism.
4. Each student shall deliver a technical seminar before a departmental evaluation committee using effective presentation techniques and suitable visual aids. The presentation should clearly explain the selected topic, summarize key research contributions, discuss comparative findings, and justify the identified research gap. Students are expected to respond confidently to questions and participate actively in technical discussions.
5. The seminar course encourages independent learning, analytical thinking, technical writing, scholarly communication, and ethical research practices. It also prepares students for dissertation work, research publication, and lifelong learning by strengthening their ability to review scientific literature, evaluate emerging technologies, and communicate research outcomes effectively.

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6. Student has to exhibit the continuous progress review through regular reporting and presentations.
7. The candidate shall submit the report on Seminar in standard format for satisfactory completion of the work, duly approved and certified by the concerned guide, Head of the Department and Principal.
8. The candidate will be assessed during ESE by two examiners, one of whom will be the guide and other is necessarily an external examiner appointed by the BoS / Head of Department / BoS Chairman. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation and report.

Assessment:

ISE II- Continuous Assessment of individual student

Maximum Marks-50

CSELC5111 Research Methodology		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs. / Week	**ISEI**	**10Marks**
Credits: 02	**ISEII**	**10 Marks**
	EndSemesterExamination	**30 Marks**

Course Objectives:

1. To guide students from understanding foundational research concepts to critically formulating research problems, culminating in the adept creation of comprehensive research plans and literature reviews.
2. To develop a comprehensive understanding of various research methods, both qualitative and quantitative
3. To facilitate students in analysing, evaluating, and creating research proposals.
4. To attain mastery in data collection methods, sampling, data analysis techniques, and result interpretation for robust research outcomes.
5. To Equip students with the skills to proficiently create and present diverse research reports, encompassing various formats, oral delivery, technical writing, and ethical awareness regarding plagiarism.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Develop the ability to comprehend core research concepts, define key elements like variables and hypotheses, and critically evaluate literature to identify research gaps.
CO2	Justify their chosen research methods and explain their advantages and limitations.
CO3	Proficient in using data analysis techniques relevant to their chosen research methods, such as statistical analysis for quantitative research or thematic analysis for qualitative research.

Detailed Syllabus:

Unit 1	**Introduction to RM:** Meaning of Research, Objectives of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem, Selecting the Problem, Technique Involved in Defining a Problem, Research Design, Important Concepts Relating to Research Design, Developing a Research Plan, Literature review.
Unit 2	**Methods of Research:** Qualitative and quantitative methods of research like Historical, case study, ethnography, exposit facto, documentary and content analysis, survey (Normative, descriptive, evaluative etc.) field and laboratory experimental studies. Characteristics of methods and their implications in research area.
Unit 3	**Methods of data collection:**Concept of sampling and other concepts related to sampling. Probability and non-probability samples, their characteristics and implications. Tools of data collections, their types, attributes and uses. Redesigning, research tools-like questionnaire, opinionnaire, observation, interviews, scales and tests etc. **Report Writing:** Meaning of Interpretation, Techniques of Interpretation, Significance of Report Writing, Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Writing a technical paper, plagiarism and its implications.

Text and Reference Books

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1. Garg B.L., Karadia R., Agarwal F. and Agarwal U.K., An introduction to Research Methodology, RBSA Publishers, 2002
2. Kothari C.R., Research Methodology: Methods and Techniques. New Age International, 1990.
3. Merriam S. B., Tisdell E. J., Qualitative Research: A Guide to Design and Implementation, 4th edition, John Wiley & Sons, 2016.
4. Creswell J. W., Research Design: Qualitative, Quantitative and Mixed Methods Approaches, 4th edition, SAGE Publications, Inc, 2014.
5. Olsen C., Devore J., Peck R., Introduction to Statistics and Data Analysis, 5th edition, Brooks/Cole, 2015.
6. Panneerselvam R., Research Methodology, 2nd edition, PHI Learning, 2014.

Assessment: ISEI(Class Test),ISEII (TA) & ESE
TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	02	06
K2	Understand	10	08	24
K3	Apply	00	03	09
K4	Analyze	05	04	12
K5	Evaluate	00	03	09
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3		
CO2	2	2	2		
CO3	2		3	1	

1 – Low, 2 – Medium, 3 – High

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Semester II

CSPCC5011: Advanced Data Mining

Teaching Scheme		**Evaluation Scheme**	
Lectures	**4 Hrs/Week**	**ISE I**	**20 Marks**
Tutorial	**-**	**ISE II**	**20 Marks**
Total Credits	**4**	**ESE**	**60 Marks**

Course Description: The objective of this course is to introduce Advanced Data Mining techniques. Application of data mining in web mining, pattern matching ,time series and cluster analysis is included to aware students of broad data mining areas.

Course Outcomes:
After successful completion the course, students will be able to:

	Course Outcomes
CO1	Understand the characteristics of advanced data mining techniques
CO2	Apply various unsupervised learning methods to real life problems
CO3	Apply sequential mining to data streams
CO4	Apply advanced data mining to time series data
CO5	Study different web mining techniques

Detailed Syllabus:

Unit 1	Data Mining: Characteristics, Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods;
Unit 2	Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns. Clustering graph and network data, advanced cluster analysis.
Unit 3	Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis;
Unit 4	Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis
Unit 5	Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.

Text and Reference Books:

1. Jiawei Han and M Kamber, Data Mining Concepts and Techniques,, Second Edition, Elsevier Publication, 2011.
2. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley, 2006.
3. G Dong and J Pei, Sequence Data Mining, Springer, 2007.

Web Resources:

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NPTEL course : Data mining https://onlinecourses.nptel.ac.in/noc21_cs06/preview

Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	1								2	1		2	1	1	
CO2	2	2	1	2				2	2	2		2	2	1	1
CO3	2	2	1	2				1	3	2		3	2	1	1
CO4	2	3	1	2				2	3	2		3	2	2	1
CO5	2	3	1	3				2	3	2		2	3	3	1

3 - High 2 – Medium 1 –Low

Assessment:
ISE I: In semester evaluations (ISE I) of 20 marks, each will be based on Class Test

ISE II: Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

1. Quiz
2. Assignments
3. Question and answer
4. PowerPoint presentation

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**End Semester Examination**
K1	Remember	05	00	12
K2	Understand	10	10	12
K3	Apply	05	10	12
K4	Analyze	00	00	12
K5	Evaluate	00	00	12
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table:

Assessment Tool	**K1, K2**	**K3,K4,K5**
	CO1,CO2	CO3, CO4,CO5
ISE I (20 Marks)	10	10
ISE II (20 Marks)	10	10
ESE Assessment (60 Marks)	24	36
Total Marks 100	44	56

Special Instructions if any: Nil

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Teaching Scheme		Evaluation Scheme	
Lectures	**4 Hrs/Week**	**ISE I**	**20 Marks**
Tutorial	**-**	**ISE II**	**20 Marks**
Total Credits	**4**	**ESE**	**60 Marks**

Course Description: This course is process seeks to predict user preferences. This specialization covers all the fundamental techniques in recommender systems, from non-personalized and project-association recommenders through content-based and collaborative filtering techniques

Course Outcomes

Students will be able to:

CO1	Relate techniques for making recommendations, including non-personalized, content- based, and collaborative filtering
CO2	Illustrate automation of a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations.
CO3	Apply techniques for making recommendations, including non-personalized, content-based, and collaborative filtering
CO4	Evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy, diversity, product coverage, and serendipity
CO4	Design recommendation system for a particular application domain

Detailed Syllabus:

Unit 1	**Introduction:** Overview of Information Retrieval, Retrieval Models, Search and Filtering Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding rating Applications of recommendation systems, Issues with recommender system.
Unit 2	**Content-based Filtering:** High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.
Unit 3	**Collaborative Filtering:** User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems. Transformer-based Recommendation Models LLM-Enhanced Collaborative Filtering, Prompt-based Personalized Recommendation
Unit 4	**Hybrid approaches:** Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design:, Limitations of hybridization strategies, Knowledge-Based Hybrid Recommender Systems Deep Learning-Based Hybrid Recommendation, Retrieval-Augmented Generation (RAG) for Personalized Recommendation

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Unit 5	**Types of Recommender Systems:** Recommender systems in personalized web search, knowledge-based recommender system, Social tagging recommender systems, Trust-centric recommendations, Group recommender systems. Evaluation of RS, Deep Learning-Based Recommender Systems

Text/References:

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, CambridgeUniversity Press (2011), 1st ed.
2. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer (2016), 1st ed.
3. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011),1st ed.
4. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer(2013), 1st ed.

Research papers : "Recommende System Challenges and Solution survey", IEEE 2019 International Conferences.

Mapping of Course Outcomes with Program outcomes

Course outcome	Program Outcomes														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1		1	1				1	1	1	1			1	2	
CO2	1	1	1				1	1	1	1			1	2	
CO3	1	1	1				1	1	1	1		2	1	2	
CO4	1		2				2	2	3	1		3	3	2	2
CO5		1	2				2	2	3	1		3	3	2	1

3 - High 2 – Medium 1 –Low

Assessment:

ISE I : In semester evaluations 20 marks, each will be based on Class Test

ISE II:. Teachers Assessment of 20 marks is based on one of the / or combination of few of the following: 1. Quiz
2. Assignments
3. Question and answer
4. PowerPoint presentation

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	10	05	10
K2	Understand	05	05	10
K3	Apply	05	05	10
K4	Analyze	00	02	10
K5	Evaluate	00	03	10
K6	Create	00	00	10
Total Marks 100		20	20	60

Assessment table:

Assessment Tool	**K1, K2**	**K3,K4,K5,K6**
	CO1,CO2	CO3, CO4,CO5
ISE I (20Marks)	10	10
ISE II (20 Marks)	10	10
ESE Assessment (60 Marks)	20	40
Total Marks 100	40	60

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Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**ISE I**	**20 Marks**
Tutorial		**ISE II**	**20 Marks**
Total Credits	**3**	**ESE**	**60 Marks**

Course Description:
This course provides an introduction to computer vision, including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification, scene understanding, and deep learning with neural networks.

Course Outcomes:
After successful completion the course, students will be able to:

	Course Outcomes
CO1	Identify basic concepts, terminology, theories, models and methods in the field of computer vision.
CO2	Articulate the known principles of human visual system in terms of mathematical representation.
CO3	Illustrate the basic methods of computer vision related to edge detection and detection of other primitives, stereo, motion and object recognition.
CO4	Suggest a design of a computer vision system for a specific problem.
CO5	Analyze the Statistical texture description.

Detailed Syllabus:

Unit 1	Introduction, Background, requirements and issues, human vision, Image formation: geometry and photometry, Geometry, photometry (brightness and color), quantization, camera calibration.
Unit 2	Image segmentation and Feature Extraction, Various methods of image segmentation, edge detection, SIFT features, Multi-view Geometry, Shape from stereo and motion.
Unit 3	Object Recognition: Traditional methods, Image features, Various classifiers (Nearest Neighbor, Bayes, SVM).
Unit 4	Introduction to Neural Networks and Deep Learning, Neural networks, loss functions, optimization methods, Image Classification and Object Detection, LeNet, AlexNet, VGG, ResNet, EfficientNet, RCNN, Faster RCNN, YOLO, SSD, FPN.
Unit 5	Vision Transformers, Transformer architecture, application to image classification and object detection, Fully Convolutional Networks.

Text and Reference Books:
1. Digital Image processing and Computer Vision", Sonka-Hlavac-Boyle, CENGEAGE LEARNING
2. Image Processing for Computer Graphics and Vision, Jonas Gomes, Luiz Velho, Alejandro C. Frery, Springer publication, 2ndedi.
3.Computer Vision, A Modern Approach, David Forsyth, Jean Ponce,ISBN-13: 978-0136085928
4. Computer Vision: Algorithms and Applications (Texts in Computer Science), Richard Szeliski ,Springer,ISBN-13: 978-1848829343

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Web Resources:
NPTEL course : Digital Image Processing
https://onlinecourses.nptel.ac.in/noc22_ee116/preview

Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	1	3					2	1	1		2	1		
CO2	3	1	3				1	2	2	2		2	2		1
CO3	2	2	2				2	2	3	2		2	2	1	1
CO4	1	2	3				1	3	2	1		2	2	1	1
CO5	1	1	1				1	1	2	1		1	3	1	1

3 - High 2 – Medium 1 –Low

Assessment:
ISE I: In semester evaluations (ISE I) of 20 marks, each will be based on Class Test
ISE II: Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

1. Quiz
2. Assignments
3. Question and answer
4. PowerPoint presentation

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**End Semester Examination**
K1	Remember	05	00	10
K2	Understand	10	05	10
K3	Apply	05	10	15
K4	Analyze	00	05	15
K5	Evaluate	00	00	10
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table:

Assessment Tool	**K1, K2**	**K3,K4, K5**
	CO1,CO2	CO3, CO4,CO5
ISE I (20 Marks)	10	10
ISE II (20 Marks)	10	10
ESE Assessment (60 Marks)	20	40
Total Marks 100	40	60

Special Instructions if any: Nil

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CSPCC5014 : Lab Computer Vision

Teaching Scheme		Evaluation Scheme	
Practical	**2 Hrs/Week**	**ISE II**	**25 Marks**
Total Credits	**1**	**ESE**	

Course Outcomes Expected:

After Completion of this course student will be able to

CO1: To process grey scale image and generate histogram equalization.

CO2: To apply filtering techniques to enhanced quality of input image.

CO3: To apply edge detection methods and segmenting the images.

CO4: To extract the features from images.

Suggestive list:

To display gray scale images.

To implement histogram equalization.

To design non-linear filtering.

To implement 2-D DFT and DCT model

To determine the edge detection problem.

To implement Edge Detection, Line Detection and Corner Detection.

To implement Segmentation problem using.

Write a program to compute the SIFT feature descriptors of the image.

To implement Project based on Computer Vision Applications.

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Teaching Scheme		**Evaluation Scheme**	
Lectures	**4 Hrs/Week**	**ISE I**	**20 Marks**
Tutorial	**-**	**ISE II**	**20 Marks**
Total Credits	**4**	**ESE**	**60 Marks**

Course Description:
This course includes the concepts and techniques of Natural language processing foranalyzing word sense based on part of speech and Constituency parsing & analyzing speech signal in time and frequency domain.

Course Outcomes:
After successful completion the course, students will be able to:

	Course Outcomes
CO1	Describe the mathematical and linguistic foundations underlying approaches for NLP modules in Text processing and speech recognition.
CO2	Demonstrate the working of sequence models for text processing.
CO3	Use signal processing techniques to analyze and represent the speech signal.
CO4	Discuss statistical approach for automatic speech recognition including featureextraction, acoustic modeling and language modeling.
CO5	Develop a deep learning models associated with the design, implementation,training and deployment of speech and text processing.

Detailed Syllabus:

Unit 1	**Language Model and Part-of-Speech-** Different Levels of NLP,Text Normalization, Minimum Edit Distance, N-gram Language Models Smoothing ,Huge Language Models , Perplexity's Relation to Entropy , Part-of- Speech Tagging , HMM for Part-of-Speech Tagging, Viterbi algorithm ,Named Entities and Named Entity Tagging , Conditional Random Fields (CRFs) - Evaluation of Named ,Entity Recognition.
Unit 2	**Constituency Parsing and Lexical Semantics -** Introduction to Parsing , Linguistic Constituents and Constituency tests, Partial or Shallow Parsing, Dependency Parsing , Word Senses , Relations Between Senses, WordNet: A Database of Lexical Relations, Methods for Word Sense Disambiguation.
Unit 3	**Feature Representation for Natural Language Processing-** Vector Semantics - Words and Vectors - Cosine for measuring similarity -TF-IDF: Weighing terms in the vector - Point wise Mutual Information (PMI) - Neural Language Models - WordEmbeddings: Word2Vec, Glove and Fast text.
Unit 4	**Deep learning architecture for NLP-** RNNs as Language Models,Stacked and Bidirectional RNN architectures, LSTM , Self-Attention Networks: Transformers, Transformers as Language Models , Applications of NLP: Sentiment analysis, Question and answering, Chat Bot.
Unit 5	**Automatic Speech Recognition:-** Introduction Acoustic feature: Speech production, Raw Waveform, MFCC, Phones, Statistical Speech Recognition: Acoustic Models, Language Model, HMM Decoding , Error Metrics ,DNN/HMM Hybrid ,Text to Speech , WaveNet for Text to Speech.

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Text and Reference Books:

1.Dan Jurafsky, James H. Martin "Speech and Language Processing", Draft of 3rdEdition, Prentice Hall 2022.
2. Uday Kamath, John Liu, James Whitaker "Deep Learning for NLP and SpeechRecognition", 1st Edition, Springer 2019.
3. Ben Gold, Nelson Morgan, Dan Ellis "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", 2nd Edition, John Wiley & Sons, 2011.
4. Jacob Benesty, M. M. Sondhi,Yiteng Huang "Springer Handbook of Speech Processing" , 1st Edition, Springer, 2008

Research papers : Natural Language Processing and its applications in machine translation: Adicronic Review" , IEEE 2020 3rd international Conference.

Web Resources:

NPTEL course :1. https://onlinecourses.nptel.ac.in/noc23_cs45/preview
2. https://archive.nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs56/

Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	1	1					2	2	1	2	2			
CO2	2	1	1					1	2	1	2	2			
CO3	2	2	1					1	3	1		2	1	2	1
CO4	2	2	1					2	3	1		3		3	1
CO5	2	1	1					2	3	1	2	3	3	2	3

3 - High 2 – Medium 1 –Low

Assessment:
ISE I: In semester evaluations (ISE I) of 20 marks, each will be based on Class Test

ISE II: Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

1. Quiz
2. Assignments
3. Question and answer
4. PowerPoint presentation

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	10	10	12
K3	Apply	05	10	12
K4	Analyze	00	00	12
K5	Evaluate	00	00	12

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K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table:

Assessment Tool	**K1, K2**	**K3,K4,K5**
	CO1,CO2	CO3, CO4,CO5
ISE I (20 Marks)	10	10
ISE II (20 Marks)	10	10
ESE Assessment (60 Marks)	24	36
Total Marks 100	44	56

Special Instructions if any: Nil

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CSPEC5110 : Big Data Analytics

Teaching Scheme		**Evaluation Scheme**	
Lectures	**4 Hrs/Week**	**ISE I**	**20 Marks**
Tutorial	**-**	**ISE II**	**20 Marks**
Total Credits	**4**	**ESE**	**60 Marks**

Course Description: This course gives an overview of Big Data Analytics, i.e. storage, retrieval and processing of big data. In addition, it also focuses on the "technologies", i.e., the tools/algorithms that are available for storage, processing of Big Data. It also helps a student to perform a variety of "analytics" on different data sets and to arrive at positive conclusions.

Course Outcomes:

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

	Course Outcomes
CO1	Applying Map Reduce paradigm to solve problems
CO2	Apply Hadoop ecosystem components for big Data use cases
CO3	Constructing a real world application to solve specific business problems using powerful analytic techniques.
CO4	Ability to initiate and design highly scalable systems that can accept, store, and analyze large volumes of unstructured data in batch mode and/or real time.
CO5	Analysis of data near real time data using tensorflow and graphs.

Detailed Syllabus:

Unit 1	**Map-Reduce:** MAPREDUCE PROGRAMMING: Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression, Real time applications using MapReduce, Data serialization and Working with common serialization formats, Big data serialization formats. Evolution of Hadoop and Map/Reduce, semi-structured data: web logs, videos, speech recordings, photographs, e-mails, Tweets, and similar data.
Unit 2	**Spark Framework** Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplication in CUDA, CUDA Memory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features. Data Analysis with Spark Shell, Writing Spark Application - Spark Programming in Scala, Python, R, Java - Application Execution
Unit 3	**NoSQL storage solutions:** Cassandra for their critical features: speed of reads and writes, ability to scale to extreme volumes. SQL Context Importing and Saving data Data frames using SQL
Unit 4	**Memory-resident and graph databases:** GraphX overview – Creating Graph, Graph Algorithms. Spark GraphX ,
Unit 5	**Tensor Flow**: Regression, Clustering, and Classification.

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Text and Reference Books:

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirk deroos et al. , "Understanding Big data ", McGraw Hill, 2012.
3. Learning Real-time Processing with Spark Streaming , Sumit Gupta.
4. Cassandra: The Definitive Guide: , EbenHewitt,O,Reilly publications
5. TensorFlow for Deep LearningFrom Linear Regression to Reinforcement Learning, Reza Zadeh, BharathRamsundar, O'Reilly Media.
6. Graph Databases: New Opportunities for Connected Data, Ian Robinson (Author), Jim Webber (Author), Emil Eifrem (Author).

Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	1	2	3	1				2		3		1	1		
CO2		2		2				1		3		1	1		
CO3		1	3	3				2	2	2		3	2	2	
CO4		2	3	2				2	2	3		3	2	2	
CO5		2	2	3				3	1	3		2	2	2	1

3 - High 2 – Medium 1 –Low

Assessment:

ISE I : In semester evaluations (ISE I) of 20 marks, each will be based on Class Test I.

ISE II: Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

1. Quiz
2. Assignments
3. Question and answer
4. PowerPoint presentation

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	10	00	15
K2	Understand	10	00	20
K3	Apply	00	10	15
K4	Analyze	00	10	10
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table:

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Assessment Tool	K1, K2	K3
	CO1,CO2	CO3, CO4,CO5
ISE I (20 Marks)	20	00
ISE II (20 Marks)	00	20
ESE Assessment (60 Marks)	35	25
Total Marks 100	55	45

Special Instructions if any: Nil

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CSPEC5111: High Performance Computing

Teaching Scheme		**Evaluation Scheme**	
Lectures	**4 Hrs/Week**	**ISE I**	**20 Marks**
Tutorial	**-**	**ISE II**	**20 Marks**
Total Credits	**4**	**ESE**	**60 Marks**

Course Description: High Performance Computing is a course on High Performance Computing Clusters providing a solid foundation in parallel computer architectures, parallel programming models. This course will discuss fundamentals of grid computing systems covering topics ranging from what an HPC cluster consists of to how to efficiently solve complex large scale problems in various the areas like cloud computing.

Course Outcomes:

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

	Course Outcomes
CO1	To Study memory hierarchies, processor types and techniques in high performance computing
CO2	To understand the Designing of high performance computing.
CO3	To Study different platforms involved in achieving high performance computing
CO4	To develop efficient and high performance programming
CO5	Apply different computing models learned in the High Performance Computing system

Detailed Syllabus:

Unit 1	Overview of Grid Computing Technology, History of Grid Computing, High Performance Computing, Cluster Computing. Peer-to-Peer Computing, Internet Computing, Grid Computing Model and Protocols, Types of Grids: Desktop Grids, Cluster Grids, Data Grids, High-Performance Grids, Applications and Architectures of High Performance Grids, High Performance Application Development Environment.
Unit 2	Open Grid Services Architecture, Introduction, Requirements, Capabilities, Security Considerations, GLOBUS Toolkit.
Unit 3	Overview of Cluster Computing, Cluster Computer and its Architecture, Clusters Classifications, Components for Clusters, Cluster Middleware and SSI, Resource Management and Scheduling, Programming, Environments and Tools, Cluster Applications, Cluster Systems,
Unit 4	Beowulf Cluster: The Beowulf Model, Application Domains, Beowulf System Architecture, Software Practices, Parallel Programming with MPL, Parallel Virtual Machine (PVM).
Unit 5	Overview of Cloud Computing, Types of Cloud, Cyber infrastructure, Service Oriented Architecture Cloud Computing Components: Infrastructure, Storage, Platform, Application, Services, Clients, Cloud Computing Architecture.

Text and Reference Books:

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1.Ahmar Abbas, “Grid Computing: Practical Guide to Technology & Applications”, Firewall
Media, 2004.
2. Joshy Joseph and Craig Fellenstein , “Grid Computing” Pearson Education, 2004.
3. lan Foster, et al.,“The Open Grid Services Architecture”, Version 1.5 (GFD.80). Open Grid
Forum, 2006. (available at http://www.ogf.org)
4.Ian Foster. *Globus Tool kit Version 4: Software for Service-Oriented Systems*. IFIP
International Conference on Network and Parallel Computing, Springer-Verlag LNCS 3779, pp 2-13,2006. (available athttp://www.globus.org/)
5.Rajkumar Buyya. High Performance Cluster Computing: Architectures and Systems. Prentice-Hall India, 1999.

Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes														
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1			2							1		2			
CO2		1	2							2		2			
CO3		1	2					1	3	3		3	1	2	
CO4		1	2	2				1	3	3		3	1	2	
CO5	1	1	3	2				1	3	3	1	3	3	2	1

3 - High 2 – Medium 1 –Low

Assessment:
ISE I: In semester evaluations (ISE I) of 20 marks, each will be based on Class Test

ISE II: Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

1. Quiz
2. Assignments
3. Question and answer
4. PowerPoint presentation

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	10	10	12
K3	Apply	05	10	12
K4	Analyze	00	00	12
K5	Evaluate	00	00	12
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table:

Assessment Tool	K1, K2	K3,K4,K5
	CO1,CO2	CO3, CO4,CO5
ISE I (20 Marks)	10	10
ISE II (20 Marks)	10	10
ESE Assessment (60 Marks)	24	36
Total Marks 100	44	56

Special Instructions if any: Nil

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CSOEC5102: Professional Ethics and Cyber Laws (OPEN ELECTIVE I)

Teaching Scheme		Evaluation Scheme	
Lectures	**2 Hrs/Week**	**ISE I**	**10 Marks**
Tutorial	**-**	**ISE II**	**10 Marks**
Total Credits	**2**	**ESE**	**30 Marks**

Course Description: This course will introduce concepts of Professional and Philosophical Ethics amongst the students; it will summarise Cyber Crimes and its associated investigation and forensics with relation to Cyber law. Students will have a new dimension to look towards their day to day computer activities.

Course Outcome:

CO1	Apply Philosophical and Professional Ethics to solve Ethical Dilemma & identify their Professional Responsibilities through IT Act.
CO2	Study Intellectual Property Rights in Cyberspace.
CO3	Summarize Cyber Forensics and its role in Cyber Security

Detailed Syllabus:

UNIT 1	**Computer and Philosophical ethics:** Moral v/s Ethics, Why Computer Ethics, Philosophical Ethics: Distinguishing Descriptive and Normative Claims, Ethical Relativism, Utilitarianism, Deontological Theories, Rights, Virtue Ethics, Professional Ethics: Why Professional Ethics, Characteristics of Professionals, The System of Professionals, is Computing a Profession.., Professional Relationships, Code of Ethics and Professional Conduct, Steps in Ethical Decision Making. **Information technology Act 2000 :**Scope, jurisdiction, offence and contraventions, powers of police, adjudication.
UNIT 2	**Ethics & Internet:** Three Morally Significant Characteristics, Hacking & Hacker Ethics, Netiquette **Intellectual property issues in cyberspace :**Introduction to intellectual property Protections via Trade Secrets, Trademarks, Patents, Etc. Contracting to protect intellectual property, Protection options - Encryption / PGP, copyright on web-content, Copyright on software, digital contracts, digital signatures.
UNIT 3	**Cyber Forensics Investigation**: Introduction to Cyber Forensic Investigation, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, EMail Investigation, E-Mail Tracking, IP Tracking. **Cyber Security:** Introduction to Cyber Security, Implementing Hardware Based Security, Software Based Firewalls, Security Standards, Assessing Threat Levels

Text and Reference Books:

1. Computers, Ethics, And Social Values, Johnson and Nissenbaum, 1994 Prentice Hall
2. Cyber security operations Handbook, John Rittinghouse,William Hancock
3. Computer ethics, Deborah G.Johnson, third edition, Pearson education

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Mapping of Course outcomes with Program Outcomes and Program Specific Outcomes:

Course outcome	Program Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1					3										
CO2					3										
CO3					2			1							

3 - High 2 – Medium 1 –Low

Assessment:

ISE I: In semester evaluations (ISE I) of 20 marks, each will be based on Class Test.

ISE II: Teachers Assessment of 20 marks is based on one of the / or combination of few of the following:

1. Quiz
2. Assignments
3. Question and answer
4. PowerPoint presentation

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	10	10	12
K3	Apply	05	10	12
K4	Analyze	00	00	12
K5	Evaluate	00	00	12
K6	Create	00	00	00
Total Marks 100		20	20	60

Assessment table:

Assessment Tool	K1, K2	K3,K4,K5
	CO1,CO2	CO3, CO4,CO5
ISE I (20 Marks)	20	00
ISE II (20 Marks)	00	20
ESE Assessment (60 Marks)	24	36
Total Marks 100	44	56

Special Instructions if any: Nil

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Semester III

INIKS6001 : VEDIC APPROACH TO MATHEMATICS		
Teaching: Scheme	**Examination Scheme**	
Lectures:02hrs/week	**ISEI**	**10 Marks**
Credits:2	**ISEII**	**10Marks**
	ESE	**30 Marks**

Course description: This course is planned as Ability enhancement course. It is an exposure to the Engineering students about Vedic Mathematics. Vedic Mathematics is a collection of Techniques/Sutras to solve mathematical arithmetic in easy and faster way. It consists of 16 Sutras (Formulae) and 13 sub-sutras (Sub Formulae) which can be used for problems involved in arithmetic, algebra, geometry, calculus, conics. By using Vedic mathematics, the problems are solved mentally with the use of few or some of steps which increase accuracy and reduce mistakes. Through the application of the sutras, it ensures both speed and accuracy and enhances computational skills. In this course some of the topics from Vedic Mathematics are introduced which are use full to Engineering Students.

Course Objectives:

The main objectives of the course are:

1. Multiply two or three digits numbers.
2. Compute the division by two and three digit divisors.
3. Check the divisibility by two or three digit numbers without actual division.
4. Evaluate square, cubes, square roots and cube roots of larger numbers within no time.
5. To factorize the quadratic expressions of single variable.
6. To find the Solution of Linear Simultaneous Equations

Course Outcomes

After completing the course, students will be able to:

CO1	Do multiplication and division of two and three digit numbers by applying Sutras in Vedic Mathematics
CO2	To factorise and find LCM/HCF of numbers by applying Sutras in Vedic Mathematics
CO3	To solve Simultaneous Linear Equations by applying Sutras in Vedic Mathematics

Detailed Syllabus:

Unit 1	**Multiplication :** 1. Ekadhikenpurven method (multiplication of two numbers of two digits) 2. Eknunenpurven method (multiplication of two numbers of three digits) 3. Urdhvatiragbhyam method (multiplication of two numbers of three digits) 4. Nikhilam Navtashchramam Dashtaha (multiplication of two numbers of three digits)

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Unit 2	**Division and Divisibility :** Part A: Division 1. Nikhilam Navtashchramam Dashtaha (two digits divisor) 2. Paravartya Yojyet method (three digits divisor) Part B: Divisibility 1. Ekadhikenpurven method (two digits divisor) 2. Eknunenpurven method (two digits divisor)
Unit 3	**Factorisation /LCM/HCF**
Unit 4	**Solution of Linear Simultaneous Equations :** Simple equations, Simultaneous Simple Equations, Quadratic Equations, Cubic Equations, Simultaneous Quadratic Equations.
Unit 5	**Power and Root Power :** (i) Square (two digit numbers), (ii) Cube (two digit numbers). (iii) Square root (four digit number) (iv) Cube root (six digit numbers) [Self Study and assignments]

Text and Reference Books

1. Vedic Mathematics,Jagadguru Swami Sri BHARATI KRSNA TIRTHAJI MAHARAJA, Motilal Banarsi Das Publishing House, New Delhi.
2. Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.
3. Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.
5. Leelavati, Chokhambba Vidya Bhavan, Varanasi.
6. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi

Assessment:

ISEI:	Shall be based on Class Tests/ Assignments/Quizzes/Presentations/ Course Projects
ISEII:	Shall be based on class test.

Mapping of Course Outcome with Program Outcomes

Course Outcome	PO I	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	POI 0	PO II	PO I 2	PSO I	PSO 2	PSO 3
CO1					2										
CO2					2										
CO3					2										

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE1	ISEII	ESE
Kl	Remember	05	05	10
K2	Understand	05	05	20
K3	Apply	-	-	-

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K4	Analyze	-	-	-
KS	Evaluate	-	-	-
K6	Create	-	-	-
Total Mars 50		10	10	30

Assessment table

Assessment Tool	**K2**	**K2**	**K2**
	CO1	**CO2**	**CO3**
ISE I (10Marks)	10	-	-
ISE II (10Marks)	-	10	-
ESE (30Marks)	10	10	10

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CSDIS6101: **Dissertation I**			
Teaching Scheme		**Evaluation Scheme**	
Practical Hours	**20 Hrs/Week**	**ISE II**	**100 Marks**
Total Credits	**10**	**ESE**	**100 Marks**
		ESE	**200 Marks**

Course Description:
The dissertation shall consist of a report on research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a work related to computer science & engineering that the candidate has to execute. The dissertation will consist of two parts as dissertation – I and dissertation – II.

Course Objectives:

1. To acquaint with the process of undertaking literature survey/industrial visit and identifying the problem
2. Able to define precise problem
3. To specify objectives on the basis of problem statement
4. To identify the research methodology processes and its implementation.

Course Outcomes:
After completing the course students will able to

Course Outcomes	
CO1	Identify a practical problem from industry or research problem
CO2	Review literature to identify gaps and define objectives & scope of the work to decide the problem definition
CO3	Interpret the problem

Detailed description:

1. Dissertation – I is an integral part of the dissertation work. In this, the student shall complete the preliminary work of the dissertation which will consist of problem statement, literature review, scheme of implementation, Layout and Design of the Set-up. The student is expected to complete the dissertation at least up to the design phase.
2. The candidate has to exhibit the continuous progress through regular reporting and presentations.
3. The candidates have to validate their work undertaken by submitting and/or publishing it at standard platforms – conference and/or peer reviewed journal.
4. The candidate shall submit the report of dissertation – I in standard format for satisfactory completion of the work, duly approved and certified by the concerned guide, Head of the Department and Principal.
5. The candidate will be assessed during ESE by two examiners, one of whom will be the guide and other is necessarily an external examiner appointed by the BoS / Head of Department / BoS Chairman. The assessment will be broadly based on literature study, work undergone, content delivery, presentation skills, documentation and report.
6. For standardization and documentation, it is recommended to follow the formats and guidelines approved by the Board of Studies.

Assessment:
ISE II- Continuous Assessment of individual student
Maximum Marks-100
ESE – Viva Voce based on presentation and report
Maximum Marks-100

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Semester IV

CSDIS6102 **Dissertation – II**		
Teaching Scheme	**Examination Scheme**	
Practical:20 Hrs. /Week	**ISEII**	**100 Marks**
Credit:10	**ESE**	**100 Marks**
	Total	**200 Marks**

Course Objectives:

1. To excel in progress review and follow schedule meticulously to meet the objectives of proposed work
2. To test the hypothesis rigorously before deployment of system
3. To validate the work undertaken
4. To consolidate the work as furnished report

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Implement suitable research methodology
CO2	Carryout experimentation responsibly and ethically
CO3	Evaluate data and evidence of work
CO4	Synthesize and write the project work

Detailed description:

1. In Dissertation – II, the student shall consolidate and complete the remaining part of the dissertation which will consist of selection of research methodology, installations, implementations, testing, results, measuring performance, discussions using data tables considered for the improvement with existing/known algorithms/systems, comparative analysis, characterization and validation of results and conclusions.
2. The candidate has to exhibit the continuous progress through regular reporting and presentations.
3. The investigations and findings need to be validated appropriately at standard platforms one at conference and other in peer reviewed journal.
4. The candidate shall submit the report of dissertation – II in standard format for satisfactory completion of the work, duly approved and certified by the concerned guide, Head of the Department and Principal.
5. The candidate will be assessed during ESE by two examiners, one of whom will be the guide and other is necessarily an external examiner appointed by the BoS / Head of Department / BoS Chairman. The assessment will be broadly based on literature study, work undergone, results and conclusion, contribution, content delivery, presentation skills, documentation and report.
6. For standardization and documentation, it is recommended to follow the formats and guidelines approved by the Board of Studies.
7. Publication Requirement

Students are encouraged to submit the review paper to:

- **Peer-reviewed journals e.g. Scopus, Web of Science.**
- **Reputed national or international conferences that accept review articles (where applicable).**

The target journal or conference should be approved by the supervisor and department.

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Format for Dissertation Report:

1. The total No. of minimum pages shall not be less than 50.
2. Plagiarism check by standard and approved software is must, and certificate shall be enclosed with the report.
3. Three report copies, loosely bound, shall be submitted in the department, one for examiner, one for supervisor and one for department.
4. The report shall be both side print hard bound. A hardbound report shall be made after examination by completing the examiner and guide's expected correction, before that report must be loosely bound.
5. For standardization of the reports the following format shall be strictly followed.

   Page size: A4
   Top Margin: 1"
   Bottom Margin: 1"
   Left Margin: 1.5"
   Right Margin: 1.5"
   Para Text: Times New Roman 12-point font
   Line Spacing: 1.5 Lines
   Page Numbers: Right aligned at footer. Font 10-point Times New Roman
   Headings: 14-Points, Times New Roman, Boldface.

Index of Report

1. Title Sheet
2. Certificate (Institution)as per standard format. Certificate shall have signatures of Guide, External Examiner, HoD and Principal.
3. Certificate (Company, if sponsored by company)
4. Undertaking by candidate as per standard format
5. Acknowledgement
6. Table of Contents
7. List of abbreviations
8. List of Figures
9. List of Photographs / Plates
10. List of Tables
11. Abstract of the Dissertation
12. Introduction
13. Literature Survey / Theory
14. Design / Experimentation / Fabrication / Production / Actual work carried out for the same
15. Observation, Results Analysis and validation
16. Conclusion
17. References
18. List of papers published
19. Plagiarism check report

Assessment:

ISE II- Continuous Assessment of individual student
Maximum Marks-100
ESE – Viva Voce based on presentation and report
Maximum Marks-100

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